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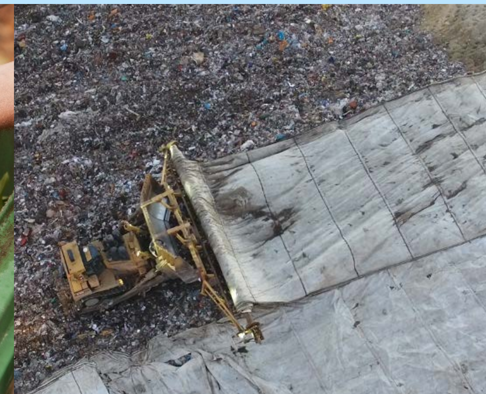
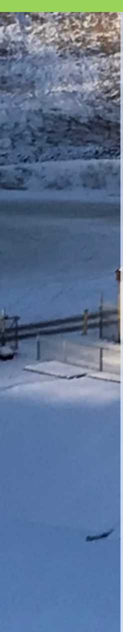
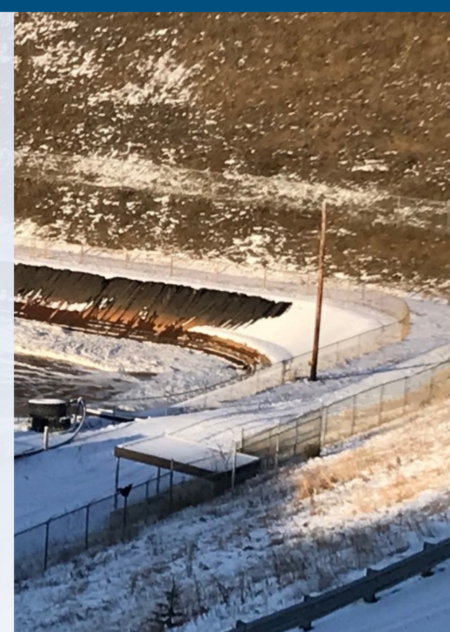




Prepared for:
Municipality of Anchorage
Solid Waste Services

INTEGRATED SOLID WASTE MASTER PLAN



TETRA TECH

November 2019
Amendment No. 1: March 2020

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DEFINITIONS AND ACRONYMS

Term or Acronym	Definition
AAC	Alaska Administrative Code
AB	Assembly Bill
ACM	Asbestos Containing Materials
AD	Anaerobic Digestion
ADC	Alternative Daily Cover
ADEC	Alaska Department of Environmental Conservation
ALPAR	Alaskans for Litter Prevention and Recycling
AMC	Anchorage Municipal Code
amsl	above mean sea level
ARC	Anchorage Recycling Center
ARL	Anchorage Regional Landfill
ARRMS	Automated Refuse Route Management System
AS	Alaska Statute
AUF	Airspace Utilization Factor
AWWU	Anchorage Water and Wastewater Utility
BTU	British thermal unit
CAA	Clean Air Act
CARB	California Air Resources Board
CBJ	City and Borough of Juneau
C&D	Construction and Demolition
Census Bureau	2010 United States Census Bureau
40 CFR	Title 40 of the Code of Federal Regulations
CNG	Compressed Natural Gas
CRS	Central Recycling Services
CTS	Central Transfer Station
CUP	Conditional Use Permit
cy	Cubic yards
DOD	Department of Defense
Doyon	Doyon Utilities
EPA	Environmental Protection Agency
EPR	Extended Producer Responsibility

Term or Acronym	Definition
EWMC	Edmonton Waste Management Center
FNSB	Fairbanks North Star Borough
GAC	Geotechnical Advisory Commission
GGE	Gasoline Gallon Equivalent
GHG	Greenhouse Gas
GWP	Global Warming Potential
HDPE	High Density Polyethylene
HHV	High heating value
HHW	Household Hazardous Waste
I-1	Light Industrial District
I-2	Heavy Industrial District
ISWMP	Integrated Solid Waste Master Plan
JBER	Joint Base Elmendorf-Richardson
k	Methane Generation Rate
kW	Kilowatts
LandGEM	Landfill Gas Emission Model
LCFS	Low Carbon Fuel Standard
LCRS	Leachate Collection and Recovery System
LCS	Leachate Collection System
LFG	Landfill gas
LFGTE	Landfill gas to energy
LMOP	Landfill Methane Outreach Program
LNG	Liquefied Natural Gas
Lo	Methane generation potential
M	Million
MatSu	Matanuska-Sustina Borough
ML&P	Municipal Light and Power
MMBTU	Million BTU
MOA	Municipality of Anchorage
MRF	Materials Recovery Facility
MSW	Municipal Solid Waste
MSWLFs	Municipal Solid Waste Landfills

Term or Acronym	Definition
MW	Megawatt
NALA	North Anchorage Land Agreement
NRC	National Recycling Coalition
OCC	Cardboard
PAYT	Pay As You Throw
PGM	Processed Green Material
PPA	Power purchase agreement
psig	Pounds per square inch gage
RACM	Regulated Asbestos-Containing Material
RCA	Regulatory Commission of Alaska
RCRA	Resource Conservation and Recovery Act
RCU	Refuse Collections Utility
RDF	Refuse Derived Fuel
RGS	Renewable Gas Standard
RNG	Renewable Natural Gas
scf	Standard cubic foot
scfm	Standard cubic foot per minute
SMM	Sustainable Materials Management Program
SPU	Seattle's Public Utilities
SWDU	Solid Waste Disposal Utility
SWF	Municipal Solid Waste Facility
SW&R	Division of Solid Waste and Recycling
SWRAC	Solid Waste & Recycling Advisory Committee
SWS	Solid Waste Services
SWU	City of Fargo's Solid Waste Utility
Tarps	Geosynthetic Fabric or Panel Products
TPD	Tons per day
TR	Transition District
U.S.	United States
WTE	Waste to energy
WMF	Waste Management Facility

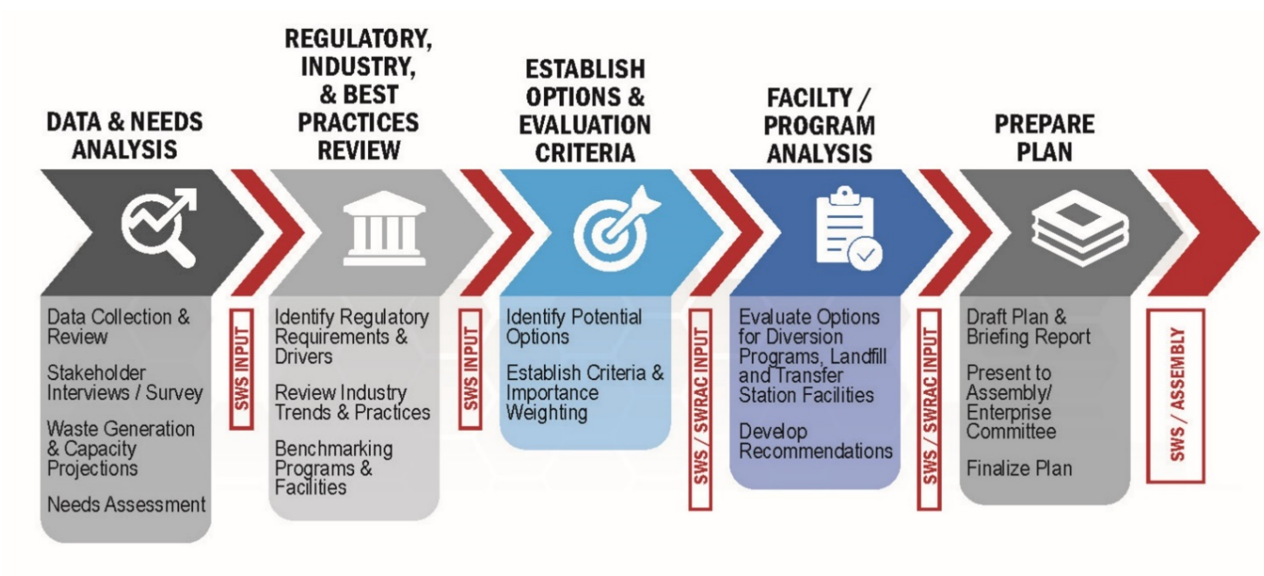
EXECUTIVE SUMMARY

The Municipality of Anchorage (MOA), Department of Solid Waste Services (SWS) authorized development of an integrated solid waste master plan (ISWMP) in order to optimize its system and assets through improved operational efficiencies, capital improvements and new practices/programs that increase landfill life, improve safety and customer service, protect the environment and increase waste reduction, improve reuse and recycling of materials that are currently disposed of as waste. SWS collaborated with Tetra Tech and DOWL consultants and the SWS Solid Waste & Recycling Advisory Committee (SWRAC) to develop the plan.

The ISWMP includes the following:

- Development of Strategies for Short, Medium and Long-term System Plan
- Optimization of Capacity at Anchorage Regional Landfill (ARL)
  - Optimizing Airspace Utilization
  - Evaluating Expansion Alternatives
  - Considering Alternative Technologies
- Optimization of Central Transfer Station (CTS) Operations
- Assessment of Diversion Opportunities

Tasks performed for development of the SWS ISWMP are presented in the planning process flow chart below:



As a municipality of almost 300,000 people, Anchorage generates a large quantity of waste each year (330,000 tons in 2016). SWS provides refuse collection services within the former City of Anchorage boundaries, which is approximately 20% of the population of the MOA and the remainder is serviced by the private sector. SWS services also include the disposal of solid waste, collection of household hazardous waste and drop off recycling at the Anchorage Regional Landfill (ARL) and seasonal food scraps collection programs at both the ARL and the Central Transfer Station (CTS). ARL is the only operating municipal solid waste (MSW) landfill within the MOA and accepts more tonnage than any other landfill in the state. The ARL is located near the community of Eagle River and has a permitted total capacity of 45.2 million cubic yards. The SWS has three transfer stations located at Girdwood, midtown Anchorage (CTS), and ARL which reduces traffic to and controls access to the working face of the ARL. Waste disposed of and hauled from the transfer stations make up approximately 80% of the total waste disposed of at ARL, with the majority coming from the CTS.

The SWS disposal utility's budget includes a recycling fund which pays for the recycling coordinator position within SWS and various community recycling and outreach programs. The fund helps support several grants with ALPAR (Alaskans for Litter Prevention and Recycling) such as glass recycling, wharfage costs, youth litter patrol, and Christmas tree recycling. Funding has also been used to support school district recycling programs and pilot programs for curbside recycling, composting, and voluntary food scrap drop-off programs. SWS is implementing a pilot program to test curbside organic waste collection in 2018 and plans on offering this service area wide in 2019.

Waste generation and capacity projections were performed for the ISWMP resulting in a gross remaining airspace of 30.3 million cubic yards at the ARL (as of 2017). Utilizing population growth projections from the Anchorage 2040 Land Use Plan, future site life projections ranged from 2062 to 2070. Internal and external data were reviewed, stakeholder interviews and a solid waste services survey were conducted, and a comprehensive review of regulatory requirements/drivers, key policies, and industry trends were considered to identify specific facility and diversion program options, potential improvements, and potential new approaches for SWS to manage solid waste. A benchmarking analysis was also completed to compare key performance indicators (KPI) of solid waste management system performance in 12 similar medium-sized jurisdictions with limited access to material markets, high annual snowfall, and sub-zero winter temperatures.

Issues and opportunities identified for the ISWMP included aging (30+ years) assets at CTS creating safety issues and operational/customer service constraints, capacity increase opportunities at ARL and low diversion rates due to lack of local markets and regulatory constraints for the MOA.

Several options for each system component (ARL, CTS and diversion programs) were evaluated for the following criteria:

- Capacity Savings;
- Capital/O&M Costs;
- Revenue Generation Potential;
- Technical Feasibility;
- Permitting Feasibility; and,
- Environmental Impacts.

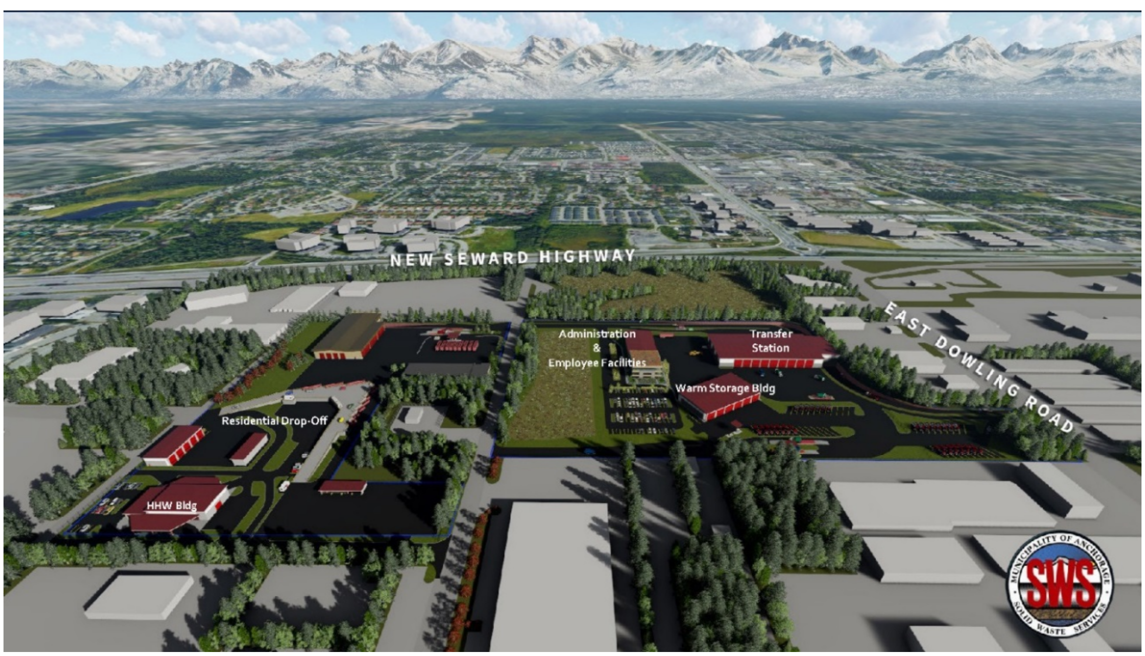
The above criteria were ranked for each option identified utilizing high, medium and low rankings; resulting in a total score for each option. More detailed evaluations were then performed on the highest ranked options.

Recommendations for short, medium and long-term strategies were developed to optimize capacity through landfill operational improvements and diversion programs and to optimize CTS operations with new and expanded facilities and services. As the feasibility of alternative technologies (Waste to Energy) and CTS design projects move forward, there will be a coordination of these efforts to make each as efficient as possible.

Short-Term Recommendations (Years 1 TO 5)

Landfill Improvements	Landfill Gas Beneficial Use
	
Increase Landfill Capacity by 30 to 40% or 5 to 9 years through the use of alternative daily covers to minimize soil use and an additional 8 to 11 years with an alternative final cover design to support steepening of final slopes.	Expand Landfill Gas to Energy (LFGTE) facility by generating 5.6 MW of additional electricity. If LFGTE facility expansion does not proceed, LFG to CNG vehicle fuel or leachate treatment fueled by medium-BTU LFG to be explored. Also, using LFG to evaporate and minimize leachate disposal requirements is currently in the process of being evaluated by SWS.

Central Transfer Station



New transfer station, administration, maintenance and warm storage building, and public drop-off facilities to replace 30+ year old assets. This improves safety, customer service, efficiency, and materials management which increases the life of the ARL through improved community diversion opportunities. Moving to a new property would prevent a 2- to 3-year shutdown of the existing facility for improvements and allows for future uses by other MOA departments (i.e. grit management facility at existing transfer station, additional warm storage and administrative space). It also controls adjacent uses that may impact future CTS operations.

Diversion Programs	Alternative Technologies
 Increase diversion through food waste reduction, organics collection/drop-off programs, expanded compost facility capacity and end market development, public sector recycling, community outreach and education programs and, C&D reuse . Increase SWS diversion rate from 16% to 27% and reduce per capita disposal from 6.1 to 5.4 lbs./day (for those within the SWS Service Area).	 Conduct feasibility study of technology alternatives to landfill disposal (including biological or thermal treatment) for addressing SWS and potentially Anchorage Water & Wastewater Utility (AWWU) needs. A 20% to 90% reduction in landfill disposal (by volume) may be achieved with biological or thermal treatment, respectively.

Medium-Term Recommendations (Years 5 to 10)

Landfill Expansion Potential	Diversion Programs
	
Evaluate landfill expansion permitting feasibility for ARL. Potential expansion to the west of ARL estimated to provide additional 40 mcy of capacity resulting in 45 additional years (extended site life to beyond 2100).	Increase diversion through commercial organics education, expanded C&D reuse and recycling and tire recycling. Increase SWS diversion rate an additional 17% to almost 40% by 2028 and decrease per capita disposal from 5.4 to 4.6 lbs./day (for those within the SWS Service Area).

Long-Term Recommendations (Years 11 and Beyond)

Plan for ARL Reaching Capacity	Diversion Programs
	
Implement permitting process for ARL expansion or alternative technology facility 20 to 25 years prior to ARL capacity projected to be reached.	Increase diversion through expanding and improving residential curbside recycling and bulky item reuse/recycling. Assessment of market demand and regulatory authority to increase recycling throughout MOA is needed.

Preliminary costs based on ISWMP recommendations and concept plans have been developed which range from $90M to $120M (in 2018 $) in the short to mid-term.

The SWS ISWMP provides a roadmap for improved customer service, safety, environmental protection and operational efficiencies resulting in preserving landfill life up to 20 additional years or to 2090, cost savings and a plan for expansion of the ARL (providing more than 45 years of additional landfill life) or an alternative technology facility (reducing landfill disposal by 20 to 90%) to address the solid waste management needs of the MOA over the next 100 years. Periodic updates are recommended to assess progress, needs and changed conditions over time.

1.0 OVERVIEW AND NEEDS ASSESSMENT

The Municipality of Anchorage (MOA), Department of Solid Waste Services (SWS) has authorized development of an integrated solid waste master plan (ISWMP) in order to improve its operations and assets through capital improvements and new practices/programs that increase landfill life, improve safety and customer service, protect the environment and increase waste reduction, reuse and recycling of materials that are currently disposed of as waste. The ISWMP includes the following:

- Development of Strategies for Short, Medium and Long-term System Plan
- Optimization of Capacity at Anchorage Regional Landfill (ARL)
  - Optimizing Airspace Utilization
  - Evaluating Expansion Alternatives
  - Considering Alternative Waste to Energy Technologies
- Assessment of Diversion Opportunities
- Optimization of Central Transfer Station (CTS) Operations

For the short-term, an evaluation was conducted, and recommendations made of the existing SWS system and will be focused on optimizing landfill capacity and overall system upgrades. For the medium-term, those programs and/or facility upgrades/enhancements that have longer lead times (more than five years to implement) were evaluated and recommendations made. For the long-term, an evaluation was completed, and recommendations made for the future SWS system once the ARL has reached ultimate capacity. Waste diversion and recycling alternatives were considered for both the SWS service area and on a municipality-wide basis. Development of the ISWMP began in October 2017 so the base year for analysis is 2016 (last full year of data available at the time).

The results and recommendations for short, medium and long-term strategies within the ISWMP will guide SWS and the MOA in achieving their mission for providing safe, efficient, innovative and sustainable solid waste management services.

The Tetra Tech Team (including DOWL) was selected by SWS to prepare the ISWMP in collaboration with internal staff and the Solid Waste & Recycling Advisory Committee (SWRAC). Data on the SWS solid waste system and SWS facilities were collected and documented herein as baseline/existing conditions. Based on available data reviewed and stakeholder input, an assessment of needs or areas of potential improvement to be addressed in the ISWMP was also conducted for concurrence by SWS. Remaining tasks to be performed for development of the SWS ISWMP are presented in the planning process flow chart in Figure 1-1 below.

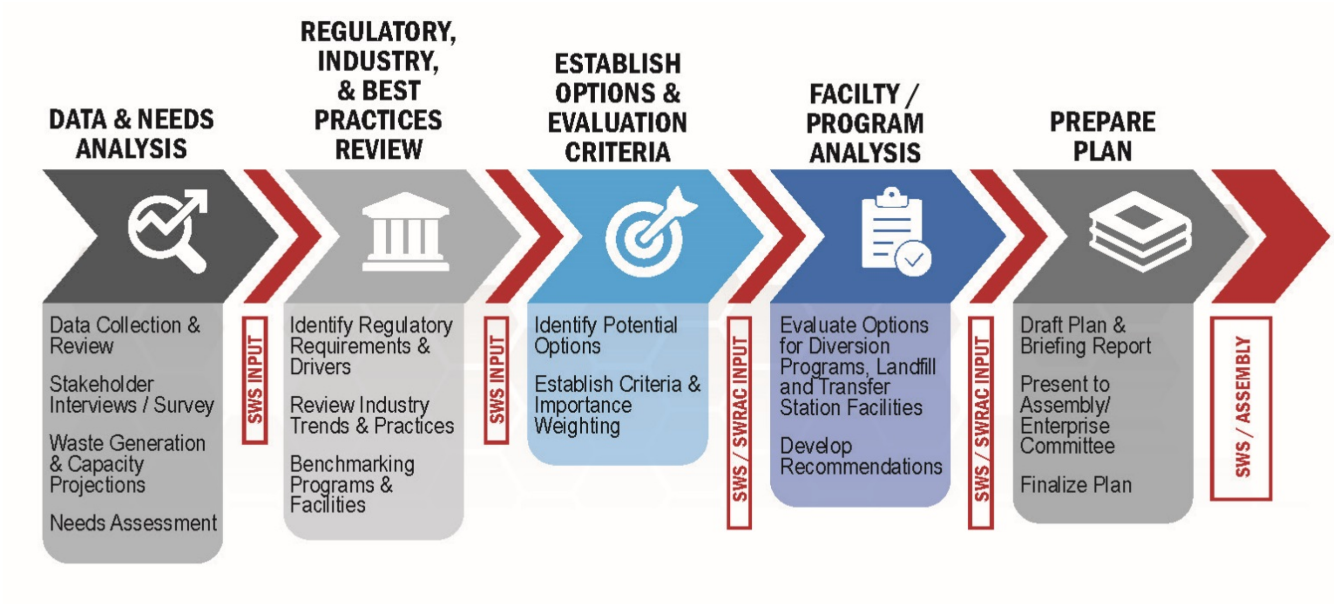


Figure 1-1: Planning Process Flow Chart

1.1 OVERVIEW OF SOLID WASTE MANAGEMENT SYSTEM

As a municipality of almost 300,000 people, Anchorage generates a large quantity of solid waste each year (approximately 330,000 tons of waste was accepted at the ARL in 2016). Management of solid waste in the MOA is provided through both public (SWS) and private services. Figure 1-2 illustrates the solid waste management system in the MOA and the flow of waste through the system.

Source

Solid waste is generated by residents (single family and multi-family households), industry, commercial enterprises, and institutions (ICI). Solid waste is also generated by construction and demolition (C&D) activity from the above sources. By and large, the generation of solid waste is highly influenced by the number of people and amount of economic activity in the region. The price of oil and other natural resources have also historically impacted both of these factors. Anchorage has a diverse economy as a hub for cultural attractions, businesses, services, and transportation in the state of Alaska. It is also home to military installations at the Joint Base Elmendorf-Richardson (JBER).

Based on scale data from SWS and Alaska Waste, households generate an estimated 35% of the trash collected in the MOA. The Anchorage 2040 Land Use Plan[1] (2040 LUP) identifies four major housing types: large-lot single family, single-family, compact housing, and multi-family/other. The 2040 LUP anticipates growing demand for more compact and multi-family housing as single family lots become scarce. Infill type development is also expected to densify the MOA in coming decades.

[1] Anchorage 2040 Land Use Plan Draft dated June 5, 2017

Figure 1-2: Summary of Solid Waste Management System in the Municipality of Anchorage

Collection

Solid waste collection in the MOA is provided through both public and private sector services. By Municipal Code, SWS provides service to a Refuse Collection area (SWS Service Area) comprising approximately 20% of Anchorage including the original downtown area (the commercial core and much of the high-density residential area). In the SWS Service Area, trash is collected from single family, duplex and triplex housing units using roll carts. Single stream recycling is provided to these customers at no additional charge. Commercial and multifamily residential (4 units or larger) customers are serviced by dumpster varying in size (3 to 8 cubic yards) and frequency (weekly to daily). Table 1-1 lists the cost for trash and recycling collection in 2017. Excess trash and bulky items are collected for an additional charge.

Table 1-1: SWS Residential Trash Collection Fees 2017

Average Weekly Volume	Trash Roll Cart	Collection	$/Month
24 Gallons	48 Gallons	Bi-Weekly	$14,10
48 Gallons	48 Gallons	Weekly	$19.10
64 Gallons	64 Gallons	Weekly	$26.60
64 Gallons	64 Gallon Bear Cart	Weekly	$28.60
96 Gallons	96 Gallons	Weekly	$36.50
96 Gallons	96 Gallon Bear Cart	Weekly	$38.50

Throughout the MOA, including the SWS service area, larger generators (those requiring roll-off bins and compactors) are serviced by private waste haulers.

Outside of the SWS service area, collection service is available from private haulers. Private residential waste haulers (Alaska Waste and Blue Arctic) are regulated by the Regulatory Commission of Alaska (RCA), and at this time cannot bundle the cost of curbside recycling with the waste collection. They are required to set rates based on cost of service. Alaska Waste (a division of Waste Connections) provides the majority of solid waste collection in the MOA. For most customers, collection fees are based on the material collected, container size, and collection frequency. All collection services outside of the SWS Service Area is an open market and subscription based as there is no mandatory waste collection service. Alternatively, residents and businesses may self-haul materials to recycling locations, transfer stations, or the ARL.

The majority of recycled materials in the MOA is self-hauled to drop-off locations. Recycling drop-off service, provided via 21 drop-off sites, is largely managed by the private sector, including sites at Anchorage Recycling Center (ARC), many grocery stores (Carrs/Safeway), high schools, and other locations. Specialty drop-offs are available for electronics, and the MOA accepts electronics, oil, batteries, and manages household hazardous waste at the ARL and the CTS. The ARL also provide recyclables drop-off bins. Although small commercial businesses may use the drop-off services, commercial recycling collection service is available for large businesses in town (grocery stores, hospital, hotels, etc.), or they may choose to backhaul packaging through their existing logistics chains. The ARC (operated by WestRock) is the primary manager of recyclables in the MOA. The facility provides drop-off bins for public use and accepts source separated recyclable paper, glass, metals, and plastic, as well as single stream recyclables collected from residents and the ICI sector.

Transfer

Transportation of trash from the SWS owned and operated transfer stations to the ARL is handled by SWS. Trash collected at the transfer stations is top-loaded into transport trailers which haul materials for disposal at the landfill.

Transportation of recyclables from drop-off centers to the ARC recycling facility is conducted under contract between the recycler and the primary waste hauler, typically Alaska Waste. Consolidation and baling of recycled materials is conducted by ARC/WestRock with subsidized shipping to west coast markets provided and coordinated by Alaskans for Litter Prevention and Recycling (ALPAR).

ALPAR is a private/non-profit agency managing donated back-haul space to provide economical transportation of recyclables from Alaska to U.S. west coast markets. As the markets for most recyclable materials are out of state, the subsidized transportation coordinated through ALPAR has been key to allowing Anchorage and communities in the Mat-Su Valley to provide low-cost recycling services. In its early years, ALPAR coordinated resources to offer free shipping of recyclables to markets but increased demand by municipal recycling programs has outstripped supply in past years requiring ALPAR to charge nominal fees to recyclers for container space and increase requests for space to donors.

Processing

The capacity to process recyclable materials in the MOA is limited. Mixed recyclables collected from residents and the ICI sector are consolidated and baled by ARC/WestRock. No sort line or material recovery type facility exists within the MOA for recyclable materials.

Central Recycling Services (CRS) operates a Material Recovery Facility (MRF) for C&D materials in Anchorage which is able to process mixed C&D materials to separate divertible materials that can be marketed for beneficial use. Peak diversion for C&D materials occurred in 2011-2013 when over 20,000 tons of material was sorted each year. In recent years, CRS has limited its sort operation to customers willing to pay a premium to divert materials due to soft diversion markets and high cost to dispose of residual materials.

Divertible C&D materials are primarily managed through CRS, a private sector entity that processes construction and demolition debris, clean wood/lumber, scrap metal, glass, asphalt and other commercial by-products at a facility in Anchorage. Large scale metal recycling operations divert ferrous and non-ferrous metals through private sector businesses. These include CRS and Alaska Scrap & Recycling. The Anchorage Recycling Center and Total Reclaim also buy back some types of metals.***Disposal and End Markets***

Disposal is provided through the ARL, a modern engineered lined landfill, owned and operated by SWS. Sources of material disposed are summarized in Figure 1-3.

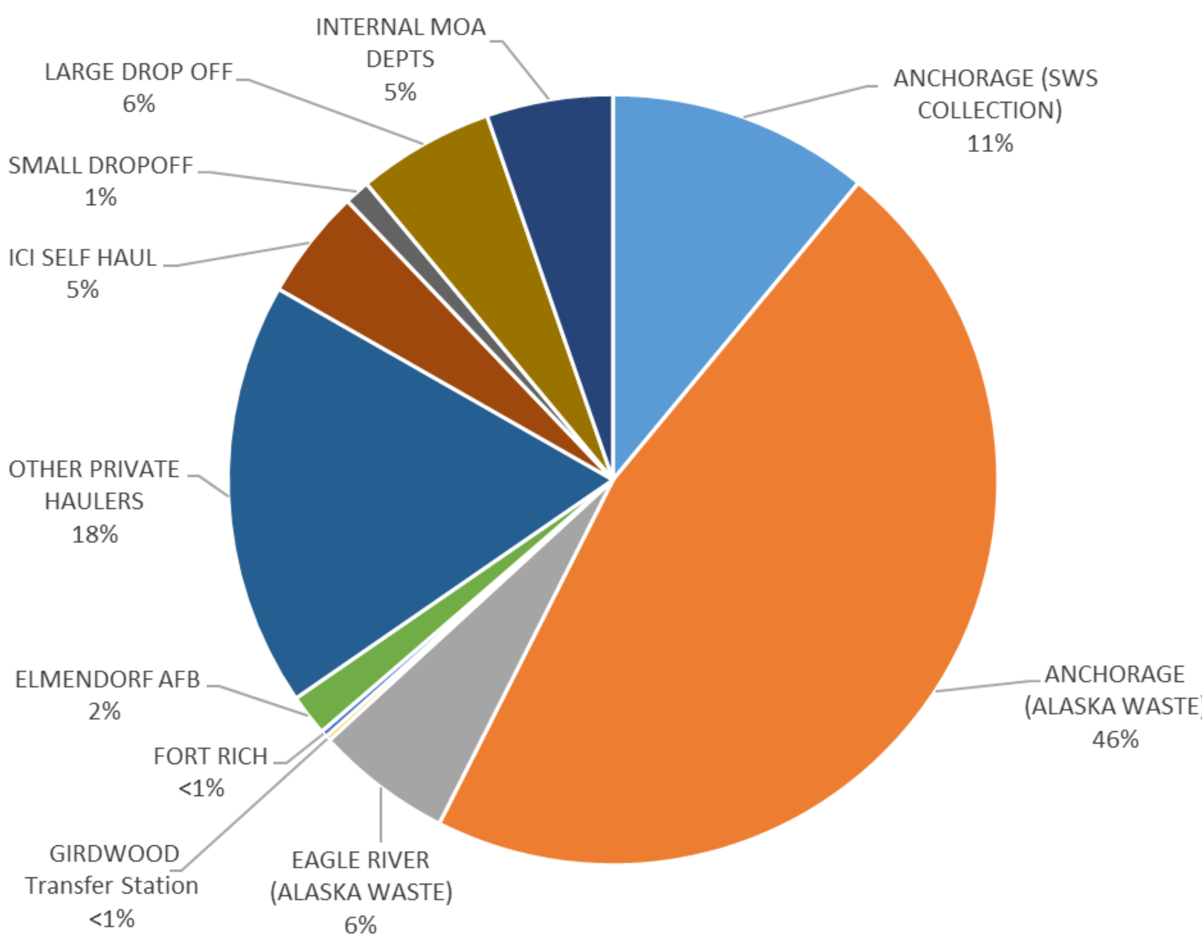


Figure 1-3: Summary of Trash Disposed at ARL in 2016 (Based on SWS Internal Tonnages)

Recyclable materials are shipped to end markets with the majority of material going to the states of Washington and Oregon for further processing and remanufacturing. A small amount of fiber material is sent to Thermo-Kool, a cellulose insulation manufacturer in Wasilla, Alaska.

Where market access is insufficient, the MOA has sought to develop local markets. Recycled glass was provided to the Alaska Railroad for use as traction sand for one year in a test situation. The glass sand proved not to be durable enough. For a few years before 2007, crushed recycled glass was sold to the shipyard in Seward for sandblast media. Recently, SWS has worked with the Anchorage Water and Wastewater Utility (AWWU) to accept crushed glass as a pipe bedding medium effectively creating a new market for the material within an industry where MOA has significant influence on materials. There are also specifications for 10% recycled glass aggregate blend in Municipality of Anchorage Standard Specifications and the State of Alaska Department of Transportation & Public Facilities.

Waste Diversion Programs

Anchorage has lower diversion rates than most large cities. This is largely because:

- Programs: MOA does not provide mandatory curbside recycling or organics collection for most of the population;
- Markets: Anchorage has limited local markets for recyclable and divertible C&D materials with markets for most materials located out-of-state requiring additional transportation coordination and cost compared to many other communities (particularly coastal Cities in the lower 48).
- Low Disposal Costs: The local landfill (ARL) has relatively low tipping fees (and high capacity, compared to other communities) providing less economic incentive to divert recyclables.
- Climate & Terrain: Logistical issues related to the northern climate, low population density, and challenges with existing infrastructure also creates challenges to establishing typical curbside collection programs, as seen in other municipalities.

A component of the ISWMP development process was to incorporate benchmarking analysis for the SWS solid waste system. The analysis includes metrics for diversion programs, transfer systems, and landfills. The MOA's overall recycling rate in 2016 was approximately 7% based on reported disposal at the ARL and recyclables processed by ARC/WestRock. This percentage does not cover all recycling activities within the MOA. The diversion rate is likely higher. Within the SWS Service Area, the residential curbside recycling rate was approximately 16% in 2016.

SWS periodically considers modifying their cost rate structure to reduce waste disposal and encourage recycling and waste reduction. Pay As You Throw (PAYT) principles have been incorporated into curbside collection programs. SWS has implemented a PAYT rate structure for its automated cart collection service and ICI service within the SWS Service Area and Alaska Waste offers similar service options to its customers within the MOA. While the current PAYT rate structures offer financial incentive for recycling in the SWS Service Area where there is no fee charged for recycling collection, the discount for downsizing containers does not offset the cost of any subscription-based recycling collection program outside of the SWS service area. Despite lack of financial incentive for recycling collection, there is community demand to improve recycling participation rates and increase diversion of materials from the landfill.

1.2 OVERVIEW OF SWS

SWS is composed of two utilities: 1) the Refuse Collections Utility (RCU); and, 2) the Solid Waste Disposal Utility (SWDU). SWS is divided into three Divisions: 1) Refuse Collections; 2) Solid Waste Disposal; and, 3) Administration (which is a support organization that fully charges out expenses to both the RCU and SWDU).

1.2.1 Refuse Collection Utility

The RCU was originally a function of the former City of Anchorage Public Works Department. When the City and Borough merged in 1975, the RCU became an enterprise activity of the MOA. The RCU provides refuse collection to the service area of the former City of Anchorage, which is approximately 20% of the population of the MOA. Since 1952, there has been mandatory service for all occupied residences of the RCU service area. The RCU has four types of services: commercial dumpsters; automated roll cart service; can and bag service; and residential curbside recycling. The RCU services over 5,000 dumpsters per week with six daily dumpster routes, and two Saturday routes to serve its commercial and multi-family residential customers. As a result of an automated trash and recycling collection service that began in the fall of 2009, most SWS residential customers are serviced using automated collection vehicles and rolling carts.

In 2015, the final phase of automated collection (Figure 1-4) rollout was completed with the RCU servicing eight automated collection routes with approximately 250 customers remaining on can/bag service. Currently, there are approximately 22,400 roll-carts and 2,000 dumpsters in service. The RCU is housed in a 27,000-square foot building located at the CTS that contains vehicle maintenance, warm storage space, and administrative offices.

Figure 1-4: RCU Automated Collection

In 2015, the SWS RCU also implemented an Automated Refuse Route Management System (ARRMS) with up-to-date route information and GPS to make refuse collection operations more efficient and cost effective. Specifically, this system provides real-time information to management and customer service staff such as: photo-documented waste containers that are overfull, not placed on curbside, or are out of compliance in some manner. The ARRMS provides a method for drivers to document extra charges, provide automated communication between refuse collection vehicles and the back office systems, provide updated route information to refuse collection vehicle operators, track vehicle progress on route, integrate with SWS existing billing system; and provide moving map displays for drivers that show customer and navigation information.

1.2.2 Solid Waste Disposal Utility

Municipal solid waste disposal was originally a function of the City Public Works Department, which operated the city landfill at Merrill Field. Under unification, the SWDU acquired responsibility for five waste disposal sites from Peters Creek to Girdwood. The SWDU was formed to operate and maintain these sites, while managing solid waste disposal throughout the MOA. The five sites were closed, and waste disposal was consolidated to the ARL in the 1980's. SWDU services include the disposal of solid waste, drop off recycling at ARL and collection of household hazardous waste at ARL and the CTS. The ARL is an award winning, state-of-the-art, engineered landfill that was opened in 1987. ARL is the only operating MSW landfill within the MOA and accepts more tonnage than any other landfill in the state. Geographically, the next nearest landfill, Matanuska-Susitna Borough, is located in Palmer, Alaska which is located approximately 27 miles north of the ARL.

1.2.2.1 Anchorage Regional Landfill

The ARL is located at the intersection of Glenn Highway and E. Eagle River Loop Road, near the community of Eagle River, Alaska (see Figure 1-5). The address is 15500 E. Eagle River Loop Road, Eagle River, Alaska 99577. The ARL is permitted under Solid Waste Permit No. SW1A001-22 issued by the State of Alaska, Department of Environmental Conservation, Division of Environmental Health, Solid Waste Program in accordance with Alaska Statute (AS) 46.03; Title 18, Chapter 15 of the Alaska Administrative Code (18 AAC 15) and Solid Waste Regulations (18 AAC 60). The ARL accepted approximately 330,000 tons of waste in 2016.

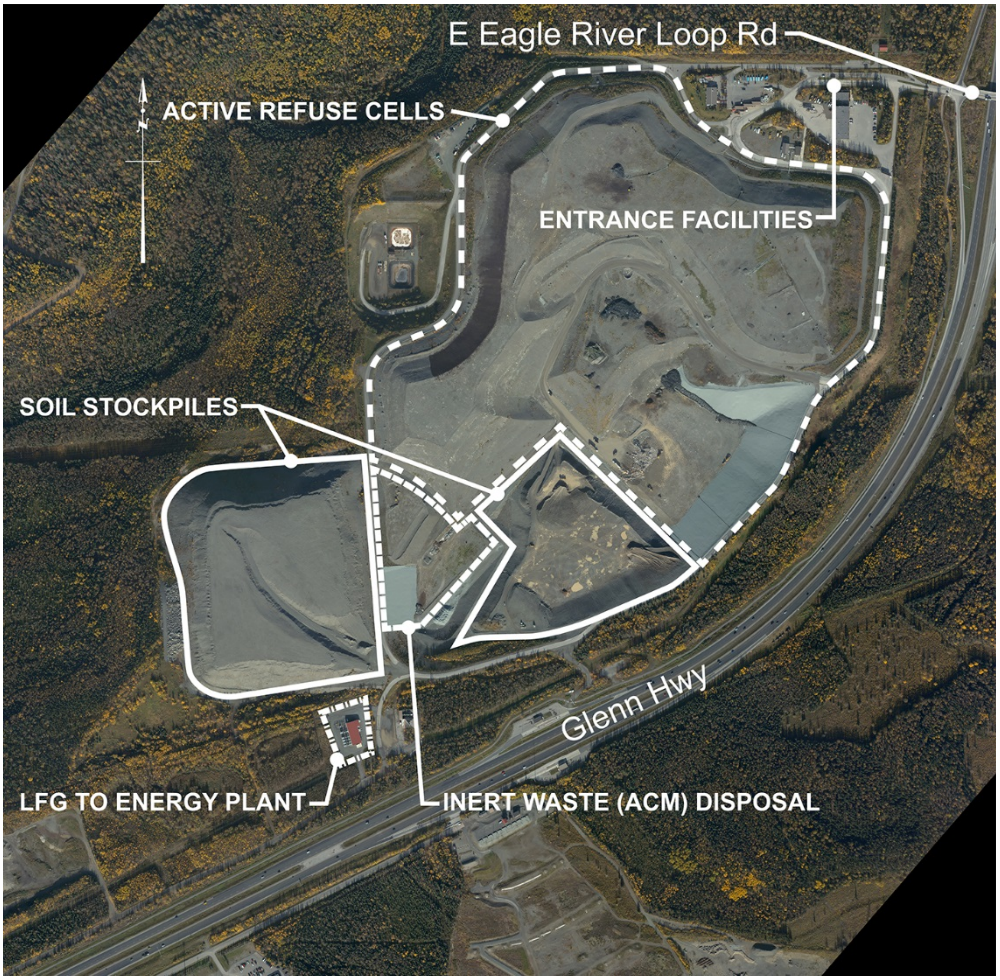


Figure 1-5: Aerial View of the Anchorage Regional Landfill (2017)

The ARL has a total land area of approximately 275 acres and is being developed in phases called cells. The ARL has a permitted total capacity of 45.2 million cubic yards. Permitted wastes accepted at the ARL include municipal solid waste (MSW), inert or C&D waste, regulated asbestos-containing material (RACM) and non-RACM, sewage solids or biosolids, treated medical waste, polluted soil, animal waste, commercial fish waste, commercial wood waste, and ash. Currently, Cells 1 through 7, 8a, 8b, 10, 11, and 12 have been constructed (comprising 137 acres). There are two remaining cells comprising 29 acres (Cells 8 and 9) that are currently anticipated to begin development in 2020 with preliminary design starting in 2019. The current overall development plan is to bring Cells 1 through 7 to an elevation of 560 feet above mean sea level (amsl); then bring cell 11/12 to an approximate elevation of 480 feet amsl to match the current Cell 10 elevation. Cell 8 has been designated as an inert waste cell and as such is exempt from active landfill gas collection requirements. Waste placement in Cell 8 may only be non-putrescent waste including asbestos containing materials (ACM), both RACM and non-RACM, C&D debris and other select materials designated and approved by the SWS Engineering Department. The ARL has been approved to substitute auto shred fluff, ground C&D debris, and wood chips on interior daily slopes in place of daily soil cover materials.

The ARL has an active landfill gas (LFG) collection and control system (GCCS) and leachate collection and recovery system (LCRS) installed. The ARL also has a liner system which includes the following components:

- Minimum 2-foot Drainage Layer;
- Geotextile Cushion;
- 80 mil High Density Polyethylene (HDPE) Geomembrane;
- Geosynthetic Clay Liner (GCL);
- Minimum 6-inch Foundation; and
- Prepared Subgrade.

Leachate generated within the waste is collected on the liner system and flows by gravity to two ponds for treatment and storage. Leachate is ultimately trucked approximately 7 miles for discharge to the public wastewater treatment system. Landfill gas (LFG) generated by the decomposing waste is collected by a gas collection and control system (GCCS). Collected LFG is sold to a third party for production of electricity. Unsold LFG is destroyed in an enclosed flare on site.

The landfill is designed with an outer perimeter road, much of which is a manmade berm. This berm not only contains waste but diverts surface water flow around the landfill site. Inside of the perimeter road is a ditch which collects and diverts all surface water leaving the landfill which has not come in contact with refuse. This ditch outfalls to a stormwater retention/infiltration pond in Cell 9 north of two leachate collection lagoons. A second retention/infiltration pond is planned to be constructed near the southeast corner of the ultimate fill footprint.

In 2018, the hours for the ARL for residential and commercial disposal are Monday through Friday - 7:30 a.m. to 5:00 p.m., Saturday -- 8:00 a.m. to 5:00 p.m. and closed on Sunday. Residential rates are $16 for a pickup truck (5 cubic yards or less, which does not exceed 1,000 pounds), $6 for a car (1 cubic yard or less), $1 each plus $1 recycle surcharge for up to four (maximum) 32-gallon bags. Fees for a pickup truck and car also include the $1 recycle surcharge. ARL is open for commercial loads of municipal solid wastes including construction and demolition debris. Disposal fees for commercial vehicles and trailers are $56.50 per ton (2017), plus a $1.50 per ton recycling surcharge, with a $15.00 minimum charge. There is no disposal fee for solid waste from facilities on Fort Richardson which are in direct support of the Active Duty Army's mission within Alaska.

As previously mentioned, the ARL accepts ACM waste. The cost of disposing of ACM waste is based on weight plus a special waste-handling fee. The current charge is $58.00 per ton disposal fee plus $70.00 per one-half hour special waste-handling fee. The disposal fee is $114.50 per ton, for ACM wastes generated from outside the MOA and determined to be acceptable for disposal at the ARL. The special handling fee is charged in one-half hour increments based on the time the ACM disposer arrives at and departs from the designated ACM disposal area. Medical waste loads are disposed by the "direct bury" method of waste disposal. A special handling fee of $140.00 is charged per load over and above standard waste disposal fees for all medical waste loads hauled to the ARL.

In November 2018, a magnitude 7.0 earthquake occurred in Southcentral Alaska. As a result of this earthquake, the landfill entrance facility building was severely damaged at the ARL. An assessment of the building determined that the building sustained damage during the earthquake that has rendered the building largely unusable. Options to restore the building to pre-earthquake functionality have been performed and are discussed further in 4.2.6.

1.2.2.2 Transfer Stations

The SWDU has three transfer stations located at Girdwood (see Figure 1-6), midtown Anchorage (CTS) (see Figure 1-7), and the ARL which allow the SWDU to reduce traffic flow and restrict access to the working face of the ARL.

Figure 1-6: Aerial View of the Girdwood Transfer Station

Waste disposed of and hauled from the transfer stations make up approximately 75% of the total waste disposed of at ARL, with almost all of it coming from the CTS. Girdwood Transfer Station serves a small community within the MOA and comprises less than 1% of the total waste disposed of at ARL.

Review of the 2016 Loads and Weights Report provided by SWS indicates that 88% of the Girdwood Transfer Station tonnage was shipped through CTS with the remainder delivered to ARL.

Central Transfer Station

The CTS and the SWS administration building are co-located in Midtown Anchorage at 1111 East 56th Avenue. The commercial entrance is located at East 56th Avenue and the residential entrance is located at 54th Avenue and Ingra.

This location also provides collection of residential chlorofluorocarbon (CFC)-containing appliances (refrigerators and freezers), used oil, batteries, and household hazardous waste. C&D debris, RACM, land clearing waste, medical waste and liquid waste, and commercially collected refrigerators are not accepted at this facility.

All loads must be covered and secured prior to arrival at the facility. Uncovered or unsecured loads are subject to an additional charge (true for all SWS facilities). In 2018, hours for residential operations are Monday through Saturday – 8:00 a.m. to 5:00 p.m. Commercial operating hours are Monday through Friday -- 6:30 a.m. to 5:00 p.m. The facility is open to the public Saturday 8:00 a.m. to 5:00 p.m. and is closed on Sunday and on free dump days (usually at the end of April or beginning of May). Disposal rates are $16 for a pickup truck (5 cubic yards or less, which does not exceed 1,000 pounds), $6 for a car (1 cubic yard or less) and $1 plus $1 recycle surcharge for up to four (maximum) 32-gallon bags. Fees for a truck and car also include $1 for the recycle surcharge. Disposal fees for commercial vehicles and trailers are $66.50 per ton (2017), plus a $1.50 per ton recycling surcharge, with a $21.00 minimum charge.

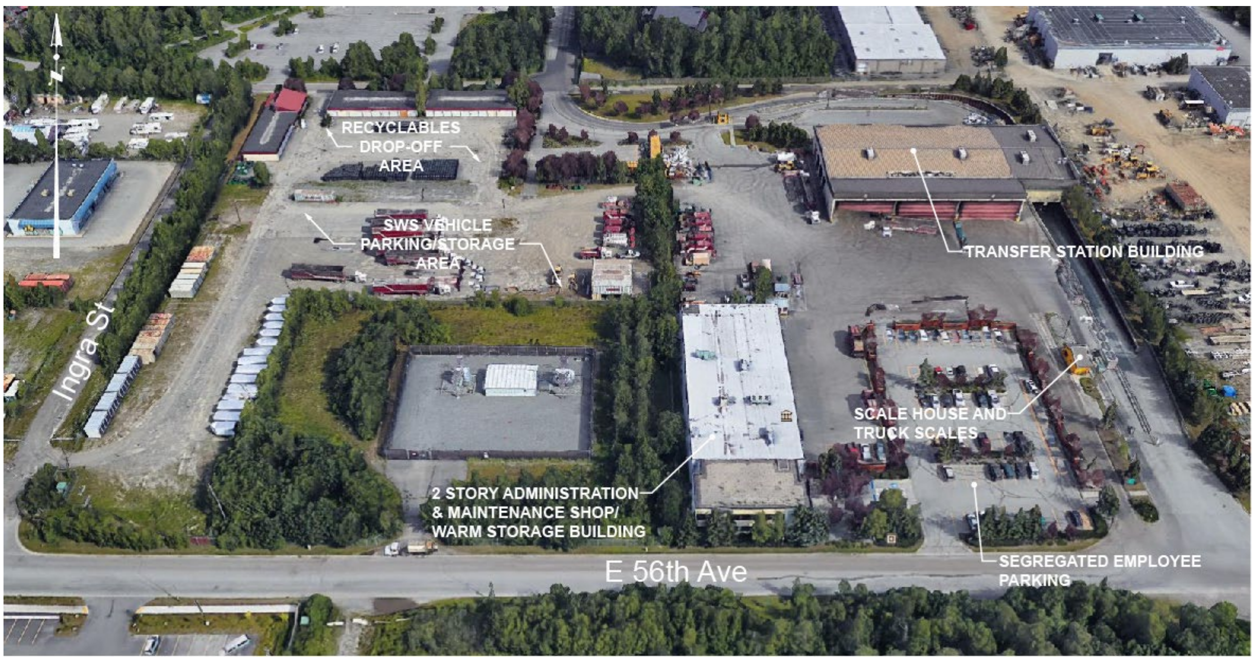


Figure 1-7: Aerial View of the Central Transfer Station

The CTS, with an operating capacity of 1,600 tons per day (TPD), receives the largest quantity of solid waste in the SWS system. According to the Loads and Weights Report, in 2016 the CTS received over 223,000 tons from almost 172,000 customers (loads or trips). During this time period, 207,550 tons (75,428 loads) were received by commercial haulers and large vehicles over the CTS's truck scales, with the remaining 15,780 tons (96,423 loads) being delivered by automobiles and pickup trucks via CTS's residential drop-off area. Operating conditions at CTS are largely governed by the number of vehicles accessing the facility per day, particularly residential vehicles. In general, Saturdays and Mondays are the highest traffic days, with commercial traffic peaking on Mondays (following facility closure on Sundays) and residential traffic increasing on Saturdays. In 2016, the day with the most vehicles accessing CTS (a "peak day") was Tuesday, May 31, 2016, at almost 1,130 loads. The next peak day at the CTS was Monday, April 18, 2016, with a total of 945 vehicles and approximately 1,074 tons.

With the increase in residential vehicles on Saturdays, CTS has experienced issues with on-site queuing and vehicle circulation. The peak day for residential vehicles at CTS was Saturday, April 23, 2016, with almost 640 inbound residential vehicles (automobiles and pickup trucks). The average number of residential vehicles per day was approximately 260 in 2016.

The SWDU operates a fleet of Transfer Trailers with a capacity of 120 CY each that transport solid waste from the CTS to the ARL for final disposal.

1.2.2.3 Hazardous Waste Collection Facility

The SWDU operates a 6,000-ft^2 hazardous waste collection(HWC) facility built in 1989 at ARL. Through 2017, the facility has collected approximately 25 million (M) pounds of hazardous waste that otherwise may have been improperly disposed of at ARL, the storm water collection system, or citizens' backyards. In addition, household hazardous waste drop-off is available for residents at the CTS on Tuesdays, Thursdays, and Saturdays. Hazardous products are shipped out of state to federally approved hazardous waste disposal sites. Other materials are rendered inert and landfilled, processed locally, or recycled. Anchorage residents bring household items such as paints, cleaners, and solvents to Reuse Centers at CTS and ARL. Some items are then stocked for other MOA residents to take home for reuse on household projects. For the hazardous waste program, of that not covered by fees, as a joint effort SWS and AWWU split the cost.

1.2.2.4 Closed Landfill Facilities

In addition to collecting refuse and operating the CTS, ARL and HWC facility, the SWDU is responsible for post closure care and monitoring of former landfill sites at Merrill Field Airport, Peters Creek (Loretta French Park), and International Airport Road (Javier de la Vega Park). At each of these sites, SWS must perform annual groundwater and LFG migration monitoring. The SDWU operates an active LFG collection system at Merrill Field to limit migration of LFG to commercial buildings constructed along Merrill Field Drive. The SWDU also operates and maintains a leachate collection system at the Merrill Field site to mitigate potential migration of groundwater contaminants to the Chester Creek system. Since no closure funds were ever designated for these sites, all post closure care activities must be funded out of the SDWU's annual operating budget.

1.2.2.5 Recycling

The disposal utility's budget includes a recycling fund, which is supported by a $1.50 per ton charge on all material that comes through any SWS disposal facility. The surcharge pays for the recycling coordinator position within SWS and various community recycling and outreach programs. The fund usually generates roughly $300,000 in flexible budget annually. The fund helps support several grants with ALPAR such as glass recycling, wharfage costs, Youth Litter Patrol, and Christmas tree recycling.

Funding has also been used to support pilot programming for curbside recycling and composting. Two voluntary food scrap drop-off programs were launched in 2016 and 2017 which diverted over 20 tons of material from approximately 600 Anchorage households. In 2017, the program size doubled, with 400 participants almost tripling the amount of food scraps diverted from the ARL. However, the program required a high level of effort from participants who were required to collect and transport food scraps to one drop-off location at the ARL in 2016 and two drop-off locations (at the ARL and CTS) in 2017, limiting scalability of the program. The program included providing finished compost product to participants in return for the food scraps; however, in both seasons the finished compost product was available only at the ARL site. In 2018 SWS is piloting program to test curbside organic waste collection.

SWS set up a $40,000 grant with Alaska Waste to increase the amount of recyclables being delivered to the ARC. This grant was used to offer Alaska Waste customers (who elect to participate in the program) three free months of curbside recycling collection. After the free first quarter, unless customers opt-out, the service would continue to be provided by Alaska Waste at a cost of $13.75 per month. Phase I of the pilot program covered 90 customers and there was a 69% retention rate at the end of the free first quarter. In early 2018, Phase II was halfway implemented with 830 new customers involved. Alaska Waste services 57,000 residential customers. Single stream curbside (ResMix) recycling makes up 25% of the total tonnage being exported by the ARC.

SWS also began offering a new commercial recycling program within its service area. Dumpster cardboard/mixed-paper recycling as well as single stream is now offered to commercial buildings including multi-family housing. Currently, there are two customers signed up for this program.

1.3 SYSTEM FINANCES

In 2016, SWS collected approximately $35 M in revenues with two thirds (over $23.5 M) coming from SWDU and one third (over $11 M) coming from RCU. Total costs to deliver services (i.e. expenses) for both utilities (SWDU and RCU) totaled $30.5 M in 2016, with approximately two thirds of costs occurring on the disposal side, which resulted in a surplus.

The majority of the SWDU revenue comes from tipping fees (83%). The remainder is a result of landfill gas sales, recycling fees, and hazardous waste fees collectively comprising an additional 13% of incoming revenues for the utility. A breakdown of the revenues in Figure 1-8 shows that SWDU revenues are primarily from tipping fees.

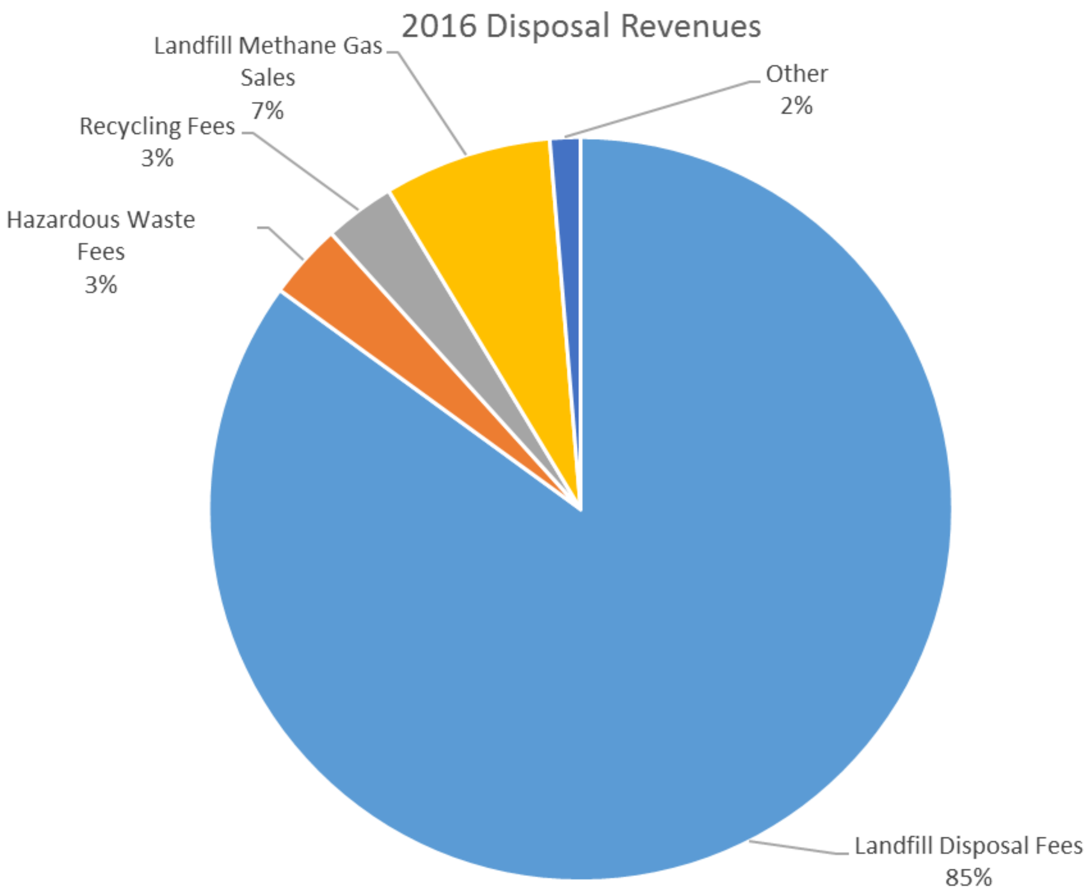


Figure 1-8: 2016 Solid Waste Disposal Utility Revenues

As per Figure 1-9, SWDU's expenses are distributed across several different areas, with labor and benefits (30%), non-labor (24%), and depreciation and amortization (21%) representing three quarters of total expenditures. Non-labor expenses include contractual services, maintenance and repair, public utility services, and supplies.

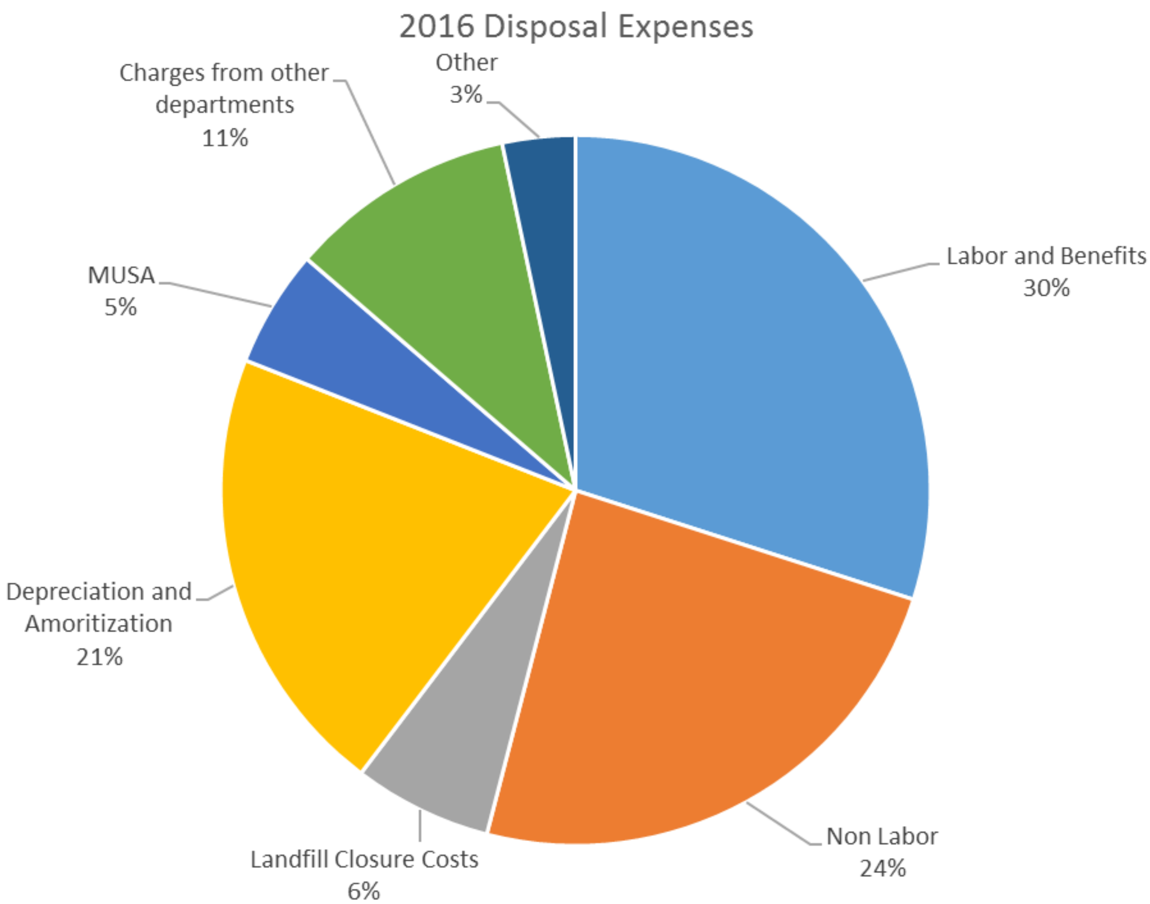


Figure 1-9: 2016 Solid Waste Disposal Utility Expenses

For the RCU, the majority of the revenue was collected from commercial (63%) and residential (30%) collection fees, as illustrated in Figure 1-10. The remainder comes from bin rentals and other sources.

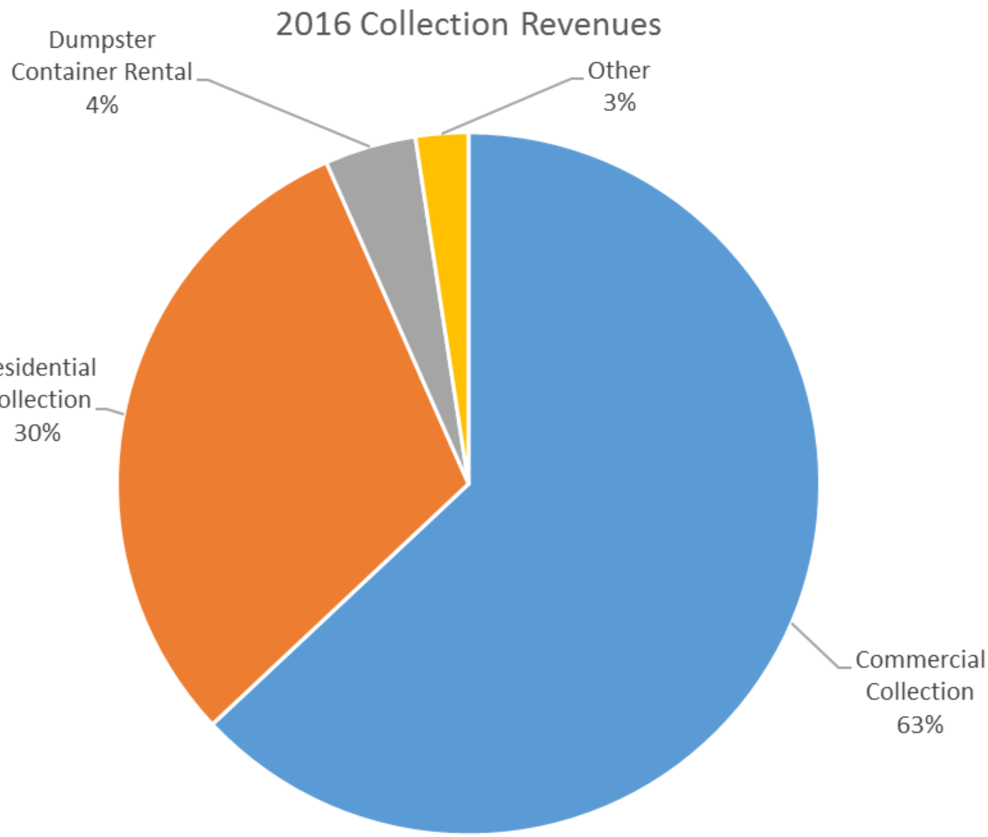


Figure 1-10: 2016 Refuse Collection Utility Revenues

In terms of expenditures for the RCU, non-labor costs represent 40% of the budget, and labor and benefits make up 29%. Over half of the non-labor costs for the RCU are SWS disposal charges (tipping fees). Figure 1-11 shows the breakdown of the 2016 RCU expenses.

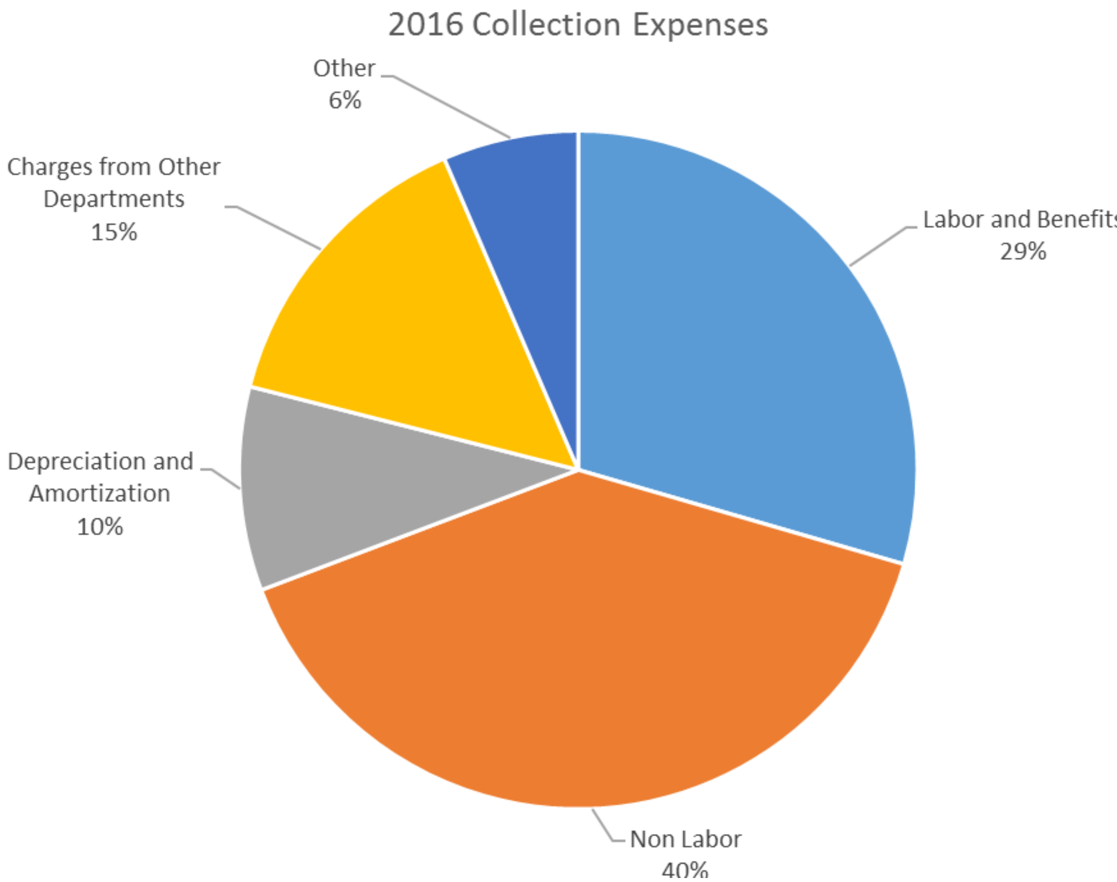


Figure 1-11: 2016 Refuse Collections Utility Expenses

1.4 WASTE COMPOSITION

SWS contracted HDR Inc. to conduct a limited waste composition study at the ARL in October 2017. The study consisted of two spot assessments of 2,000 lbs. of waste from a randomly selected truck dumping at the active landfill face. The waste was sorted into 13 categories and weighed to determine a by-weight composition. Results across the two assessments found that the sorted waste was primarily composed of food scraps (18%), wood and yard waste (17%), inert material (16%), paper (10%), and plastics #3-7 (10%). Further grouping of the sorted categories into material groups illustrates that compostable organics (food scraps, yard waste, and other organics), paper (including cardboard), wood and construction waste, and plastics comprise most of the waste stream. It should be noted that composition varied significantly between the two spot assessments and a comprehensive waste composition study with a large number of samples would provide a more accurate composition.

Additionally, waste composition studies in comparable municipal regions were assessed for high level comparison with the spot assessments completed for SWS. Comparable municipalities were identified based on geographical, climatic, population distribution, and solid waste service similarities. Comparable municipalities showed similar waste composition, with compostable organics as the largest component of the waste stream followed by paper, plastic, and construction and demolition materials. However, waste composition varies depending on the regional industries and the local recycling and composting services available.

An example of a comparable municipal region is the Peace River Regional District (PRRD) located in the North-Eastern corner of British Columbia. A 4-season waste composition study was performed for the PRRD that was comprised of over 150 samples (20 lbs. /sample) across four sectors (residential, commercial, drop off and work camps). Trucks for sampling were selected based on location and sector of origin to ensure that a comprehensive cross-section of the total waste stream was assessed. Preliminary results from the PRRD study indicate that the primary components of the solid waste stream are compostable organics, paper, plastics, and building materials. A waste composition study similar to the PRRD study (and other municipalities) with a statistically significant number of samples and breadth of categories would enable SWS to develop a baseline set of data for the various sectors. These data would then allow SWS to benchmark future programs and initiatives to clearly assess effectiveness.

1.5 WASTE GENERATION AND CAPACITY PROJECTIONS

1.5.1 Waste Generation Projections

Historical disposal tonnages were reviewed to assess existing disposal trends in the MOA. Per capita disposal rates were estimated based on SWS disposal records and US Census Bureau population estimates. Per capita disposal rates have seen overall decreases over the past 16 years as shown in Figure 1-12.

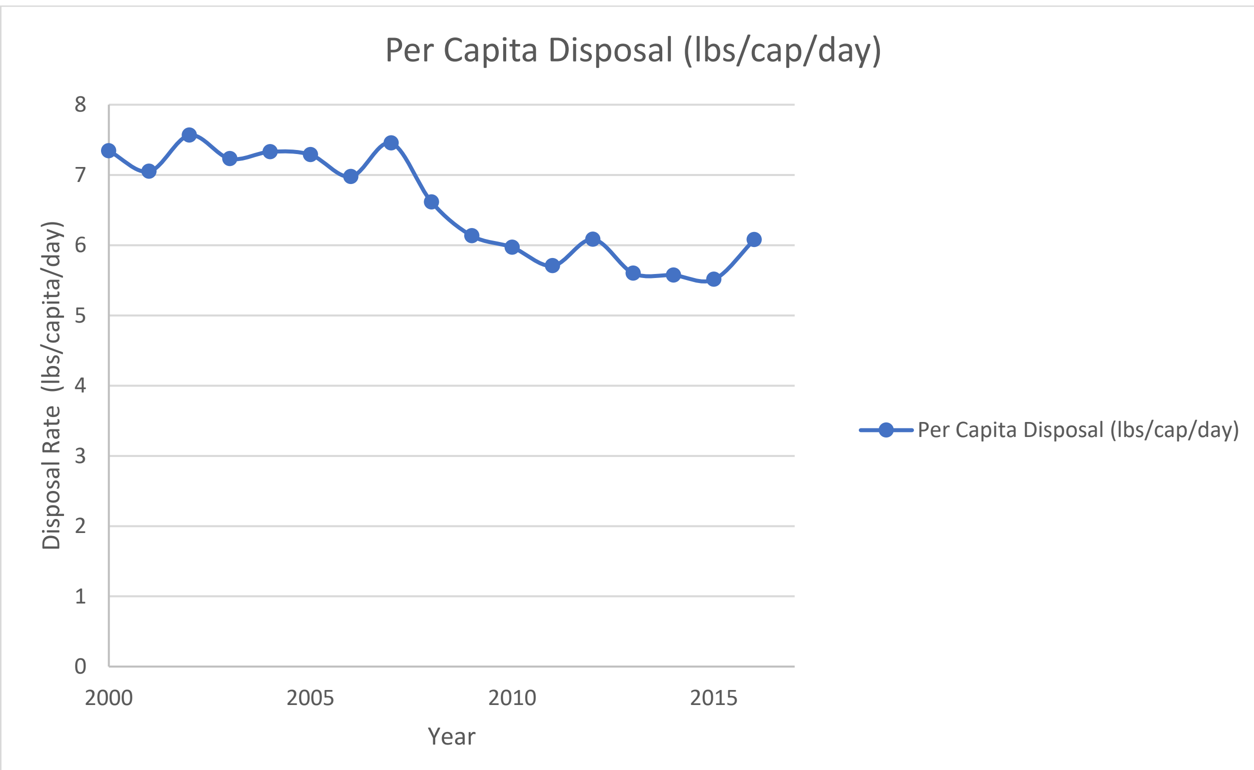


Figure 1-12: Per Capita Disposal Rate in MOA

An average per capita disposal rate from 2012 to 2016 was calculated to allow for forward waste disposal projections. Table 1-2 summarizes the per capita disposal rates estimated from 2012 to 2016. The average disposal rate of 2106 lbs./capita/year was used for future projections of material disposed at ARL.

Table 1-2: Per Capita Disposal Estimates

Year	Total Waste Disposal (lbs.)[1]	Population[2]	Per-Capita Disposal Estimate (lbs./capita/year)	Per-Capita Disposal Estimate (lbs./capita/day)
2012	662,850,525	298,527	2220	6.1
2013	615,488,200	301,143	2044	5.6
2014	610,947,198	300,429	2034	5.6
2015	600,158,405	298,312	2012	5.5
2016	661,611,880	298,192	2219	6.1
		Average 2012-2016	2106	5.8

[1] Waste Disposal based on data provided by SWS: 1988-2017 Municipal Solid Waste Quantities By Source and Revenue of Nonrevenue Category (REVTONS 17.xls).
[2] Population based on United States Census Bureau Annual Estimates of Resident Population: April 1, 2010 to July 1, 2016 2016 Population Estimates. (Available online https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk)

Disposal projections were developed based on the three population growth scenarios identified in the Draft Anchorage 2040 Land Use Plan[2].The population growth scenarios developed include base (0.8%), low (0.3%), and high (1.1%) annual growth. Based on these scenarios, annual and cumulative disposal tonnages were calculated assuming existing waste reduction and recycling programs. Projected cumulative tonnages are presented in Figure 1-13 and summarized in Table 1-3.

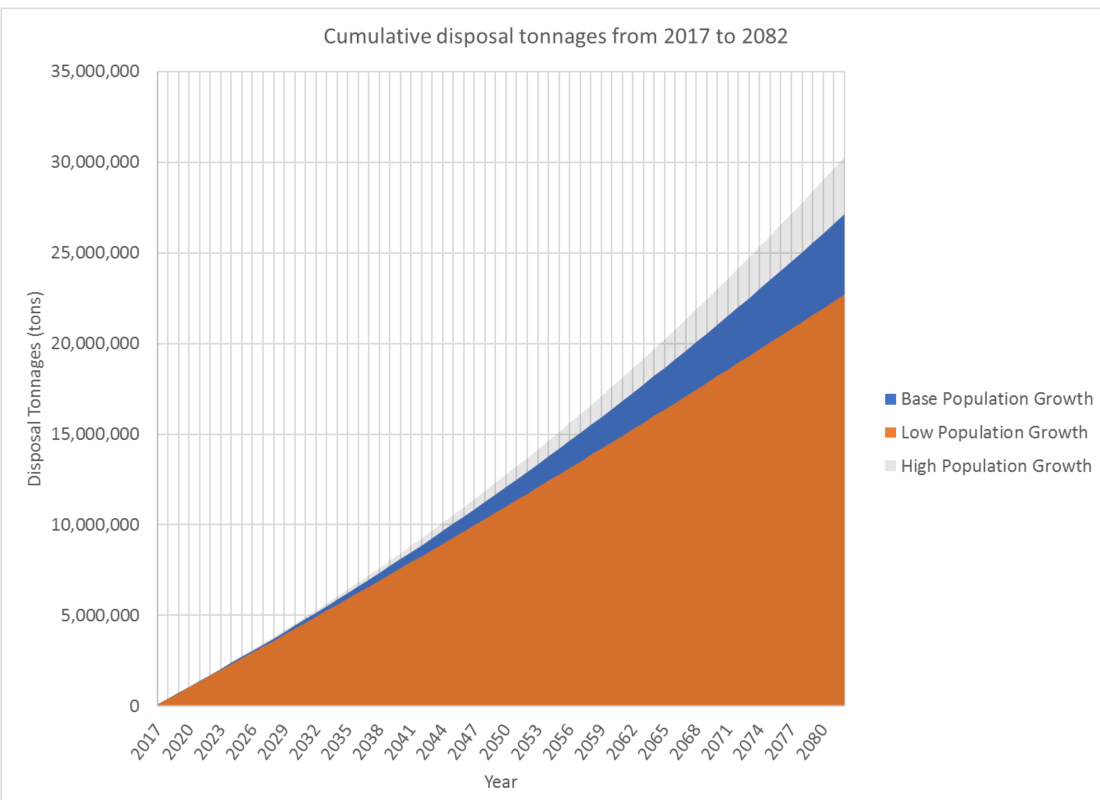


Figure 1-13: Projected Disposal Tonnages based on Anchorage 2040 LUP Population Growth Scenarios

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[2] The Draft Anchorage 2040 Land Use Plan was adopted by the Municipal Assembly (with amendments) in June 2017. The draft plan is available online https://www.muni.org/Departments/OCPD/Planning/Pages/Anch2040LandUsePlanPHD.aspx

Table 1-3: Projected Cumulative Disposal from 2016 to 2082

	Base Population Growth (0.8%)	Low Population Growth (0.3%)	High Population Growth (1.1%)
MOA Projected Cumulative Disposal, 2017-2082 (tons)	27,139,811	22,713,099	30.312,328

Further modeling of disposal rates and totals was completed as discussed in Section 4.0 to assess the effects of diversion and disposal options and scenarios.

1.5.2 Landfill Capacity Projections

Previous landfill capacity projections for the ARL were based on a 2011 Cell Sequencing Plan prepared by Bristol Engineering Services Corporation and BHC Consultants. That final grading plan was based on the geomembrane final cover design included in the site's Preliminary Closure and Post-Closure Maintenance Plan (PCPCMP) and called out two 50-foot wide access roads, 3:1 horizontal to vertical slopes, no benches, and a maximum elevation of 720 feet amsl (see Figure 1-14). The slope grades shown on the 2011 plan range from 3:1 to 5:1 horizontal to vertical. The final grades tied off to the perimeter access road on the southerly two thirds and existing refuse slope on the northerly third based on the 9/12/10 topography. Tetra Tech revised the 2011 final grading plan to include 3:1 horizontal to vertical slopes in between 15-foot wide benches every 50 feet vertically, two 50-foot wide access roads and a maximum elevation of 650 feet amsl at the south end and 740 feet amsl at the north end based on updated Bryant Army Airfield clear zone restrictions provided by SWS. The revised final grading plan is shown on Figure 1-15. The revised plan is graded so that the geomembrane in the final cover section will tie into the hinge point on the liner termination of the existing lined cells. The perimeter channel at the toe of the final cover slope will need to be either a 10-foot wide trapezoidal riprap channel or a six-foot wide trapezoidal channel in order to convey a 100-year, 24-hour storm to either the existing basin at the north or the proposed basin at the south of the ARL. The channel sizing was based on a preliminary hydrology and hydraulic analysis that was performed. A width of 30-feet was maintained around the base of the final grades so that either a 20-foot or 24-foot wide road would be provided depending on the channel configuration selected. The revised final grading plan provides approximately 2,380,000 cubic yards of additional airspace as compared to the 2011 plan. It is recommended that a seismic analysis and a final hydrology and hydraulic analysis be performed for the revised final grading plan.

Based on the revised final grading plan prepared by Tetra Tech, there is approximately 30,270,000 cubic yards of gross remaining airspace at the ARL as of 2017. In order to determine remaining site life, an Airspace Utilization Factor (AUF in tons/cubic yard) is used to convert remaining airspace in cubic yards to tons which is divided by projected refuse disposal tonnages. The AUF considers soil usage (refuse to soil ratio) and refuse density (or compaction rate). SWS staff have performed an evaluation of the AUF for the site and analyzed the year over year airspace utilization over a 10-year period utilizing the Draft 2016 ARL Annual Volume Calculations prepared by Bristol Engineering Services Corporation (although the last entry covered a two (2) year period). There are three AUFs reported which include a net effective AUF of 0.89, an active fill area AUF of 0.62 and a trailing total (since inception) AUF of 0.54. The SWS has suggested utilizing a 0.60 AUF for future waste filling projections. Assuming a 0.60 AUF, the remaining life of the landfill is 44 to 53years from 2017 and the anticipated closure date will be between 2062 and 2070 (Tables 1-4 and 1-5) based on projected disposal tonnages presented in Figure 1-13.

1.6 NEEDS ASSESSMENT

1.6.1 Stakeholder Input

The Tetra Tech Team and key SWS personnel conducted interviews from November 14 through 16, 2017 with primary stakeholders in the MOA with responsibility for or influence on how solid waste is managed. A list of those stakeholders with salient points from each interview follows:

- Central Recycling Services (CRS) – Shane Durand and Donna Mears
  - CRS estimates that they manage 75% of the demolition waste in the MOA.
  - Mixed C&D recycling started in 2009 but lack of markets for divertible materials (especially wood) keep tipping fee high for recycling so that only customers who have to meet specific diversion goals pay the extra to divert materials.
  - Crushed glass used locally for utility (AWWU) pipe bedding.
  - CRS is building a new scrap metal yard in 2018.
  - Suggested MOA could support end-markets by specifying recycled materials and writing specifications to allow or require alternative materials to be used in Municipal projects.
- SWS Solid Waste Action Group (SWAG)
  - SWAG members have been developing a Strategic Plan over the past year and are finalizing the plan now.
  - Multiple waste diversion pilot programs have been developed over the past several years.
  - Approximately 16% of residents in the SWS Service Area have opted out of curbside recycling due to concerns about potential fees for lost/stolen carts and recycling contamination.
  - In 2009, SWS began selling backyard composting bins which turned into a coordinated effort with the Anchorage Soil and Water Conservation District.
  - Current estimates are that approximately 20% of the material received at the landfill is C&D.
  - Landfill staff go back to recover airspace on landfill slopes as they settle.
  - Approximately 2/3 of landfill gas is collected for beneficial use (currently converted to electricity).
  - Current landfill tipping fees are less than half of those at surrounding municipalities.
  - Potential land for landfill expansion will be through agreement with the US Military at JBER.
  - CTS has circulation and queuing issues that limit capacity on the residential side. Facility is not properly designed for the amount of double axle trailers coming in on the residential side. Scale system break-downs have caused issues in the past. There is no indoor workshop for the Disposal Utility at CTS.
- Alaska Waste/Waste Connections (AW) – Kurt Froenig
  - AW is highly invested in the state and services over 94% of Alaska.

  - AW is SWS's biggest customer and AW and SWS partner on a number of initiatives including recycle coordinator position with the Anchorage School District, bio-diesel program, curbside recycling boost program, etc.
  - There are 57,000 residential customers in the MOA outside of the SWS Service Area.
  - AW and other residential haulers are regulated by the RCA which focuses on consumer protection for trash collection services (disposal and recycling not in purview of RCA).
  - Curbside recycling is by subscription so cost for collection is high. Currently about 20% of commercial customers have recycling collection.
  - Other haulers primarily service ICI and roll-off.
  - Due to RCA requirements, AW can't build diversion services into its garbage service fee unless a municipal ordinance requires the service be provided.
  - AW supports any changes at CTS that provide more flexibility in hours of operation.
- Alaskans for Litter Prevention & Recycling (ALPAR) – Mary Fisher
  - Operating since 1984 to promote waste recycling and environmental protection.
  - Cost of back-haul to lower 48 supported by ALPAR shipping donors.
  - Recyclers pay for each van used now.
  - Have previously run out of vans and had to renegotiate higher capacity threshold.
  - ALPAR had 1,130 containers committed last year; 1,050 used.
  - Constraints with subsidized back-haul capacity if recycling increases significantly.
  - ALPAR serves municipalities from Anchorage to Fairbanks, the Mat-Su valley, and communities throughout the state.
- Mara Kimmel, First Lady of Anchorage
  - Focusing on presenting a vision for Anchorage and ensuring that the MOA is resilient.
  - Food scraps and food security is high priority as well as sustainability.
  - Encouraged innovation, adaptability and flexibility in ISWMP.
  - Suggested finding opportunities to work with other departments to achieve mutual goals.
- Mayor Ethan Berkowitz
  - Wants the ISWMP to be bold and push the envelope if we think it's the right thing to do.
  - Look at being fiscally responsible by being more efficient and being good stewards of resources.
- ARC/West Rock - Randy Virgin
  - Recent challenges with export markets have squeezed recyclers.
  - Higher quality materials (single material, low contamination) are most likely to be sold and resilient to market changes (particularly with stricter contamination thresholds and enforcement imposed by China for imported recyclables).

  - A MRF in the MOA could improve the quality of materials to suit available markets.
  - Have been looking at other export markets to replace capacity in China. Mixed recycling will be most impacted.
  - Locally, Thermo Kool takes newspaper and cardboard (OCC) to create insulation.
  - Freight is the bottle neck to more recycling in Anchorage.
- Solid Waste & Recycling Advisory Committee
  - Current system is working well but could still improve on safety and liability.
  - General thoughts were that more communication/outreach is key to implementing ISWMP recommendations.
  - Mandatory recycling will be a challenge.
  - SWRAC will focus on ISWMP for the next few months,
- Bill Falsey, Municipal Manager
  - Need to define what problems we're trying to solve with the options we develop.
  - Provide direction on optimizing landfill capacity.
  - Position MOA for what happens after landfill capacity reached.
  - Would like to see recycling offered throughout MOA.
- Enterprise and Utility Oversight Committee
  - Want to build on successes.
  - Need to consider cost impacts due to new programs/requirements.
  - Want to encourage and replicate innovation like what happened with glass recycling use by AWWU.
  - Look into expanding ARL to include original 600-acre congressional appropriation for the landfill (now subject to terms of North Anchorage Land Agreement [NALA]).

There were a number of outcomes from the stakeholder consultation process that will influence development of the ISWMP and much of Tetra Tech's subsequent research and work was a direct result of discussions with stakeholders and staff. The main themes identified during stakeholder consultation are summarized below:

- **SWS wants to be ambitious** with its first ISWMP in 30 years. This ambition is supported by political leaders who wish to balance cost effectiveness and efficiency with pushing the envelope to do the right thing. SWS is viewed as forward thinking and proactive. The plan should focus on improving the system and setting SWS up for the next generation of waste management.
- **Alternative markets for materials influence diversion.** Through partnerships with AWWU and industry leaders, SWS has developed a local market for recyclable glass. Feasibility of recycling of other materials is highly influenced by forces outside of the MOA and by availability of subsidized shipping to external markets. Improving the quality of materials diverted from the MOA will enhance the marketability of the materials collected and diverted from disposal.
- **Operational issues should be addressed through the plan.** Existing and growing challenges associated with, or resultant from, adjacent development, traffic volume, services provided, and real estate usage at

CTS and operations at the ARL should be considered in the ISWMP to improve efficiencies and optimize capacity.

- **SWS can build on existing partnerships to reach its goals.** SWS has developed partnerships with public and private sector entities which have resulted in successful pilot programs, market development, and diversion programs. These successful partnerships offer significant opportunities to grow diversion programs.
- **Political changes may be required to drive significant diversion.** As SWS controls a limited amount of solid waste in the MOA, policy changes/regulatory requirements for increased diversion and/or approvals to further incentivize diversion through differential tipping fees or mandates may be required.

Moving forward with the ISWMP process, stakeholder input will be primarily conducted through the SWRAC and coordinated through SWS staff. Key stakeholders will be considered in future design, permitting and implementation of CTS improvements. Notes from the stakeholder meetings are included in Appendix A.

1.6.2 Solid Waste Services Survey

A Solid Waste Services survey was conducted through Survey Monkey from February through March 23, 2018. An advertisement including a link to the survey was placed on both the February SWS invoices and the Alaska Daily News website. There were respondents from 18 different zip codes, six of which are in, or partially in, the SWS service area. Of the respondents, 234 residents or business owners are within the SWS service area, comprising 50 percent. The below regions were represented:

- Anchorage: 329 respondents
- Chugiak/Eagle River: 58 respondents
- Joint Base Elmendorf-Richardson: 6 respondents
- Girdwood: 3 respondents
- Miscellaneous: 13 respondents

Of the 474 total respondents, 65 declined to answer the question regarding zip code. Of the 474 respondents, 457 were residential users and 17 were commercial businesses.

1.6.2.1 Residential

Of the 474 total respondents, 457 were residential users. Per the survey responses, 83.71 percent of residential users own their primary residence, and the remaining 16.29 percent rent. Most respondents (99.36 percent) currently have waste services, and 50.8 percent have recycling service. Nearly 40 participants use a solid waste or recycling service less than once a month (39.97 percent).

Home Type

- Single Family Home (detached): 72.84%
- Duplex or Fourplex: 13.1%
- Townhome: 9.27%
- Apartment: 2.88%
- Mobile Home: 1.92%

Trash Collection

- Curbside Collection: 81.79%

- Self-Haul: 12.14%
- Dumpster Service: 6.07%

Waste Discard: The most common types of wastes that are discarded (identified by more than 50 percent of respondents) include recyclables, single-use packaging, food scraps, soiled paper, hygiene items, and pet waste. Less common waste types discarded (identified by less than 50 percent of respondents) include yard trimmings, construction material, depot items (paints, electronics, appliances, tires), and bulky objects.

Recycling Services: Of the 50.8 percent of residential respondents that indicated they participate in recycling services, recyclables are collected as follows:

- Curbside: 48.56%
- Self-haul: 27.16%
- N/A: 24.23%

The ARC is most commonly used (48.25%), followed by the SWS CTS (28.75%), and ARL (15.65%). The Central Recycling Services (6.71%) and Girdwood Transfer Station (0.64%) are the least used recycling centers. Respondents were able to select more than one recycling facility; 17.89% of respondents stated that they do not recycle.

The respondents who use a recycling depot or facility state they do so because they do not want to pay for curbside recycling services or they do not have access to service collections at their residence. Twenty-one percent of respondents state a recycling depot is more convenient, as they can return many products at once.

Types of Recyclables: When asked what type of recyclables respondents would like to see accepted provided at a recycling depot or facility, the following responses were received:

- Compost: 27 respondents
- Plastic (more types): 26 respondents
- Glass: 17 respondents
- Electronics: 10 respondents
- Wood/Yard/Organic Scraps: 10 respondents
- Metals: 5 respondents
- Styrofoam: 4 respondents
- Paper/Cardboard: 4 respondents

A total of 17 respondents wished for more information and education regarding recycling programs, and 10 respondents wished for more incentives to recycle, including lowering the cost to recycle.

Composting: Per the survey, 58.79 percent of respondents want to participate in composting. Of those, 47.31 percent already participate in some organic composting at home, and 44.62 percent are aware of the backyard composting program, but have not yet started. Two percent of respondents have a backyard composter purchased through the SWS program but do not currently compost. Some respondents (17.2 percent) have participated in the community composting pilot drop-off program in the previous two years (2016 and/or 2017).

Curbside Recycling: The below are additional curbside collection services that respondents would like to have at their home:

- Large item pick-up: 50.48% of respondents
- Yard and garden waste: 49.52% of respondents
- Recycling (paper, cardboard, glass, plastic, metal): 41.21% of respondents
- Kitchen/food scraps (organics): 37.06% of respondents

In addition, 75 residents responded that they would like to include all recyclables in curbside recycling, specifically glass, organic yard waste, paper and cardboard, plastics, and furniture. Five residents responded that they would like curbside recycling, however do not want to pay for the service.

Residential Comments: Participants were asked what works well for services within the MOA, and what are some challenging aspects, as well as suggestions on how to improve waste management. Below are the most common responses:

- Desire more frequent pick-up times and extended hours of drop-off
- Residents are happy with current service
- Desire to recycle more types of products
- Lowering cost of service or incentives to increase participation in program
- Requests for more education on recycling and composting services
- Desire for improved receptacles (bear proof, more size options)
- Desire for more composting and yard waste options
- Desire to enhance recycling options for residents in apartments (such as community pick-ups)
- Create a waste-to-energy program
- Make recycling mandatory in Anchorage
- Create a local recycling program, rather than having to export to recycle

Table 1-6 represents residential participant's rate of satisfaction with garbage and recycling collection, self-hauling waste to regional transfer stations, recycling depots, and promotion and education of solid waste services.

Table 1-6: Residential Rate of Satisfaction

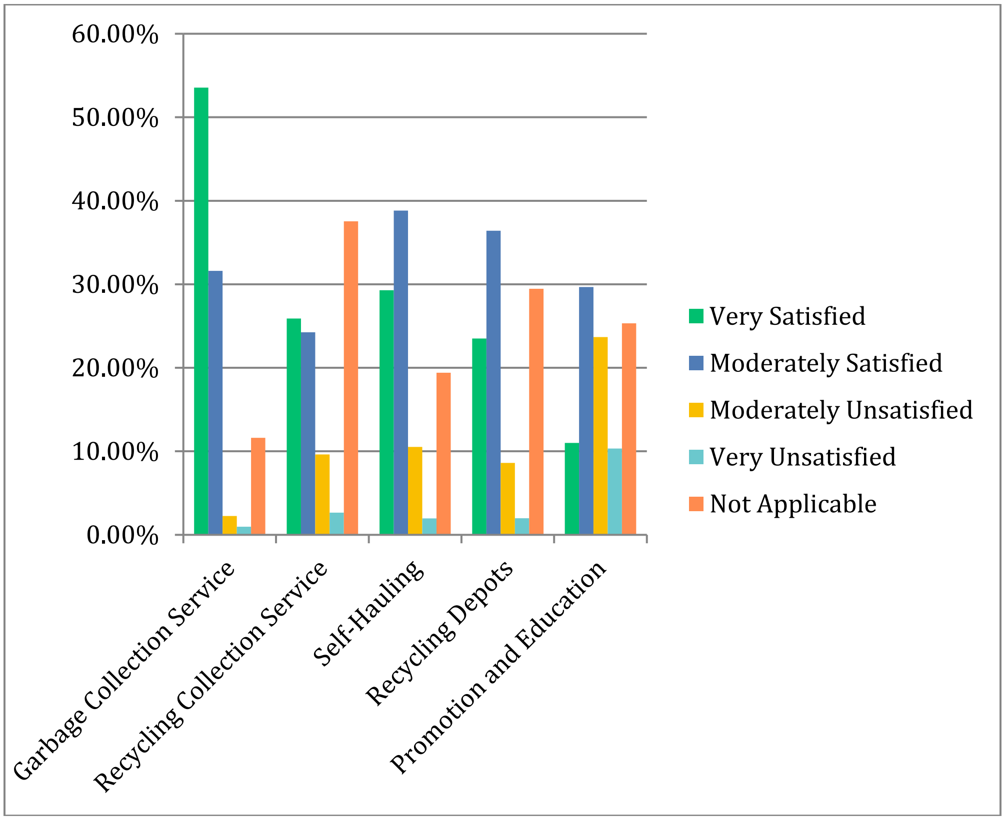
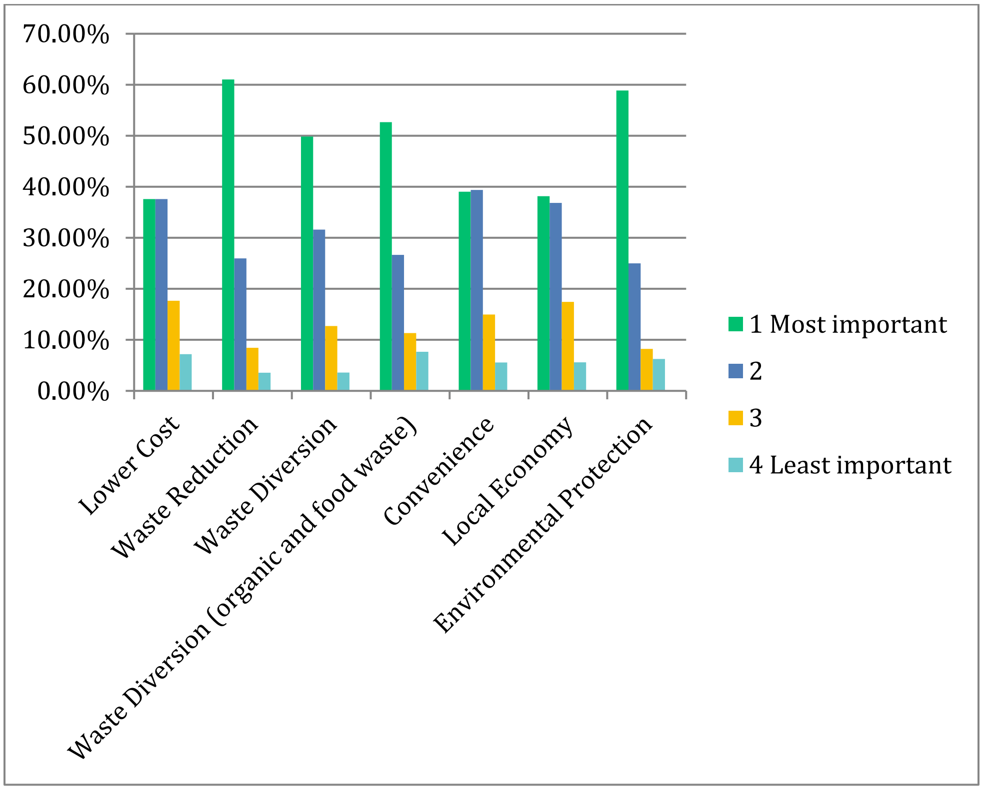


Table 1-7 represents residential participant's responses to what the most important considerations were when deciding on the next waste management solution for the region, ranked from most important (1) to least important (4).

Table 1-7: Most Important Considerations for Waste Management Solutions (Residential)



1.6.2.2 Commercial

Per the survey, 17 participants were commercial users; however, only six participants continued to the commercial survey. Of the six that participated, two respondents are Alaska Waste customers. The types of commercial businesses represented follows:

- Construction and/or Demolition: 3 respondents
- Retail: 1 respondents
- Hauling: 1 respondents
- Office: 1 respondents

Types of Waste: Commercial participants were asked what types of waste their business produces and were asked to check all that apply. The below materials were identified:

- Recyclables (paper, plastic, glass, metal): 6 respondents
- Construction and Demolition materials (wood, drywall, tiles): 4 respondents
- Single-use Packaging: 3 respondents
- Food Scraps: 2 respondents
- Yard Trimmings: 2 respondents
- Bulk Objects (furniture): 1 respondents

Commercial Trash Service: The SWS CTS, the ARC, and the ARL are most commonly used by commercial businesses for solid waste. Most commercial respondents use these facilities once per month or less

(57.15%), with fewer businesses using it once every two weeks (28.57%), or more than once a week (14.29%). The types of commercial trash service used by commercial businesses include:

- Self-Haul: 3 respondents
- Trash Dumpster: 2 respondents
- Trash Roll Carts: 2 respondents
- Recycling Roll Carts: 1 respondents

Recycling: One of the commercial participants noted that their business does not recycle. Of those that do, the CRS and ARC are most commonly used (two respondents), followed by the SWS CTS and ARL with one response each.

Table 1-8 represents commercial participant's rate of satisfaction with garbage and recycling collection, self-hauling waste to regional transfer stations, recycling depots, and promotion and education of Solid Waste Services.

Table 1-8: Commercial Rate of Satisfaction

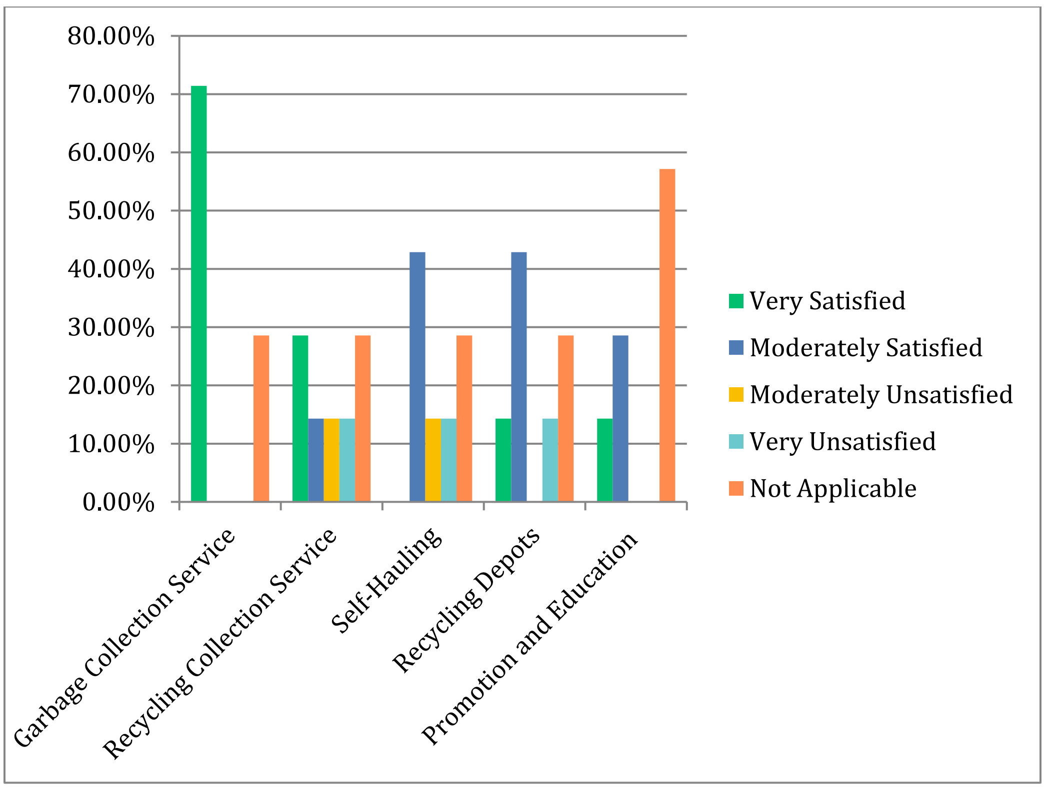
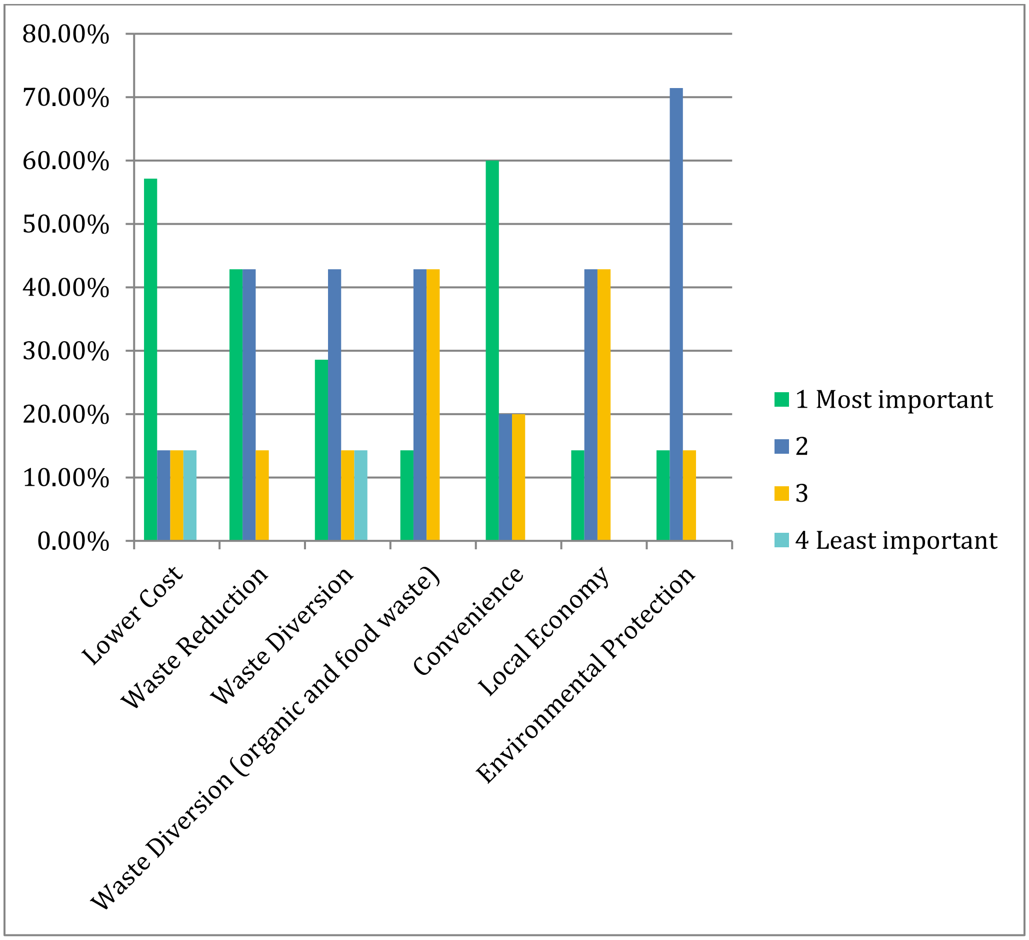


Table 1-9 represents commercial participant's responses for what the most important considerations are when deciding on the next waste management solution for the region, ranked from most important (1) to least important (4).

Table 1-9: Most Important Considerations for Waste Management Solutions (Commercial)



1.6.3 Benchmarking

The desired outcome of the data and needs analysis for the ISWMP is to form the baseline for SWS. Understanding the baseline helps to assess the state of the current solid waste management system and areas that can be improved.

Benchmarking serves as a best practice and management tool for utilities to identify areas to be improved. "Benchmark" means reference point or standard, herein referred to as key indicators. To benchmark means to compare something, in our case solid waste management systems, against a reference point or standard. It is a means to quantitatively assess performance through key utility goals and criteria. Understanding one's performance allows utilities to compare with one another, and more importantly, identify areas where improvement and innovation potential exist.

1.6.3.1 Key Performance Indicators (KPIs)

As part of their Strategic Plan, SWS has developed guiding principles that focus on community sustainability, customer experience/satisfaction, and operational excellence. These principles were used to develop KPIs that could be compared with other jurisdictions. An important consideration for benchmarking is to ensure that the definitions are the same or consistent. Below are SWS's list of KPIs that are categorized into their respective guiding principles and contain a definition and target for benchmarking purposes.

KPI	Definition	Target
Community Sustainability		
Waste Generation Rate	The average amount of waste disposed each day from each resident in the MOA. This typically includes waste from the residential (RES), institutional, commercial and industrial (ICI) and C&D sectors. It is important to note that some jurisdictions include materials diverted from disposal as part of the waste generation terminology. For this metric, waste generation only refers to the municipality's disposal rate.	Annual disposal rate to be less than 5 lbs. per capita per day by 2025
Recycling Rate	Represents the amount of material diverted from disposal relative to the amount of waste disposed and recycled in the MOA.	Increase to 25% by 2020
Customer Experience / Satisfaction		
Missed Pick Ups	Represents the number of missed pick-ups that would occur over the entire year or month or week. The comparative rate needs to be defined.	• 80% picked up on time by 2017 • 95% picked up on time by 2018
Processing time	Represents the average amount of time customers within the facility (transfer station or landfill) will spend before exiting the site.	Under 15 minutes per visit

KPI	Definition	Target
	Operational Excellence	
Fleet Fuel Efficiency	Tracking fuel consumption of the collection fleet	Need to track the baseline before determining target.
Landfill Waste to Cover Ratio	Monitoring of landfilled waste to cover ratio. Based on a weight basis.	Improve landfilled waste to cover ratio to 1.4 (waste) to 1 (cover material) per Strategic Plan.
Employee Training Per Year	Amount of training time employees are given for professional development and health & safety training.	Offer each employee 40 hours of training per year
Injury Reduction	Tracking of injuries that are claimed from the job site. Can be based on the number of incidents or the cost of workers compensation claims.	50% reduction by 2020

1.6.3.2 Approaches to Benchmarking

Any aspect of a business or utility can be benchmarked, including organizational structure; management processes; service standards; work practices; program/project delivery approaches; technical standards; process performance; and costs.

All solid waste management systems are similar from the perspective that waste is generated and waste is ultimately disposed. The similarities start to vary as the materials move from the source or starting point (waste generation) to the end point (disposal facility). The numerous pathways that waste materials can travel depend on many factors such as solid waste programs, collection systems and processing options.

Similarities in solid waste systems are excellent aspects for benchmarking. The Tetra Tech Team recommended benchmarking the following components of the solid waste management system in the MOA as data is available:

- Tipping fees for disposal ($/ton);
- Cost for solid waste services ($/customer/month);
- Level of Service (mandatory and optional services available to customers);
- Service delivery method (contracted services vs. municipal crews);
- Missed pick-ups (#/day, #/week, #/month, #/year);
- Injuries (#/month, #/year);
- Non-Injury Period (# days without safety incident);
- Customer satisfaction rating (completed through surveys);
- Waste disposal per household (lbs./household/year);
- Waste diversion per household (lbs./household/year);
- Recyclables diverted per household (lbs./household/year);

- Waste disposal by employee (for ICI sector disposal rate); and
- Public Education funding ($/capita/year).

Additional metrics of the solid waste system that may be collected through benchmarking include:

- Customer pick-ups (#/truck/day);
- Self-haul disposal rate (t/yr.); and
- Average self-haul disposal load (lbs./customer visit).

Change in the solid waste industry is inevitable. Over the past 20 years, solid waste programs have evolved from strictly trash disposal services to include recycling (paper, metal, glass and plastics), then to include organic waste diversion (yard waste, green waste and food scraps), and now to include greenhouse gas (GHG) emission reduction opportunities. Understanding "where we are" and "where we can go" are the basic principles of benchmarking and are an invaluable tool for long-term planning of solid waste systems.

1.6.3.3 Other Jurisdictions

Other jurisdictions that are reasonable to be compared with the MOA include the following:

American Jurisdictions	Canadian Jurisdictions
Fairbanks, Alaska	Whitehorse, Yukon
Juneau, Alaska	Yellowknife, NWT
Seattle, Washington	Vancouver, British Columbia
San Francisco, California	Saskatoon, Saskatchewan
Fargo, North Dakota	Edmonton, Alberta or Victoria, BC
Buffalo, New York	Calgary, Alberta

1.6.4 Diversion Opportunities

A number of potential opportunities exist to reduce waste in the MOA. Options to increase waste reduction will be evaluated to address gaps in the waste management system and capitalize on opportunities to increase effectiveness of existing programs and services. The options presented in Table 1-10 are categorized into four core areas for consideration:

- Reduction and Diversion Programs – Programs and services aimed to promote reduction, reuse, and recycling of materials.
- Construction and Demolition Waste Programs – Programs targeting reduction, reuse, and recycling of materials from the C&D sector.
- Promotion and Education Programs – Programs and materials aimed at educating the public and supporting sustainable behaviors.

- Policies and Management Tools – Rules, guidelines, and laws that support waste reduction, reuse, and recycling within the MOA.

The options listed below are presented for discussion as the "long list" of items for consideration. As part of the ISWMP development, a high-level evaluation will be performed to rank and prioritize options for further analysis. Although Table 1-10 presents the options as stand-alone policies or programs, in reality, programs must be integrated and implemented with care in order to achieve greater diversion without adversely impacting the system's financial, social, or environmental sustainability. Long-term diversion of materials from the landfill will require:

- Policies and programs to encourage and/or support diversion;
- Leadership by the MOA for waste diversion and end uses;
- Generators changing their behavior to divert instead of dispose materials;
- Service providers willing to receive and process or manage the materials;
- Infrastructure to process and create marketable materials; and
- Stable markets for materials.

Table 1-10: List of Potential Options to Increase Waste Diversion in the MOA

Option	Description
	Reduction and Diversion Programs
Material Disposal Bans	Establish list of materials that are banned from disposal to disallow certain materials from reaching the landfill and/or encourage diversion.
Recycling Mandate	Mandate recycling collection to be packaged with garbage collection in the MOA through a municipal ordinance.
Recycling Depots	Standardize recycling opportunities at all major SWS facilities (improve availability of recycling at ARL and Girdwood Transfer Station).
Government Building Recycling Programs	Work with all levels of government to ensure that recycling programs are in place in offices and facilities where practical.
ICI Waste Reduction Strategy and Toolkit	Develop an ICI Waste Reduction Strategy and Toolkit to educate, facilitate and legislate waste reduction practices in the private sector.
ICI Waste Reduction Grant and Technical Assistance Program	Develop a program to provide technical support and grants to help businesses reduce waste. Alternatively, strongly promote and support existing organizations such as the Green Star Business program.
Expand Curbside Recycling	Expand curbside recycling materials and collection to be mandatory for all occupied residences throughout the MOA.

Option	Description
Yard and Garden Waste Drop-Off	Create Yard and Garden Waste drop-off facilities throughout the MOA for processing at ARL or by a private contractor. Provide drop-off locations at all SWS facilities and at other MOA facilities as appropriate.
Yard and Garden Waste Collection Program	Implement seasonal collection of yard and garden waste in the SWS Service Area.
Organics Collection Program	Implement year-round collection of organic waste (yard and garden waste and food scraps) in the SWS Service Area.
ICI Waste Diversion Working Group	Create a group of ICI sector stakeholders that meet to discuss common issues and challenges related to waste diversion in this sector and identify potential solutions
Expand Free Store/Reuse Center System	Expand Reuse Centers for household items (furniture, small electronics, etc.) at ARL and transfer stations (possibly managed by established local volunteers and charity groups such as re:MADE) to accommodate increased re-use of discarded materials
Waste Exchange Program	Create or promote existing online waste information system that encourages re-use by listing materials available that would otherwise be disposed at a landfill.
Material Recovery Infrastructure	Work with material recovery stakeholders to build/expand the material recovery infrastructure in the MOA to support processing of collected recyclable materials from residential and commercial sources to create an end product that would be acceptable to global and local commodity markets.
Support Recycling Markets	Create a grant program for businesses to integrate recyclable materials into their manufacturing process.
Construction and Demolition Waste	
Disaster Debris Response Plan	Develop a plan to deal with debris generated during disasters to minimize the impact on the landfill threshold. This can involve disposal of C&D waste at other facilities during disaster events and include ways to marshal equipment and sort out recyclable materials.
C&D Material Recovery Plans	Establish a requirement for all large developments to create a material recovery plan outlining how waste from construction, renovation and demolition projects would be managed and diverted.
C&D Re-use program	Create or promote existing C&D re-use programs within the region. (e.g. building materials such as dimensional lumber, large beams, siding, windows, doors, sinks, light fixtures, etc.)

Option	Description
C&D Deposit Refund Program	Develop a deposit program to accompany C&D project permit applications in the region. A refund would be given upon completion of the project based on waste diversion performance.
C&D Diversion Brochure	Include an approved C&D disposal and recycling facilities brochure in all municipal building and demolition permit packages.
C&D Residual Disposal	Work with local recyclers to assess feasibility of accepting residual material from C&D sort lines at a reduced tipping fee as alternative daily cover or materials of beneficial use at the landfill. Promote more end uses in contract specifications for C&D (other than ADC) to allow for recycled material end use. Provide MOA leadership for developing end markets with use on municipal projects.
Promotion and Education Programs	
Waste-as-Resource Promotional Material	Prepare promotional materials that shift the perception of trash from a “wasted material” to a “commodity” or “resource” and introducing this revised language in all communications.
Focus on CBSM	Develop education and engagement programs based on Community-Based Social Marketing (CBSM) principles.[3]
Community-Based Metrics and Waste Diversion Promotion and Recognition Program	Track waste diversion and other metrics on a community basis and publish an annual report of communities’ performance to encourage greater participation. Create a program to raise waste diversion awareness and participation through highlighting waste diversion achievements in the MOA. Provide positive reinforcement to communities with the highest recycling rates.
Education Coordination	Increase staff resources for education and communication functions to support diversion programs.
Informational Directories	Develop and maintain directory of locations/facilities within the MOA that recycle, reuse, divert waste (i.e., food banks, donation stores).
Standardize Signage	Prepare signage specifications to standardize messaging and maximize ease-of-use for the public at all SWS facilities.
Zero Waste Events	Carry out Zero Waste Special Events throughout the region that highlight waste diversion opportunities and public education.

[3] Community-Based Social Marketing I an approach aimed to creating sustainable behavior change in communities. Community-based Social Marketing, 2017. http://www.cbsm.com

Option	Description
Master Recycler/Composter Program	Develop a Master Recycler/Composter program to identify and educate environmental leaders within MOA communities to educate constituents.
Grass-Cycling Resource	Promote/update information resources to educate the public on how to use mulching mowers and composters to deal with grass clippings on-site.
Backyard Composting Promotional Material	Prepare backyard composter promotional material and support neighborhood level projects to promote organic waste reduction within a resident's property and neighborhood.
Waste Reduction Leadership Presentations	Identify businesses and solid waste management initiatives that could provide leadership to better implement ICI initiatives. Create relationships with representing bodies through presentations and promotions of ICI waste reduction materials.
Policies and Measurement Tools	
Solid Waste Management Plan Annual Reporting	Report annually on the progress of implementing the Integrated Solid Waste Master Plan against targets.
Tipping Fee Structure	Structure tipping fees to encourage diversion of high and medium value materials (such as C&D, clean wood, metals, etc.).
Solid Waste Terms and Procedures	Develop standard solid waste terms and procedures for use in all municipality contracts
Procurement Policy	Adopt a procurement policy and develop a procurement guide to encourage and require the purchasing of products and services that assist in the reduction of solid waste generation and prioritize materials with recycled content. Promote key aspects of procurement policies in government departments throughout the MOA.
Waste Composition Audits	Conduct additional waste composition audits on a periodic basis from varying sectors to gain a stronger understanding and characterization of the waste stream as well as track progress of diversion efforts.
Pilot Projects	Implement pilot projects for all options before municipality wide roll-out.

1.6.5 Landfill Operations

1.6.5.1 Airspace Utilization and Capacity Optimization

Landfill airspace utilization and site life is dependent on many factors including variations in waste type, compaction rates, the use of alternative daily covers, and the annual tonnage delivered to the landfill. In addition, long-term landfill settlement can also have a great impact on site life and may average 25 percent of the total refuse thickness over time. It is estimated that much of the total settlement will occur during the operating life of the landfill and will be accounted for in periodic topographic surveys.

There are several changes in operations that could be made to improve airspace utilization. It is our understanding that the ARL experiences large amounts of settlement, soil is primarily used for daily and intermediate cover (on occasion snow, wood chips used), daily or intermediate cover is not currently recovered and cells are constructed that are in use for long durations (five to ten years). Tetra Tech will assess these areas of operation and provide recommendations on the following:

- Compaction;
- Alternative daily and intermediate cover usage; and
- Engineering planning/fill phasing.

Tetra Tech performed analyses of how improving the AUF, through potential operational efficiencies and waste stream alterations, impacts the overall site life. After establishing the appropriate AUF(s) for future planning, the data from the waste generation model was used as the basis for the landfill diminishing capacity model. This is an important exercise since the projections will be used for future capital planning for the ARL. All assumptions and the model will be provided to the SWS for future tracking and to make adjustments as needed.

As mentioned in Section 1.5 – Waste Generation and Capacity Projections, there are several key items which will affect the total capacity available at the ARL that have been discussed with SWS, including a potential revised military-imposed landfill height limit, final cover stability and modifications to the final closure grading. A slope stability analysis has not been performed for the current landfill final grading plan and cover and the site is located in the highest recorded active seismic zone in Alaska. All of these items are considered in Section 4.2 of the ISWMP.

1.6.5.2 Leachate Generation

The ARL generates a relatively high amount of leachate (approximately 26 M gallons in 2016) with an annual average of approximately 11.4 M gallons per year over the past 26 years. This amount is expected to increase with the development of remaining Cells 8C and 9. Data shows an immediate increase in leachate generation during the rainy season which is usually indicative of a short circuiting of the collection system occurring and after new cells are developed. Currently, SWS hauls leachate from ARL to a dump station located at the intersection of Turpin Road and Glenn Highway. This dump station is owned and operated by AWWU. SWS is in the evaluation process of constructing a lift station to be located at the ARL and associated pipeline so that collected leachate can be discharged directly to a Doyon Utility (Doyon) owned collection system located on Fort Richardson, which ultimately discharges to AWWU's wastewater collection system. Limitations on discharge to the AWWU system are expected to become more stringent in the coming years requiring additional treatment prior to discharge. Another option being considered by SWS is a leachate evaporation system utilizing landfill gas to reduce the volume of discharge to AWWU while beneficially utilizing the landfill gas.

Leachate generated within the waste is collected on the liner system where it flows by gravity to the leachate processing and storage ponds. The ponds are lined impoundments with a capacity of 1.2 million and 1.4 million gallons, respectively. Leachate receives limited treatment by coarse bubble aeration in Pond 1 using one of two 2,500 scfm blowers. Treatment is intended to reduce biological oxygen demand (BOD) and precipitate dissolved metals prior to loading for discharge. The pond liners and blower systems were installed in 1995 with little modification or replacement since and are rapidly approaching the end of their useful life. SWS has conducted studies to determine the most effective treatment to achieve anticipated changes to discharge limitations imposed by AWWU for disposal in the POTW.

As leachate is costly to treat and transport, reducing the amount of leachate generated will reduce operations costs. There are several ways to limit leachate production including the following options which will be evaluated:

- Interim storm water management:
  - Temporary basins
  - Storm water pumps
  - Diversion berms
  - Storm water interceptors within the LCRS
- Alternate engineering planning/fill phasing strategies
- Daily and intermediate cover material type alternatives
  - Tarps
  - Onsite soil
  - Wind defender
  - Green waste material
  - Diverted inert waste material

Tetra Tech will work with SWS staff on the feasibility of implementing recommendations.

1.6.5.3 Landfill Expansion

SWS has previously assessed two potential landfill expansion locations to the north and to the west of the ARL. The location to the north is bisected by a 24-inch water main and preliminary capacity calculation have been generated. It is the Tetra Tech Team's understanding from discussions with SWS staff that the location to the west is more desirable and that a conceptual level plan has already been developed. Tetra Tech reviewed the conceptual plan and capacity calculations provided by SWS and evaluated the potential airspace available and corresponding site life in Section 4.2.2.

1.6.5.4 Landfill Entrance Building Damage

The primary function of the Landfill Entrance Building at the ARL, constructed in 1987, is for vehicle maintenance and storage, with administration offices attached. This facility is essential to the operation of the ARL and especially during adverse winter weather conditions.

The ARL is located in a highly active seismic zone in Alaska. In November 2018, a magnitude 7.0 earthquake took place in Southcentral Alaska, and damage was sustained by the Landfill Entrance Building. An assessment of its structural integrity was performed immediately following the event, determining that the building received significant damage that renders it largely unusable. This assessment is included in Appendix B, which found that the Landfill Entrance Building experienced damaged concrete masonry unit (CMU) block walls, and non-structural damage to the administrative portion of the building; features not compliant with current seismic code which will require retrofitting include installation of a lateral resistance system in the north-south direction of the building, and reinforcement of existing CMU shear walls. The full scope of the damage and subsequent repair needed on this building can only be realized once construction for repair is started.

1.6.6 Landfill Gas Beneficial Use Opportunities

The ARL currently has an active LFG GCCS in operation. This GCCS controls LFG generated by waste disposed of at the ARL for environmental protection, but also provides fuel for a third-party electrical generating facility owned and operated by Doyon.

The LFG recovery potential at the ARL will eventually exceed the processing capacity of the Doyon facility. This section provides a review of the potential LFG resources available outside of the existing Doyon contract and what options may be available to SWS in order to fully utilize this long-term resource.

LFG Recovery Potential

Landfill gas recovery projections have been performed utilizing the USEPA's Landfill Gas Emission Model (LandGEM) V3.02. LandGEM is based on a first-order decomposition equation for quantifying emissions from the decomposition of waste in MSW landfills. The model provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at http://www.epa.gov/ ttnatw01/landfill/landflpg.html.

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in GCCS design and GCCS operating practices, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate.

In addition to the waste mass inputs, there are two variables within the equation – k (methane generation rate) and L_0 (potential methane generation capacity). These factors vary based upon refuse types and the moisture of the waste mass. The k and L_0 that Tetra Tech utilized to model LFG recovery at ARL are 0.045/year and 100 m3/Mg, respectively. These values reflect the largely MSW content of the waste mass and the relative moisture exhibited within the waste mass. There were concerns when the GCCS was originally installed that some portions of the waste mass would be very cold, if not frozen, on a long-term basis, and not conducive to active methanogenesis. Reports from ARL staff indicate temperatures up to approximately 130°F within the Cell 1-6 waste mass and an average gas temperature at the blower inlet of approximately 70°F. These factors are indicative of a fairly active waste mass, with healthy biological activity.

Temperatures in Cell 7 (2008 initial waste placement) and Cell 10 (2010 initial waste placement) are significantly cooler, with the most productive LFG wells exhibiting temperatures of about 70°F, and methane concentrations closer to 40% by volume. This indicates that there is a lag in LFG production, as originally anticipated. However, once a substantial thermal mass has been created to insulate the interior of the landfill area, biological decay appears to be occurring at a rate comparable to landfills in more temperate environments.

Based upon the operating conditions evidenced for the current GCCS, a projection for the LFG recovery potential for the entire facility can be estimated. This projection can be compared to the current and historical rates of LFG recovery, in order to compare the modeling values utilized. In the case of the ARL, the site provided operating records of LFG collected in the past. By "normalizing" this data to a consistent heating rate (i.e. a methane quality of 50% CH4 by volume), the projected rate of LFG recovery can be compared to the historical rates.

The percentage of the waste mass that is impacted by the GCCS for the given time period should also be considered. For example, if the model predicts a LFG recovery potential of 1,000 SCFM (standard cubic feet per minute), but a GCCS has been constructed on only 50% of the waste mass, then the rate of LFG recovery that can reasonably be expected would be approximately 500 SCFM.

ARL provided a layout of the existing GCCS, compared to the topography of the site (*2016 Base Map ARL.dwg*). Based upon a review of the documented construction of the GCCS, it is estimated that approximately 70-80% of the waste mass is impacted by the existing GCCS. This provides a level of potential improvement in overall recovery efficiency from the waste mass.

The historical LFG recovery has been compared to the modeled rates of LFG recovery, from 2012 to the present, as shown on Table 1-11. Historical readings from 2012 were excerpted from the *Landfill Gas Recovery Projections, Anchorage Regional Landfill*, prepared by SCS Engineers in August 2014. The observed rate of LFG extraction for 2013-2017 were excerpted from the *ARL Daily Gas Readings 2017.xls* spreadsheet, provided by SWS. This includes flow to both the Doyon facility as well as the on-site flare.

Table 1-11: Flow Summary

Year	Average LFG Flow (SCFM)	Average Methane Content (%CH_4)	Normalized LFG Flow (SCFM)
2012	1,614[1]	50.4	1,628
2013	2,037	53.0	2,159
2014	2,482	53.5	2,654
2015	2,078	52.7	2,191
2016	2,203	53.5	2,358
2017	2,251	53.7	2,419

The Tetra Tech Team modeled the 2017 LFG recovery rate for the ARL which is approximately 2,429 SCFM @ 50% CH_4 which compares well to the cumulative rate for the site. Tetra Tech's future LFG recovery projections, from 2018 through 2071 (post-closure), have been developed as a range of recovery potential. For details on future waste projection rates, refer to Section 1.5 Waste Generation and Capacity Projections.

The site is currently employing and planning a fairly aggressive schedule of LFG wellfield construction. In developing a range of potential flows, the upper end of potential LFG flow was set to be 10% over the nominal recovery flow projection to account for additional coverage of the waste mass that could be achieved. However, the wet nature of the waste mass, coupled with the potential for increased recycling and diversion rates within the industry at large, has a greater potential to depress the relative rate of LFG production and recovery, dropping the lower range of projected recovery to 15% below the nominal recovery flow projection. This provides a range of recovery potential that should encompass changes in site operations. As shown in Figure 1-16, the resultant projection for the peak year of (2062) has a range of LFG recovery, from approximately 4,680 SCFM to 3,615 SCFM. Appendix C for Tetra Tech's LFG recovery projection and background information used for modeling.

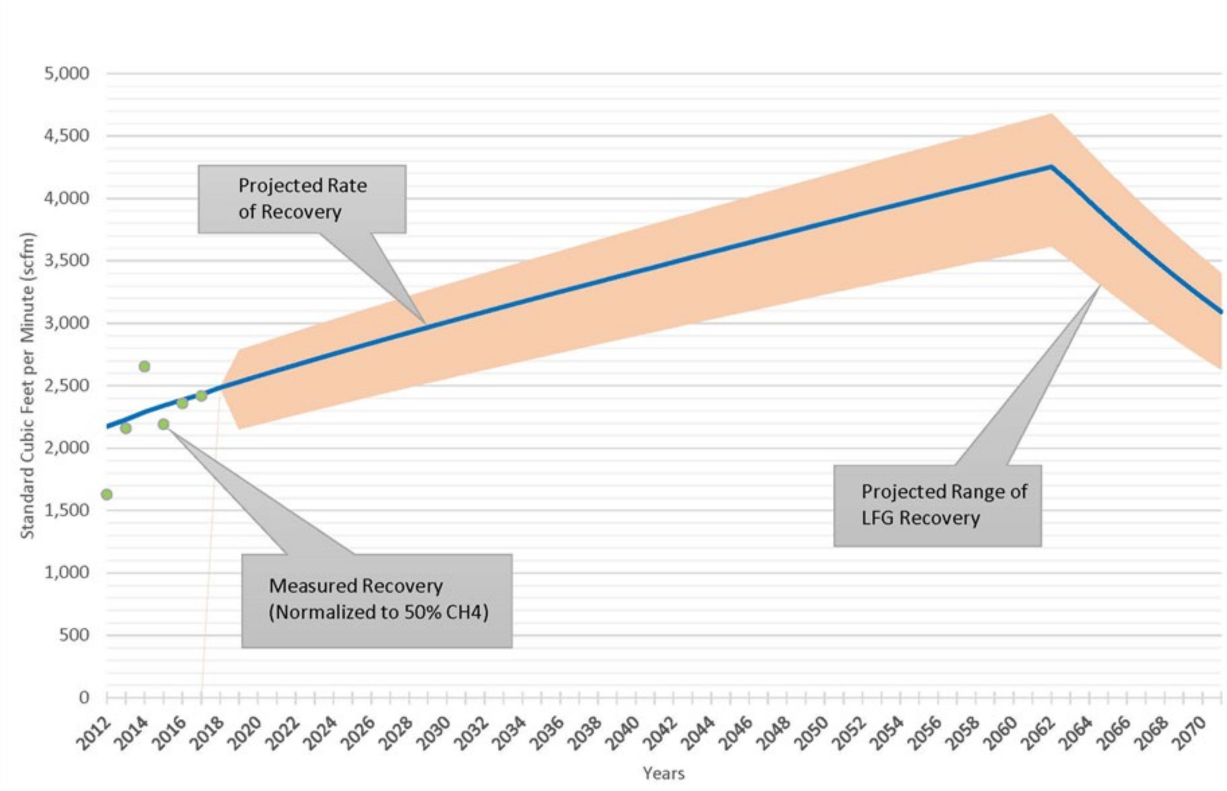


Figure 1-16: Measured vs. Projected LFG Recovery

It should be noted that the LFG recovery potential is estimated assuming the waste moisture, liquids recovery from extraction wells, wellfield construction and maintenance, etc. remains consistent with 2017 operations. If putrescible materials are removed from the incoming waste stream, through economic pressures or formalized diversion programs, the rate of LFG generation and recovery will decrease over time. If any significant changes in the incoming waste stream or the management of liquids, is identified, the long-term projection of LFG resources should be re-assessed.

It should also be noted that LFG models, like any other mathematical projection, should be used only as a tool, and not an absolute declaration of the rate of LFG recovery. Fluctuations in the rate and types of incoming waste, site operating conditions, refuse moisture and temperature may provide substantial variations in the actual rates of LFG generation and recovery.

Potential Utilization Options

Generation from renewable resources will play an increasing role in the United States' energy future transition to a de-carbonized electricity supply. Technological improvements are increasing the conversion efficiency, while new construction and deployment methods have reduced installation costs.

The site currently has an agreement with Doyon to supply fuel for their electrical generation facility. This facility is dedicated to the supply of electrical power for the adjacent JBER. The specifics of the Doyon facility include:

- Operation initiated in 2012;
- Five (5) GE Jenbacher JGS 420 engine-generators;
- 7 megawatts (MW) output (1.4 MW output each);
- 2,000 SCFM @ 50% CH_4 LFG consumption (400 SCFM @ 50% CH_4 LFG each); and
- Constructed space for a sixth generating unit.

There are a number of potential opportunities for the future development of LFG utilization at this facility including an expansion of the existing Doyon facility, or building a new LFG-electricity plant, medium British thermal unit (BTU) projects or biogas to compressed natural gas (CNG) vehicle fuel production, based on the quality of gas being generated.

More than 450 LFG beneficial use projects in the US utilize LFG as fuel in a variety of ways, including the following:

- Electrical generation;
- Direct-use to replace fossil fuels;
- Cogeneration, combining the production of thermal and electrical energy; and
- Production of alternative fuels by converting LFG to a high-BTU fuel.

To assess potential utilization methods for LFG at the ARL, the Tetra Tech Team reviewed current usage of certain resources such as electricity, low BTU gas, high BTU gas, diesel that could be converted to CNG, current uses of CNG, as well as others. In conjunction with this resource assessment, the Tetra Tech Team obtained current costs (or estimates based on market information where current costs are not available) of these resources, now, as well as information about future projections for these resources.

The Tetra Tech Team has used this information to begin to develop utilization methods that have the greatest potential to bring positive economic and socio-economic results to the MOA, which are discussed below.

Direct Sales of Medium BTU Gas

The simplest way of utilizing LFG is direct sales and the replacement of fossil fuels with LFG. LFG can be used as fuel for combustion in boilers, dryers, kilns and other thermal applications. A wide range of industries use LFG as fuel, including manufacturing, industrial wastewater treatment, chemical production, refinery operations, and many others.

LFG collected in landfills has a high heating value (HHV) of 450 to 500 BTU/standard cubic foot (scf). Natural gas has a HHV of approximately 1,000 BTU/scf. The difference between the two fuels is the presence of carbon dioxide, nitrogen and oxygen in LFG that compose approximately 50 percent or more of the gas but add no fuel value. These characteristics of LFG determine the markets for direct gas sales and the technology required to prepare it for use.

Most direct gas use and sales projects involve the utilization of medium-BTU LFG with minimal processing after its collection from the landfill. Medium-BTU gas can be blended with natural gas or other higher BTU gases for use in industrial boilers and heaters with only minor modifications to combustion equipment and burner management systems.

LFG intended for use as medium-BTU gas is collected from the landfill, compressed to a desired pipeline pressure, chilled for removal of moisture and, depending on the gas composition, treated for removal of siloxane, hydrogen sulfide and other contaminants prior to being delivered to an end user by pipeline.

Direct Sales of High BTU Gas

High-BTU gas use and sales involve the upgrading of medium-BTU LFG by separating and removing the carbon dioxide from the methane. The resulting gas is more than 90 percent methane and has an approximate heating value of +900 BTU/scf, approximately the same as natural gas. LFG-derived high-BTU gas, otherwise referred to as RNG, can then be delivered to natural gas pipelines. An alternate use of high-BTU LFG is the production of CNG or liquid natural gas (LNG) for vehicle fuel.

The processes required for production of high-BTU fuels from LFG are substantially more involved and, as a result, more expensive than those needed to prepare medium-BTU gas. The process involves the compression of LFG collected from the field to a pressure dictated by the separation technology used. Membrane technology is used for the removal of carbon dioxide, operating at approximately 520 pounds per square inch gage (psig). Following compression, the LFG is processed to remove moisture, carbon dioxide, and trace contaminants such as hydrogen sulfide, siloxane and condensed organics. After removal of these constituents, the high-BTU gas is chilled prior to entering a natural gas pipeline or being further processed into CNG.

The processes required for production of high-BTU gas are adversely impacted by the oxygen and nitrogen that are typically present in LFG collected in systems installed for compliance purposes. LFG collection systems designed for compliance, such as the ARL system, are operated at relatively high vacuum in order to minimize emissions of LFG to the atmosphere. As a result, compliance systems inherently draw some amount of atmospheric air containing oxygen and nitrogen into the gas stream. Collection systems designed specifically for high quality gas collection are operated at lower vacuum, or limit collection to deep areas of the landfill, in order to avoid drawing air into the system. Thus, production of high-BTU gas from LFG is generally considered an additional process that augments, but does not replace, a basic energy recovery system using medium-BTU gas.

RNG Vehicle Fuel

RNG vehicle fuel facilities as shown in Figure 1-17, utilize biogas from a range of anaerobic decomposition processes, including LFG, to produce a replacement fuel for conventional CNG vehicle fuel. These facilities are generally scaled in increments from 100 SCFM to 400 SCFM, producing approximately 500 gasoline gallon equivalent (GGE) to 3,000 GGE, respectively. With a relatively small footprint and the capability of being implemented as a supplement to an existing beneficial-use project, RNG vehicle fuel facilities provide an effective use of small gas streams and fit well into both Renewable Fuel and Low Carbon Fuel development programs.

Figure 1-17: RNG Vehicle Fuel Production and Fueling Facility (Clean World Sacramento Biodigester)

Electrical Generation

As noted above, the most common beneficial use of LFG is generation of electricity. Electricity can be generated from LFG using a variety of technologies including internal combustion engines, gas turbines, microturbines, fuel cells, steam turbines and combined cycle. For these applications, the processing of LFG follows that of the medium-BTU direct use and sales but without the chiller, pipeline and need for additional compression to overcome pressure losses in the pipeline. Also, unlike the high-BTU option, the majority of technologies used for electrical generation can utilize lower BTU fuels (400 – 500 BTU/SCFM) that contain carbon dioxide, oxygen and nitrogen. This provides flexibility in the way that the LFG collection system is operated and is not adverse to a system used to prevent LFG from escaping to the atmosphere or adjacent properties.

Internal Combustion Engines. The most frequently used technology for producing electricity from LFG is internal combustion engines, which typically are large diesel engines modified to burn medium-BTU gaseous fuel. LFG is processed as described above and supplied to the engine at a pressure of 1 psig to 5 psig. A variety of generation options are available, ranging from approximately 300 kilowatts (kW) to 3,000 kW.

Gas Turbine Engines. Gas turbines are often used for larger projects in which the minimum long-term electrical generation exceeds 3 MW. Such projects may be feasible for sites with at least 1,000 TPD of long-term waste intake. Gas turbines are also used in large combined cycle projects, in which LFG is used to fuel gas turbines for electrical generation, and heat is recovered from the turbine exhaust to generate steam feeding a steam turbine/generator for additional electricity generation. Waste heat can also be used for other processes.

Microturbines. Microturbines have been used recently to generate power from LFG, typically for small projects with a generation potential less than 1 MW. While the use of microturbines has certain advantages such as low emissions and the ability to link modules, their use presents certain disadvantages, including:

- Low power generation efficiencies;
- Low fuel usage and power output;
- Requirement for more gas clean-up than internal combustion engines and larger gas turbines; and
- A limited track record using LFG as fuel.

Steam Boiler/Turbine. Relatively few landfill gas-to-energy (LFGTE) recovery projects have used medium-BTU LFG as a primary or supplemental fuel in conventional boilers to generate steam for industrial processes or power generation. Use of LFG in these kinds of projects is generally limited either to very large landfills or to sites located near existing industrial plants or generating stations with all or part of the necessary equipment already in place.

Fuel Cell. Fuel cells are beginning to be utilized for generation of electricity from biogas. The benefits are that fuel cells can generate electricity with significantly less emissions than internal combustion engines or turbines. The negatives are the high costs of the fuel cells and the need to often pretreat the biogas to remove impurities that can foul the fuel cells. It is anticipated that fuel cell pricing will come down in time along with biogas pretreatment facilities. It is unknown how long that will take however before fuel cells can generate electrical power economically given the lower value of electricity on the market at this time.

Application to ARL

For purposes of this evaluation, it is assumed that ARL has committed the fuel supply for the existing Doyon facility to be fully built out with a sixth engine-generator. This would consume approximately 2,400 SCFM of LFG and increase the total electrical output to approximately 8.4 MW.

The usage of this level of fuel on a long-term basis, limits the options for additional utilization of LFG. Incorporating the projected Doyon usage into the projected rate of LFG recovery provides a baseline for the consideration of other options (See Figure 1-18).

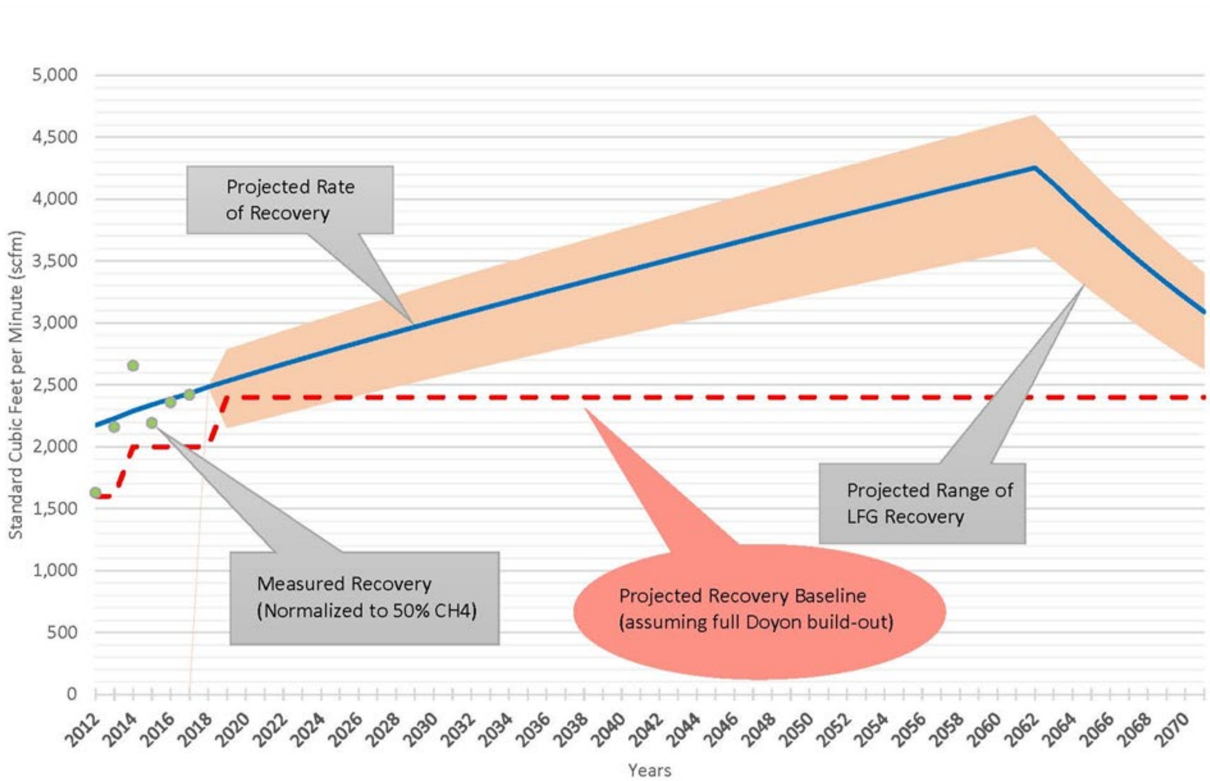


Figure 1-18: LFG Utilization Baseline

Electrical Generation. The development of additional electrical generating capacity is a likely opportunity for additional LFG utilization since the infrastructure for an expansion (switchgear, transmission system, end-user, etc.) is largely in place. Additional engines or other generation equipment, such as turbines, could be installed as fuel becomes available. To this end, Doyon commissioned a Business Case - Expansion of the Landfill Gas Power Plant for Doyon Utilities, LLC, April 2017 by Electric Power Systems. The Business Case reviewed the potential for expanding the existing generating facility and delivering additional power to JBER, through a series of development alternatives or "pathways", and ultimately recommended full development of the LFG resource for electrical generation, specifically. Pathways 5/7 (the installation of two 2.72 MW generating units). There was, however, a recommendation for a reduction in the gas sales price in order to develop the system fully, with a caveat that reduced expansion would be recommended under the existing gas sales agreement, specifically. Pathway 1 (the installation of one 1.42 MW generating unit).

It is understood that expansion of the existing operation requires the consent of JBER. If the base determines that additional electrical power is not required from Doyon, any expansion of the generating capacity would require another end-use customer for direct sale or wheeling into the local power grid. With recent construction by Municipal Light and Power (ML&P) of a new power plant (three now in Anchorage), the electricity generation capacity in the MOA appears saturated.

Another option for electrical generation would be for on-site usage. As an offset for power currently purchased from the utility, the SWS could self-generate a portion of the power required for ongoing and/or future site operations, including but not limited to, leachate pumps, lighting and general electrical service. Grid power would be maintained as a backup supply, but site-generated power would take a primary role in day-day usage.

Leachate Evaporation. SWS currently transports approximately 25 M gallons per year (80,000 to 90,000 gallons per day) of leachate to an off-site sanitary sewer septic dump station via 6,000-gallon tank trucks. This involves approximately 18 tank truck trips per day to and from the dump station, which is an 18-mile round trip haul per load. If this liquid were managed of on-site, SWS would improve worker safety and that of the public, reduce the traffic around the facility, reduce the potential for environmental impact due to spills during loading, unloading or transport and very likely will reduce the overall cost of leachate disposal.

Leachate evaporation systems, fired by medium-BTU LFG, are efficient options for long-term liquids disposal. It is estimated that a system designed to treat 90,000 gallons per day (consisting of two units, each treating 40,000 to 45,000 gallons per day) would require approximately 1,600 SCFM of LFG @ 50% CH4. Assuming the Doyon facility is operating at full capacity (2,400 scfm), ARL could install one of these units, and operate it at full capacity, in approximately 2028, with the second unit installed in approximately 2049.

RNG Vehicle Fuel. If SWS begins a program of converting fleet vehicles as they require replacement, or local haulers or JBER embark on such a program, excess LFG could be converted to CNG vehicle fuel for local use. The lack of an existing commercial CNG fueling system emphasizes the need for a fleet structure to be implemented.

Approximately 600 SCFM of LFG is flared at the ARL that cannot be processed by Doyon. If this LFG were processed as CNG, SWS could produce approximately 2,000 to 3,000 diesel gallon equivalents per day (DGE/day), depending upon the system configuration. This production rate could be increased as fuel availability grows and could potentially yield as much as 7,000 DGE/day.

1.6.7 Transfer Station Operation Optimization

The existing CTS is located on the site of the former waste receiving and shredding facility that operated from the mid-1970s until the redevelopment of it in its current state approximately 30 years ago (1986-87).

The facility is bounded to the north by E. 54th Avenue, to the west by Ingra Street, to the south by E. 56th Avenue, and to the east by three (3) privately owned, adjoining lots, The CTS property that includes three (3) parcels that combine to provide 11.4 acres.

CTS parcel 009-252-09-000 (7.1 acres) contains the following assets and operations:

- 2 story Administration & Maintenance Shop/Warm Storage Building
    - Total SF ≈ 25,730
        - First Floor SF ≈ 18,850
        - Second Floor SF ≈ 6,880
    - The south end of the Building utilizes ≈ 6,880 SF of the first floor and the entire second floor for employee facilities and administration offices (≈ 13,760 SF total).
    - The remainder of the Building allows ≈ 11,970 SF of the first floor for support services that include vehicle/equipment maintenance and warm storage.
- Fueling Island (for SWS equipment and vehicles)
- Segregated Employee Parking

    - Providing ≈ 58 parking spaces (including 4 ADA parking spaces)
- Split Story Transfer Station Building (TS)
    - Total SF ≈ 30,880
        - Tipping Floor SF ≈ 24,640
        - Loadout Slot & Utility Area SF ≈ 6,240
    - Loadout Tunnel SF ≈ 2,950
- Access from E. 56th Ave. to a 1 story Scale House and Truck Scales (for commercial haulers)
- Access from E. 54th Ave. (via Juneau St. extension) to a 1 story Cash Booth (for residential customers)
- HHW/Reuse Receiving & Storage Area with two (2) Railcars (stationary) & Shed
- Recyclables Receiving & Storage Area
- Used Oil Receiving and Storage Area
- Bulky/White Goods Receiving & Storage Area
- SWS Vehicle Parking/Storage Area

The remaining CTS parcels 009-252-22-000 & 009-252-23-000 (4.3 acres combined) contain the following assets and operations:

- Access from Ingra St. & E. 54th Ave. to Container Storage Areas
- Three (3) 1 story Storage/Container Repair Buildings (repurposed, former “self-storage” units)
- SWS Vehicle Parking/Storage Area (vehicles and equipment)

Figure 1-19, “Existing CTS Site Plan” provides visual details of the existing Facility.

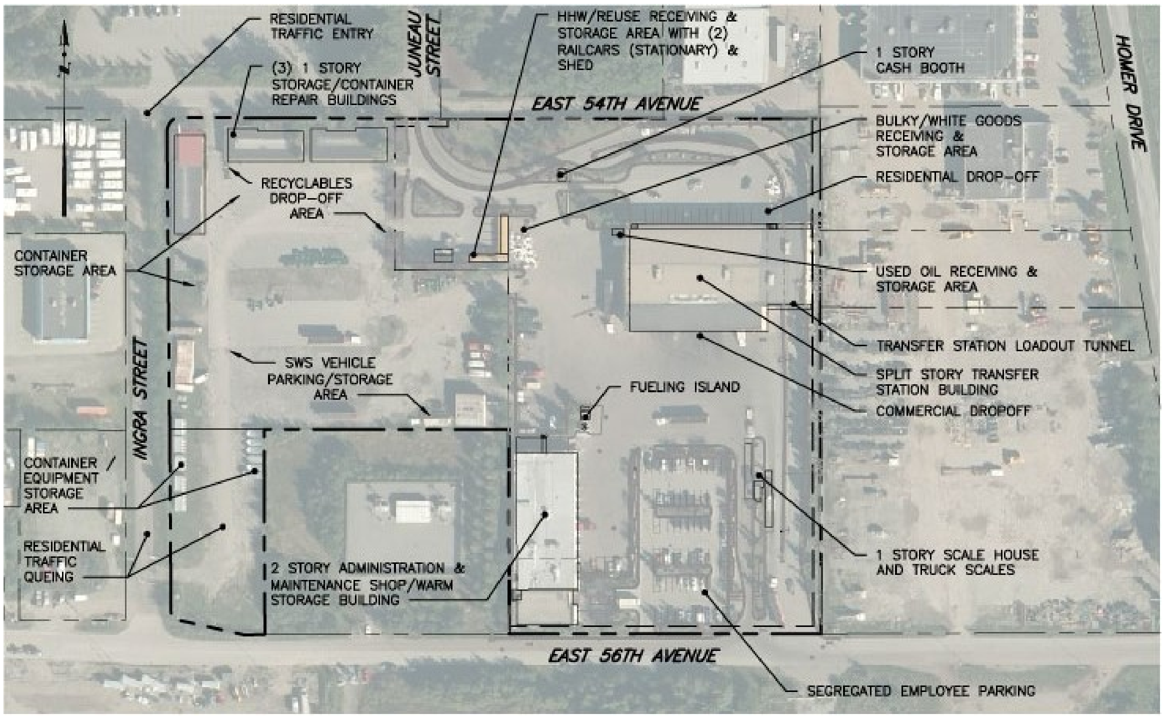


Figure 1-19: Existing CTS Site Plan

Review of existing documents provided by SWS, site walks on November 13th & 15th, 2017, and discussions with CTS managerial, operations, and technical staff served to provide first hand assessment of current CTS assets and operations. This assessment, combined with the perspective and relayed experience of SWS staff, identified aspects of the CTS which accommodate current and future needs of SWS and also served to identify those which present challenges.

The size, location, capacity, and configuration of the Transfer Station Building continue to provide efficient operations for the receipt, scaling, and tipping of waste materials from segregated, commercial haulers via the dedicated curb cut from E. 56th Avenue, proximity to Seward Hwy. via Homer Drive, and separate inbound and outbound Truck Scales with an appropriately located Scale House.

The existing waste management procedures utilized within the Transfer Station Building also provide for streamlined operations having multiple advantages including:

- A large Tipping Floor that incorporates single direction "push path" for Wheel Loaders to load waste materials through two (2) drop chutes to Transfer Trailers positioned within the full depth Loadout Tunnel.
- Two (2) stationary Electric/Hydraulic Pedestal Cranes positioned at the back side of the drop chutes to segregate, kick-sort, and groom waste materials during the loading of Transfer Trailers.
- Single direction, depressed, full depth Loadout Tunnel with sub-slab, hydronic radiant heating that provides a separate, weather resistant travel path for Transfer Trailers that eases housekeeping procedures.
- Three (3) dedicated, ≈ 60' wide commercial receiving/tipping bays of adequate height to accommodate 40 CY roll-off boxes.

- Four (4) segregated SWS Equipment access bays at the west side of the Transfer Station Building that serve to provide direct access to the Tipping Floor without conflict with Tipping Vehicle traffic.

Challenges experienced at CTS include those expected from a solid waste facility that has remained in operation for 30+ years, those resulting from the large residential vehicle counts listed under Section 1.2.2.2, and solid waste and recycling (materials management) services and practices that have progressed since the facility's original design.

Subject to a more thorough structural, mechanical, and electrical assessment, the Transfer Station Building requires the following elements to be addressed as part of a comprehensive refurbishment as is typical of transfer stations with three plus (3+) decades of continuous operations:

- Additional replacement of reinforced concrete Tipping Floor (including refinements to embedded steel "wear rails", drop chutes, push walls, and other miscellaneous metals);
- Structural repair/replacement to pedestals and anchoring embeds supporting the two (2) Electric/Hydraulic Cranes;
- Address height of interior roof drain conveyance piping proximate to the commercial tipping bays;
- Replacement of sheeting (roof and siding), supporting purlins and girts (as needed), and doors; and
- Evaluation of mechanical, electrical, and lighting systems to determine lifecycle stage and realization of increased efficiencies via current technologies.

A proposed first step of conceptual design consideration for the remainder of the CTS includes addressing current challenges presented by the high volume and lengthy on-site dwell time of residential traffic and evaluating the need for increased maintenance, repair and storage space. Conceptual design consideration must also accommodate future policy, asset, operational, and process/technology additions and/or advancements, while reserving flexibility within the site for the next 30 years of SWS's operations. With this in mind, the initial iteration of site design concepts will focus on the physical separation of Indirect Operations (support assets/ activities) from Direct Operations (material management activities). This may entail the relocation of existing assets and operations including those for:

- Administrative Services;
- Employee Facilities;
- Employee Parking;
- Maintenance Facilities (for vehicles, equipment, and containers);
- Heated (indoor) Storage Structures (for vehicles and equipment); and
- Cold (outdoor) Storage Areas (for vehicles, equipment, and containers).

Refinement of Direct Operations will then focus on the segregation of Direct Service Traffic into five (5) patterns that incorporate (as afforded by the area of dedicated real estate) single direction traffic flows from discrete access locations:

- Residential Autos (dropping off bagged waste, recyclables, E-waste, HHW, items for reuse, potentially food scraps, etc.);

- Residential Pickups, Vans, Trailers (dropping bulky/white goods, tires, furniture, etc.);
- Commercial Haulers (those subject to weighing procedures);
- SWS Transfer Trailers; and
- SWS On-site Operations and Equipment (for materials processing, recovery, and management).

In addition to the operational efficiencies to be gained and the inherent safety advantages achieved, the above approach has proven to decrease the on-site dwell time of Direct Service Traffic while promoting more efficient engagement of staff at other municipalities for which Tetra Tech has provided this approach. The design and placement of real assets supporting the Direct Service Traffic may include some or all of the following:

- Elevated Recyclables/Bagged Waste Receiving Center (designed for expansion of traffic volume and segregated materials);
- Beneficial Materials Re-use Center;
- HHW and E-waste Receiving and Storage Center;
- Food Scraps/Organics Receiving and Storage Center; and
- Materials Recovery and Processing Facility (dependent on development of future markets.)

The next steps of conceptual design for CTS included further engagement with SWS staff to:

- Create defined list of desired materials management and recovery processes and assets to be incorporated within the future CTS;
- Determine future on-site fleet assets and employee/staffing needs;
- Develop Maintenance Shop services, sizing, & needs;
- Establish expectation for current and future storage (containers, assets, equipment, etc.); and
- Define and target real estate assets for acquisition (as necessary and available – see Figure 1-20, "Real Estate Map").

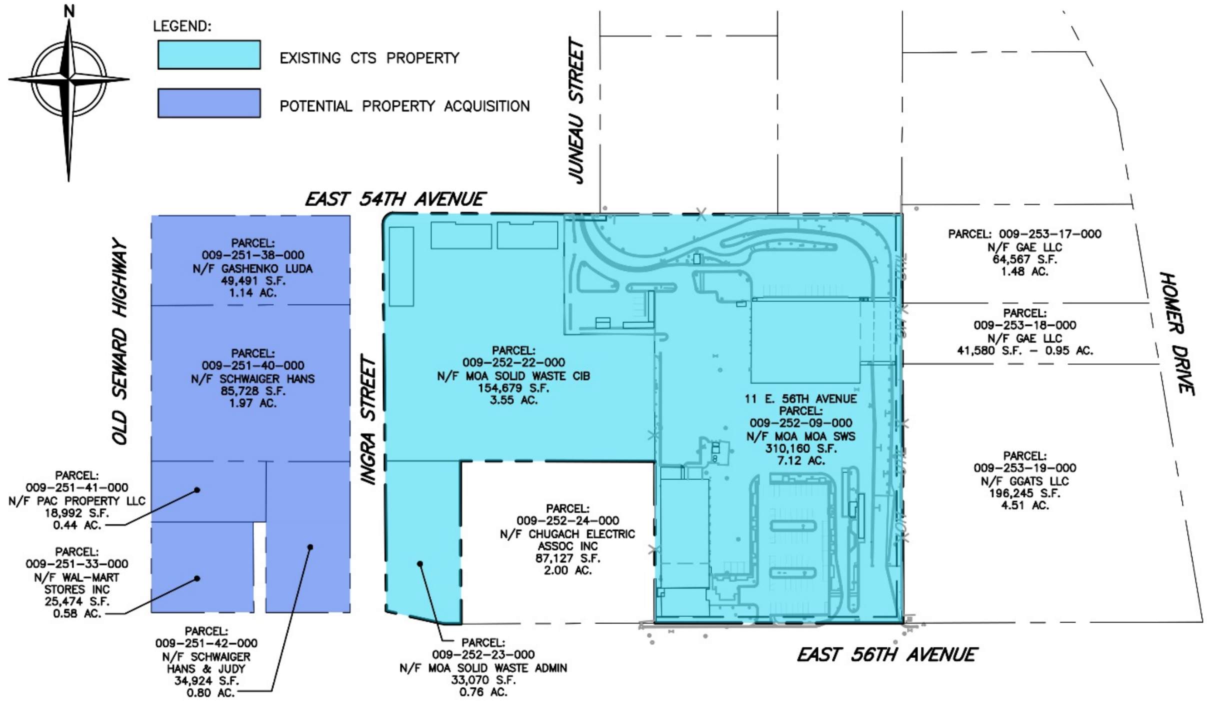


Figure 1-20 Real Estate Map

2.0 REGULATORY REVIEW / INDUSTRY TRENDS / BENCHMARKING

This section presents information related to regulatory requirements, industry trends, and benchmarking that will be considered when identifying specific facility and diversion program options, potential improvements, and potential new approaches to solid waste management to be analyzed as part of the ISWMP. This information includes:

- An evaluation of federal, state, and local legislation and policies that could apply to strategies for planning of SWS diversion programs, transfer, and disposal operations.
- Identification of permitting requirements for potential facility and operations improvements.
- Discussion of international, national and state solid waste management industry trends and best practices.
- A comparative review (benchmarking) of SWS resource and solid waste management programs and facilities to industry standards for other comparable municipalities.

This section presents a comprehensive review of regulatory requirements/drivers and key policies for readers with varying degrees of solid waste management industry background. A high-level summary of findings for each section is provided in Subsections 2.1.4, 2.2.5, and 2.3.4 for a quicker read.

2.1 REGULATORY REQUIREMENTS / DRIVERS AND KEY POLICIES

2.1.1 Diversion and Recycling

2.1.1.1 Federal

The United States (U.S.) Environmental Protection Agency's (EPA) mission is to protect human health and the environment. EPA Region 10 serves Alaska, Idaho, Oregon, Washington, and 271 Tribes. The U.S. Federal government does not have diversion goals or requirements but advocates for recycling through the USEPA. The Resource Conservation and Recovery Act (RCRA) set forth a framework for the management of non-hazardous solid wastes enabling the USEPA to address environmental impacts that could result from solid waste management.

USEPA's Sustainable Materials Management Program (SMM) Strategic Plan presents the collective thinking of EPA staff and management across the country in taking a systematic approach to using and reusing materials more productively over their entire life cycle. SMM represents a change in how our society thinks about the use of natural resources and environmental protection. By looking at product's entire life cycle, new opportunities can be found to reduce environmental impacts, conserve resources and reduce costs. The USEPA's SMM Strategic Plan presents three strategic priority areas including:

1. **The Built Environment.** *Conserve materials and develop community resiliency to climate change through improvements to construction, maintenance, and end-of-life management of our nation's roads, buildings, and infrastructure;*
2. **Sustainable Food Management.** *Focus on reducing food loss and waste*; and

3. **Sustainable Packaging.** *Increase the quantity and quality of materials recovered from municipal solid waste and develop critically important collection and processing infrastructure.*

Additional emphasis areas include sustainable electronics management, life cycle assessment and SMM international efforts, and overarching measurement efforts. Although the USEPA understands that recycling programs are managed at the state and local level, it provides a host of information identifying the basics, benefits, How-To, and frequently asked questions on the following topics:

- Reduce and Reuse,
- Recycle;
- Electronics Recycling;
- Reducing Wasted Food; and
- Food Recovery Hierarchy.

The National Recycling Coalition (NRC) is a non-profit organization focused on promoting and enhancing recycling in the United States through education and networking. NRC's vision is that: waste reduction and sound management practices for raw materials in North America lead to an environmentally sustainable economy. NRC performs nationwide research to identify what is being disposed in order to identify which materials should be targeted.

2.1.1.2 State

Office of the Governor

The State of Alaska does not currently have a solid waste diversion goal, but that may change in the future, as promulgated by the State of Alaska, Administrative Order No. 289 which requests from State departments and agencies the implementation of regulatory and statutory changes that prioritize, develop, implement and recommend actions that address the issue of climate change.

On October 31, 2017, Bill Walker, Governor of the State of Alaska, established the Alaska Climate Change Strategy and the Climate Action for Alaska Leadership Team to advise the Governor on critical and timely actions to address climate change challenges that will safeguard Alaska now and for future generations. The Alaska Climate Change Strategy provides a means for the development of solutions (recommended plan of action) for a rapidly changing climate. The initial Climate Action Plan for Alaska was presented to the Governor in September 2018. The following categories and their interactions were addressed:

- **Mitigation**: *Actions to **reduce, sequester, and offset GHG emissions** to decrease our carbon footprint.*
- **Adaptation:** *Actions to evaluate risks and adopt measures to address or reduce the vulnerability of Alaska's citizens, environment, and infrastructure to climate change impacts.*
- **Research:** *Actions to support and bolster monitoring, observing, modeling, scientific analysis, data sharing, planning, innovation, and public outreach and education related to climate change and mitigation and adaptation strategies.*
- **Response:** *Actions to plan and train for timely and robust responses to protect and address near-term threats to Alaska's communities and regions from current consequences and impacts of climate change,*

including, but not limited to, ocean acidification, coastal erosion, storm impacts, oil and other toxic spills, and infrastructure damage.

Climate Action Plans have led to legislation in other states focused on reducing GHG emissions such as the State of California Assembly Bill (AB) 32, the California Climate Solutions Act of 2006. AB 32 requires California to reduce GHG emissions to 1990 levels by 2020 – a reduction of approximately 15 percent below emissions expected under a "business as usual" scenario. Pursuant to AB 32, the California Air Resources Board (CARB) and CalRecycle have adopted numerous regulations to achieve the maximum technologically feasible and cost-effective GHG emission reductions. Methane emissions from landfills are a primary target for reducing GHG emissions as methane has a global warming potential (GWP[4]) of 28-36 over 100 years (according to the USEPA).

Similar to AB 32 in California, Alaska's Administrative Order 289 has the potential to impact solid waste management including collection, processing, and disposal. Activities such as composting, in-vessel anaerobic digestion and thermal renewable technologies have the ability to divert material from landfills and lower overall GHG emission within the MOA.

Alaska Department of Environmental Conservation (ADEC)

The Alaska Department of Environmental Conservation's (ADEC) main goal is "conserving, improving, and protecting Alaska's natural resources and environment to enhance the health, safety, economic and social well-being of Alaskans." ADEC Division of Environmental Health, Solid Waste Programs is the main regulatory agency having compliance oversight for the various disposal facilities, as further discussed in Section 1.2.3. Non- disposal activities including solid waste diversion and litter collection that are currently managed by ADEC in accordance with Alaska Statute (AS) 46.03; Title 18, Chapter 15 of the Alaska Administrative Code (18 AAC 15) and the Solid Waste Regulations in Chapters 64, 65, and 66 (18 AAC 64, 65, 66) include the following:

- **18 AAC 64 – Litter Receptacles:** Requires that owners or operators of public places provide litter receptacles. The placement, number of containers, minimum standards, anti-litter symbology, and maintenance requirements can be found in 18 AAC 64.

- **18 AAC 65 - Litter Reduction and Resource Recovery Grants** – ADEC provides litter reduction and resource recovery grants (amount of grant will not exceed $15,000) to a project for specified purposes.

- **18 AAC, Chapter 66 – Waste Reduction and Recycling Awards for Schools** – ADEC, in consultation with the Department of Education and Early Development, grant an award to a public school to recognize the efforts of the public school and its students to reduce and recycle waste generated as part of the overall public-school operations.

The marijuana industry is a new and developing industry in Alaska that will generate solid waste. The management of such solid waste is to be regulated through ADEC's environmental and public health requirements.

[4] Global Warming Potential was developed to allow comparisons of the global warming impacts of different gases. Specifically, it is a measure of how much energy the emissions of 1 ton of a gas will absorb over a given period of time, relative to the emissions of 1 ton of carbon dioxide (CO_2) (USEPA website).

Regulatory Commission of Alaska (RCA)

Utilities including trash collection services in Alaska are regulated by the RCA which "regulates public utilities by certifying qualified providers of public utility and pipeline services and ensuring that they provide safe and adequate services and facilities at just and reasonable rates, terms, and conditions."[5] This includes commercial waste collection entities with a gross income exceeding $300,000.

The RCA's Consumer Protection & Information Section may investigate refuse and utility issues including but not limited to:

- Billing and Collection Requirements;
- Can/Dumpster/Roll-On & Roll-off Container Rates;
- Cancellation/Discontinuance of Service;
- Deposit Requirements;
- Interval of Pickup;
- Late Fee and Finance Charges;
- Non-recurring Rates and Surcharges;
- Quality of Service; and
- Safety Issues.

The RCA does not regulate damage claims, recycling, or landfill tipping fees. The RCA does regulate the SWS Collection Utility; however, they have deferred economic regulation (rates) of that utility to the Anchorage Assembly. The RCA regulatory cost charge, following the mandate of the legislature in 1992, allowed the Commission to enact regulations allowing it to recover its operations costs through an assessment on the revenues of the utilities it regulates. Any waste collection rate increase for residential refuse collection outside the SWS collection service area has to be approved by the RCA.

Alaskans for Litter Prevention & Recycling (ALPAR)

As stated in the ALPAR website, ALPAR is "dedicated to eliminating litter and increasing economically-viable recycling in Alaska. ALPAR's programs help clean up litter in Alaska's communities, parks, beaches and waterways and assist community recycling centers with shipping assistance, outreach and recycling grant programs."

In addition to managing donated back-haul space as discussed in Section 1.1, ALPAR has various programs throughout Alaska including litter cleanup, litter prevention and recycling programs which include the following:

- **Recycling Mini-Grants** – Available to communities and non-profits to promote recycling. With a total budget of $15,000 in 2018, the funds must be used for the purchase of equipment, recycling events, and education and public awareness effort.
- **In-Store Plastic Bag Recycling, Reuse and Conservation Toolkit** – The toolkit outlines how to launch plastic bag recycling in stores.

[5] Regulatory Commission of Alaska.

- **Flying Cans** – Provides rural communities the ability to send their aluminum cans to Anchorage via aircraft.
- **Can-Do Kids Kits** – Provides information on aluminum can recycling to kids.
- **Youth Litter Patrols** – Provides summer jobs for kids to pick up litter all over Alaska.
- **Volunteer Community Clean Ups** – ALPAR provides volunteers free bright yellow clean up bags to 160 communities.
- **Christmas Tree Recycling** – Drop off at Carrs/Safeway parking lots to be recycled into wood chips for local trails.
- **Recycling and Public Awareness** – Supports and promotes recycling awareness in the Railbelt communities in a variety of ways, such as publishing a yearly Guide to Recycling for Anchorage and the Matanuska-Sustina Borough (MatSu).
- **Adopt -A-Bike-Path** – Program where volunteers adopt a bike path to keep them free of litter during the summer. ALPAR provides bags, safety vests, gloves, and pickers. Transport to ARL and Central Transfer Station (CTS) provided by volunteers.

2.1.1.3 Municipality of Anchorage

SWS Strategic Plan

SWS's Strategic Plan guiding principles includes a Community Sustainability principle which goal is to drive per-capita waste generation below five pounds per person per day and increase SWS recycling rate to 25% by 2020. The strategies employed to achieve these goals include 1) promote the diversion of food waste, yard waste, metals, glass, plastics, paper, and cardboard; 2) improve recycling options for businesses; and 3) standardize recycling outreach and labeling.

SWS's Strategic Plan includes the following mission, vision, and values:

- **Mission:** Providing safe, efficient and innovative solid waste management for the Municipality of Anchorage.
- **Vision:** Advancing solid waste management through continuous improvement and transparent performance.
- **Values:** Providing value to our community through safe, innovative, and sustainable solid waste management.

MOA Municipal Code

The MOA Code of Ordinances provides solid waste regulations for the purpose of regulating the storage, collection, processing and recovery, and disposal of solid waste in order to protect public safety, health and welfare and to enhance the environment. Key sections under Chapters 26.70 and 26.80 include the following:

26.70.030 - Use of municipal collection service required. – Requires that residents and business owners within the SWS area (former City of Anchorage) use the waste management system provided by the municipality.

26.80.055 – Solid Waste Disposal Fee Reduction. – A business or organization involved in recycling of paper, plastic, glass, steel, aluminum, copper and brass will be granted a 50% reduction in disposal fees for residual waste resulting from their recycling operations. Such business or organization must meet established conditions for recycling operations that recover post-consumer solid waste materials.

26.80.070 – Surcharges to Support Community Recycling Initiatives. – Requires the SWDU to implement community-wide initiatives to support reduction, recycling, and reuse of waste products otherwise disposed at the landfill. These initiatives are financed and implemented through a surcharge collected by the SWDU on all wastes delivered to solid waste transfer or disposal facilities.

Anchorage Proposed Climate Action Plan

The Proposed Climate Action Plan (PCAP) for the MOA was prepared in 2009, by the Climate Action Team (C-CAT) at the University of Alaska Anchorage and edited by two professors from the department of Political Science (i.e., Mara Kimmel and Kimberly Pace). The PCAP was never approved or implemented and is now being updated under the current administration led by Mayor Ethan Berkowitz. The plan focuses on six main points including outreach and education, consumption and solid waste, transportation, energy efficiency, energy production, and city planning. An increase in recycling and composting programs in partnership with SWS are potential programmatic outcomes of the PCAP. There is a desire to take the finalized PCAP to the MOA Assembly to see what of the PCAP the Assembly would support implementing.

2.1.2 Pre-Processing and Recycling Facilities

Federal Regulations. There are no federal regulations that require a permit or identify requirements for proposed improvements, expansion, or new pre-processing and recycling facilities at this time.

State Regulations. Facilities used to store materials for transfer, reuse, recycling, or resource recovery are not required to obtain a facility permit under Title 18 of the Alaska Administrative Code (18 AAC), in particular under the Solid Waste Regulations in 18 AAC 60, unless such facility is causing or contributing to a nuisance or poses a risk to public health and the environment. If this occurs, the facility operator would be required to submit a facility design and operating plan.

Proposed improvements, expansion, or new pre-processing and recycling facilities including transfer stations, MRF, construction and demolition recycling, and composting facilities (including in-vessel digestion) which are not located or occurring in a permitted facility such as the ARL would not be required to obtain a solid waste facility permit under 18 AAC 60.

Municipality of Anchorage. The Anchorage Municipal Code (AMC) provides for regulations pertaining to solid waste pre-processing and recycling facilities in Title 21, Chapter 21.05.060 and Title 26, Chapter 26.70 (Collection).

Title 21, Chapter 21.05.060(E), Subsections (1.) Composting facility (2) Hazardous waste treatment facility (3) Incinerator or thermal desorption unit (4.) Junkyard and salvage yard (6) Landfill (7) Recycling drop-off (9) Solid waste and/or recycling include use-specific standards for solid waste and/or recycling transfer facilities including use-specific minimum size requirements, setback requirements, outdoor storage limitations, noise, dust and litter control, and fencing requirements.

Title 26, Chapter 26.70.030 states that all solid waste generated within the municipality shall be disposed of by delivering to state-permitted solid waste processing and disposal facilities located in the municipality. This is significant in order to control flow of solid waste to facilities within the MOA.

The Planning and Zoning Commission Recommended Draft Anchorage 2040 Land Use Plan identifies the General Industrial land use designation as the zone where a full range of light to heavy industrial uses can take place including recycling facilities, waste processing and salvage, and hazardous materials storage.

2.1.3 Municipal Solid Waste Landfills

The ARL is a Class I municipal solid waste facility fully permitted under Solid Waste Permit No. SW1A001-22 issued by the ADEC, Division of Environmental Health, Solid Waste Program in accordance with Alaska Statute (AS) 46.03; 18 AAC 15 and Solid Waste Regulations in 18 AAC 60. The ARL is operated by the SWS and is located near the community of Eagle River. Consideration of increased optimization of capacity at the ARL to meet the goals of the SWS's Integrated Solid Waste Master Plan includes changes in design/operation as follows:

- Alternate engineering planning/fill phasing strategies;
- Alternate daily and intermediate cover material types;
- Landfill expansion; and
- Alternative technologies for landfills.

In order to implement any of these landfill optimization options, compliance with various regulatory requirements will be necessary as discussed further below.

2.1.3.1 Federal Regulations

Non-hazardous solid waste is regulated under Subtitle D of the RCRA regulations. Regulations established under Subtitle D ban open dumping of waste and set minimum federal criteria for the operation of municipal waste and industrial waste landfills, including design criteria, location restrictions, financial assurance, corrective action (cleanup), and closure requirements. States play a lead role in implementing these regulations and may set more stringent requirements. In the absence of an approved state program, the federal requirements must be met by waste facilities. The state of Alaska through the ADEC has implemented an approved state program and regulations for solid waste management in 18 AAC 60. Therefore, all solid waste facility operations, design and permitting are in accordance with 18 AAC 60.

In regard to federal standards for air emissions, the EPA has initiated Title 40 of the Code of Federal Regulations (40 CFR), Part 60, Subpart XXX (effective date October 28, 2016) which updates the Standards of Performance for Municipal Solid Waste Landfills. The standards for municipal solid waste landfills applies to landfills that commence construction, reconstruction, or modification after July 17, 2014. The ARL is currently required to comply with 40 CFR, Title 60, subpart WWW pursuant to the site's Title V Air Quality Operating Permit. Should an expansion of the landfill be proposed that increases the current design capacity, the ARL would be required to comply with subpart XXX upon initiation of construction of expansion areas. Subpart XXX does not replace subpart WWW which compliance would also still be required.

2.1.3.2 State Regulations

The ARL is regulated under 18 AAC, in particular under the Solid Waste Regulations in 18 AAC 60. Modification (i.e., alternate engineering planning/fill phasing strategies) or expansion of the ARL could require re-design of many aspects of the landfill including final grades, base grades for undeveloped areas, and environmental systems (i.e., landfill gas, groundwater and leachate collection). Any modification to the design and/or operation of the ARL would require compliance with the regulations included in Articles 2 and 3 of 18 AAC 60 which includes requirements for Operation/Closure Standards in Article 2 of 18 AAC 60 and Location, Design, and Closure Standards for municipal solid waste (MSW) landfills in Article 3 of 18 AAC 60. Under the current solid waste permit the landfill is permitted for the full build-out of the current landfill site, including yet-to-be-built cells 9 and 8C. If SWS expands the footprint beyond the currently permitted footprint we will trigger a permit modification.

It should be noted that any lateral expansion will require a Wetlands Determination from the U.S. Army Corps of Engineers or information from the National Wetlands Inventory documenting that the area is not designated as wetlands. If the expansion is located in a wetland, an ADEC Additional Wetlands Information Form must be completed.

The current Solid Waste Disposal Permit for the ARL sets the maximum final height for the site to not exceed 720 feet amsl due to the close proximity of the ARL to the US Military at JBER. The current ARL property is owned by the MOA and is adjacent to property that is subject to the NALA. NALA is a three-way agreement between the MOA, the Eklutna Native Corporation and the State of Alaska. Expansion of the landfill onto adjacent land will require coordination with JBER and compliance with any limitations/requirements included in NALA.

Any revision or upgrades in design of the landfill gas system would be regulated under 18 AAC 60.333 which also incorporates requirements in 18 AAC Chapter 50 (18 AAC 50) - Air Quality Control. Revisions. Upgrades in design of the groundwater/surface water monitoring systems would be regulated under Article 7 of 18 AAC 60.

Daily and intermediate cover materials and types of alternatives may be considered in order to more efficiently utilize airspace, divert materials for beneficial use (i.e., C&D, green waste) and conserve available soil sources. The current ARL Solid Waste Disposal Permit includes approved alternative daily cover materials consisting of auto shredder fluff, ground C&D debris, and wood chips on interior daily slopes in place of daily soil cover materials specified in 18 AAC 60.340(a); which requires 6 inches of cover at the end of each operating day.

18 AAC 60.243 and 18 AAC 60.340 regulate intermediate and daily cover, respectively. 18 AAC 60.243 indicates that an operator shall apply an intermediate cover using a soil material at least 12 inches thick. Intermediate cover is required for areas of the landfill which do not receive waste for periods of 90 days or more. No allowance for an alternative intermediate cover is provided. However, 18 AAC 60.340(c) does indicate that the ADEC will approve an alternative material of an alternative thickness for daily cover if the owner or operator demonstrates that the alternative material and thickness will control disease, vectors, wildlife attraction, fire, odor, blowing litter, and scavenging without posing a threat to public health or the environment.

2.1.3.3 Municipality of Anchorage

The AMC provides for regulations pertaining to landfill operations in both Title 21, Chapter 21.05 and Title 26, Chapters 26.70 and 26.80. Title 21, Chapter 21.05.060(E)(6) includes general requirements for landfills including set-backs, run-off containment and treatment, nuisance control and required compliance with 18 AAC 60. Title 21, Chapter 21.05.060(E)(9) includes use-specific standards for solid waste and/or recycling transfer facilities including location, minimum size requirements setback requirements, outdoor storage limitations, and fencing requirements. In general, the regulations in Title 26, Chapter 26.70 (Collection) regulate disposal service, rates, billing, solid waste storage on private property, collection schedule and contracts. Regulations in Title 26, Chapter 26.80 (Disposal) regulate where waste may be disposed, disposal rates, hazardous and toxic waste disposal procedures, charges, closure and post-closure care liability. Overall these regulations provide support for solid waste services provided by the SWS which in turn rely on the DEC regulations for design, operation and permitting of solid waste facilities.

2.1.4 Summary of Regulatory Requirements / Drivers and Key Policies

The following provides a summary of the key findings of the Federal, State and local regulatory requirements/drivers and key policies review which are to be considered during the development of the SWS ISWMP.

- **USEPA's mission is to protect human health and the environment which includes sustainable material management.** Through its Sustainable Material Management Strategic Plan, the EPA has strategic priority areas it promotes that includes the conservation of materials, the development of longer lasting products and infrastructure, sustainable food management, and an increase to material recovery.
- **Climate Action Plans can be a catalyst to sustainable solid waste management practices.** Similar to AB 32 in California, the State of Alaska Administrative Order 289 has the potential to impact solid waste management including collection, processing, and disposal in order to achieve reductions in GHG emissions.
- **The Proposed Climate Action Plan for the MOA is being updated under the current administration.** An increase in recycling and composting programs in partnership with SWS are potential programmatic outcomes of the PCAP.
- **The Regulatory Commission of Alaska regulates single-family residential trash collection services outside SWS collection area.** Any single-family residential waste collection rate increase outside the SWS collection area would have to be approved by the RCA. The RCA does not regulate damage claims, recycling, landfill tipping fees, or SWS.

- **SWS's Strategic Plan goals include a recycling rate of 25% by 2020 and less than five pounds per person per day.** Although the Federal government and State of Alaska do not have diversion goals or targets, SWS has established goals for its agency. Various strategies in the ISWMP will be recommended to help achieve this goal.
- **ADEC has limited oversight over non-disposal activities.** Proposed improvements, expansion, or new pre-processing and recycling facilities are not required to obtain a solid waste facility permit under 18 AAC 60.
- **MSWLFs in Alaska are regulated through the ADEC.** Any changes to the ARL that may be considered for the ISWMP (including expansion, revised grading, capacity increase, additional ADCs) will likely involve a modification/revision to the existing Solid Waste Permit No. SW1A001-22 issued by the ADEC in accordance with 18-AAC-60 and the permit application requirements.
- **For expansion of the ARL onto adjacent property, coordination with JBER and consideration of NALA is required.** In addition, to seeking approval from JBER for expansion onto military land, consideration must also be given to limitations/requirements of NALA (agreement between the MOA, the Eklutna Native Corporation and the State of Alaska).
- **The AMC provides for regulations pertaining to landfill operations in both Titles 21 and 26.** Overall these regulations provide support for solid waste services provided by the MOA which in turn rely on the ADEC regulations for design, operation and permitting of solid waste facilities.

2.2 INDUSTRY TRENDS AND BEST PRACTICES

This section examines and analyzes solid waste disposal industry trends and best practices that focus on efforts to move away from traditional landfill disposal practices to a diversified portfolio approach for sustainable waste management. Alternative technologies to landfilling and best practices for optimizing available landfill capacity are also presented in this section as well as industry trends in biogas beneficial use.

2.2.1 Diversion and Recycling

Diversion from landfills through material reuse, reduction and recycling has been practiced to varying degrees throughout the U.S. with a goal of "zero waste" to landfills which typically consists of established diversion goals for highest achievable diversion. As discussed in Section 2.1.1.2, there has been an increase in regulatory drivers for organics diversion due to climate change policies requiring significant reductions in GHG emissions resulting from the decomposition of organic material in landfills.

Zero Waste and Circular Economy

The goal of zero waste is to reduce, reuse, recycle, and/or convert to beneficial use, resources that are now being disposed so as to divert waste from landfills. To reach higher diversion goals, the concept of zero waste strategies must consider the entire lifecycle of a product or material. By designing and managing materials with a "cradle to cradle" instead of "cradle to grave" mindset, zero waste eliminates or reduces the need for raw materials and waste disposal and instead holds producers responsible for management of their products and packaging, as well as consumers for their purchases.

Zero waste focuses on a "closed-loop" process where all products are designed to be cycled safely back into the economy or the environment. This closed-loop system not only heightens diversion levels but also helps communities achieve a local economy that operates efficiently, sustains jobs, and provides a measure of selfsufficiency. There are several programs and policies, as well as infrastructure, that need to be considered when planning for a city's or community's diversion goals. When considering programs and policies to implement, there are upstream (pre-consumption) and downstream (post-consumption) options that need to be evaluated, as illustrated in Figure 2-1.

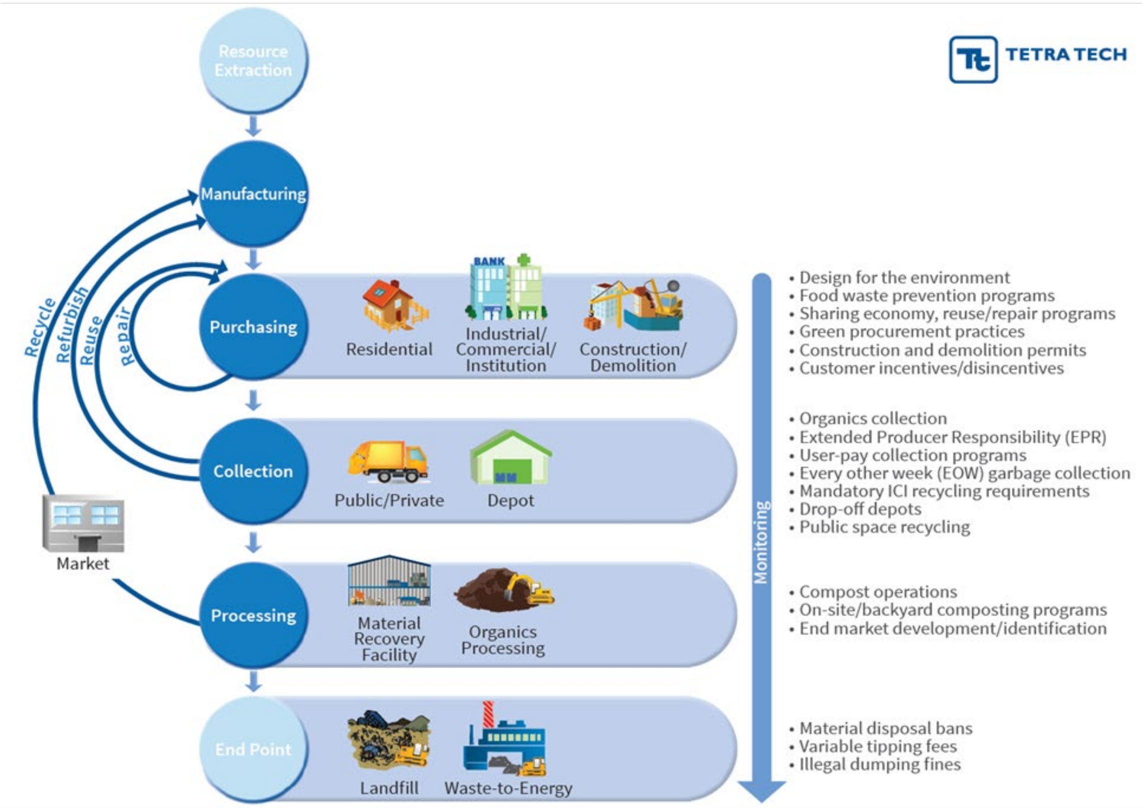


Figure 2-1. Aspect of a Circular Economy

Upstream Options. Upstream options focus on "source reduction" which requires designing, manufacturing, purchasing, or using materials in ways that reduce the amount and/or toxicity of waste. Source reduction also conserves resources and reduces pollution, including GHG that contribute to climate change. Upstream strategies include more significant, society-level changes such as extending the lifespan of consumer products, reducing product packaging, and increasing recycled content in products.

The following are the main goals of upstream source reduction:

- Increase useful life of consumer products;
- Reduce the amount of waste in products and packaging;
- Increase recycled content of products and packaging; and
- Make products and packaging more recyclable.

Some examples of programs and policies that can help reach these source reduction goals include: supporting a Green Building Initiative, creating or expanding a Junk Mail Reduction Campaign, bans on polystyrene food containers, plastic bags, and/or non-recyclable packaging.

Downstream Options. Downstream options focus on reuse, recycling, organics diversion, and education. Reusing a product extends its "life" which in turn reduces the amount of raw material needed to be extracted, as well as, reduces the amount of waste which needs to be managed or eventually ends up in a landfill. Recycling involves taking a product or material at the end of its useful life and turning it into a usable raw material to make another product. Organics diversion refers to compostable organic material, including grass clippings, yard and food waste, wood, non-recyclable paper, etc., and diverting it from being landfilled. Some examples of programs to increase organics diversion would be increasing green waste pick-ups, developing supermarket produce collection and composting, banning organics from landfills, and allowing inclusion of residential food waste in the "green" waste can. Education involves informing the public of the importance of zero waste goals, motivating them to become involved in the process, and then instructing through tools and resources (such as websites, seminars, courses, and advertisements), so that they can help make a difference.

Solid Waste Management Hierarchy

Those advocating for sustainable waste management trends recognize that landfills and transformation (e.g., waste-to-energy) facilities are necessary components of an integrated solid waste management system and essential components of the waste management hierarchy. Many jurisdictions have established a hierarchy of waste management practices in the following order and priority: (1) source reduction; (2) recycling and composting; and (3) environmentally safe transformation and land disposal. As part of the current integrated waste management hierarchy, the largest volume of solid waste is managed through disposal. However, many jurisdictions are promoting a new solid waste management paradigm (see Figure 2-2) with the following waste management hierarchy (from most to least preferred): (1) waste prevention (including source reduction, product design, and producer responsibility); (2) reuse; (3) recycling; (4) conversion/compost; (5) transformation/waste-to-energy; and (6) landfilling. In the new paradigm, the least volume of waste would be managed through disposal.

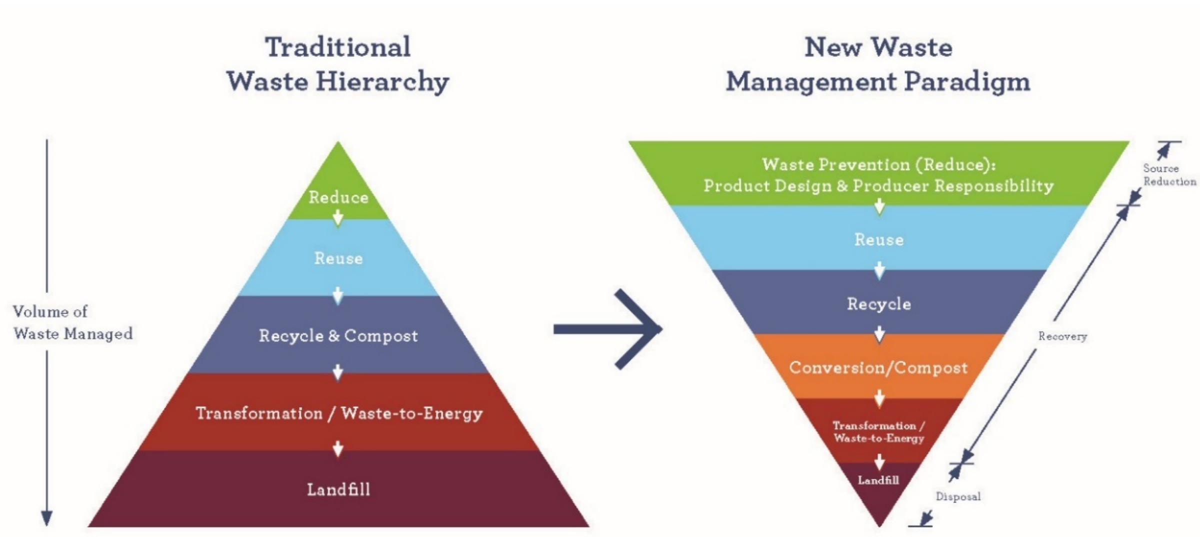


Figure 2-2. Solid Waste Management Hierarchy

Food Recovery Hierarchy

The latest foremost trend in many U.S. States is to reduce the amount of organic waste at the source, particularly food waste, from homes and businesses. Diverting green waste through curbside collection programs is the most common practice for organics diversion. Diverting food waste is the next big challenge.

The USEPA has prioritized actions that organizations can take to either prevent the wasting of food or divert food that has become waste from landfills. These actions are listed from the most to the least preferred in the Food Recovery Hierarchy shown in Figure 2-3.

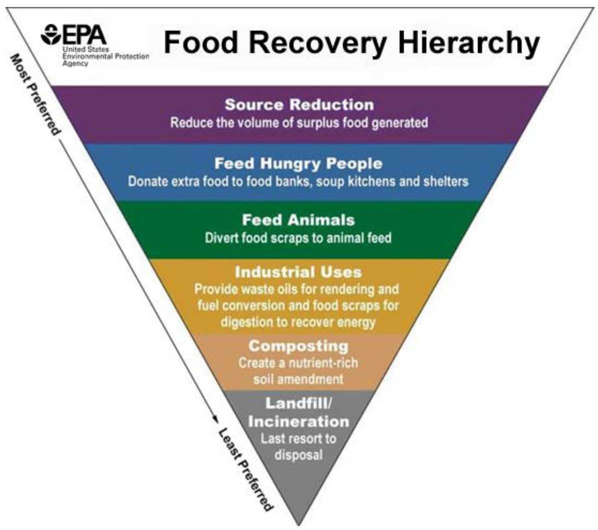


Figure 2-3. U.S. EPA Food Recovery Hierarchy6

A collaborative effort between the Municipality, residents, and businesses is required to reduce the amount of organic waste (particularly food waste) being generated and that would result in a reduction in organic waste recycling demand; ultimately reducing the organic waste processing capacity requirements.

Canadian Zero Waste and Organics Diversion Initiatives

Our neighbors in Canada have been implementing zero waste and organics diversion programs since the early-1990s starting with a 50% diversion rate goal by 2000 that was set in 1989 primarily due to diminishing landfill capacity and environmental stewardship concerns. Compliance was essentially left up to the individual Provinces to determine how they wanted to implement waste diversion initiatives, including organics, to meet diversion goals. Below are highlights of Canadian Provincial initiatives/drivers as it relates to diversion, particularly organics:

- Nova Scotia started in 1995 when they banned the landfilling of recyclables and organic materials primarily to address leachate issues and landfill capacity. This spurred organics collection and processing in the Province.
- City of Toronto started the “Zero Waste” mantra in early 2000 when they were having disposal capacity issues and fears that the borders would be closed to their refuse. Their stated pursuit to achieve Zero

[6] *https://www.epa.gov/sustainable-management-food/food-recovery-hierarchy*

Waste helped gain political support for collecting organics (food scraps and soiled paper) and building an anaerobic digestion facility.

- Several larger communities in Ontario followed suit to be comparable with Toronto. Within the last year or so, Ontario established a cap and trade system for carbon and that has provided Provincial direction to collect and process organics and to also manage landfill gas using the best available control technology.
- British Columbia has a goal that is essentially an organics ban. Most regional districts were already collecting and processing organics when this goal was announced. They have a goal to have 75% of the population have access to organics collection and diversion, and to drive the annual disposal rate to less than 350 kg/capita or 772 lbs./capita. Currently, about 60% of the population has organics diversion collection, and many more are planning for this new program. Some regional districts have achieved the disposal rate goal but most are quite a bit above it.
- Quebec is proposing an organics disposal ban by 2019. This is driving many cities to build processing facilities (Anaerobic Digestion and composting) and plan to collect organics in the near future.
- Alberta's largest cities (Edmonton and Calgary) are also collecting and processing organics. The Province has a goal to be landfill free and organics diversion would be part of that. There is no specific mandate to divert organics or ban organics from disposal.

The population from these provinces is more than 85% of Canada's population. High landfill tip fees, currently on the order of $100 per ton and lower Organics processing fees at $70-$90 per ton have supported the development of programs and facilities to comply with diversion requirements and associated organics bans.

China National Sword 2017

China has been the largest importer of recyclables in the world and recently enacted new policies for accepting recyclables. Regarded by some as a second Green Fence[7], the newest campaign, called "National Sword 2017" began with the announcement from China that it would ban the importation of 24 recyclable materials. As part of the National Sword program, customs officials have been told to focus on the quality of waste paper and plastics. Incoming recyclables that have over 0.5% contamination (i.e. trash in the recyclables) will be rejected from entering the country. The examinations will focus on checking the level of non-fiber impurities and excessive moisture in bales of paper. This has led to excessive supply affecting pricing, sending it plummeting for paper and plastics. The sale of U.S. bales of fiber and plastic sold to China have to compete with bales from other countries around the world, so efforts are being made to reduce the amount of contamination in our recyclable commodities affecting generators and MRFs. Increased enforcement of source separation practices and modernization to MRFs operations and design are being implemented in many jurisdictions and this will increase costs for recycling. At the same time, this campaign is an opportune time to develop or enhance local markets to support a circular economy, and to investigate whether new recycling processes are technically and financially sustainable.

[7] China Green Fence – a policy enacted by China in 2013, due to frustration with being the world's trash dump and wanting recoverable materials with minimal contamination.

2.2.2 Alternative Technologies

Traditionally, landfill practices have long included utilization of landfill gas for beneficial use. Depending on regulatory requirements and site-specific economic considerations, landfill gas may be passively vented, flared, or used in a landfill gas-to-energy system producing electricity (similar to the ARL). With upgrading, the landfill gas may also be used to generate compressed natural gas (CNG) or LNG for vehicle fuel or renewable natural gas (RNG) for pipeline injection.

As new technology is developed and uses for biogas are expanded and with increased regulatory drivers for organics diversion, interest in the solid waste industry has begun to focus on the use of conversion technologies, principally anaerobic digestion and gasification, for generation of renewable energy from MSW and to help meet diversion goals. These systems are amenable in varying degrees to utilization of source separated organic waste (e.g. food waste, yard waste), residuals from operation of MRFs, or mixed waste. Numerous companies are marketing technologies or providing conversion technology services for mixed MSW.

A preliminary assessment of Alternative Technologies was performed for this ISWMP, included in Appendix F. A high-level summary of industry trends in developing alternative technology facilities is presented in the following sections.

2.2.2.1 Anaerobic Digestion

Anaerobic digestion is a biological process that uses bacteria to decompose biodegradable organic materials (such as food waste, yard waste, and non-recyclable paper) in the absence of oxygen. The process results in production of biogas consisting primarily of methane and carbon dioxide. The biogas can be used to generate electricity, or it can be upgraded to pipeline-quality natural gas or other types of fuel (such as CNG). The remaining solid material that is not converted to biogas is called digestate. The digestate can be marketed as a fertilizer or soil amendment, typically after composting and curing. Currently the market for digestate is limited. It can be gasified to extract the remaining energy value or be landfilled. Anaerobic digestion can result in residue requiring landfill disposal, both from pre-processing of the feedstock and post-processing of the digestate. Factors that affect viability of an individual anaerobic digestion project include the following:

- Regulatory requirements to divert organic waste from disposal or reduce GHG emissions;
- Quantity and characteristics of organic feedstock;
- Carbon credits;
- Tipping fees to process organics;
- Long-term fuel or power purchase agreements (PPAs); and
- Strength and stability of the market for beneficial use of digestate; and
- Avoided cost of disposal.

The cost to anaerobically digest organics is between $100 to $150 per ton depending on size and location of the facility. As noted above, there are many factors affecting the viability of establishing a facility in any location and a site-specific feasibility analysis is typically required to understand the magnitude of each factor above and the likely end result.

Anaerobic digestion facilities are highly suitable for processing source-separated food waste or source separated food and yard waste. When yard waste is processed, the woody components may be removed and used as a bulking agent in a post-digestion composting process, rather than being used as feedstock to the digester, since these materials are slow to digest and yield lower levels of biogas. Management of source-separated organic waste requires infrastructure to collect this waste separately from other municipal waste. Anaerobic digestion facilities can also process mixed waste but would usually be paired with a mixed waste processing facility (integrated or as part of a separate operation) to recover recyclables, remove non-biodegradable materials, and digest an organic-rich fraction separated from the mixed waste. Without such pre-processing, the digesters would need to be substantially oversized to handle waste constituents with little or no biogas generation potential, and the resulting digestate would have significantly reduced potential for beneficial use.

Outside of the United States, there are many commercial anaerobic digestion facilities processing mixed waste and source-separated organics (sometimes in combination with other types of organic feedstock). Many of these facilities have operated for five to 10 years, and some facilities have operating histories that approach 20 years. These facilities are widespread across Europe, including large numbers in Germany, Spain, France, Italy, and Portugal, and there is a number in other countries including Canada.

In the United States, anaerobic digestion has been commercially established for many years using feedstock from farms (e.g., manure), biosolids, and process streams from the food and beverage industry (e.g., brewery waste). Recently, there has been progress on development of anaerobic digestion projects in the United States for source-separated organic waste (predominantly food waste and also yard waste from residential and commercial sources), and for the organic fraction separated from mixed waste. While some of the focus has been on site-specific feasibility studies and procurement activities, several projects are at advanced development stages or in operation.

2.2.2.2 Gasification

Gasification is a process that converts the carbon-bearing materials in MSW (such as paper, plastic, wood, rubber, and other organics) into a synthesis gas that consists primarily of hydrogen and carbon monoxide. The synthesis gas can be processed and then potentially combusted to generate electricity or converted to fuels (e.g. ethanol) or chemicals (e.g. naphthalene) providing flexibility for optimizing project economics.

In general, gasification is an emerging technology that works best when the feedstock is homogeneous. The wide range of materials that can be found in mixed waste and residue from mixed waste processing facilities has received mixed results. Inert materials (including glass, sand, and metals) that are not converted to synthesis gas and can potentially be recovered for recycling or beneficial use, particularly if the process converts the inert material to a vitrified slag or aggregate material. Gasification can result in residue requiring landfill disposal, both from pre-processing of the feedstock as well as from residual inert material remaining after gasification and not otherwise vitrified or marketable (commonly called ash).

The viability of an individual gasification project will typically depend on the quantity and characteristics of the feedstock, the ability to enter into a long-term fuel or PPA under favorable economic terms, the strength and stability of the market for beneficial use of residue, and the avoided cost of disposal.

There are many variations of gasification technology including: pyrolysis (gasification in the absence of oxygen); gasification at differing temperature profiles, and plasma (high temperature gasification). The variations relate to synthesis gas yields, space requirements, energy needs, and other infrastructure needs. Gasification technologies are usually proprietary, with patented features for reactor design and related components. Many gasification technologies use some type of preprocessing to prepare the feedstock, including size reduction, removal of non-processible materials, and recovery of recyclable materials. Certain gasification technologies may require inputs such as steam to promote production of synthesis gas or such materials as limestone, coke and natural gas to support the process.

Gasification of mixed waste is established outside the United States with numerous commercial applications in Europe and Japan. In the United States, gasification has been demonstrated or commercially established for certain feedstocks (e.g. lignite, biomass, wood from forestry applications, and biosolids from wastewater treatment). Recently, there has been progress on development of gasification projects in the United States.

2.2.2.3 Mass Burn

Combustion, also referred to as waste to energy (WTE), mass burn or incineration, is defined as the burning of fuel to produce heat and subsequently power. Combustion occurs with oxygen in slight stoichiometric excess to rapidly complete a thermal oxidation reaction. The products of combustion are heat, an ash residue, and an off gas made up of predominantly nitrogen ($N2$), carbon dioxide ($CO2$), and water vapor. The off gas must be treated to meet regulatory emission requirements for chemical pollutants and particulates. Combustion is an exothermic (net heat output) process; therefore, the technology lends itself to heat recovery in many applications. Heat generation can be used in boilers or converted to power via turbines. The combustion process is highly developed commercially and is available in numerous vendor specific designs.

The most common direct combustion technology for biomass is stoker boiler technology. Various forms of stoker boilers have been employed since the 1920s. Stoker boilers employ direct fire combustion of solid fuels with excess air, producing hot flue gases, which then heats water to produce steam in the heat exchange section of the boiler. The steam is used directly for heating purposes or passed through a steam turbine generator to produce electricity. The energy recovery capabilities of the boiler system can be further enhanced when excess heat is used in a district

heating/energy infrastructure. While this technology is conventional and well proven, it is not as environmentally friendly as other alternative technologies. This type of technology typically produces more fly ash and air emissions than other technologies, which usually requires close monitoring and management. Combustion technologies can process most types of MSW, but operate more efficiently with dry feedstock materials that have medium to high calorific value.

Mass burn technologies have the ability to process biosolids from wastewater treatment plants. Depending on the moisture content of the biosolid, a mass burn facility can process biosolids up to 20% of the plant's design capacity. Generally, mass burn facilities are able to process more biosolids the lower the moisture content.

2.2.3 Municipal Solid Waste Landfills

The main solid waste disposal industry trend for MSWLFs is optimization and preservation of landfill capacity due to the increased difficulty to site and permit new facilities or expand existing MSWLFs. Some of the measures taken by municipalities throughout the US and internationally to preserve airspace include:

- Diversion of waste
- Increased Compaction
- Alternative daily cover and soil recovery

- Engineering planning/fill phasing
- Beneficial reuse of landfill gas

Diversion is the most common trend in preserving landfill capacity and involves many options which were discussed in Section 2.2.1. Following is a discussion of the other above listed trends and best management practices to optimize and preserve landfill capacity.

Compaction

Landfill permitting provides for an area with an allowed depth and final elevation which results in a finite number of cubic yards of space that, depending on anticipated waste stream and compaction densities, determines the landfill life expectancy. The key to this life expectancy is how the space is filled.

The Handbook of Landfill Operations (Bolton, 1995), states that waste compaction is one of the most important components of operating a landfill. Because a landfill has limited permitted airspace, the more compacted the waste, the longer the site will last. In addition to increasing site life, good compaction will reduce the amount of cover needed. If refuse is well compacted, less soil will seep through between the waste minimizing the amount of soil needed for daily cover.

Factors governing compaction which can be controlled include the following:

1. **Weight of compactor:** The load that a compactor can exert on the waste is directly related to the weight of the compactor;
2. **Speed of compactor:** The higher the speed, the greater the compaction;
3. **Waste layer thickness:** The depth of each compacted refuse layer is an important factor influencing density. To obtain maximum density, waste should be spread and compacted in layers not exceeding a depth of two feet;
4. **Design of compactor (wheels and teeth):** Wheel diameter, width, and tooth design will affect a compactor's performance in several ways;
5. **Number of passes made over the waste:** Regardless of the type of machine use, the unit should make three to four passes to achieve optimum density;
6. **Slope:** Maximum compaction is achieved by working the waste on a slope of 3:1 or less; and
7. **Moisture Content:** It is believed that water tends to weaken the bridging characteristics of waste, particularly paper such as large pieces of cardboard.
8. **Waste Characteristics:** Other factors such as waste characteristics (i.e., large, bulky items and lumber) also affect compaction and should be segregated, if possible.

The best measure of compaction effectiveness is the AUF which considers refuse to soil ratio and refuse density in tons/cy. As discussed in Section 1.5, the use of a 0.60 AUF for the ARL was recommended to be used for planning proposes by SWS based on historical and recent factors affecting the AUF. Municipal landfills considered in the benchmarking analysis included in Section 1.4 have AUFs ranging from 0.55 to 0.75. Privately operated landfill facilities typically achieve higher AUFs ranging from 0.85 to 1, thus greatly optimizing the facility's capacity through the use of specialized and efficient compaction equipment and optimizing waste layer thickness, moisture content and slope grades. The Tetra Tech Team will review SWS' operations at the ARL to determine if any modifications are recommended to increase AUF at the site and ultimately increase optimization of landfill capacity.

Alternative Daily and Soil Recovery

Alternative daily covers (ADC) have proven beneficial to many landfill operators in minimizing the cost of having to use either imported or on-site soil as a daily cover. Another important cost saving result of using certain ADCs is the reduction in airspace consumed. The cost savings in airspace are typically quite significant, resulting in savings of millions of dollars over the site life. The capacity optimization afforded by certain ADCs is the reason why so many landfills are using ADCs at their sites.

As discussed in Section 2.1.3.2, there is no allowance for an alternative intermediate cover provided in Alaska state regulations. However, it does allow for an alternative material of an alternative thickness for daily cover if the owner or operator demonstrates that the alternative material and thickness will control disease vectors, wildlife attraction, fire, odor, blowing litter, and scavenging, without posing a threat to public health or the environment. As mentioned in Section 2.1.3.2, the current ARL Solid Waste Disposal Permit includes approved alternative cover materials consisting of auto shredder fluff, ground C&D debris, and wood chips on interior daily slopes in place of daily soil cover materials. Other ADCs and cover operations that may be considered for the ARL include:

- Geosynthetic Fabric or Panel Products (Tarps)
- Soil Recovery from Previous Daily Cover Application
- Green Waste Material

Tarps. Daily cover tarps have been proven as an industry standard for protection of the waste fill from litter production and from vectors and birds (see Figure 2-4). Typical tarp placement protocols are as follows:

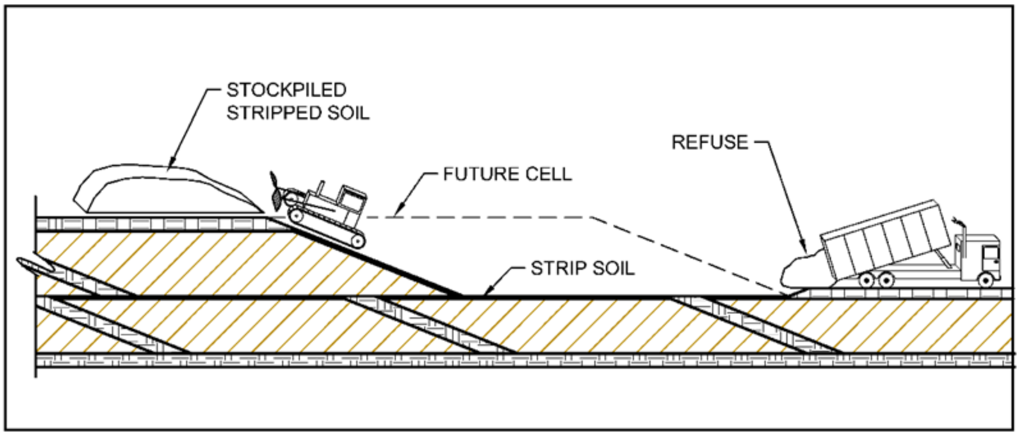
- Tarps are used only when site conditions allow (i.e. dry/warm weather seasons);
- Soil cover is used during periods of excessively high winds;
- Tarps are placed across the working face each day;
- Tarps are placed and overlapped to promote drainage off the working face;
- Typical overlaps are two feet during periods when rain is forecast and one foot all other times;
- Tarps lap a minimum of two feet on to adjacent soil cover;
- Tarps are held in-place using waste tires or other manageable inert objects.

Figure 2-4. Tarp Placement as ADC

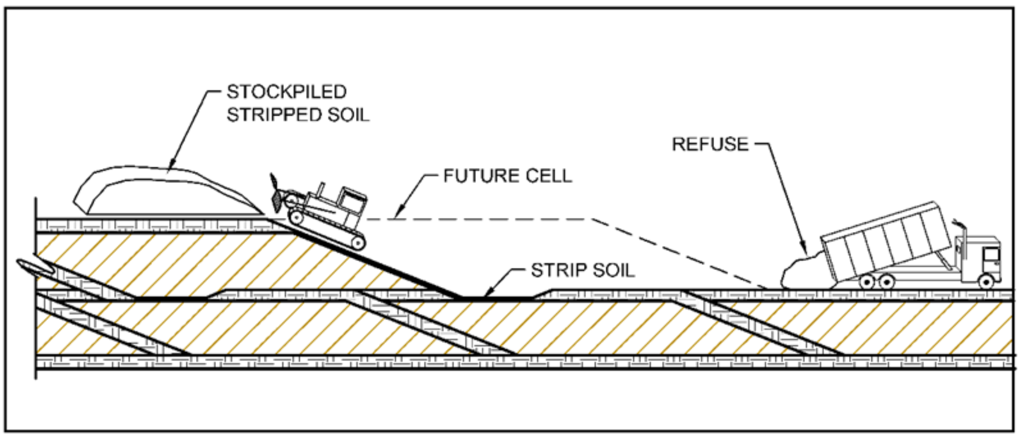
The general procedures for use of tarps at the landfill is as follows: 1) waste spreading, grading, and compaction is completed at the end of the day; 2) outer edges (slopes of the horizontal lift) are covered with soil cover; 3) tarps are positioned as described above using landfill equipment assisted by landfill staff labor; 4) tarps are anchored by placing tires or other heavy objects around the perimeter; and 5) additional soil cover is placed on the active face as necessary to cover all waste.

Tarps are used mainly on the working face. Soil cover is applied to the outer (3:1) edges of the active fill area. Typically, soil cover is applied to the outer slopes on a daily basis; however, this schedule may vary with the actual working-face location and configuration. In some cases, the slopes may be covered by tarps. Tarps are removed in the morning and are folded to half their size then pulled off the waste fill using landfill equipment. When not in use, the tarps are kept on the ground near the working area out of the way of traffic.

Soil Recovery. Reusing soil that was placed as daily or intermediate cover benefits in three ways. Any soil that is recovered does not consume airspace, the soil is already located at the working face and does not need to be brought in (providing an operational cost savings), and removing the soil reduces the potential for leachate mounds to develop and promotes better gas collection. Even though this soil may contain too much garbage for use as the surface cover, it works very well to fill in the voids in the surface of the trash and will prevent perched leachate. At the beginning of the day, the daily cover should be pushed back off the working face and put to the side, a small portion of the soil will remain on the slope to minimize contaminating the soil with the underlying refuse. The intermediate cover can be removed to a depth of six inches so that there is six inches remaining in place to provide a working surface for the trucks to unload onto. Soil recovery should be performed as weather permits; however, at a minimum a strip of soil at the base of the working face should be removed in order to key in the refuse and provide a continuous path for leachate percolation. Figure 2-5 illustrates the minimum and maximum soil recovery processes.



SOIL RECOVERY



MINIMUM SOIL RECOVERY

Figure 2-5. Soil Recovery

Green Waste Material. Since processed green material (PGM) is organic, it was originally believed that it would eventually break down quickly and not have a significant impact on landfill airspace capacity. Tetra Tech was commissioned to conduct an evaluation in Southern California of the degradation and settlement of PGM to verify the capacity savings. It was determined that PGM responds to compaction loading very similar to MSW due primarily to the high lignin content of PGM. The biodegradation modeling conducted by Tetra Tech estimated that the loss in mass of the PGM ranged from approximately 1.6 percent to 6.7 percent over an eight-month period. The study concluded that PGM has similar compaction and settlement characteristics as MSW. Therefore, the use of PGM as an ADC does not conserve airspace at a landfill, but if no alternative use for the PGM is available, use as an ADC would reduce the amount of soil needed.

Potential use of these ADCs and soil recovery at the ARL could beneficially impact both landfill capacity optimization and conservation of available soils for use as daily cover applications and final cover in lieu of daily cover. The Tetra Tech Team will evaluate the above ADCs for SWS consideration in pursuing additional permitting to allow use of these ADCs.

Engineering Planning/Fill Phasing

The Tetra Tech Team will be reviewing engineering planning/fill phasing at the ARL to optimize landfill capacity and to evaluate options to reduce leachate generation. The ARL generates a relatively high amount of leachate (approximately 26 M gallons in 2016) with an annual average of approximately 11.4 M gallons per year over the past 26 years. Data shows a relatively high spike in leachate generation after construction of a new cell and during the rainy season which is indicative of a short circuiting of the collection system occurring.

Best management practice options available to optimize capacity and reduce leachate include the following:

- Re-design refuse cells;
- Wet weather operations;
- Less permeable daily cover;
- Temporary scrim cover; and/or
- Interim storm water management.

Re-design Refuse Cells. Currently refuse cells are constructed at approximate five to ten-year intervals which leaves a large portion of lined area exposed for years before refuse is placed over it. Breaking the cells up into smaller units would require construction more frequently but would delay capital expenditures resulting in potential cost savings. It would also limit the amount of exposed drainage layer and in turn limit the area for leachate collection. Mid-slope benches could also be added to divert drainage and reduce exposed liner (see Figure 2-6).

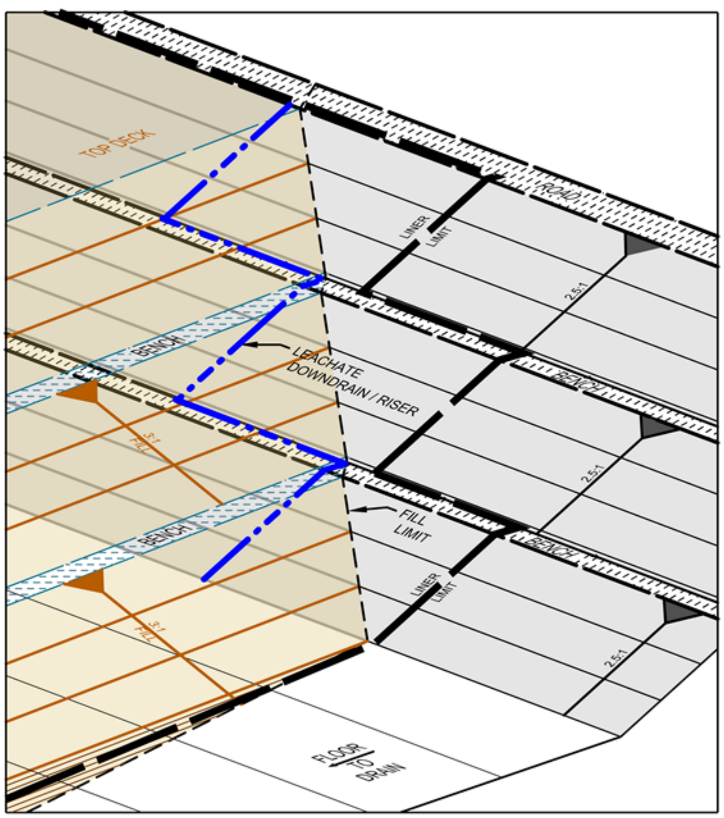


Figure 2-6. Utilization of Mid-Slope Benches to Divert Drainage

Wet Weather Operations. Any storm water that contacts refuse is considered leachate. Having a smaller working face limits the amount of refuse exposed and, therefore, limits the amount of leachate created. The location of the working face also has an impact in that working in a new cell, the working face is at the lowest point and all drainage is directed to the working face. Having a designated area above grade for wet weather operations makes it easier to promote drainage away from the working face. SWS establishes above grade wet weather areas.

Less permeable Daily Cover. Use of tarps and well-graded soils as daily cover will limit the amount of storm water that permeates through the cover and into the refuse mass. The use of snow as ADC is a good option in terms of limiting soil use, however, when the snow melts it becomes leachate and, therefore, should be limited. If well-graded soils are used, it is recommended to recover it to reduce potential for leachate mounds as previously discussed under soil recovery.

Temporary Scrim Cover. A temporary scrim cover could be placed over the liner system drainage layer to limit storm water intrusion into the leachate collection system (see Figure 2-7). The scrim would have to be anchored with either a rope and sandbag ballast system or Wind Defender. Wind Defender is a reinforced geotextile windscreen made of knitted ultra violet (UV) stabilized high density polyethylene (HDPE) filament. Wind Defender is typically utilized as a ballast system to protect underlying geosynthetics from wind damage and prolonged UV exposure. The system is well suited for short to mid-term cover applications such as landfill cell rain covers, temporary caps and a variety of bulk stockpile covers. Wind Defender is fairly quick and easy to install, requires little to no maintenance, increases the life-span of underlying geosynthetics, and enhances site aesthetics. The scrim and ballast system would be installed when a new cell is constructed and removed in sections as refuse placement advances. The system would keep storm water out of the drain layer and on the surface where is could be managed with temporary drainage controls. SWS would also like to consider the scrim material on itermediate cover areas for interior landfill slopes.

Figure 2-7. Temporary Scrim Cover

Interim Storm Water Management. Interim storm water management is key to minimizing leachate generation especially when refuse placement is below grade. Temporary lined storm water basins can be constructed in the lowest portion of the cell and storm water pumps can be used to pump water above grade to perimeter drainage improvements. Diversion berms can also be used to divert storm water away from the working face and into temporary collection systems.

2.2.4 Renewable Technology Trends in LFG Utilization

Recent changes in the energy marketplace (lowering prices for electric power) have initiated a gradual shift in the development of LFG beneficial-use projects. In many markets nationally, the development of electric-generating facilities utilizing internal combustion engines or turbines has been replaced by RNG applications. The primary drivers in this venture are the expansion of more aggressive air pollution control regulations which increase costs of generating electricity versus the price that can be obtained for that electricity, the relative increase in both the need for and cost benefits of gaseous fuels and the currently available Renewable Energy Credits. It should be noted that some information provided herein is dated through 2016 and 2017,as yet available when this review occurred in early 2018.

A review of projects registered under the USEPA's Landfill Methane Outreach Program (LMOP) indicated the current distribution of LFG utilization projects as of November 2017:

- Electrical Generation 476 Projects
- Medium-BTU Direct Thermal 117 Projects
- High-BTU RNG 44 Projects

The only LFG Utilization project listed as "operational" in the State of Alaska is the Doyon electrical generating facility at the ARL. There are no projects pending in the State according to LMOP.

Electrical Generation. Utilizing LFG to generate electricity for export to the power grid has long been a mainstay of LFG beneficial-use. Traditionally, these projects were developed because of the relative ease of transport, both on-site and off-site, via the existing electrical grid infrastructure and the use of LFG-to-electric projects to fill the requirements of a State-mandated Renewable Portfolio Standard (RPS) for the electrical utilities or for Federally-mandated fossil-fuel offset programs (i.e. military installations, government offices, etc.). Prices for these projects were largely predicated on wholesale prices and fluctuated substantially based upon the regional "supply" and "need" for renewable power.

There is currently no RPS in Alaska. In the 2009-2010 legislative session, the Alaska legislature enacted House Bill 306 with the goal that "the state receive 50 percent of its electrical generation from renewable energy sources by 2025.", however, this language does not appear in codified statutes (National Conference of State Legislatures – www.ncsl.org).

In most states, the utilities have met their RPS requirements and are not offering enough value in their recent PPA to make the development of LFG-to-electric projects economically viable. Several respondents in a recent survey, conducted by Tetra Tech, reported that their biogas to electricity project is now reaching the end of the PPA term, and due to lower electricity prices offered, they plan to shut down their electric generators and look for a different technology to use their biogas.

Having a direct delivery contract, rather than one that fluctuates with market prices, is more advantageous in the current development setting. It lends stability to what has become an increasingly unstable market in some areas. If JBER determines that additional electrical power is not required from Doyon, any expansion of the generating capacity would require another end-use customer for direct sale or wheeling into the local power grid. With recent construction by ML&P of a new power plant (three now in Anchorage), the electricity generation capacity appears saturated. Another option for electrical generation would be for on-site usage.

Medium-BTU Direct Thermal. Medium-BTU applications (Medium-BTU generally consisting of projects where the BTU content of the original biogas is not concentrated), which use minimally-processed gas as a replacement for oil, coal, natural gas, etc. is another application that has been widely developed for LFG beneficial-use. These applications generally include processing that is limited to gross liquids removal and a relatively low degree of compression, typically less than 20 psig, producing a fuel with a higher heating value (HHV) of approximately 450 to 500 BTU/cf. This type of LFG beneficial-use application is very appropriate in that the fuel price is lower than that of natural gas; however, the processing costs are substantially lower and the overall delivery process simpler than observed in many other beneficial-use applications.

These projects do require; however, an end-user in relative proximity to the landfill. Although some medium-BTU pipelines exceed 20 miles in length, the majority are well within a 10-mile radius of a landfill. Since the LFG has not been "dried", the management of condensate to varying degrees is still required as part of the fuel transport to the end-user. This limits the application of medium-BTU projects geographically, with respect to the individual landfill. As such, the development of new medium-BTU projects is generally limited to appropriate users locating facilities near potential landfills or the development of a landfill in proximity to an appropriate user.

Except for JBER, it is not apparent that any potential medium-BTU users exist in proximity to ARL. If an end-user can be determined within JBER, or at the landfill itself, this may be a viable option for further development.

High-BTU RNG. Thirty-nine biogas to RNG/High-BTU facilities were brought on-line in the U.S. from 2007 through 2012, approximately 6.5 projects per year. This rate dropped to eight (8) projects in 2013 and 2014, with an additional twelve (12) projects projected for 2015 and 2016. These projects are undergoing development throughout the US, as noted in Figure 2-8, however much of the processed fuel is distributed to California to take advantage of the relatively greater demand and financial incentives.

At the time of this review, there were no RNG projects listed in Alaska, under either LMOP or the American Biogas Council.

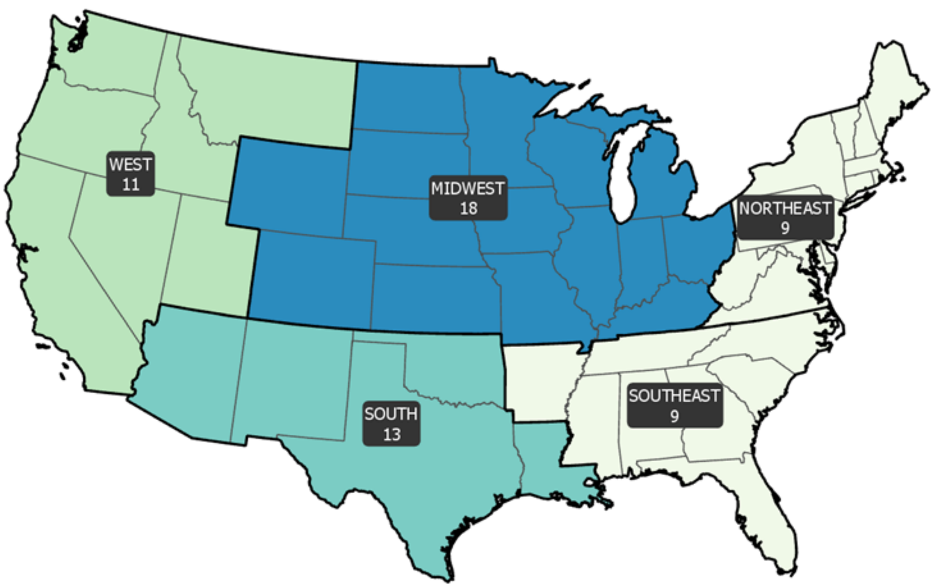


Figure 2-8. Distribution of Biogas to RNG Facility Startups (2007-2016)

Although this type of development has traditionally been the province of projects with large gas flow rates, since 2012 the largest development reported is approximately 3,500 standard cubic foot per minute (scfm). This reflects the relative efficiency of the equipment currently being utilized and its capacity for producing fuel cost-effectively.

A significant percentage of the fuel sources used for RNG applications are landfills, approximately 40 percent in 2015-16, although down from approximately 80 percent in 2013-14. The balance of the fuel is derived from anaerobic digester and wastewater treatment plant facilities.

Within the umbrella of RNG development are four sub-sets of development:

- Compressed Natural Gas (CNG) Interstate
- CNG Local
- LNG
- Pipeline Injection

Through 2012, the development of CNG for Interstate transport, CNG for local usage and injection into pipelines were developed at comparable rates, with relatively few LNG projects developed. From 2013-14 there was a spike in interstate CNG projects, however, in recent years local applications of CNG fuel have been the predominant development – approximately 60 percent of projects (see Figure 2-9). This is likely due to the relatively low cost of Natural Gas – approximately $2.85 per million BTU (MMBTU) in February of 2018, down from approximately $4.50/MMBTU in 2015 and more than $10/MMBTU in 2008 (Reference Henry Hub Spot Index).

At the time of this review in early 2018, released reports by LMOP indicated that 2017 was a relatively light year for development, with only seven projects or expansions coming on-line – three electrical generation projects and four RNG projects. The outlook for 2018 was approximately 36 new, defined projects proposed for start-up, of which thirteen were noted as RNG pipeline projects and ten noted as RNG/CNG projects. The RNG projects made up approximately 72% of the projects planned for start-up in 2018.

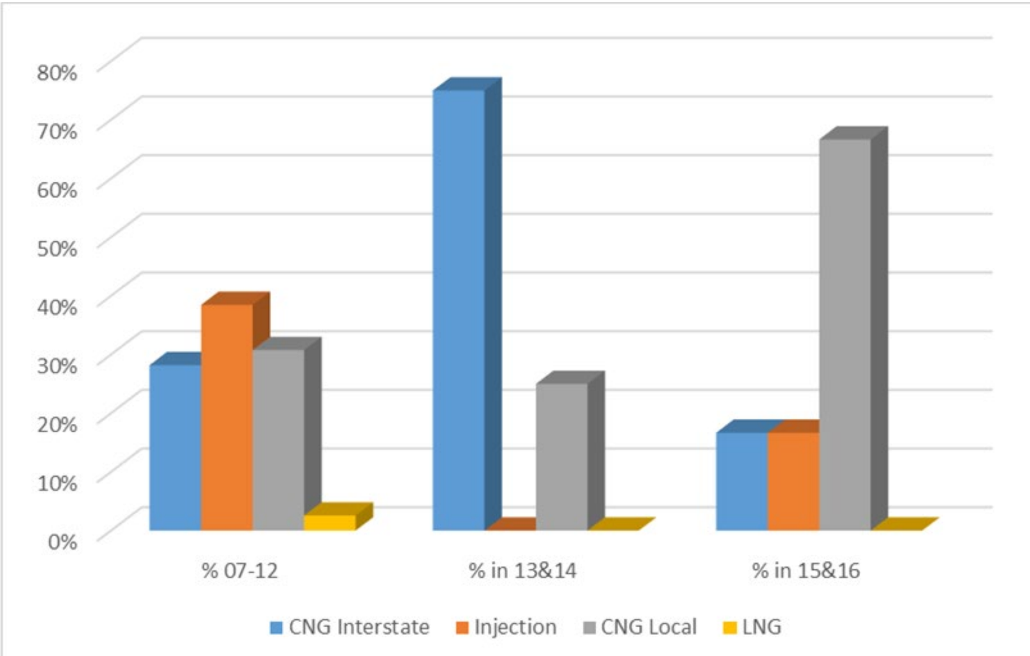


Figure 2-9. RNG Applications

Additional Market Forces

Numerous forces in today's market are driving biogas to energy projects toward high BTU systems. The market forces are proving that high BTU projects, once requiring a minimum of 3,000 scfm inlet to be economically feasible, are now economically feasible at as low as 100 scfm of raw inlet biogas.

Abundant Natural Gas. Fracking of shale in the US has resulted in abundant amounts of natural gas, with a 2017 average of $2.99 per MMBTU on the Henry Hub and a December Spot Price of $2.95. For biogas to high BTU projects that sell RNG into the natural gas pipeline, several survey respondents reported that their projects are not meeting financial goals set for them because the natural gas price is currently so low.

Transport of RNG Using the Natural Gas Grid. While selling RNG into the natural gas pipeline infrastructure is less financially viable, injecting into the pipeline; paying a transport fee and selling the RNG to a vehicle fueling station owner is proving economically viable. The transport of RNG is supported by the American Gas Association and wheeling fees are very reasonably priced.

Gasoline and Diesel versus CNG/LNG. Gasoline and diesel prices in Anchorage (late summer 2018) were about $3.15 and $3.20 per gallon, respectively. The energy value of gasoline and diesel were 112,114 and 128,448 BTU/gallon, respectively. Considering these factors, the price for gasoline and diesel equated to about $27 and $26 per MMBTU, respectively. In effect, price for gasoline and diesel being more than eight times higher than the Henry Hub price for natural gas (see Figure 2-10). As such, the revenue opportunity is much higher for biogas as vehicle fuel than as a heating fuel.

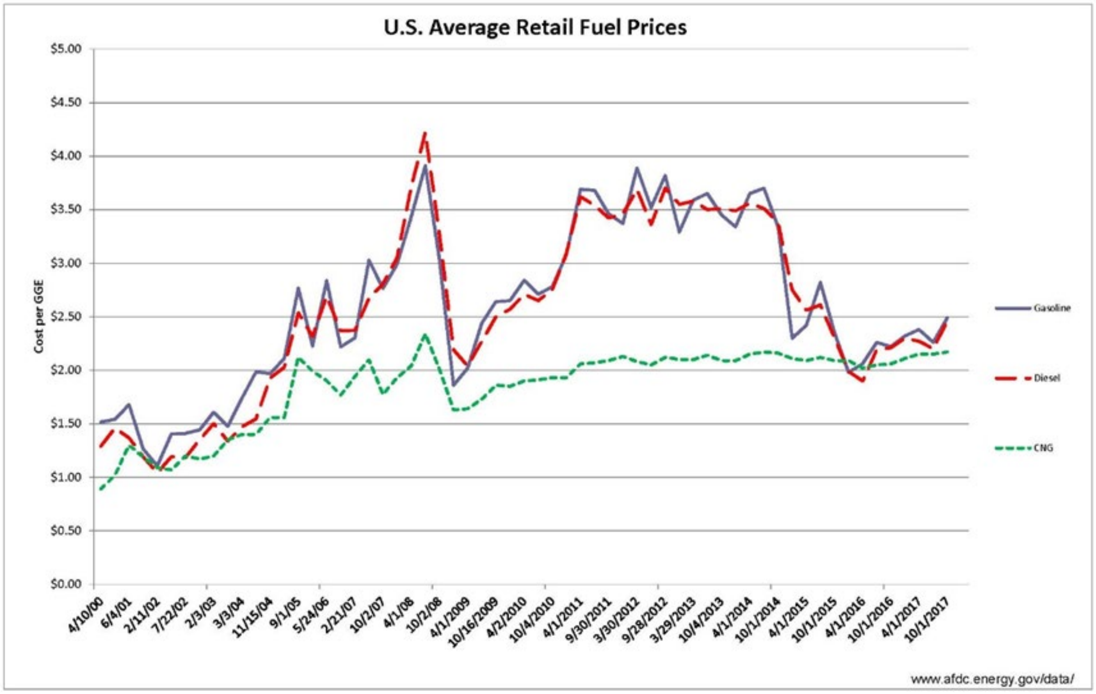


Figure 2-10. Fuel Price Comparison

In recent years, vehicle fueling in the US with CNG and LNG has become a huge industry. CNG/LNG fueling stations are now located along most major interstate highways, with more being built every month. The trend toward the use of CNG or LNG by truckers and owners of heavy duty vehicles has occurred largely because the cost for CNG/LNG is about 65 percent less than diesel, and their vehicles experience less internal wear and tear when using CNG/LNG.

Hundreds of large fleet owners and thousands of small vehicles have made the switch to CNG or LNG fuel. More vehicle conversions to CNG/LNG are occurring all the time resulting in substantial cost reductions and GHG emission reductions, with CNG conversions applicable to residential and relatively “short haul” or local vehicles such as service or collection vehicles and LNG conversions used for “long haul” trucking applications. A review of public stations in the Anchorage area shows no currently active public CNG vehicle fuel facilities (www.CNGNow.com). Any use of CNG vehicle fuel would need to be a dedicated fleet conversion, likely for either ARL, their associated waste haulers or JBER vehicles. Waste haulers, as well as SWS vehicles, could re-fuel at the landfill using both fast-fill and slow-fill fueling islands, depending upon the “home location” for the vehicles. If a plan to fuel vehicles at JBER were developed, it would likely include a dedicated fueling station(s) on base, with fuel provided via a dedicated RNG pipeline or over-the-road transport utilizing transport trailers (see Figure 2-11) to a storage/dispensing facility. Over-the-road transport trailers could also haul CNG to a storage/dispensing facility at the CTS to fuel collection trucks.

Figure 2-11. Typical CNG Transport Trailer

Incentives for LFG Utilization Projects. Incentives for LFG utilization projects come and go (one-time grants or incentives to multi-year tax credits or market incentives) and vary based on how the LFG is utilized (electricity, pipeline, vehicle fuel). The following incentives apply specifically to LFG utilization projects.

Renewable Fuel Standard. As a result of emission reductions when CNG, LNG and ethanol are used in vehicles, the US federal government has established the Renewable Fuel Standard (RFS) and renewable index number (RIN) program, which requires US oil refineries to meet renewable fuel goals. If they cannot meet the goals themselves, they are required to purchase the RINs. The price paid for RINs varies.

An August 18, 2014 amendment to the RFS created a cellulosic biofuel (D-3) RIN whose value is currently (as of January 2017) about $2.59 per RIN, $30.37/MMBTU, $3.74 per GGE or $4.32/DGE. D-3 RIN's are applicable to LFG, wastewater treatment plant gas, and other biogas.

RINs available for RNG that is used to fuel vehicles. The availability of RINs and the process to set the price of the RINs through 2022 are relatively clear, based on the current regulation, however projecting the availability and pricing structure beyond 2022 is very unclear. Many large developers, through the RNG Coalition, are lobbying to assure the future of RINs, and investing hundreds of millions of dollars to ensure that RINs will be available in some form beyond 2022.

Low Carbon Fuel Standard. Recognizing the emission reductions created by using treated biogas as vehicle fuel, the California Air Resources Board (CARB) created a Low Carbon Fuel Standard (LCFS) credit program. The value of the LCFS is volatile but results in about $4/MMBTU of income. Other states in the NW Pacific, including Oregon and Washington, as well as Canada, are undertaking the development of LCFS programs. They are in various stages of development and dates of implementation, as well as program details, have yet to be defined. There are no currently active or pending LCFS programs in Alaska.

As noted in Figure 2-12, fuel derived from LFG has the lowest-rating for carbon intensity, making it an effective application for LCFS programs.

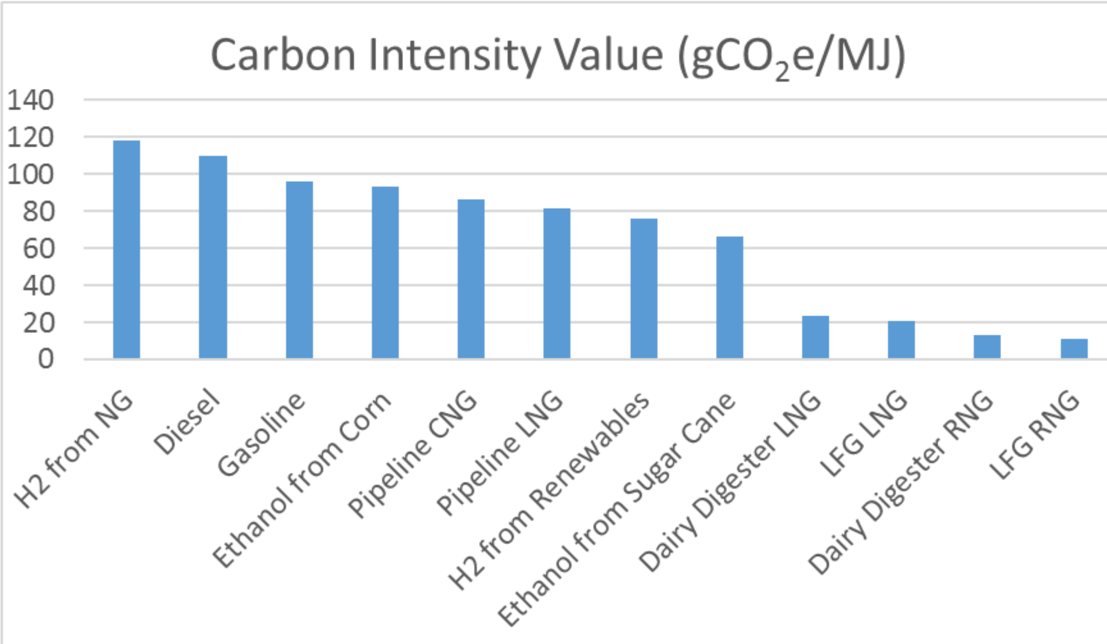


Figure 2-12. Fuel Carbon Intensity (CARBB Low Carbon Fuel Standards)

Renewable Gas Standard. The Bioenergy Association of California and others continue to lobby and move closer to achieving a Renewable Gas Standard (RGS) for California, which would set the stage for RGS in other states. A RGS is a carbon-based standard that will require gas sellers to gradually reduce the carbon intensity of the gas that they sell by increasing the percentage of renewable gas. The standard would apply to all gas sellers, including both utilities and gas providers that sell directly to large customers.
A RGS would provide many benefits such as:

- Cut GHG emissions, including methane and black carbon, by tens of millions of tons per year;
- Reduce landfilling of organic waste;
- Protect public health and disadvantaged communities by cutting pollution from fossil fuels, especially diesel used in heavy duty vehicles;
- Improve soils and agricultural productivity by providing non-petroleum-based fertilizers and organic soil amendments that sequester carbon and conserve water;
- Reduce wildfire and burning of agricultural and forest waste; and
- Produce 2 to 6 times as many jobs as provided by fossil fuel gas, including in disadvantaged and rural communities.

The details of such a plan are not yet final at a State or Federal level, including in Alaska, however, promulgation of an RGS would have a real impact on biogas to pipeline projects creating a real and significant demand that may lead to substantial price increases for biogas to pipeline projects. Any impact on regulations in Alaska in the near term is anticipated to be minimal. The actual implementation of State or Federally-mandated RGS is not certain, either in terms of form or schedule. If California, or any other state, actually implements an RGS, there would likely be a significant lag period before any comparable legislation would be considered in Alaska.

2.2.5 Summary of Industry Trends and Best Practices

The following list summarizes the results of industry trends and best practices review for diversion and recycling, MSWLFs, alternative technologies and renewable technologies for LFG utilization.

Diversion and Recycling

- **Materials reduction, reuse, and recycling has been a common practice throughout the U.S. with a goal of "zero waste".** Both upstream and downstream options have been employed focusing on "source reduction" and reuse, recycling, organics diversion, and education respectively.
- **Many jurisdictions are promoting a new solid waste management paradigm.** In the new paradigm, the least volume of waste would be managed through disposal.
- **The latest foremost solid waste industry trend in many U.S. States and in Canada is to reduce the amount of organic waste to landfills.** In addition to programs for collecting and diverting green waste already practiced in many municipalities throughout the U.S., the USEPA has prioritized actions that organizations can take to either prevent the wasting of food or divert food from landfills that has become waste.
- **China's "National Sword 2017" has impacted the recycling industry on a national and international level.** This policy has banned the importation of 24 recyclable materials and is impacting recycling program operations and costs due to improved collection and facility modifications needed to reduce contamination levels. It has also provided opportunity to improve source separation and collection programs, modernize and optimize MRFs to achieve reduced contamination levels, and develop or enhance local markets to support a circular economy.
- **The solid waste industry in the U.S. and Canada has increased interest in use of alternative technologies.** Already employed in many parts of Europe and Asia where tip fees are high and there are strong regulatory drivers for waste diversion from landfills, alternative technologies on a commercial scale are starting to gain traction in the U.S and have been employed in certain parts of Canada. There are many factors affecting the viability of establishing a conversion technology facility in any location and a site-specific feasibility analysis is required to understand the magnitude of each factor and the likely end result.

Municipal Solid Waste Landfills (MSWLFs)

- **The main solid waste disposal industry trend for MSWLFs is optimization and preservation of landfill capacity.** Still a necessary component of an integrated solid waste management hierarchy, landfill capacity is considered a valuable resource as new or expanded facilities are difficult to permit. Measures taken by municipalities throughout the US and internationally to preserve airspace include: diversion of waste, increased AUF, alternative daily cover use and soil recovery, and engineering planning/fill phasing.
- **Increased AUF greatly optimizes landfill capacity.** The AUF for the ARL proposed by SWS for future planning purposes is 0.60 based on historical reference which is on the low end of AUFs reported (range of 0.58 to 0.74) for the benchmarking analysis presented in Section 2.3. Increasing the ARL's AUF will be evaluated with a focus on the use of specialized and efficient compacting equipment and optimizing waste layer thickness, moisture content and slope grades as well as increasing refuse to soil ratios.
- **The ARL Solid Waste Permit and ADEC regulations allow for ADC use.** The ARL is currently permitted to utilize auto shredder fluff, ground C&D debris, and wood chips on interior daily slopes in place of daily soil cover materials. Additional potential ADCs may include tarps and PGM. Additionally, soil recovery may be a potential practice that can be implemented at the ARL for both daily and intermediate cover as it reduces

airspace consumption, provides operational cost savings, reduces the potential for leachate mounding and promotes better gas collection.

- **Reducing leachate generation reduces operational costs.** Best management practice options for evaluation of use at the ARL to reduce leachate generation as well as optimize capacity include re-design of refuse cells, separate wet weather operations, less permeable daily cover, temporary scrim cover, and/or interim storm water management.

Renewable Technologies for LFG Utilization

- **Recent changes in the energy marketplace (lowering prices for electric power) have initiated a gradual shift in the development of LFG beneficial-use projects.** In many markets nationally, the development of electric-generating facilities utilizing internal combustion engines or turbines has been replaced by RNG applications. The primary drivers are the increase in more aggressive air pollution control regulations which increases costs of generating electricity versus the price that can be obtained for that electricity, the relative increase in both the need for and cost benefits of gaseous fuels and currently available Renewable Energy Credits. The only LFG Utilization project listed as "operational" in the State of Alaska is the Doyon electrical generating facility at the ARL. There are no projects pending in the State according to the USEPA's Landfill Methane Outreach Program.
- **Utilizing LFG to generate electricity as a beneficial use is on the decline.** Although utilizing LFG for electricity has long been a mainstay of LFG beneficial-use, in most states utilities have met their Renewable Portfolio Standard requirements and are not offering enough value in their recent PPA to make a LFG-to-electricity projects viable. In Anchorage, the electricity generation capacity appears saturated with recent construction by ML&P of a new power plant (three now in Anchorage). Recent input from JBER representatives indicated that they would like to move forward with expanding the existing Doyon LFG-to-energy facility pending the base cost of power from Municipal Light & Power, that may make expansion of the Doyon facility economically unattractive. Therefore, the proposed expansion of the existing Doyon electrical generating facility is currently proposed for the SWS ISWMP. This option provides a sound, long-term opportunity for beneficially utilizing the resource that LFG affords. Another option for electrical generation would be for on-site usage.
- **A significant percentage of the fuel sources used for Renewable Natural Gas applications are landfills.** The balance of the fuel is derived from anaerobic digester and wastewater treatment plant facilities. Within the umbrella of RNG development are four sub-sets of development:
  - Compressed Natural Gas (CNG) Interstate
  - CNG Local
  - LNG
  - Pipeline Injection
- **Numerous forces in today's market are driving biogas to energy projects toward high BTU systems as well as medium BTU systems.** The market forces are proving that high BTU projects, once requiring a minimum of 3,000 scfm inlet to be economically feasible, are now economically feasible at as low as 100 scfm of raw inlet biogas. Medium-BTU applications which use minimally-processed gas as a replacement for oil, coal, natural gas, etc. is another application that has been widely developed for LFG beneficial-use. This type of LFG beneficial-use application is very appropriate in that the fuel price is lower than that of natural gas; however, the processing costs are substantially lower and the overall delivery process simpler than observed in many other beneficial-use applications. However, an end-user in relative proximity to the

landfill is needed. Except for JBER, it is not apparent that any potential medium-BTU users exist in proximity to ARL. If an end-user can be determined within JBER, or at the landfill itself (i.e., for use in leachate treatment), this may be a viable option for further development.

- **Incentives for LFG utilization projects come and go (one-time grants or incentives to multi-year tax credits or market incentives) and vary based on how the LFG is utilized (electricity, pipeline, vehicle fuel).** Incentives which apply specifically to LFG utilization projects include the Renewable Fuel Standard, Renewable Index Numbers available for RNG that is used to fuel vehicles, LCFS, and Renewable Gas Standard. California has established a LCFS credit program recognizing the emission reductions created by using treated biogas as vehicle fuel. Other states in the Northwest Pacific, including Oregon and Washington, as well as Canada, are undertaking the development of LCFS programs. There are currently no currently active or pending LCFS programs in Alaska.

2.3 BENCHMARKING

Utility benchmarking is a useful management tool that helps utility managers quantitatively evaluate system performance against real world examples. A benchmarking analysis was completed for the SWS ISWMP to identify a baseline for key indicators of solid waste management system performance in medium sized jurisdictions with limited access to material markets, high annual snowfall, and sub-zero winter temperatures.

Results of the benchmarking analysis provided an understanding of existing and potential programs that were carried forward into the ISWMP development process to inform goals, targets, and options for future programs.

2.3.1 Metrics for Comparison

Benchmarking metrics were identified through analysis of the existing SWS key performance indicators (KPIs) and industry standard metrics for evaluating solid waste management system performance. The metrics were grouped as follows:

- Service Provision (level of service, service delivery method);
- Waste Flows (disposal per household, diversion per household);
- System Performance (injuries, airspace utilization, customer satisfaction); and
- Financial Considerations (including tipping fees, service costs per household, collection fees for residents, funding sources, and education/communication budget allocations).

2.3.2 Comparable Jurisdictions

Solid waste management system performance is influenced by several factors. These include regulatory environment, climate, community size, market access (for divertible materials), disposal capacity and material processing capabilities. Comparable jurisdictions that were benchmarked for comparison against the SWS solid waste management system were identified based on population, climate, and location (i.e. proximity and access to markets for recyclable materials). The jurisdictions presented below (with associated diversion rates) were selected in both the United States and Canada to represent diverse approaches to managing solid waste.

Table 2-1: Comparable Jurisdictions for Benchmarking

American Jurisdictions	Diversion Rate	Canadian Jurisdictions	Diversion Rate
Fairbanks, AK	2%*	Whitehorse, Canada	31%
Juneau, AK	7.5%	Yellowknife, Canada	16.4%*
Seattle, WA	58.8%	Vancouver, Canada	63%
Minneapolis, MN	37%	Saskatoon, Canada	21.8%
Fargo, ND	36%	Edmonton, Canada	35.7%
Buffalo, NY	27.8%	Calgary, Canada	30%
* Diversion rate calculated by Tetra Tech based on reported volumes and tonnages of household hazardous waste (HHW) and other diverted materials.			

The following Section 2.3.3 summarizes key information from each jurisdiction with a summary of findings presented in Section 2.3.4.

2.3.3 Solid Waste System Summaries

The following describes the solid waste management systems in each of the 12 communities surveyed in early 2018. The communities are presented in order based on their reported diversion rate from highest to lowest.

2.3.3.1 Vancouver, Canada

City of Vancouver, British Columbia Community Data		
Population	631,486	
Households	283,916	
Area	44.39 $miles^2$	
SF Collection Service Levels	Garbage	Every-Other-Week
	Recycling	Weekly
	Organics	Weekly
Infrastructure	▪ Transfer Station ▪ Recycling Drop-offs ▪ Landfill ▪ Regional Processing Facilities	
Existing Targets	City: 838 lbs./capita/year Region: 80% diversion rate	

The City of Vancouver is the largest municipality in the Canadian province of British Columbia and is part of the Metro Vancouver regional district. Vancouver is bordered by water on three sides and encompasses 283,916 households with 631,486 residents.

Solid waste management is integrated among the 21 municipalities that make up Metro Vancouver that work together to provide disposal and material processing facilities. The annual waste composition monitoring data for the Metro Vancouver area is shown on Figure 2-13.

The City manages the Vancouver South Transfer Station and Recycling Facility, which oversees significant portions of the City's garbage and recycling material flows. In addition, the City owns and operates the Vancouver Landfill. Vancouver benefits from the provincially mandated Extended Producer Responsibility (EPR) legislation which requires manufacturers to manage end of life care of their products. This enables collection for most recyclable materials generated by households, to be managed by product stewards rather than local municipalities. RecycleBC, the EPR Steward responsible for packaging and printed paper, contracts two haulers to provide weekly collection of recyclable paper, plastic, and glass for all residences in the City that have access to curbside garbage collection

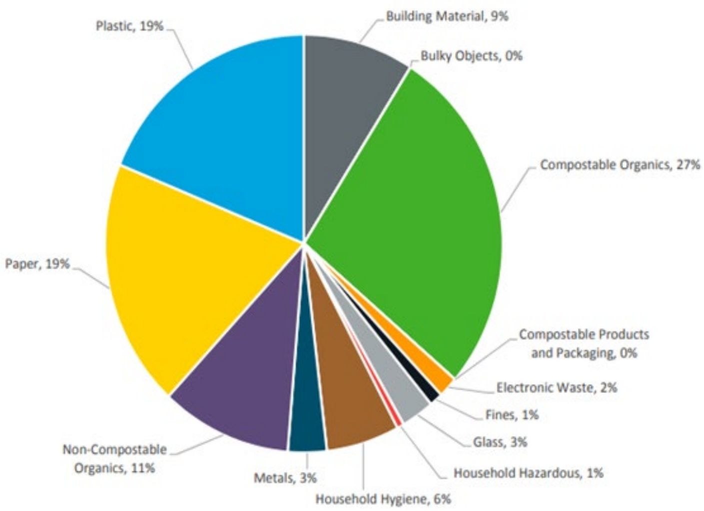


Figure 2-13. Metro Vancouver Annual Waste Composition Monitoring Data 2016

- Extended Producer Responsibility legislation is in place and enabled collection and processing cost for recyclable materials to be borne by EPR Stewards.
- Vancouver's Zero Waste Strategy includes several initiatives to drive waste diversion including reducing single use items and eliminating food waste.
- The region is currently diverting 63% of its waste from disposal with a goal of 80% by 2020.
- Vancouver disposes 1080.3 lbs. of garbage per person per year (2.96 lbs. per person per day) and recycles 1763.7 lbs. of materials per person per year (4.83 lbs. per person per day).
- Vancouver aims to reduce disposed waste to approximately 838 lbs. per person per year (2.3 lbs. per person per day).

2.3.3.2 Seattle, Washington

City of Seattle Community Data		
Population	704,358	
Households	338,824	
Area	217 miles²	
SF Collection Service Levels	Garbage	Weekly
	Recycling	Every-Other-Week
	Organics (Food and Yard Waste)	Weekly
Infrastructure	▪ North Recycling and Disposal Transfer Station ▪ South Recycling and Disposal Transfer Station ▪ Two Moderate Risk Waste Collection Facilities	
Existing Targets	70% diversion by 2025	

The City of Seattle (Seattle) is the largest city in the State of Washington with a population of more than 700,000. Seattle's Public Utilities (SPU) department manages the overall disposal system for the city, establishes the framework for the solid waste management system, and regulates solid waste facilities. SPU contracts its curbside garbage and recycling collection for single-family homes.

SPU promotes a PAYT philosophy that enables customers to choose from several sizes of garbage cans with a service pricing structure that increases with larger garbage can sizes. Multi-family units are required to subscribe to garbage service, while recycling service is available at no charge. Materials are collected and brought to one of the SPU's two transfer stations. The end-stage for recycling processing is Rabanco, Ltd., and organics (food scraps and yard waste) are sent to Cedar Grove's Maple Valley and Everett composting facilities. All other waste goes to the Columbia Ridge Landfill in Gilliam County, Oregon.

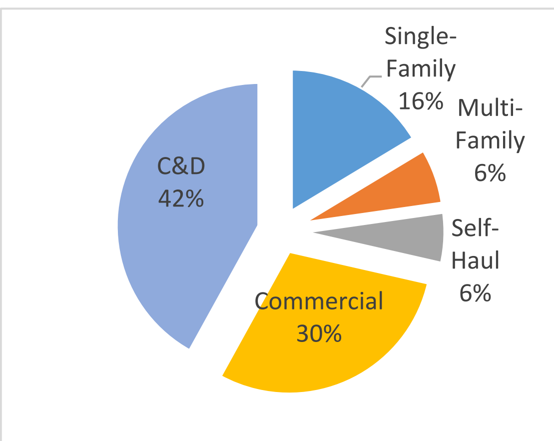


Figure 2-14. Seattle's MSW Generation by Sector 2016

In 2010, the single-family sector recycled 70.3% of its waste. The multi-family sector recycled 29.6%, and the self-haul sector recycled 13.7%. The commercial sector recycled 58.9%. Figure 2-14 shows Seattle's municipal solid waste generation from these four sectors. Seattle was diverting 58% of its waste from disposal by 2016 with a diversion goal of 70% by 2025.

The diversion strategy is to continue to contract the waste collection and disposal to private companies, while enhancing programs to divert more materials, and to direct C&D loads to C&D processors. The City also plans to add more products to Washington State's electronic product recycling law.

2.3.3.3 Minneapolis, Minnesota

The City of Minneapolis (Minneapolis) is a major city in the State of Minnesota with a population over 413,600. Along with the neighboring state capital of St. Paul, it forms the "Twin Cities", a major metropolitan area built around the Mississippi, Minnesota, and St. Croix rivers in east central Minnesota with a population of over 3 million.

Solid waste service in Minneapolis is provided through the Division of Solid Waste and Recycling (SW&R) by city crews and private sector contractors. SW&R provides collection services for over half (approximately 290,000) of Minneapolis residents in 106,000 dwelling units, a small number of commercial customers, city facilities, and public spaces. SW&R also licenses commercial haulers to collect solid waste in Minneapolis. SW&R has a city ordinance that mandates all residential buildings containing fewer than four units to collect, remove and dispose of solid waste. Waste materials received in 2016 are shown on Figure 2-15.

City of Minneapolis Community Data		
Population	413,651	
Households	169,803	
Area	58.4 miles^2	
SF Collection Service Levels	Garbage	Weekly
	Recycling	Every-other-week
	Organics	Weekly Curbside Food Scraps Seasonal Weekly Yard Waste
Infrastructure	▪ South Transfer Station	
Existing Targets	50% diversion by 2020 80% diversion by 2030	

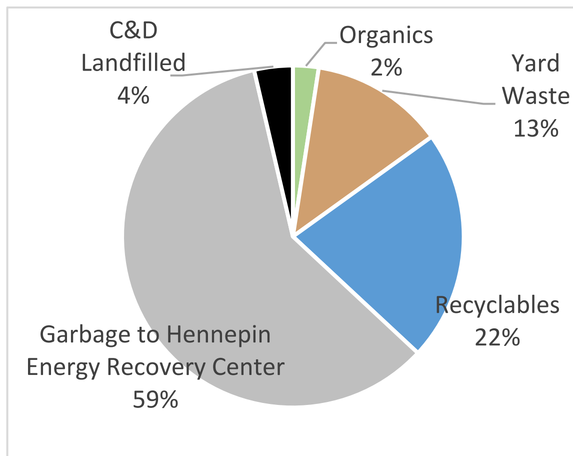


Figure 2-15: Waste Material Received by Solid Waste Facilities in 2016

2.3.3.4 Fargo, North Dakota

City of Fargo Community Data		
Population	120,762	
Households	49,956	
Area	48.8 miles^2	
Service Levels	Garbage	Weekly
	Recycling	Every-Other-Week (by subscription)
	Organics	Drop-off yard waste Seasonal brush collection
Infrastructure	Fargo City Landfill ▪ Multiple Drop-Off Locations	
Targets	N/A	

The City of Fargo (Fargo) is the largest city in the State of North Dakota with approximately 120,000 people. Its neighboring city is Moorhead, Minnesota. They form the Fargo-Moorhead metropolitan area with a combined population of approximately 240,000.

The City of Fargo's Solid Waste Utility (SWU) controls most solid waste management services within City boundaries including collection, disposal, and processing using City crews to complete most of the work. The SWU exclusively manages garbage and recycling collection for residences and offers competitive collection services for the light industrial, commercial, and institutional (ICI) sector.

Garbage service is mandatory for all residences. Single stream curbside recycling collection is offered on a subscription basis for $3 per household per month, ICI recycling is offered for $5 per collection for single commodities. Residential yard waste and recyclables are collected at drop-off facilities throughout the City. The SWU also offers seasonal yard waste collection and annual Christmas tree collection for residents at no additional fee.

The SWU operates the Fargo City Landfill which includes a small compost facility for yard waste and brush. Residents have access to compost and wood chips on an annual basis with the remaining materials sold or used at the City's facilities. The SWU is also responsible for care of the closed landfill which is located near the active landfill. SWU is currently reclaiming/mining the closed landfill because the Fargo City Landfill is running out of airspace. SWU plans to remove the solid waste in the closed landfill, install new lined cells, and resume landfilling at the old site in the next three to five years. SWU reports annually on the Performance Measures identified in Table 2-2.

Table 2-2: Fargo Solid Waste Operational Performance Measures

Operational Performance Measure	2016 Actual	2017 Expected	2018 Projected
Residential Accounts	24,565	25,302	26,060
Single Stream Recycling	10% Complete	100% Complete	Completed
Commercial Accounts	966	1,020	1,036
Roll Off Activity (Pulls)	3,733	3,800	3,900
Landfill Tonnage (tons)	210,421	214,600	219,000
Old Landfill Reclamation	10% Complete	15% Complete	25% Complete
Renewable Energy Expansion (LFG-CNG)	10% Complete	50% Complete	75% Complete

2.3.3.5 Edmonton, Canada

City of Edmonton, Alberta Community Data		
Population	932,546	
Households	369,757	
Area	264.58 miles²	
Service Levels	Garbage	Every-Other-Week
	Recycling	Every-Other-Week
	Organics	Collected with Garbage
Infrastructure	EWMC MRF Transfer Station Compost Facility	
Existing Targets	90% diversion	

The City of Edmonton is the capital of the Canadian province of Alberta. Known as the "Gateway to the North" with a population of 932,546, the City is the northernmost large city in North America.

City crews provide garbage and recycling collection to all single-family residents, some multi-family dwellings, and some businesses. Waste is transported to the Edmonton Waste Management Center (EWMC), a multi-faceted waste management facility with a variety of processing facilities aimed at diverting waste from disposal.

The EWMC consists of a composting facility, anaerobic digestion facility, residential transfer station, MRF, electronic waste recycling facility, C&D recycling facility, biosolids lagoons, and a waste to biofuels & chemicals facility. The City also manages 20 community recycling drop-offs, four Eco stations for household hazardous waste drop-off, and 12 big bin annual events. Tipping fees are shown on Table 2-3.

Recyclables collected from Edmonton residents are processed at the City's MRF. The remainder of the residential waste stream is taken to the transfer station where garbage and organics (food scraps and yard waste) are separated and directed towards their respective processing operation.

Table 2-3: Edmonton Tipping and Residential Collection Fees

Material	Fee
Residential Municipal Solid Waste	$60 per ton
Non-Residential Municipal Solid Waste	$94 per ton
Mixed Construction and Demolition	$85 per ton
Single Unit Residential	$45.93 per month
Multi-Unit Residential	$29.85 per month

The City's Waste Services' operating methodology has been to rely on processing facilities to drive diversion of materials from the landfill as opposed to source-separation or other methods. However, their operations have come under scrutiny as a recent City Auditor's report outlined deficiencies in the current system.

2.3.3.6 Whitehorse, Canada

City of Whitehorse Community Data		
Population	21,732	
Households	8,875	
Area	34.95 km²	
Service Levels	Garbage	Every-Other-Week
	Recycling	Subscription
	Organics	Every-Other-Week
Infrastructure	▪ Waste Management Facility	
Existing Targets	Zero waste by 2040	

The City of Whitehorse (Whitehorse) is the largest Canadian city north of the 60th parallel and is the capital of the Yukon Territory.

The City manages the disposal system, established the framework for solid waste management, and regulates solid waste facilities within the region.

The City provides weekly curbside garbage and organics (food scraps and yard waste) collection to urban single-family residences, and multi-family buildings with four or fewer units for a fee. Collection alternates weekly between garbage and organics. Materials are collected and brought to the City's Waste Management Facility (WMF) which is operated by City crews. The WMF includes a compost facility, a Reuse store, and transfer stations for compost, batteries, e-waste, metals, tires, large appliances, construction and demolition waste, clean wood, bulky items, cardboard, plastics, paper, glass, and tin. The City also hosts special waste drop-off and pick-up events, such as a "Household Hazardous Waste Day" twice a year, "Clean Up Days" where tipping fees are waived once a year, and "Tag 'n' Take" where items are left curbside for whoever wants to take them. The Whitehorse Diversion Goal Tracker chart is shown on Figure 2-16.

Whitehorse differs from the typical waste management evolution process because organics collection was implemented first instead of municipal collection of curbside recycling. Curbside recycling collection is offered as a subscription-based service provided by private sector service providers (i.e. Whitehorse Blue Bins).

Figure 2-16: Whitehorse Diversion Goal Tracker (Available on City of Whitehorse Website)

Recycling is provided as a self-haul activity at one of two drop-offs (private sector and not for profit society). Recyclable material can be dropped off at P&M Recycling (private sector) and Raven Recycling (non-profit).

2.3.3.7 Calgary, Canada

City of Calgary - Community Data		
Population	1,239,220	
Households	466,725	
Area	826 km^2	
Service Levels	Garbage	Single Family EOW[8] Multi-Family
	Recycling	Weekly
	Organics (food and yard waste)	Weekly
Infrastructure	▪ Three City Landfills ▪ One Compost Facility ▪ 40 Community Recycling Drop-Offs ▪ Six HHW Drop-Off Locations	
Existing Targets	70% diversion by 2025, averaged across four sectors. Specific diversion targets by sector are: Single Family – 70% Multi-family – 65 % ICI – 75 % C&D – 40%	

The City of Calgary (Calgary) is the largest city in the Canadian Province of Alberta. Calgary is known as a leader in the oil and gas industry, and for its high personal and family incomes. In recent years, the City has communicated its long term zero waste plan and has been active in implementing strategies to achieve its goal of 70% waste diversion by 2025.

Calgary primarily provides waste management services for single family residents (three streams) and most multi-family residents (garbage and recycling). Much of the Calgary's ICI sector waste is taken to a transfer station outside city boundaries and disposed in a private sector landfill that charges lower tipping fees.

City crews provide curbside collection service for garbage, recycling, and organics (food scraps and yard waste), for single-family homes. Calgary offers collection services for multi-family buildings and ICI buildings, on a subscription basis. However, multi-family and ICI customers have the option to arrange collection services from private sector service providers. The City's 2014 waste composition is shown on Figure 2-17.

Calgary owns and operates three active landfills within City limits. Calgary recently commissioned an in-vessel composting facility to process curbside collected single family organics (food and yard waste). Recyclables from residents are processed by a MRF with a long-term contract with the City. Approximately 40 community recycling drop-offs and six household hazardous waste drop-off locations are maintained by the City. Calgary maintains five closed landfill sites. Calgary also has a large collection fleet that services over 300,000 single-family households.

Figure 2-17: 2014 Waste Composition

[8] EOW – Every-other-week collection.

Waste composition studies are conducted every two to three years to track their progress with waste diversion programs and goals. Specifically, Calgary conducts targeted studies for pilot programs such as their green bin and every-other-week garbage pilot areas to identify the impact of new programs on the composition of material in the garbage. Regular monitoring studies are used to monitor whether behavior is changing and to identify material streams to target for diversion. In many communities the amount of organics present in their garbage drives new programs aimed at collecting and processing organics.

Waste composition studies involve a team of field staff sorting a large number of samples across different sectors, aiming to achieve statistical validity for changes in composition type and quantities. Samples are sorted into multiple material categories tailored to the municipality's interests with the study conducted over several days or weeks. Studies vary in cost depending on the number of samples and level of detail required. A typical study conducted for a medium sized city or region would have a cost in the range of $40,000 to $100,000 depending on the number of samples, frequency of events (for seasonality) and reporting requirements.

2.3.3.8 Buffalo, New York

City of Buffalo, New York Community Data		
Population	256,902	
Households	113,000 total (85,000 serviced by the City)	
Area	Land – 40.6 miles^2	
SF Residential Service Levels	Garbage	Curbside weekly
	Recycling	Curbside weekly
	Organics Yard Waste	Curbside Weekly – (Seasonal)
Infrastructure	▪ Transfer Stations ▪ Recycling Drop-Offs ▪ Material Recovery Facility ▪ Compost Facility ▪ Landfill	
Diversion Rate Target	34%	

The City of Buffalo (Buffalo) is the second largest city in the State of New York, located on the Eastern shore of Lake Erie which forms part of the bi-national Buffalo-Niagara region. "The City of Light" as coined for its early adoption of electricity supports 256,902 people.

The City provides weekly curbside collection service for garbage, recycling and yard waste to almost 85,000 housing units. The garbage is brought to the City's East Side Transfer Station which is operated under contract to Waste Management Inc. Yard waste is brought to the Lardon Construction Compost Facility where the City has a contract to accept and process that material. Collection and processing of recyclables is contracted to Republic Services/Modern Recycling, who owns and operates a comingled MRF.

Both garbage and recyclables collection are mandatory for City residences (covered under city ordinances). In the fall, the City operates five-yard waste collection drop-offs as an additional service for residents who receive curbside yard waste collection. Other services provided by the City include weekly large item pickup (maximum of two items).

The City's solid waste program is primarily funded through user fees for services as shown in Figure 2-18.

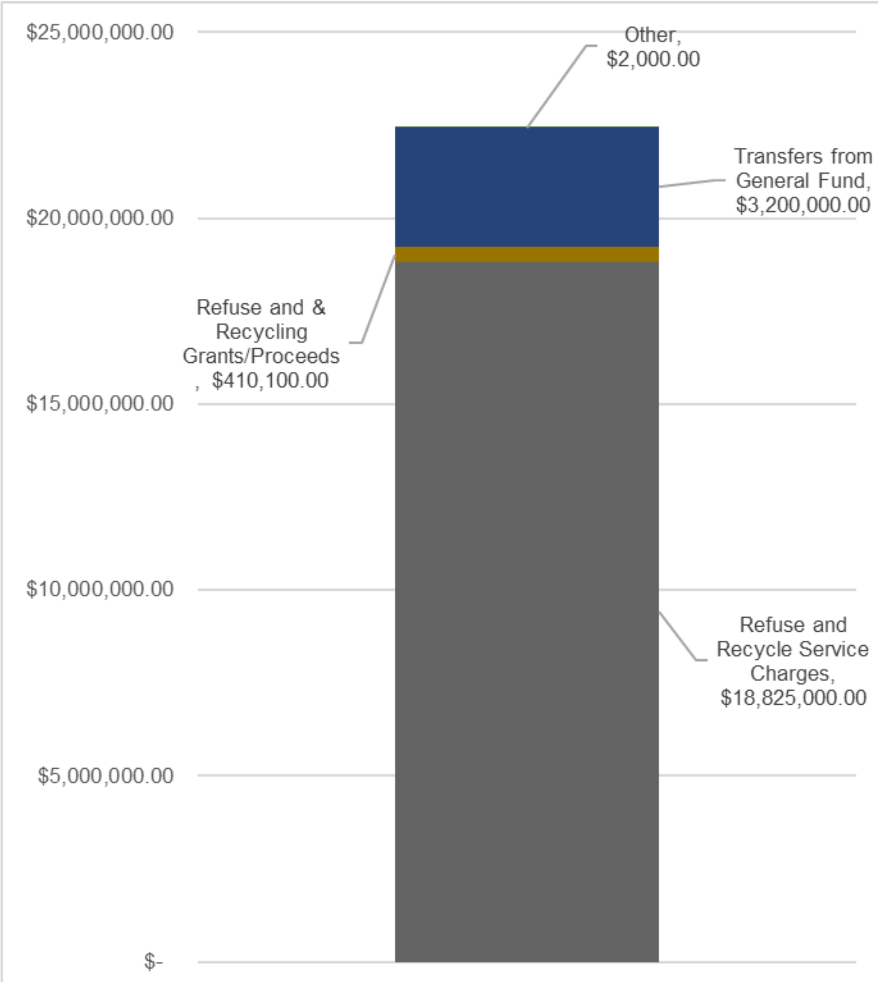


Figure 2-18: City of Buffalo Solid Waste Source of Revenues

2.3.3.9 Saskatoon, Canada

City of Saskatoon Community Data		
Population	246,376	
Households	98,565	
Area	88 miles^2	
Service Levels	Garbage	Every-Other-Week (Oct - Apr) Weekly (May - Sept)
	Recycling	Every-Other-Week
	Organics	Every-Other-Week (May - Nov)
Infrastructure	▪ One Regional Landfill ▪ Two Compost facilities ▪ Four Recycling Drop-Offs	
Existing Targets	70% diversion by 2023	

The City of Saskatoon (Saskatoon) is the largest city in the province of Saskatchewan. It is a member of the National Zero Waste Council, which brings governments, businesses, and NGOs to advance waste prevention in Canada.

Saskatoon manages the overall disposal system for the region, establishes the framework for the solid waste management system, and regulates solid waste facilities within the region. The estimated waste composition for Saskatoon is shown on Figure 2-19. Saskatoon provides curbside garbage collection for single-family homes, as well as some multi-family residents and commercial customers. Saskatoon contracts curbside recycling collection and has a subscription-based yard waste collection program that supports approximately 7,500 single-family homes.

Saskatoon provides recycling collection through contracted services to all multi-family properties. For garbage collection, each building enters into an agreement with private service providers for those services.

Saskatoon owns and operates several waste management facilities:

- Regional Landfill (Saskatoon Regional Waste Management Center);
- Two compost facilities; and
- Four recycling drop-offs.

There are also two private sector landfills that are within six miles of Saskatoon. One of those landfill operators has also been providing curbside recycling service to single family households since 2013.

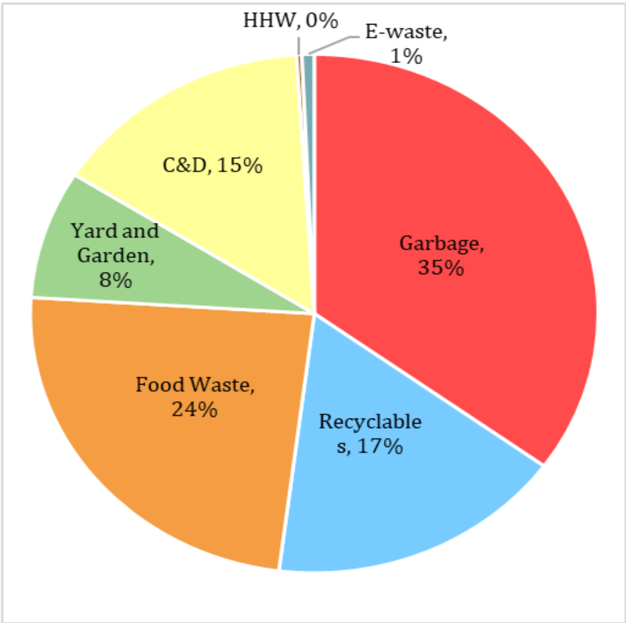


Figure 2-19: City of Saskatoon 2016 Estimated Waste Composition

2.3.3.10 Yellowknife, Canada

City of Yellowknife Community Data		
Population	19,600	
Households	7,100	
Area	40.7 $miles^2$	
Service Levels	Garbage	Every-Other-Week
	Recycling	Drop-Off
	Organics (food and yard)	Every-Other-Week
Infrastructure	▪ Yellowknife Solid Waste Facility ▪ MSW Balefill ▪ Compost Facility ▪ Transfer Station / Drop-off ▪ Recycling Drop-off ▪ C&D Landfill ▪ Soil/Water Treatment Facility	
Existing Targets	40% diversion rate	

Yellowknife is the capital of the Canadian Northwest Territories. The city is located on the northern shore of the Great Slave Lake and has a population of approximately 19,600.

Yellowknife manages a municipal solid waste facility (SWF) that includes a balefill (landfill constructed primarily of baled solid waste), compost facility, and transfer station. Automated garbage collection by a contractor varies by neighborhood because the city is in the process of rolling out a curbside organics (food scraps and yard waste) collection program. In neighborhoods without organics collection, the city provides weekly garbage collection. In areas where organics collection is provided, the city alternates weekly collection of organics and garbage. Automated collection with curbside carts has been in place since 2014.

Large item pickup is offered to residents once per year free of charge with limitations. Yard waste can be dropped off at the SWF free of charge, where it is composted.

Six City recycling drop-offs are located around Yellowknife (including one at the SWF). Many recyclable materials are collected free of charge including cardboard, paper, glass, tin cans, and plastics. Electronic waste and hazardous waste is accepted at the SWF.

Beverage containers and electronics are also collected at privately operated bottle depots refunded through an EPR program funded by the Territorial government.

2.3.3.11 Juneau, Alaska

City and Borough of Juneau, Alaska – Community Data		
Population	Urban – 24,537 City and Borough – 32,468	
Households	12,138	
Area	Urban – 14 miles^2 City and Borough – 2702 miles^2	
SF Collection Service Levels	Garbage	Weekly Curbside
	Recycling	Curbside Drop-Off
	Organics	None
Private Sector Infrastructure	Solid Waste Facilities ▪ Landfill ▪ Recycling Drop-Offs	
Existing Targets	Increase Diversion	

The City and Borough of Juneau (CBJ) is the capital of the State of Alaska, straddling the Gastineau Channel in the Alaskan panhandle. Accessible only by air or water, the CBJ is home to 32,468 people spread over 2,700 square miles of land.

CBJ does not control most of the collection and waste management infrastructure in the region. Waste Management Northwest owns and operates the Capitol Landfill and Recycling Center which receives most of the garbage and recycling on behalf of the region. Pacific Environmental (Arrow Refuse) is the exclusive provider of curbside garbage and recycling collection and services approximately 6,800 residential and 550 commercial customers. CBJ is working to develop a pilot program to compost food and yard waste. A private food waste composter (Juneau Composts!) offers subscription-based food scraps collection in Juneau.

Material Stream	Tonnage (2016)
Municipal Solid Waste	25,309
Construction and Demolition	7,700
Recycling	1,715
Household Hazardous Waste	300.5
Scrap Metal	920

Three CBJ recycling drop-offs are located around Juneau, in addition to the Recycling Center at the Capitol Landfill. CBJ recently established five recycling drop-boxes throughout the region to increase diversion rates. Some electronic waste and hazardous waste is accepted at the Recycling Center, but most is transferred to the Household Hazardous Waste Facility operated by Stericycle Environmental Solutions.

2.3.3.12 Fairbanks, Alaska

City of Fairbanks – Community Data		
Population	City – 32,469 Metro (incl. City) – 100,605	
Households	City – 11,100 Metro – 35,300	
Area	32.53 miles^2	
Collection Service Levels	Garbage	Weekly
	Recycling	Drop-Off
	Organics	None
Infrastructure	Solid Waste Facility ▪ Landfill ▪ Transfer Stations ▪ Recycling Drop-Offs	
Existing Targets	40% Diversion	

The City of Fairbanks is the largest city in the interior of Alaska, part of the Fairbanks North Star Borough (FNSB) and known as "The Golden Heart City". Straddling the Chena River, the city has approximately 32,500 people with the total regional population of 100,600 when including residents in the borough.

The City and FNSB co-manage solid waste collection and disposal facilities in the region for trash and recyclables. The City also provides weekly curbside trash collection and fee-based large item collection for over half of the City's households.

Of the 105,791 tons of waste disposed in the region, 80,027 tons were from residential and commercial sources and 14,003 tons were construction and demolition activities. As shown on Figure 2-20, tipping fees have increased annually over the past 10 years.

Fairbanks has brought renewed effort to diverting recyclables from the landfill with the recent opening of the Central Recycling Facility.

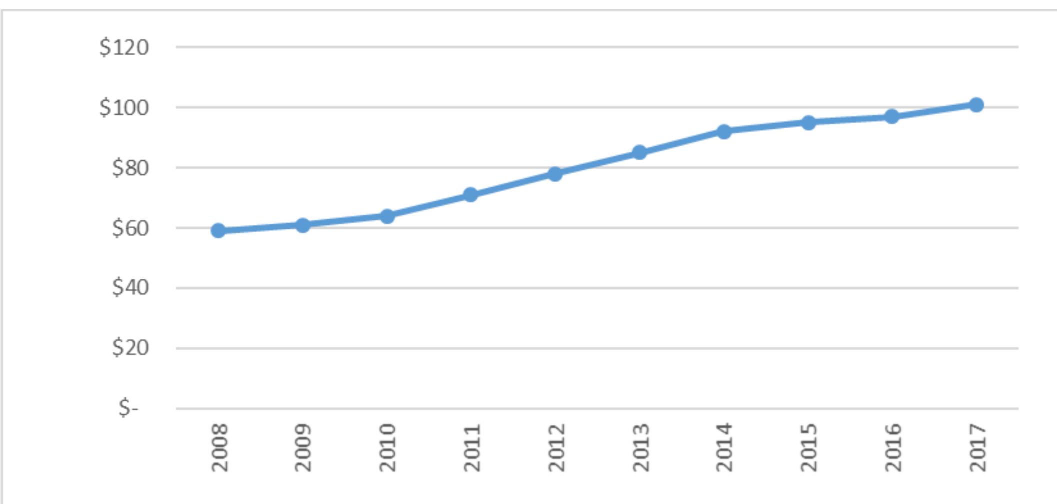


Figure 2-20: Tipping Fee for Solid Waste from 2008 to 2017

- The FNSB contracts the recycling of several materials, including aluminum, antifreeze, scrap metal, and vehicle batteries.
- Flammable liquids, used oil, and fuels are collected by the FNSB and burned for energy recovery in several waste-to-energy facilities.

- Biosolids from the Golden Hart Utilities Wastewater Treatment Plant are composted. Solid waste materials are currently not diverted to this program.
- The City of Fairbanks and FNSB currently do not track diversion rate, although they do collect data on the amount of recyclable and household hazardous material they divert from the landfill.

2.3.4 Summary of Benchmarking Study Findings

Table 2-4 summarizes the results of the benchmarking study. Based on the information collected, the following can be concluded:

- **There is no standard reporting for solid waste.** There is significant variability in system performance information tracked and available between communities. Several communities included tonnages and diversion rates in their annual budget reporting or in separate performance reports published on a regular basis, while others did not.
- **Solid Waste Planning is common on a municipal and regional basis.** Most communities surveyed have published plans for solid waste management and/or waste diversion.
- **Some communities have defined quantitative diversion goals.** Approximately half of the communities surveyed have defined quantitative diversion goals. Those who defined goals tended to set very ambitious goals (ranging from 50% diversion to 90% diversion).
- **Curbside collection of garbage is universal.** Of the 12 communities surveyed, all provided curbside garbage collection directly to a majority of their residents either using their own crews or a contracted hauler managed by the municipality.
- **Curbside collection of recyclables is common.** Curbside recycling is provided by the local or regional government in eight of the 12 communities. The remaining communities have subscription-based curbside recycling collection and/or collection drop-offs for residents to self-haul materials. Drop-Off or subscription-based collection is most common in northern communities where shipping recyclables from the community to processors is a significant barrier to increasing collection service.
- **Collection of source separated organics is increasing.** Half of the communities surveyed provide year-round organics collection, most of these programs focus on collecting the food scraps that are produced by residents throughout the year. Some add seasonal yard waste collection from mid spring through late autumn. Some communities also collect self-hauled yard waste or brush at their transfer stations or recycling drop-off locations.
- **High diversion communities use Pay-As-You-Throw.** Four of the programs reporting the highest diversion rates were based on a pay-as-you-throw model for garbage. These programs had diversion rates ranging from 36% (in Fargo, ND) to 63% (in Vancouver, Canada) with communities offering collection of the smallest bin for half the cost of the largest bin or less. In Seattle, households are charged between $22.85/month and $156.00/month for garbage collection.
- **Tipping fees are not consistent between communities.** Fees range from $40/ton in Buffalo, NY to $195/ton in Juneau. ARL tipping fees are less than half of what is charged in other major communities in Alaska. Key drivers for landfill tipping fees relate to the cost of airspace (cost to expand, cost to operate, cost to close, and cost of long-term liabilities) and the competitive environment. Economies of scale tend to decrease the per ton cost of operations.

- **The AUF for the ARL is in the lower range of municipalities surveyed who provided data.** The AUF's for municipal landfills who reported their data ranged from 0.55 to 0.75 tons/cubic yard and the AUF for the ARL is at 0.60 tons/cubic yard.

Table 2-4: Benchmarking Summary (1 of 3)

Location	Anchorage, AK	Vancouver, BC	Seattle, WA	Minneapolis, MN
Population	298,192	631,486	704,358	413,651
Households	115,544	283,916	338,824	169,803
Total Area (square miles)	1,963	44	84	58
Solid Waste Plan	Plan in progress. Strategic plan in place.	Yes	Yes	Yes
Published Diversion Rate	7% estimated for 2016	Regionally 63% in 2016	58.8% in 2016	37% in 2015
Diversion Target	25% Recycling Rate by 2020. Waste generation rate below 5 lbs./ capita/ day by 2025.	Regional goal of 80% diversion. Goal of 50% reduction of waste going to landfill from 2008 levels by 2020. 71% C&D 49% ICI 67% SF 35% MF	70% recycling by 2025	50% diversion by 2020. 80% diversion by 2030.
Role in Solid Waste Management	Provide disposal and transfer facilities for the region. Provide collection services for 20% of the Municipality.	Manages residential collection and operations of the Vancouver South Transfer Station.	Seattle Public Utilities manages solid waste collection and transfer systems.	The City manages solid waste collection and transfer with disposal and processing facilities managed by the county and private sector.
Level of Service	Within SWS Collection Service Area: - Weekly Garbage (mandatory) - EOW Recycling (free) All other collection services are subscription based.	Mandatory curbside collection from single family homes. Private haulers service multi-family buildings.	Garbage, recycling and organics are all mandatory	Collection services are mandatory for residents.
Service Delivery	SWS crews complete collections (in the SWS collection service area) and facility management. The private sector supports recycling systems and provides collection outside of the SWS collection service area.	The City manages their facilities directly. Collection services are contracted to private haulers.	Seattle public utilities manages the system through contracted operations including for ICI technical assistance.	City crews provide collection services and operation of City facilities. Most solid waste facilities in the region are operated by either the private sector or the county.
Tipping Fee ($/ton)	Garbage tipping fee at Central Transfer Station = $66.50/ton Garbage tipping fee at ARL = $56.50/ton	Garbage tipping fee $80 CAD/ton.	Garbage tipping fee $145/ton.	Garbage tipping fee $76/ton.
Cost of Solid Waste Collection ($/Customer /Month)	Garbage collection: - $14.10 - $38.50/HH/month depending on cart size. Recycling collection: Included in Monthly Garbage Fee (SWS) or additional $10/HH/month (Alaska Waste).	Garbage collection - $7.00- $13.75 CAD/HH/month. No charge for recyclable collection. Organics collection $9.90- $16.90 CAD/HH/month.	Garbage collection - $22.85-$156.00/HH/month. No charge for recyclable collection. Organics collection $6.05- $92.55/HH/month.	Garbage collection: base fee $2/small cart; $5/large cart Recycling collection: included in base fee Organics collection: service include in base fee (opt-in)
Public Education funding ($/capita/year)	$1.93	Declined to provide.	Declined to provide.	Declined to provide.
Missed pick-ups (#/day, #/week, #/month, #/year)	January 2018: 0.06% of Stops Missed	0.20%	36 missed pickups per day	Declined to provide.
Injury Rate (Injuries/Year)	25 in 2017	Declined to provide.	Declined to provide.	Declined to provide.
Landfill Airspace Utilization (tons/yard³)	0.6	0.72	Not Available - private landfill.	Not Available - only a private monofill in the area
Customer satisfaction rating (completed through surveys)	Satisfied with customer service: 93% Satisfied with recycling collection: 80% Satisfied with commercial garbage collection: 92% Satisfied with residential garbage collection: 92%	Declined to provide	Customer satisfaction survey launched Jan.22	2016: 93% satisfaction with garbage collection services 89% satisfaction with recycling and composting services
Waste disposal per household (lbs./capita/day)	6.1	3.0	Declined to provide.	1.7 (Residential curbside only)
Waste diversion per household (lbs./capita/day)	0.4	8.2	Declined to provide.	1.0 (Residential curbside only)
Waste disposal by employee (for ICI sector disposal rate)	Not tracked	Not tracked	Not tracked	Not tracked

Table 2-4: Benchmarking Summary (2 of 3)

Location	Fargo, ND	Edmonton, AB	Calgary, AB	Whitehorse, YT	Buffalo, NY
Population	120,762	932,546	1,239,220	20,296	256,902
Households	49,956	369,757	466,725	8,975	85,000
Total Area (square miles)	49	265	319	14	53
Solid Waste Plan	No	Yes	Yes	Yes	Yes
Published Diversion Rate	No published diversion rate. Staff estimate the current diversion rate is 36%.	35.7% in 2016	30% in 2015	31% in 2015	Recycling Diversion Rate: 27.78%
Diversion Target	No	90% from residential streams. Non-residential waste diversion 80,000 ton per year.	70% by 2025	50% by 2040	No
Role in Solid Waste Management	Full service solid waste collection and management of compost facility and landfill.	The City manages solid waste collection, transfer, and disposal systems.	The City manages solid waste collection, transfer, and disposal systems.	The City manages solid waste collection, transfer, and disposal systems. Recycling is provided by the private sector.	The City manages solid waste collection and transfer systems.
Level of Service	Mandatory garbage collection. Curbside recycling by subscription.	Mandatory garbage and recycling collection.	Mandatory garbage, recycling, and organics collection for single family households.	Mandatory garbage and organics collection. Subscription based recycling collection.	Mandatory garbage and recycling for single family and multi-family residences.
Service Delivery	The City manages collection and disposal systems directly.	City crews deliver all City managed collection services and garbage facilities. Some management contracts are in place for organics and recycling processing facilities.	City crews deliver all City managed collection services and landfills. Compost facility operations are contracted.	The City manages collection programs and facilities directly. Recycling services are provided by the private sector.	The City manages collection systems.
Tipping Fee ($/ton)	Garbage tipping fee $43/ton.	Garbage tipping fee is $65 CAD/ton for residential waste, $94 CAD/ton for non-residential waste.	Garbage tipping fee is $113 CAD/ton.	Up to 8 bags of garbage can be dropped at the landfill for $5 CAD.	Tipping fees are based on contracted rates with the private landfill. Cost for residents is $40.50/ton under the City's contract.
Cost of Solid Waste Collection ($/Customer /Month)	Garbage collection $6 - $14/HH/month. There is no fee for recycling collection.	Waste collection fee is $45.93 CAD/HH/month.	Waste collection fee is $19.90 CAD/HH/month.	Garbage collection is $11 CAD/household/month.	Garbage and recycling fee is $11.08/household/month.
Public Education funding ($/capita/year)	$ 0.61	500 volunteers, 7000 hrs. of support	Declined to provide.	$1.48 CAD ($30,000 CAD Total)	Declined to provide
Missed pick-ups (#/day, #/week, #/month, #/year)	Declined to provide.	Target is less than 3/10000	Not Reported	N/A	Declined to provide
Injury Rate (Injuries/Year)	Declined to provide.	4.36 Actual 4 Goal	Not Reported	"low, but not zero, at compost facility"	Declined to provide
Landfill Airspace Utilization (tons/yard^3)	0.60	Not Available - private landfill.	0.59	Declined to provide.	Not Available - private landfill.
Customer satisfaction rating (completed through surveys)	Unknown (not tracked)	93% satisfaction for single family households 86% satisfaction for multi-family households 93% satisfaction with eco stations.	79% customers satisfied with overall level and quality of city services and programs; 64% say they are very satisfied with the service, 29% say they are somewhat satisfied.	Unknown (not tracked)	Declined to provide
Waste disposal per household (lbs./capita/day)	7.3	Declined to provide	3.5	Declined to provide	3.7
Waste diversion per household (lbs./capita/day)	Unknown (not tracked)	Declined to provide	0.5	Declined to provide	1.1
Waste disposal by employee (for ICI sector disposal rate)	Not tracked	Not tracked	Not tracked	Not tracked	Not tracked

Table 2-4: Benchmarking Summary (3 of 3)

Location	Saskatoon, SK	Yellowknife, NT	Juneau, AK	Fairbanks, AK
Population	246,376	19,569	Urban - 24,537 City and Borough - 32,468	City - 32,469 Borough - 100,605
Households	98,565	7,130	12,138	46,403
Total Area (square miles)	88	41	2,702	33
Solid Waste Plan	Yes	In Progress	Yes	No
Published Diversion Rate	21.8% in 2015	16.4% in 2014	7.50%	No (Tetra Tech calculated 1.7%)
Diversion Target	70% of waste from disposal by 2023.	No	No	No
Role in Solid Waste Management	The City manages solid waste collection, transfer, and disposal systems.	The City manages solid waste collection, transfer, and disposal systems.	The City of Juneau provides programs to protect the health and safety of the community and environment primarily by managing service contracts with the private sector.	The Fairbanks North Star Borough provides proper and efficient solid waste management, disposal, recycling, and waste-to-energy programs. The City of Fairbanks provides collection services for 6,300 residential customers in the City.
Level of Service	Mandatory garbage and organics collection. Subscription based recycling collection.	Garbage and organics collection is mandatory. Recycling collection is subscription based (through a private hauler).	Garbage collection is mandatory.	Public Works Department provides mandatory collection services to all residential solid waste in the city.
Service Delivery	City owns and operates a regional landfill, two compost drop-offs, and four recycling drop-offs.	The City manages collection programs and facilities directly. Operation of the compost facility has been contracted to the private sector in the past.	The City primarily contracts collection and facility management to the private sector.	The City provides residential collection within the City. The borough and City provide drop-off facilities. The private sector supports recycling systems and provides commercial collection.
Tipping Fee ($/ton)	Garbage tipping fee $120 CAD/ton.	Tipping fees are volume based (i.e. $112 CAD/load for a 1 Ton Truck)	Garbage tipping fee $180/ton (estimated).	Garbage tipping fee $145/ton.
Cost of Solid Waste Collection ($/Customer /Month)	There is no explicit cost for collection (currently costs are blended in tax rates).	Collection fee is $22 CAD/household/month.	Utility Fee - $4/month/household	Collection: Single Family Dwelling $ 80.95 Per quarter Duplex $ 162.00 Triplex $ 243.00 Fourplex $ 324.00 Senior Rate $ 61.00 Per quarter (rounded from $60.77)
Public Education funding ($/capita/year)	Declined to provide.	Declined to provide.	Declined to provide.	Declined to provide.
Missed pick-ups (#/day, #/week, #/month, #/year)	Declined to provide.	Declined to provide.	Declined to provide.	Declined to provide.
Injury Rate (Injuries/Year)	Declined to provide.	Declined to provide.	Declined to provide.	Declined to provide.
Landfill Airspace Utilization (tons/yard³)	0.74	0.58	Not Available - private landfill.	Declined to provide.
Customer satisfaction rating (completed through surveys)	Declined to provide	Unknown (not tracked)	Declined to provide.	Declined to provide.
Waste disposal per household (lbs./capita/day)	Declined to provide	5.6	Declined to provide.	5.8
Waste diversion per household (lbs./capita/day)	Declined to provide	5.2	Declined to provide.	0.1
Waste disposal by employee (for ICI sector disposal rate)	Not tracked	Not tracked	Not tracked	Not tracked

3.0 OPTIONS IDENTIFICATION AND EVALUATION CRITERIA

This section identifies the options which were established for further evaluation in Section 4.0 of the ISWMP for the ARL, including LFG utilization options; CTS; and diversion programs. Also included is the preferred option for restoring the function of the Landfill Entrance Building post-earthquake. This section also presents evaluation criteria which was utilized to evaluate facility and program options.

3.1 FACILITY OPTIONS

3.1.1 Central Transfer Station

Based on information gathered during interviews with SWS staff, a site visit and data/plan reviews, Tetra Tech's next steps for the CTS evaluation included the preparation of two conceptual Site Plans for the redevelopment/development of the CTS using the strategies outlined in Section 1.6.7 of the ISWMP.

The first Conceptual Site Plan is to support a short to mid-term strategy that focuses on:

- Addressing immediate operational needs/challenges;
- Renovating/improving the existing transfer station building;
- Redesigning/relocating administrative and/or maintenance structures, while;
- Requiring little additional real estate. The exception to this assumption is if a Grit Management Facility is proposed for the existing CTS property that may occupy up to 40% of the property. Additional real estate would then be needed to deal with the immediate operational needs/challenges (e.g. the residential traffic/queue issues) or to allow for any significant improvement to the facility.

The second Conceptual Site Plan would then envision/provide for a mid to long term strategy that, in whole or in part:

- Addresses pre-determined challenges inherited from legacy asset design/location;
- Revamps site vehicle access/egress;
- Segregates and expands operations and services;
- Redesigns and relocates a new transfer station building;
- Redesigns and relocates administrative and/or maintenance structures;
- Accommodates future growth by providing area(s) to incorporate advancements in policy and technology; and
- Incorporates significant additional real estate.

Input from SWS was required on a number of planning parameters for the CTS conceptual design evaluation and a questionnaire was provided to SWS to obtain that input.

One of the critical assumptions for the CTS evaluation is the future property acquisitions that will enable significantly improved design and operations. Based on available information and knowledge, Figure 3-1 presents the adjacent properties that were under consideration. Input from SWS was obtained on the properties to be assumed for the first and second Conceptual Site Plan to be prepared for the CTS which included property to the west and south of the CTS, respectively.

Figure 3-1 CTS Properties

3.1.2 Anchorage Regional Landfill

Table 3-1 below presents the facility options which were proposed to be evaluated as part of the ISWMP for the ARL. Options are presented for four (4) areas of review including: operations, engineering and planning, ARL expansion, and post ARL closure. Also included in the table below are options for restoring the function of the Landfill Entrance Building post-earthquake.

Table 3-1: List of Options for the Anchorage Regional Landfill

Option	Description
Operations	
Alternative Daily Cover(s)	ADCs have proven beneficial to many landfill operators in minimizing the cost of having to import soil (near-term and long-term) and/or excavate of on-site soil and can provide a significant cost savings in using certain ADCs (i.e. tarps) that reduce airspace consumption. SWS plans to purchase tarps for ADC and pilot them soon. SWS also uses construction debris, green waste, and snow as ADC at various times throughout the year. ADCs could include other synthetic spray on and rolled out materials to reduce infiltration, odor and vector intrusion.
Soil Recovery	Reusing soil that was placed as daily or intermediate cover can benefit in several ways. For any soil that is recovered, airspace is conserved, the soil is already located at the working face so does not need to be brought in from a soil stockpile providing an operational cost savings, and removing the soil reduces the potential for leachate mounds to develop and promotes better gas collection.
Engineering and Planning	
Re-design Refuse Cells	Adding benches, phasing liner on the upper benches and/or reducing the size of the cells reduces leachate impingement.
Temporary Scrim Cover	Scrim covers for existing and future lined slopes prevent storm water intrusion directly into the LCRS.
Interim Storm Water Basins	Temporary lined storm water basins with pumps and diversion berms to minimize leachate generation may be needed as the landfill becomes fully lined.
ARL Expansion	
North Expansion	Of two expansion areas adjacent to the ARL identified by SWS, the North Addition expansion area would be a more challenging option due to utility pipeline and NALA considerations.
South Expansion	The South Addition expansion area would be an easier option than the North Addition expansion as it was originally appropriated to the MOA by congress.
Alternative Technologies	Alternative technologies such as Anaerobic Digestion are gaining traction in other areas of the United States as an alternative for diverting organics from landfills to extend the life of landfills. Potential benefits of technologies that can also address other waste disposal/treatment were to be considered.

Option	Description
Landfill Entrance Building Improvements	
Replacement of Building	After the November 2018 earthquake, an assessment of the building's structural integrity was performed. The assessment determined that the storage and maintenance portions of the building sustained significant structural damage, the administration portion of the building sustained non-structural damage, and the existing building does not appear to be up to current code. A concept was evaluated for complete demolition and replacement of the existing building with one of similar functionality as the existing building during pre-earthquake conditions, and built to comply with current codes.
Repair of Building	A concept was evaluated for needed repairs of the building to restore operation to pre-earthquake conditions and to bring the building up to current code, including but not limited to installation of a new lateral resistance system, reinforcement of existing shear walls, and repair of other non-structural damage. The full scope of damage and required repair would not be realized until during construction.
Post ARL	
Export Waste to Another Landfill	A review was conducted of existing landfills in the surrounding area with a permitted closure date/capacity beyond the ARL.
Alternative Technologies	The alternative technologies to be considered for post-ARL closure include biological and thermal treatment technologies. The alternative technologies were to be evaluated at a high level with a recommendation to evaluate in more detail twenty years or more prior to the ARL reaching capacity. Consideration was to be given to maintaining some capacity at the ARL for disposing of residuals from alternative technologies.

The options described above were evaluated for potential applicability and feasibility for SWS, as discussed in Section 4.0. Criteria used in the evaluation of the ARL facility options included:

- Capacity Savings – The estimated amount of airspace that can potentially be conserved on a cubic yard basis.
- Immediate Capital Cost – Cost for purchase, installation and construction .
- Future Operating/Replacement Cost – Cost for operation and maintenance of disposal facility options.
- Technical/Operational/Environmental Permitting Feasibility – Feasibility of implementing option due to operational, technical and/or permitting challenges.

3.2 LANDFILL GAS UTILIZATION

Table 3-2 below presents the landfill gas utilization options initially evaluated as part of the ISWMP. Four (4) utilization options for SWS beneficial use of LFG were initially evaluated as follows:

- Direct Thermal Use (Medium BTU);
- Electrical Generation;
- CNG Local; and,
- RNG Pipeline Injection.

Table 3-2: List of Options for Landfill Gas Utilization

Option	Description
Direct Thermal Use (Medium BTU)	Medium-BTU applications use minimally-processed gas as a replacement for oil, coal, natural gas, etc. and have been widely developed for LFG beneficial-use. This type of LFG beneficial-use application is very appropriate in that the fuel price is typically lower than that of natural gas; the processing costs are substantially lower and the overall delivery process simpler than observed in many other beneficial-use applications. However, an end-user in relative proximity to the landfill is needed and consideration must be given to seasonality of use (more applicable to industrial uses vs. seasonal building heating use). If an end-user can be determined within JBER, or at the landfill itself, this may be a viable option for further development. Additionally, SWS is presently evaluating a leachate evaporation system as a direct thermal use of LFG.
Electrical Generation	There is potential for additional LFG to electrical generation with remaining LFG not utilized by Doyon. This option assumes that Doyon will not be expanding their facility and that SWS will pursue use of excess gas to electricity. Having a direct delivery contract, rather than one that fluctuates with market prices is more advantageous in the current development setting. It lends stability to what has become an increasingly unstable market in some areas. If JBER determines that additional electrical power is not required from Doyon, any expansion of the generating capacity would require another end-use customer for direct sale or wheeling into the local power grid. Tetra Tech will evaluate direct sale or selling to the local power grid. Another option to be evaluated is electrical generation for on-site usage (i.e. leachate treatment). The order of priority would be expansion of the Doyon project, utilization of excess gas for on-site uses, and possible offsite electrical sale to the grid.
CNG Local	The conversion of LFG to CNG is an option for use as vehicle fuel for a dedicated fleet conversion, likely for either ARL or their associated waste haulers or JBER vehicles. Assumes that existing fleet vehicles are replaced with CNG-fueled vehicles as part of scheduled change-out.
RNG Pipeline Injection	Pipeline injection is a potential option for conversion of LFG to RNG. Consideration should be given to the proximity of a transmission pipeline as well as availability of markets for RNG. One of the main gas transmission lines feeding Anchorage runs between the landfill and the Glenn Highway within SWS buffer area. Consideration should also be given to costs associated with cleaning the LFG to pipeline quality in an economic feasibility.

Criteria selected to be considered in ranking landfill gas utilization options for further evaluation included:

- Capital/O&M Costs;
- Revenue Generation Potential;
- Technical Feasibility;
- Permitting Feasibility; and,
- Environmental Impacts.

Evaluations assume that the existing Doyon electrical generating facility remains in place at the current rate of fuel consumption for the term of the ISWMP projection.

Capital/O&M Costs

Indicates whether the implementation of that option will increase or decrease the cost of wellfield construction and operation.

- High score would be a direct correlation to no increase in costs or a cost savings.
- Medium score would be a direct correlation to a minor increase in costs.
- Low score would be a direct correlation to a significant increase in costs.

Revenue Generation Potential

Indicates the relative impact on revenue currently generated by the LFG utilization facilities, including potential incentive programs, or deferment of costs resulting from the implementation of a selected option. This would include the gross revenue of the project net the capital and operating expenses associated with that project.

- High score would be a direct correlation to an increase in revenue.
- Medium score would be a direct correlation to a minor increase in revenue.
- Low score would be a direct correlation to no increase in revenue.

Technical Feasibility

Indicates relative technical feasibility of applying the available LFG stream to the proposed application to achieve the project goals.

- High score would indicate the quality and rate of available fuel is sufficient for the application.
- Medium score would indicate the quality and rate of available fuel is sufficient for partial implementation of the application.
- Low score would indicate the quality and rate of available fuel is not sufficient for the application.

Permitting Feasibility

Indicates the anticipated level of difficulty in permitting a selected option, relative to current regulatory restrictions or environmental impacts.

- High score would indicate little anticipated difficulty in obtaining a permit.
- Medium score would indicate some anticipated difficulty in obtaining a permit.
- Low score would indicate a high degree of difficulty in obtaining a permit.

Environmental Impacts

Indicates the relative environmental impact of a selected option, compared to continued flaring of the LFG.

- High score would indicate a relative decrease in environmental impacts
- Medium score would indicate no perceived benefit in environmental impacts
- Low score would indicate a relative increase in environmental impacts

As part of the ranking evaluation of options, the implementation time frame is also noted which will be considered when developing recommendations for the final ISWMP. The implementation time frame assumptions are as follows:

- Short-term indicates a period within five (5) years.
- Medium-term indicates a period between five (5) to ten (10) years from this year.
- Long-term indicates a period beyond ten (10) years from this year.

Table 3-3 presents results of the high-level options evaluation based on the criteria presented above.

Table 3-3: LFG Utilization High-Level Options Evaluation

Option	Criteria						
	Capital/ O&M Costs	Revenue Generation Potential	Technical Feasibility	Permitting Feasibility	Environmental Impact	Score (L=1, M=3, H=5)	Implementation Timeframe
Direct Thermal Use (Medium BTU)	H	M	M	M	M	17	S
Electrical Generation	H	H	H	L-M	M	20	M-
CNG Local	M	H	H	H	H	23	S
RNG Pipeline Injection	L	M	M	M	H	15	SL

Based on the ranking analysis results for the LFG to Utilization options, LFG conversion to electrical generation and CNG local is the focus of further evaluation in Section 4.2.4 as they were the highest ranked options for the criteria used (achieved a score of 20 or more).

3.3 DIVERSION PROGRAM OPTIONS

This section outlines the various diversion program options that SWS could undertake to augment its existing operations. The program options are thematically categorized by color to enable easier identification of targeted sections of the waste stream. Additionally, the program options were ranked against several criteria to identify a shortlist of options that will be evaluated in more detail.

The diversion program options in this section have been evaluated at a high level to indicate high (H), medium (M) or low (L) levels of alignment with evaluation criteria. A more thorough evaluation of potential programs and policies to increase diversion was completed and is discussed in Section 4.3 based on the shortlist of higher ranking options. A draft matrix table, presented as Table 3-4, lists more refined options than originally presented in the ISWMP Section 1.0. The list includes Reduction and Diversion Programs, Construction and Demolition Waste Programs/Options, Promotion and Education Programs, and Policies and Measurement Tools. The criteria proposed for evaluating the Diversion Program options are based on the three pillars of sustainability:

1. Environmental Sustainability

High Diversion Potential

Indicates whether the implementation of that option will increase or decrease the amount of trash being disposed at the landfill based on waste landfilled, recycled, and/or composted.

- High score would be direct correlation to an increase in diversion.
- Medium score would be little to no increase in diversion.
- Low score would be no diversion or increased disposal.

Reduces GHG Emissions

Indicates the impact of option implementation on GHG emissions (described in industry accepted assumptions underlying the US EPA WARM Model v14), considering tonnage, landfill, and recycling data for SWS.

- High score would be direct correlation to a decrease in GHG emissions considering landfill gas production and reduction in emissions due to decreased use of virgin materials (e.g. food waste prevention).
- Medium score would be a small decrease in GHG emissions, most likely due to decreased use of virgin materials (e.g. metal/plastics recycling) or fossil fuels.
- Low score would be no decrease or an increase in GHG emissions (e.g. curbside collection of household hazardous waste).

2. Social Sustainability

High Community Acceptance

Indicates whether there would likely be a positive or negative reception to the option after implementation from the community (including residents, businesses, and organizations) and how much effort SWS may need to put into public engagement. Consideration in ranking was not given to initial start-up of options as there is typically resistance up-front with any new program, policy or change in service.

- High score would be an option with likely broad public support (e.g. recycling programs paid for or supported by private industry).
- Medium score would be an option with likely some support from portions of the community.
- Low score would be an option with likely low or no support from the community.

Aligns with SWS Goals and Long-Term Plans

Indicates whether implementing the option will positively or negatively contribute to the overall trajectory of solid waste management in the region and how that aligns with SWS targets. Considered within these criteria are the Anchorage 2040 Land Use Plan, and SWS Strategic Plan.

- High score would be an option that would directly contribute to overall SWS vision and published goals/milestones.
- Medium score would be an option that would make small contributions to overall SWS vision and published goals/milestones.
- Low score would be an option that would make no or negative contributions to overall SWS vision and published goals/milestones.

3. Economic Sustainability

Positive Impact on SWS Finances

Indicates how option implementation could affect SWS' revenues and costs (i.e., diversion will decrease the tipping fee revenues at the landfill, but potentially decrease operating costs).

- High score would be an option that would likely have a net financial gain with respect to SWS' overall budget, considering impacts on revenues (i.e. tipping fees), operating costs, and capital costs, considering long-term financing and planning.
- Medium score would indicate the option would likely have little to no impact on SWS' overall budget.
- Low score would be an option that would likely have a net financial loss with respect to SWS' overall budget.

Reduces Cost to Waste Generator

Indicates whether implementation of the option would likely increase/decrease the cost of services for residents/SWS customers (i.e., recycling collection may increase SWS operational costs and, therefore, would likely increase fees for customers).

- High score would be an option that would likely reduce costs paid directly by customers.
- Medium score would be an option that would likely have little or no change in costs paid directly by customers.
- Low score would be an option that would likely increase costs paid directly by customers.

Table 3-4 below presents the high-level ranking analysis of options results with the justification for ranking included in Appendix D. The scoring in Table 3-4 was provided for discussion with SWS. Based on this initial scoring, Tetra Tech recommended focusing further analysis of diversion programs on options scoring 22 or higher.

Table 3-4: Draft Diversion Program Options Ranking Matrix

Option (Color Coding - Recycling, Yard and Garden, Mixed Organics, ICI Sector, Reuse, Bulky Items)	Criteria						
	High Diversion Potential	Reduces GHG Emissions	High Community Acceptance	Aligns with SWS Goals and Long-Term Plans	Positive Impact on SWS Finances	Reduces Cost to Waste Generator	Score (L=1; M=3; H=5)
Reduction and Diversion Programs							
Material Disposal Surcharge to Support Recycling	H	H	H	H	L	L-M	23
Mandatory Curbside Recycling for All Residences with Trash Collection (Non-SWS)	H	H	H	H	L	L-M	23
Mandatory Recycling – ICI Generators	H	H	M	H	L	L	20
Regionalized Mandatory Curbside Recycling for All Residences (including Non-SWS)	H	H	H	H	L	L	22
Expand the Materials Collected through Existing Curbside Recycling (i.e. accept glass, or other items, likely in other containers)	M	M	H	H	M	M	22
Expand/Improve Recycling Depots	M	M	H	M	M	M	20
Mandate Standardized Government Building Recycling Programs	M	M	H	H	H	H	26
Partner with Private Sector to Stimulate and Support Recycling Markets	L	L	H	H	H	H	22
Expand Yard and Garden Waste Drop-Off to CTS, Girdwood, ARL for beneficial use	M	M	H	H	M	M	22
Add Seasonal Yard Waste Drop-Off Depots	L-M	L-M	M	H	M	M	18
Implement Curbside Yard and Garden Waste Collection Program (SWS)	H	H	H	H	L	L-M	23
Partner with private sector to increase composting capacity for green/yard waste	M	M	H	H	M	M	22

Option (Color Coding - Recycling, Yard and Garden, Mixed Organics, ICI Sector, Reuse, Bulky Items)	Criteria						
	High Diversion Potential	Reduces GHG Emissions	High Community Acceptance	Aligns with SWS Goals and Long-Term Plans	Positive Impact on SWS Finances	Reduces Cost to Waste Generator	Score (L=1; M=3; H=5)
Foster Partnerships with Community Gardens for Yard Waste Drop-Off	L	L	M	H	H	H	20
Mixed Organics (food and yard) Curbside Collection Program	H	H	H	H	L	L-M	23
Food Waste Drop-off at CTS, Girdwood, and ARL	L-M	M	M	M	M	M	17
Food Waste Drop-off Depots at other locations	L-M	M	M	M	L	M	15
Implement Food and Food-Soiled Paper Curbside Collection	H	H	H	H	L	L-M	23
Develop Food Waste Reduction and Prevention Programs – Residences	M	H	H	H	H	H	28
Partner with the Private Sector for Food Waste Reduction, Prevention, Rescue, and Recovery	M	H	H	H	H	H	28
Promote and Subsidize Backyard Composting	L-M	M	M	H	M-H	H	22
Facilitate ICI Waste Diversion Working Group	L	L	M	H	H	H	20
Develop ICI Waste Reduction Strategy and Toolkit	L	L-M	M-H	H	H	H	22
Roll-out ICI Waste Reduction Grant and Technical Assistance Program	M	M	M	M	L	H	18
Encourage the Development and Expansion of Thrift Store/Free Store/Reuse Center System	M	M	H	M	M	H	22

Option (Color Coding - Recycling, Yard and Garden, Mixed Organics, ICI Sector, Reuse, Bulky Items)	Criteria						
	High Diversion Potential	Reduces GHG Emissions	High Community Acceptance	Aligns with SWS Goals and Long-Term Plans	Positive Impact on SWS Finances	Reduces Cost to Waste Generator	Score (L=1; M=3; H=5)
Develop a Small-scale Resource Recovery Center for Upcycling	L	L	H	M	M	H	18
Develop Small-scale Repair/Re-use Centers (e.g. Tool libraries)	L	L	H	M	M	H	18
Develop Waste Exchange Program (official website format of the repair/re-use centers)	L	L	H	M	M	H	18
Implement Bulky Item and Mattress Curbside Collection	L	L	H	L	L	L	10
Implement drop off program for diversion of Bulky Items and Mattresses	L	L-M	H	H	M	L-M	18
Partner with the Private Sector to recycle/ process mattresses and bulky items	L	L-M	H	H	H	H	23
Construction and Demolition Waste							
Develop C&D Re-use Mandates and Policies in new buildings	M	M	L	H	H	M	20
Promote/Facilitate C&D Re-use programs (e.g. building material re-use centers)	M	M	H	H	H	H	26
Develop Disaster Debris Response Plan	L	L	H	H	H	H	22
Develop policies that support C&D recycling (e.g. minimum diversion for C&D projects)	M-H	M-H	M	M	H	M	22
Partner with the Private Sector to stimulate and develop material markets	L	L	M	H	H	H	20
Create C&D Recycling Deposit Refund Program as part of building permits	M	M	M	M	H	L	18

Option (Color Coding - Recycling, Yard and Garden, Mixed Organics, ICI Sector, Reuse, Bulky Items)	Criteria						
	High Diversion Potential	Reduces GHG Emissions	High Community Acceptance	Aligns with SWS Goals and Long-Term Plans	Positive Impact on SWS Finances	Reduces Cost to Waste Generator	Score (L=1; M=3; H=5)
Develop Deconstruction Strategies and Implement Policies that Prioritize Deconstruction over Demolition	M	M	L	M	H	M	18
Promotion and Education Programs							
Establish Community Based Social Marketing as framework for Promotion and Education	L	L	H	H	H	H	22
Develop Community-Based Metrics and Waste Diversion Promotion and Recognition Program (i.e. track performance by community and create a diversion competition)	L	L	H	H	H	H	22
Develop Standardized Signage, Branding, and Color Coding for Region	L	L	H	H	H	H	22
Promote Zero Waste or "Waste as a Resource" through community engagement programs and events	L	L	H	H	H	H	22

Option (Color Coding - Recycling, Yard and Garden, Mixed Organics, ICI Sector, Reuse, Bulky Items)	Criteria						
	High Diversion Potential	Reduces GHG Emissions	High Community Acceptance	Aligns with SWS Goals and Long-Term Plans	Positive Impact on SWS Finances	Reduces Cost to Waste Generator	Score (L=1; M=3; H=5)
Policies and Measurement Tools							
Conduct Annual Solid Waste Master Plan Reporting	L-M	L-M	H	H	H	H	24
Develop Green Procurement Policy for MOA Government Contracts	L	L	H	H	H	H	22
Perform Regular Waste Composition Audits (every 2-3 years)	L-M	L-M	H	H	H	H	24
Pilot Projects to Test New Initiatives	L	L	M	L	M	H	14
Lobby State Government to Create Extended Producer Responsibility Programs (e.g. Bottle Deposits, Mattresses, HHW, Electronics, etc.)	M	M	H	H	H	M	24

Several of the options identified are interrelated and supportive of each other. As options are analyzed, supporting education and promotion activities, policies and measurement tools will be recommended to support the success of potential diversion programs.

Based on the preliminary ranking, Tetra Tech recommends further analysis of the options presented in Table 3-5 that scored 22 or higher in the initial ranking analysis presented in Table 3-4. The Options have been grouped for clarity.

Table 3-5: Recommended Options for Further Analysis

Program Area	Recommended Option for Analysis	Score
Increase Food Waste Reduction, Prevention, Rescue, and Recovery	Develop Food Waste Reduction and Prevention Programs – Residences	28
	Partner with the Private Sector for Food Waste Reduction, Prevention, Rescue, and Recovery	28
Increase Organics Diversion	Mixed Organics (food and yard) Curbside Collection Program	23
	Implement Food and Food-Soiled Paper Curbside Collection	23
	Promote and Subsidize Backyard Composting	22

Program Area	Recommended Option for Analysis	Score
	Partner with private sector to increase composting capacity for green/yard waste	22
Increase Recycling (Residential & ICI)	Mandate Standardized Government Building Recycling Programs	26
	Material Disposal Surcharge to Support Recycling	23
	Mandatory Curbside Recycling for All Residences with Trash Collection (Non-SWS)	23
	Mandatory Recycling – ICI Generators	22
	Expand Materials Collected through Existing Curbside Recycling	22
	Develop ICI Waste Reduction Strategy and Toolkit	22
	Promote/Facilitate C&D Re-use programs (e.g. building material re-use centers)	24
Reuse and Recycle C&D Waste	Develop and Expand Thrift Store/Free Store/Reuse Center System	22
	Develop policies that support C&D recycling (e.g. minimum diversion for C&D projects)	22
	Implement Curbside Yard and Garden Waste Collection Program (SWS)	23
Increase Yard and Garden Waste Diversion	Expand Yard and Garden Waste Drop-Off to CTS, Girdwood, ARL for beneficial use	22
	Partner with private sector to increase composting volume for green/yard waste	22
	Partner with the Private Sector to recycle/ process mattresses and bulky items	23
Increase Bulky Item Diversion	Develop Disaster Debris Response Plan	22
Plans and Strategies	Establish Community Based Social Marketing as framework for Promotion and Education	22

Program Area	Recommended Option for Analysis	Score
Communication, Education, Monitoring, and Promotion	Develop Community-Based Metrics and Waste Diversion Promotion and Recognition Program (i.e. track performance by community and create a diversion competition)	22
	Develop Standardized Signage, Branding, and Color Coding for Region	22
	Promote "Waste as a Resource" Through Community Engagement Programs and Events	22
	Conduct Annual Solid Waste Master Plan Reporting Updates	24
Policies and Measurement Tools	Perform Regular Waste Composition Audits (every 2-3 years)	24
	Lobby State Government to Create Extended Producer Responsibility Programs (e.g. Bottle Deposits, Mattresses, HHW, Electronics, etc.)	24
	Develop Green Procurement Policy for MOA Government Contracts	22

3.4 GOALS AND TARGETS

Goals and targets are developed to gauge performance and progress. SWS has developed several short-term goals related to community sustainability, customer experience, and operational excellence.

The following sections recommend short, medium, and long-term goals and targets in the areas identified by SWS and additional areas which are typically tracked by municipalities. The timing of each goal as identified in the ISWMP will be developed based on the implementation timeline for new programs and initiatives assessed in Section 4.3.

3.4.1 Recycling/Diversion Rate

The SWS' current Strategic Plan has a recycle goal of 25% by 2020 for its service area. The 2016 MOA wide recycling rate is estimated as 7%, as discussed in Section 1.1, while the recycling rate for SWS' curbside collection program is estimated as 16%. The current diversion rates of various North American jurisdictions were presented in Section 2.3.2 and are summarized in Table 3-6.

Table 3-6: Summary of Municipal Solid Waste Diversion (Recycling) Rates

American Jurisdictions	Diversion Rate	Canadian Jurisdictions	Diversion Rate
Fairbanks, AK	2%*	Whitehorse, Canada	31%
Juneau, AK	7.5%	Yellowknife, Canada	16.4%*
Seattle, WA	58.8%	Vancouver, Canada	63%
Minneapolis, MN	37%	Saskatoon, Canada	21.8%
Fargo, ND	36%	Edmonton, Canada	35.7%
Buffalo, NY	27.8%	Calgary, Canada	30%
* Diversion rate calculated by Tetra Tech based on reported volumes and tonnages of household hazardous waste (HHW) and other diverted materials.			

Based on the current diversion rate for the SWS service area and the diversion rates achieved by the jurisdictions included in the benchmarking study, Tetra Tech recommends the following diversion goals.

- Short term: 25% diversion of solid waste from the landfill.
- Medium term: 40% diversion of solid waste from the landfill.
- Long term: 60% diversion of solid waste from the landfill.

3.4.2 Disposal Rate

The SWS Strategic Plan has a goal to decrease the annual per-capita waste generation to less than 5 lbs. per person per day by 2025. The per capita disposal rate for the MOA was calculated based on US Census Bureau annual population estimates and SWS' reported tonnages disposed at ARL. Table 3-7 below was presented in Section 1.5.

Table 3-7: MOA Per Capita Disposal Estimates

Year	Total Waste Disposal (lbs.)[1]	Population[2]	Per-Capita Disposal Estimate (lbs./capita/year)	Per-Capita Disposal Estimate (lbs./capita/day)
2012	662,850,525	298,527	2,220	6.1
2013	615,488,200	301,143	2,044	5.6
2014	610,947,198	300,429	2,034	5.6
2015	600,158,405	298,312	2,012	5.5
2016	661,611,880	298,192	2,219	6.1
		Average 2012-2016	2,106	5.8

[1] Waste Disposal based on data provided by SWS: 1988-2017 Municipal Solid Waste Quantities By Source and Revenue of Nonrevenue Category (REVTONS 17.xls).

[2] Population based on United States Census Bureau Annual Estimates of Resident Population: April 1, 2010 to July 1, 2016 2016 Population Estimates. (Available online https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk)

Section 2.3 presented results of a benchmarking evaluation as summarized in Table 3-8 below.

Table 3-8: Benchmarks for Disposal Rates at American and Canadian Jurisdictions

American Jurisdictions	Disposal Rate (lbs./capita/day)	Canadian Jurisdictions	Disposal Rate (lbs./capita/day)
Fairbanks, AK	5.8	Whitehorse, Canada	N/A*
Juneau, AK	N/A*	Yellowknife, Canada	5.6
Seattle, WA	N/A*	Vancouver, Canada	3.0
Minneapolis, MN	1.7**	Saskatoon, Canada	N/A*
Fargo, ND	7.3	Edmonton, Canada	N/A*
Buffalo, NY	3.7	Calgary, Canada	3.5

* Jurisdiction declined to provide information data.

** This number reflects the amount of trash collected by the municipality, which only comprises the residential sector and does not include ICI or C&D tonnages, unlike the other jurisdictions listed.

Based on the current disposal rate in the MOA and the disposal rates achieved by the jurisdictions included in the benchmarking study, Tetra Tech recommends the following disposal rate goals.

- Short term: Decrease disposal to 5 lbs./capita/day.
- Medium term: Decrease disposal to 4 lbs./capita/day.
- Long term: Decrease disposal to 3 lbs./capita/day.

3.4.3 Refuse to Soil Ratio

The SWS Strategic Plan has a Refuse-to-Soil ratio goal of 1.4 tons of waste to 1 ton of cover material. Increases in the refuse-to-soil ratio conserves landfill airspace and reduces cost for on-site soil excavation or import. A minimum refuse-to-soil ratio of 2:1 to 3:1 is a reasonable target based on other jurisdictions in North America.

3.5 SUMMARY

The options and criteria presented herein for the ARL, CTS, diversion programs and LFG utilization are to be concurred on by SWS and the Solid Waste and Recycling Advisory Committee in order to perform the facility and program analysis presented in Section 4.0 and subsequent recommendations for the ISWMP.

4.0 SELECTED FACILITY OPTIONS/PROGRAMS/PROJECTS

Upon review of all potential facility and program options and the results of initial screening based on selected evaluation criteria, options for various components of the SWS system were selected for further evaluation. In specific, a discussion of options for the CTS facility improvements, ARL improvements, waste diversion programs and potential alternative technologies to support waste diversion and conserve landfill space are provided in this section of the ISWMP. In-depth analysis and reviews were performed for the, CTS facility improvements, alternative technologies, and ARL Entrance Building, respectively. A summary of these options is provided below with the complete evaluations included in Appendices E, F and B, respectively.

4.1 CENTRAL TRANSFER STATION FACILITY IMPROVEMENTS

A Conceptual Planning Design Basis Memorandum was prepared for the CTS and is included in Appendix E to this ISWMP. The conceptual planning exercise was driven by multiple factors, which can be generally traced to aging solid waste and recycling assets at the CTS, safety risks associated with intermingled customer/vehicle streams, and a desire to respond to SWS customer requests, concerns, and complaints. The existing Transfer Station Building has been in operation for almost four (4) decades and needs comprehensive refurbishment activities and upgrades to enable continued efficient operations. The most prominent customer feedback is related to the high volume and lengthy on-site dwell time of residential traffic, and the unavailability of solid waste and recycling (materials management) services and practices that have progressed since the facility's original design. Additionally, SWS has experienced a need for increased maintenance, repair, and storage space to keep pace with ongoing operations. This need is specific to the amount of warm (indoor) storage, outdoor storage space, and maintenance facilities (vehicles and equipment, as well as container repair).

The proposed conceptual designs must also accommodate future policy, asset, operational, and process/technology additions and/or advancements that are incorporated as part of this ISWMP, while reserving flexibility within the site for the next 30 years of SWS's operations. For example, SWS customers are interested in expanding materials recovery operations for cardboard, as this material is prevalent in the waste stream and is currently infeasible to recover. At this time, it is anticipated that future additions to SWS operations may include organics collection, grit management, and alternative waste conversion/diversion technologies (e.g. waste-to-energy, aerobic/anaerobic digestion, refuse derived fuel (RDF) production, etc.).

Four concept plans have been provided for the CTS facility improvements including:

- Concept Plan No. 0 - No Expansion Alternative
- Concept Plan No. 1 - Facility Upgrades
- Concept Plan No. 2A - Facility Expansion
- Concept Plan No. 2B - Facility Expansion with Alternative Waste Conversion/Diversion Technology

SWS has also considered purchase of additional property to allow for the needed improvements which included:

- Two (2) Schwaiger properties that are located on Old Seward Highway and East 56th Avenue, respectively (009-251-40-000 and 009-251-42-000);

- The PAC property (009-251-41-000) that is adjacent to the Schwaiger properties and is located on Old Seward Highway with access to the site from a driveway off Old Seward Highway; and
- Seven (7) potential acquisition properties currently owned by Wal-Mart. One (1) isolated parcel (009-251-33-000) would be associated with Conceptual Plan No. 1 that is located north of East 56th Avenue. The remaining six (6) parcels are associated with Conceptual Plan Nos. 2A/2B and are located south of East 56th Avenue.

Following is a summary of the concept plans considered for the CTS and recommendations.

4.1.1 Potential Properties Zoning Designation

The combined seven (7) parcels included in the current SWS and proposed Schwaiger, PAC, and isolated Wal-Mart Properties considered under Conceptual Plan No. 1 are designated as Light Industrial/Commercial in the Anchorage 2040 Land Use Plan. These parcels are zoned Light Industrial (I-1) District as shown in Figure 3-1. The six (6) Wal-Mart parcels considered under Conceptual Plan Nos. 2A & 2B are also located in an area that is zoned Light Industrial, I-1. AMC 21.04.050B states that the intent of the I-1 District is:

> *The I-1 district is intended primarily for urban and suburban light manufacturing, processing, storage, wholesale and distribution operations, but also permits limited commercial uses. Regulations are intended to allow efficient use of the land while at the same time making the district attractive and compatible for a variety of uses.*

Within the I-1 District, the minimum lot area is 6,000 square feet (sf) with a minimum lot width of 50-ft. In areas where adjacent properties are non-residential, as the properties are, the front setback requirement is 10-ft. and the side and rear setbacks are 0-ft. The maximum building height is 50-ft., except that non-building industrial structures and appurtenances are exempt from this height requirement.

A Solid Waste and/or Recycling Transfer Facility is defined within AMC 21.05.060E. The intention of the I-1 District is for public and private light and general manufacturing, processing, service, storage, wholesale, and distribution operations along with other uses that support and are compatible with industrial uses (AMC 21.04.050B). Specific requirements for this use include:

- Facility cannot be located within 500-ft. of any academic school, hospital, or residential zoning district.
- Minimum lot size is 2-acres with 150-ft. lot width.
- Outdoor storage height cannot exceed 35-ft. and storage cannot be within the front or side setbacks set forth in AMC 21.06.
- In addition to landscaping, a Solid Waste and/or Recycling Transfer Facility is to be surrounded by an 8-ft. high fence, except that public drop-off areas do not need fencing unless located adjacent to a residential area.

A Solid Waste and/or Recycling Transfer Facility is a conditional use within the I-1 District and could be permitted following approval of a Conditional Use Permit (CUP) which requires review and approval in accordance with the procedures of Section 21.03.080, Conditional Uses. A CUP is intended for situations where a use may or may not be appropriate in a district, depending on the specific location, the use characteristics, and potential adverse impacts of the use on surrounding properties and community. Visual Enhancement Screening landscaping is also required along classified streets. It should also be noted that, without a variance, the 500-ft. separation to lands zoned Residential would preclude use of the eastern Wal-Mart parcels for Solid Waste and/or Recycling Transfer Facility as lands east of Seward Highway are less than 500-ft. from these parcels and are zoned Residential District.

A discussion of Incinerator/Composting Facility zoning/land use designations (for consideration in Conceptual Plan No. 2B) is included in Section 4.1.5.

4.1.2 Concept Plan No. 0 – No Expansion Alternative

The No Expansion Conceptual Plan provides SWS with the option of developing minor upgrades to select services (including HHW, White Goods, E-Waste & Waste Tire Collection, Reuse facilities, Container Repair, and Roll-Cart/Roll-Off Storage) and refurbishing the existing Transfer Station Building to meet short-term goals and maintain existing operations (see Drawing No. 0 in Appendix E).

1. The Transfer Station Building would require a comprehensive refurbishment and upgrades for continued use by Residential, Commercial, and Small Contractor traffic.
2. A permanent, purpose-built structure would be erected for a HHW, White Goods, E-Waste, and Waste Tire Collection Building (depending on SWS needs and processing area requirements), serving Residential and Small Contractor traffic.
3. The Container Repair facilities, currently housed within former rental storage units, would be upgraded to include complete employee facilities (including an office, lockers, restroom/showers, breakroom), five (5) maintenance bays, and adjacent outdoor storage areas for containers and carts.
4. Facility entrances, exits and access roads would be improved in order to provide queuing space and segregated bypass lanes.
5. The HHW, White Goods, E-Waste, and Waste Tire Collection Building will have two (2) segregated entrances. The eastern entrance will be for Small Contractors, which can then continue to the Waste Drop-Off Area at the Transfer Station Building or exit the site. The western entrance to the HHW, White Goods, E-Waste, and Waste Tire Collection Building will be dedicated to Residential traffic.
6. No modification to the existing Truck Scales and Scale Booth is proposed.
7. The existing Refueling Area would be relocated to streamline access by SWS vehicles (Direct and Indirect), in the location northwest of the existing Maintenance Shop/Warm Storage Building as depicted on Drawing 0 in Appendix E.

Development of the components of this alternative would occur concurrently, to minimize downtime and the duration of construction activities. However, this Conceptual Plan is anticipated to require an interruption of Transfer Station operations during implementation which may approach a period of two (2) to three (3) years.

This Conceptual Plan assumes that no additional real estate will be purchased to support CTS operations, leaving only the open space on the western portion of the existing property for redevelopment activities.

The No Expansion Conceptual Plan (Conceptual Plan No. 0) is presented as the baseline, as upgrades and refurbishments are necessary for continued operation of the CTS. This option allows for only partial improvements to existing assets, without addressing the main operational issues (safety, customer feedback, resource management options) while providing little to no strategic advantage that accommodates growth.

4.1.3 Concept No. 1 – Facility Upgrades

Conceptual Plan No. 1 focuses on SWS' short- to mid-term goals to improve existing CTS operations with some small property acquisitions and relocation of select assets to segregate Direct and Indirect Operations. The proposed layout of facility operations is depicted on Drawing No. 1 – Conceptual Site Plan No. 1 Facility Upgrades (see Appendix E).

1. Indirect Operations (support assets/activities) would be relocated to the Schwaiger, PAC, and isolated Wal-Mart Properties (see Section 5.2 of Appendix E), including:
    - Administration & Employee Facilities Building;
    - Maintenance Building;
    - Warm Storage Building;
    - Employee Parking; and
    - SWS Collection Vehicle Parking.
2. The Residential Drop-Off would be improved and expanded, utilizing the area vacated by the relocated Administration & Employee Facilities Building. An elevated, one-way drive-through design would promote segregated, safe, and streamlined residential operations.
3. A permanent, purpose-built structure would be erected for a HHW, White Goods, E-Waste, and Waste Tire Collection Building (depending on SWS needs and processing area requirements), serving Residential and Small Contractor traffic.
4. The Container Repair facilities, currently housed within former rental storage units, would be upgraded to include complete employee facilities (including an office, lockers, restroom/showers, breakroom), five (5) maintenance bays, and adjacent outdoor storage areas for containers and carts.

Within the existing CTS property, the Transfer Station Building would require a comprehensive refurbishment and upgrades for continued use by Commercial and Small Contractor traffic. This Conceptual Plan is anticipated to require an interruption of Transfer Station operations during implementation which may approach a period of two (2) to three (3) years.

Conceptual Plan No. 1 assumes the availability of Parcel 009-251-40-000 (N/F Schwaiger Hans), Parcel 009-251-42-000 (N/F Schwaiger Hans & Judy), Parcel 009-251-33-000 (N/F Wal-Mart Stores), and Parcel 009-251-41-000 (N/F PAC Property), with a total additional area of 3.79 acres (Schwaiger, PAC, and isolated Wal-Mart Properties). Siting considerations were reviewed and are discussed in detail in Section 5.3 of Appendix E. No major siting obstacles were noted for these properties.

4.1.4 Concept No. 2A – Facility Expansion

Conceptual Plan No. 2A (See Figure 4.1-1 and Drawing No. 2A in Appendix E – Conceptual Site Plan No. 2A Facility Expansion) applies the same strategy as the Concept Plan No. 1 to address the operational challenges currently experienced at the CTS, by segregating Indirect Operations (support assets/activities) from Direct Operations (materials management activities) and then further separating the resultant traffic into the below five (5) discreet patterns, to the extent possible:

- SWS Employee Vehicles;

- SWS Operations Vehicles (*Collection Vehicles {parking, warm storage, & maintenance}, Containers, Container Movements*);
- Residential;
- Small Contractor; and
- Commercial.

This plan carries over the design of assets from Conceptual Plan No. 1 that are proposed on the current SWS property, including the HHW, White Goods, E-Waste, and Waste Tires Collection Building, Residential Drop-Off, Organic Material Segregation Area, and Container Repair Building, for use by both Residential, SWS Operations, and Small Contractor traffic.

Select Direct Operations would be relocated to the Wal-Mart Properties south of East 56th Avenue, including:

- New Transfer Station Building;
- Employee/visitor entrance and exit;
- Small Contractor Waste Drop-Off Area entrance and exit;
- Administration & Employee Facilities Building;
- Maintenance Building;
- Warm Storage Building;
- Employee Parking; and,
- SWS Collection Vehicle Parking.

The development of Conceptual Plan No. 2A will occur in stages to ensure a construction timeline that enables CTS operations to remain continuous.

Conceptual Plan No. 2A assumes the availability of Parcels 009-284-01-000, 009-284-02-000, 009-284-09-000, and 009-284-10-000 (N/F Wal-Mart Stores Inc.), with a total additional area of 16.46 acres. Conceptual Plan No. 2A avoids infringement on the Latouche Street ROW and the eastern Wal-Mart Properties (Parcels 009-281-70-000 and 009-281-71-000), based on future land development planned in these areas, potential wetlands concerns and zoning constraints. However, it is understood that the six (6) Wal-Mart parcels south of East 56th Avenue must be purchased as a block.

Siting considerations were reviewed and are discussed in detail in Section 5.3 of Appendix E. As shown in Figure 4 in Appendix E, Parcels 009-284-01-000 and 009-284-02-000 contain designated wetlands, as indicated by the wetlands mapping performed by the U.S. Army Corps of Engineers. A significant portion of Parcel 009-284-01-000 contains wetlands that are designated as “A” wetlands (high valuation), and the portion of wetlands on Parcel 009-284-02-000 is considered “C” wetlands (low valuation). Both wetlands areas are identified within Site #46 on Anchorage Wetlands Atlas Map #44, at the Northwest Intersection of East Dowling Road and Seward Highway. For Conceptual Plan No. 2A, it has been assumed that no development will be allowed in the “A” wetlands as these wetlands have been preserved through permit POA-2005-510-4. Although there is potential for development in the “C” wetlands given a successful General/Nationwide Permit or Individual Permit application process, a conservative approach has been used within Conceptual Plan No. 2A which minimizes encroachment on wetlands having either designation. It is likely that the minor “C” wetlands disturbance associated with Conceptual Plan No. 2A would qualify for a Nationwide Permit and/or MOA Watershed Management Services General Permit and may require mitigation depending on the area of disturbance.

4.1.5 Concept No. 2B – Facility Expansion with Alternative Waste Conversion/Diversion Technology

Conceptual Plan No. 2B would be a continuation of the development proposed in Conceptual Plan No. 2A, accounting for the potential siting of an Alternative Waste Conversion/Diversion Technologies facility on the eastern Wal-Mart Properties. The eastern Wal-Mart Properties are comprised of Parcels 009-281-70-000 and 009-281-71-000 (N/F Wal-Mart Stores Inc.), with a total additional area of 11.18 acres.

At this stage of conceptual planning, these parcels have just been reserved for potential use in support of an Alternative Waste Conversion/Diversion Technology which options are discussed in Section 4.4 and a complete assessment of alternative technology types is included in Appendix F. It is our understanding that this future development would be part of SWS's long-term strategy (10+ years), and a proposal would be subject to a future feasibility study and input from SWS. Potential alternative technology uses include a mass burn facility or an anaerobic digester (AD) facility (see Figure 4.1-1). Siting and planning restrictions on this site are discussed within Section 3.7 – Zoning Designation and Section 6.3.1 – Wetlands of Appendix E. In specific, siting of these types of facilities on the eastern Wal-Mart Properties include zoning and separation requirements as discussed below:

Incinerator (Mass Burn Waste-To-Energy facility)

As discussed in Section 4.1.1, the Wal-Mart properties are in an area that is zoned I-1. A zone change from I-1 to I-2 (Heavy Industrial District) would be required from the Planning and Zoning Commission followed by a Conditional Use Permit. The 2040 LUP does not support a rezone from I-1 to I-2 on the subject Wal-Mart property parcels which does not prohibit a petitioner from making the case to do so but is much easier to have a rezone approved if the 2040 LUP supports the new zoning designation. There is also a requirement for a 1,315-foot separation from residential, parks, or school for an incinerator. Because of the proximity to residential across New Seward Highway, SWS would be required to go to the Urban Design Commission for a variance from the set-back requirement.

Composting Facility/AD Facility

As with the incinerator use, a zone change from I-1 to I-2 would be required from the Planning and Zoning Commission. A composting facility is a permitted use in I-2 so would not require a Conditional Use Permit. It also has a setback requirement of 200 feet from any lot line abutting a residential district zone, which it would meet. Title 21, Chapter 21.05.060E.1. (E. Waste and Salvage; 1. Composting Facility) defines a composting facility as *a facility where organic matter, including leaves, grass, manures, and non-meat, non-biosolids waste, amassed primarily from off site, is processed by **composting and/or processing** for commercial purposes.* Based on this composting facility land use definition, an anaerobic digestion facility (**processing**) could be deemed a permitted use in I-2, similar to a composting facility.

Both Incinerator and Composting facilities are conditional uses in the Public Lands and Institutions (PLI) District so a rezoning to PLI is another option but would still require approval from the Planning and Zoning

Commission followed by a Conditional Use Permit. For an incinerator, a variance for the setback requirement would also still be needed from the Urban Design Commission.

4.1.6 Recommendations

The No Expansion Conceptual Plan (Conceptual Plan No. 0) is presented as the baseline, as upgrades and refurbishments are necessary for continued operation of the CTS. This option allows for only partial improvements to existing assets, without addressing the main operational issues (safety, customer feedback, resource management options) while providing little to no strategic advantage that accommodates growth.

Conceptual Plan No. 1 addresses the main concerns presented by current conditions; however, it does not address all of the challenges nor does it accommodate future resource management goals. The extent of reconstruction needed to perform the refurbishment of the existing Transfer Station Building would be significant for both Conceptual Plan No. 0 and Conceptual Plan No. 1, requiring a suspension of transfer operations at the CTS during the multiple year construction, with a cost estimated to approach that of a new, larger, and more advanced replacement facility. In addition, the future operations would continue to be subject to the existing Transfer Station framework which has demonstrated issues relating to vehicle dwell time, access/egress, and safety. Further financial impacts would include the unnecessary expense for demolition of the existing Administration and Maintenance Shop/Warm Storage Buildings which could otherwise be repurposed and additional costs to procure land and construct a regional grit management facility. Conceptual Plan No. 1 also does not serve SWS's longer-term goals that includes expansion or addition of services, materials management, and extending the life of the ARL.

Conceptual Plan No. 2A addresses SWS's current challenges (safety, customer feedback, resource management options), while providing the greatest flexibility for future growth and materials management opportunities. Further benefits include additional space for expanded organics management capacity, the opportunity to use the existing Transfer Station Building as a regional grit management facility and avoid the associated costs with new construction of this facility, and the ability to re-purpose the existing Administration and Maintenance Shop/Warm Storage Buildings for other MOA uses. Also, the construction of a new Transfer Station Building would alleviate the difficulties associated with the cessation of operations at the CTS during refurbishment activities. The acquisition of the larger Wal-Mart properties also gives SWS the opportunity to further waste diversion initiatives in the future by establishing a location for a future Alternative Waste Conversion/Diversion technology facility (e.g. waste-to-energy, aerobic/anaerobic digestion, RDF production, etc.).

The opportunities available to the SWS upon the acquisition of the Wal-Mart properties and subsequent development of Conceptual Plan No. 2A provide SWS with an inimitable opportunity to resolve decades old operational challenges and address short- and long-term needs and priorities of their customers through the realization of progressive solutions for waste and resource management strategies. It also provides SWS with control of future adjacent land uses that could affect ongoing SWS operations.

Note that the initial intent of Conceptual Plan Nos. 2A and 2B included the relocation of all Direct and Indirect Operations to the Wal-Mart Properties from the existing CTS site, as previously discussed with SWS staff. However, the presence of undevelopable "A" wetlands on Parcel 009-284-01-000 has decreased the available area by almost three (3) acres. Therefore, select Direct Operations involving Residential and limited Small Contractor traffic, Indirect Operations for container repair and storage, and the parking of SWS Transfer Trailers remain on the western portion of the existing CTS property.

Siting in alternative technology facility on the eastern Wal-Mart property has many obstacles including zoning and separation requirements from residential, parks, or school. A facility falling under the Incinerator or Composting definition is a conditional or allowed use in Heavy Industrial or PLI Districts only. Therefore, a zone change would be required from the Planning and Zoning Commission and for an Incinerator use, a conditional use permit would also be required as well as a variance approval for setback requirements from the Urban Design Commission.

Conceptual cost estimates for Conceptual Plan No. 1 and Conceptual Plan No. 2A are presented and explained within Attachment 3 of Appendix E.

4.2 ANCHORAGE REGIONAL LANDFILL

This section presents the evaluation of options selected to be further considered for the ARL which include landfill operations improvements, expansion options LFG utilization and exportation of MOA refuse when ARL capacity is exhausted.

4.2.1 Anchorage Regional Landfill Operations Improvements

As discussed in Section 3.1, several operational improvement options were identified for the ARL including:

- ADCs;
- Soil Recovery;
- Redesign of Refuse Cells;
- Temporary Scrim Cover;
- Revised Final Grading Plan; and
- Interim Storm Water Basins.

The above options were evaluated for applicability and feasibility for SWS. Criteria considered in the evaluation of the ARL facility options, where applicable, included:

- Capacity/Cost Savings – The estimated amount of airspace that can potentially be conserved on a cubic yard basis or potential cost savings in $ per year.
- Immediate Capital Cost – Cost for capital purchase, installation and construction.
- Future Operating/Replacement Cost – Cost for operation and maintenance of disposal facility option.
- Technical/Operational/Environmental Permitting Feasibility – Feasibility of implementing option due to technical operational, and/or environmental permitting challenges.

Table 4.2-1 presents the results of the evaluation based on the above criteria along with the time frame in which these options should be initiated.

Table 4.2-1: Anchorage Regional Landfill Operations Improvements Evaluation

Criteria					
Option	Capacity/Cost Savings	Immediate Capital Cost	Future Operating/ Replacement Cost (Annual $)	Technical/Operational/ Environmental Permitting Feasibility	Term (Short, Medium, Long)
Operations					
Reusable Geosynthetic Fabric (Tarps) as ADC	104,200 cy/year (airspace saved, and soil excavation avoided)	Estimated initial purchase price of $50,000 for tarps with deployment system	Keep two to three tarps on hand and replace one every 3 months for $3,250 each Annual budget cost = $13,000	ADEC approval required	Short
Non-reusable Polyethylene film as ADC	104,200 cy/year (airspace saved, and soil excavation avoided)	EPI Deployer Model 800 = $289,000 (new). Each roll of film covers 93,500 sq. ft (22 working faces) and costs $2,600 Additional cost may be required for ballast material.	EPI Deployer Model 800 = $289,000 (new). Assume that the Deployer is replaced every 10 years Annual budget cost = $28,900	ADEC approval required	Short
Synthetic Spray as ADC	104,200 cy/year (airspace saved, and soil excavation avoided)	Rubber-tired, towed Finn LF-120 = $70,000 (new).	Replace Finn LF-120 every 5 years (budget $14,000/year) Spray costs $12.50 / bag which totals about $23,000 / year Annual budget cost = $37,000	ADEC approval required	Short

Criteria					
Option	Capacity/Cost Savings	Immediate Capital Cost	Future Operating/ Replacement Cost (Annual $)	Technical/Operational/ Environmental Permitting Feasibility	Term (Short, Medium, Long)
Operations (Continued)					
Soil Recovery	26,000 cy / year (airspace saved, and soil excavation avoided)	$0	$0	No approval needed.	Short
Working Face Controls	Varies	$1,000 / year expenses and additional hour/day from manager or foreman	$1,000 / year expenses and additional hour/day from manager or foreman (approximately $17,000/year[9]) Annual budget cost = $18,000	No approvals needed. Additional management time.	Short
Engineering and Planning					
Re-design Refuse Cells	Potential cost savings of $600,000 to $1,200,000 with smaller refuse cells (4 remaining cells versus 2) and reduction in leachate generation.	N/A	$200,000 engineering and permitting for two additional cells.	ADEC approval required. Design modification.	Medium

[9] Assumes $135,000 FTE.

Criteria					
Option	**Capacity/Cost Savings**	**Immediate Capital Cost**	**Future Operating/ Replacement Cost (Annual $)**	**Technical/Operational/ Environmental Permitting Feasibility**	**Term (Short, Medium, Long)**
Engineering and Planning (Continued)					
Temporary Scrim Cover	16,500,000 gallons / acre / year potential reduction in leachate generation for future cells (19 acres). Leachate treatment cost savings of up to $52,250 acre /year[10] (assuming $0.045/gallon for leachate management).	Scrim material $15,600 / acre; Installation $6,600 / acre (immediately following cell construction). Total annual cost = $22,200	Material $15,600 / acre, Installation $6,600 / acre (following each future cell construction) Total annual cost = $22,200	ADEC approval required. Operating Plan modification needed.	Short
Interim Storm Water Basins	Not applicable	$50k to $100k per basin	$50k to $100k per basin	ADEC approval required. Design modification needed.	Medium

[10] Assumes $0.045/gallon for leachate processing (2016 cost data plus 2% inflation)

Alternative Daily Cover Airspace Savings Calculations: The following describes how the capacity and cost savings were calculated.

- The measurements below were determined for the period between aerial surveys conducted on 10/5/16 and 9/26/17 and furnished by SWS (in DensityCalcs.xls spreadsheet):
  - Airspace filled with waste and cover soil 452,700 cy
  - Waste landfilled 300,807 tons
  - Daily and intermediate cover soil used 153,208 cy
  - Cover ratio (cover soil volume / airspace filled) = 153,208/452,700 = 0.34
  - Airspace Utilization Factor (AUF) 300,807/452,700 = 0.66 tons of waste per cy of airspace filled = 1,329 lbs. / cy
- For a 51 week (approximately 51 weeks between the 2016 and 2017 aerial surveys), 6 day/week operation, this corresponds to the following daily units:
  - Airspace filled with waste and cover soil 1,479 cy/day
  - Waste landfilled 983 tons/day
  - Daily and intermediate cover soil used 501 cy/day
- Daily and Intermediate cover proportions (for alternative daily cover savings calculations): Daily cover 68%, Intermediate cover 32%, Assumes a recommended daily landfill cell at 100 ft wide, 10 ft deep and 40 ft long (advance direction), with a slope length of 41 ft. This size cell is based on an average daily airspace consumption of 1,479 cy. During peak operating days it is recommended that the daily cell be deeper as opposed to wider to limit potential infiltration and reduce cover soil use.
- The airspace savings was calculated as follows: (daily and intermediate cover used in approximately one year) x (proportion of daily cover) = 153,200 cy x 0.68 = 104,176 => rounded to 104,200 cy.

For the first three cases of ADC in Table 4.2-1, an annual airspace/excavation savings of 104,200 cy/year is estimated, the corresponding daily and intermediate cover ratio becomes 14% (cover soil volume / airspace filled), or 3.5 tons of waste per 1 ton of soil. For the Soil Recovery option in Table 4.2-1, the corresponding daily and intermediate cover ratio becomes 30%, or 1.35 tons of waste per 1 ton of soil.

Alternative Daily Covers: ADCs have proven beneficial in minimizing the cost of importing soil, excavation and transport of on-site soil (to the landfill working face from the soil borrow area) and reducing airspace consumption. SWS plans to purchase tarps and pilot them in the near future and also uses construction debris, green waste, and snow as ADC at various times. It is recommended that snow no longer be used as a daily cover option as it contributes to leachate generation when it melts. Various types of ADCs were evaluated including geosynthetic fabric tarps, non-reusable polyurethane film, and synthetic spray.

- Tarps are made of a heavy 9.43 oz., 20.5 mil. polypropylene fabric that is reinforced with high strength webbing on all exterior sides and every 25-feet of the interior of the tarp. The corners are also structurally reinforced with webbing. The reinforcement webbing is 2.75-inches in width and can withstand approximately 15,000 pounds of tension. Seams and reinforcement webbing are stitched with high-stress polyester thread. Pull straps are provided every 25-feet on two sides. Two bulldozers attach the pull straps to hooks on their blades and pull the tarp over the working face to cover all exposed waste (Figure 4.2-1). Tarps are weighed down around their perimeter with soil placed by a loader or excavator. Tarps can be deployed by landfill equipment (source: Space Savers) or specialty tracked machines/deployment systems (source: Tarp Armor).

Figure 4.2-1 Tarp Placement as ADC

- Non-reusable polyurethane film is being used successfully in cold climates (source: Environmental Products, Inc. – EPI). The film is spread over the exposed working face with specialized equipment (e.g. EPI Deployer Model 800) which also provides ballast and seals at panel overlaps to create a continuous impermeable barrier between waste and the surrounding environment. This type of cover remains in place and after being covered is mechanically destroyed by subsequent placement of waste and further deteriorates by stress conditions within the landfill, resulting in no intervening barriers within the landfill to impede the movement of leachate and gas for collection and treatment. This type of system may require availability of ballast material.
- Synthetic spray-on materials can reduce infiltration, odor and vector intrusion. Spray-on daily cover is easily applied to a landfill working face by spraying with special application equipment similar to a commercial hydro-seeder, typically pulled by a bulldozer. The sprayed material is a blend of cellulose fiber mulch and a binding agent that forms a slurry when mixed with water. The mulch is manufactured from recycled fiber stock (mixed papers) and the binding agent is a synthetic tackifier. It is typically packaged in 50-lb. plastic bags, with a nominal bag size of 12"x15.5"x36". Shipments typically consist of 660 bags per load.

Soil Recovery: For soil recovery, a dozer is used to remove daily cover each morning. Stripped cover may contain some waste and should be used as the first layer of daily cover. Some clean soil will be needed when cover is applied each night. For annual airspace savings calculations, it was assumed that 50 percent of the prior day's cover soil is removed and reused and that soil recovery from daily cover is not feasible during snowy, inclement weather (six months per year). The airspace savings was calculated as follows: (Daily & intermediate cover used in six months) x (proportion of daily cover) x (50% of prior daily cover reused) = (153,200/2 cy) x 0.68 x 0.50 = 26,044 => rounded to 26,000 cy.

Reusing soil that was placed as daily or intermediate cover can benefit in four ways:

- For any soil that is recovered, airspace is created, and cell lift depth is extended.
- The soil is already located at the working face, so it does not need to be excavated or transported from a stockpile which reduces operating expenses.

- Removing the soil barrier prevents leachate mounds from developing, which reduces the potential for side slope seeps. It also promotes better gas movement and collection.
- Removal of cover soil on slopes (especially intermediate cover) eliminates a potential sliding plane (with friction reduced by leachate) and improves slope stability.

Working face controls: Working face controls can be employed to minimize the size of a safe working face, optimize compaction, and minimize the volume of cover soil used. Controls include:

- Manager or foreman stakes the boundaries of the working face before tipping starts each day, based on the expected daily waste intake. This keeps the face moving in the desired direction and helps maintain a small working face. Estimated expenses are for stakes, flagging, and measuring equipment.
- Before applying cover at the end of the day, compact the surface with a heavy bulldozer to flatten the irregularities caused by the compactor. A smoother surface makes installation of tarps safer and reduces the potential for damage. It also reduces the volume of soil or spray cover needed to fill compactor depressions.
- SWS tracks the volume of cover soil used. If not already done, records should be reviewed during Annual Volume Calculation Reviews and compared to excavated volumes. Daily and intermediate cover ratios have ranged from 31 to 37 percent in the last 10 years. Goals can be established, and progress checked after each annual volume calculation. Based on the 34 percent measured in 2017, a 30 percent goal is reasonable in the near term.
- Quarterly topographic surveys of the working face can be conducted to measure operational AUF and compare to established AUF goals. When AUF values fall, additional monitoring of working face operations is warranted. However, care should be taken when calculating AUF to ensure that surveyed volumes represent areas active during the prior quarter and that waste weights received from one quarter to the next are comparable (e.g., contaminated soil will lead to a higher numerator than the same volume of MSW).

Re-design Refuse Cells: Reducing the size of future refuse cells delays capital improvement expenditures and reduces potential leachate generation. There are two remaining cells to be constructed at the ARL which comprise a total of approximately 30 acres and are assumed to provide approximately 10 years of capacity each. For ease of calculation, it was assumed that each cell is equally sized at 15 acres each and would each cost $5.7 million, based on the Cell 11/12-unit construction costs of approximately $380,000/lined area. If the remaining acreage were broken into 4 cells with 7.5 acres of liner and 5 years of capacity each, the cost would be approximately $2.85 million. The time value of money of delaying spending $2.85M per cell (in 2018 $) for 5 years is approximately $300,000 to $600,000 based on a two to four percent interest rate (accounting for one percent annual average inflation). The additional design cost would be approximately $100,000, for a net savings of $200,000 to $500,000. By doing this twice, the total savings for breaking up the remaining cells could be $400,000 to $1M. Smaller cells would also reduce potential leachate generation as the smaller cell would be covered by refuse sooner which reduces the potential for storm water to enter the leachate collection system through the exposed liner. Some landfill operators design cells with 1.5 to 2 years of capacity. To do this at the ARL, a phasing plan can be prepared based on waste intake and airspace consumption versus time and determination of the optimum size and location of the next cells considering access roads, interim drainage, and interim slope angles. The phasing plans can become part of a Master Development Plan for the site which should also considers optimizing final landfill grades based on an updated slope stability analysis.

Temporary Scrim Cover: Scrim covers anchored in place over newly constructed leachate collection system (LCS) gravel blankets or protective cover (soil) layers prevent storm water intrusion directly into the LCS. In reviewing a histogram of leachate collection from the site (see Figure 4.2-9), there are relatively large changes in leachate production within a calendar year, which indicate short circuiting of the leachate collection system, and even larger sustained differences in production that are sustained over time. Based on data review and discussion of operations with SWS staff, there appears to be several factors that contribute to these relatively large spikes in production including: annual precipitation patterns (record snowfall and rain), lack of fine grain soils for use on operations/daily/intermediate soil layers, use of snow as daily/intermediate cover layer, inadequate drainage away from the waste cell, previous leachate injection (no longer performed), and increased waste footprint. While not all of these factors can be readily addressed, one of the main factors for short circuiting is likely that precipitation is allowed to collect over recently constructed liner expansion areas as precipitation directly enters the LCS through the exposed highly permeable rock layer that serves as both the operations and leachate collection layer.

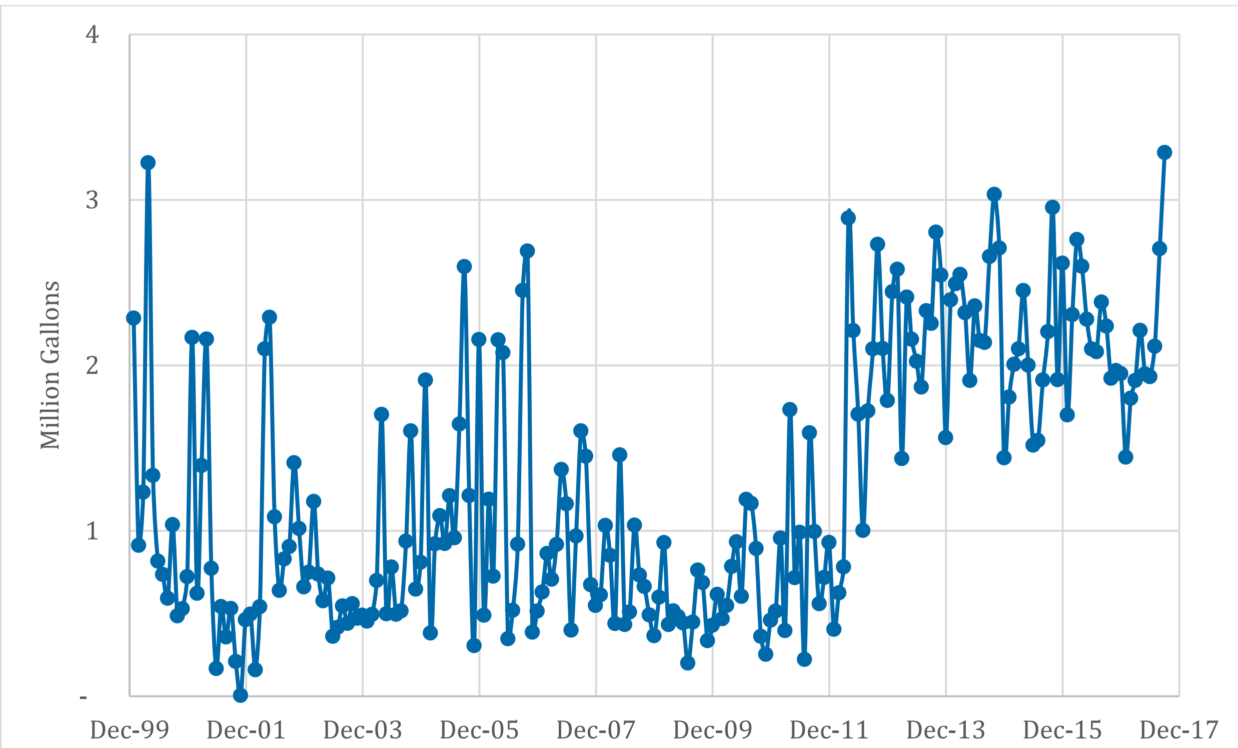


Figure 4.2-9: MOA Leachate Collection

Reducing exposure of the operations/LCS layer with a temporary scrim cover should address short circuiting of the system. The temporary scrim cover would only need to be installed over exposed slope liner, as the base of the cell should be immediately filled with a minimum of one lift of refuse which would greatly reduce leachate infiltration on the base. As an example of potential for cost savings, if a temporary scrim cover was installed on the exposed slopes of Cell 11/12, a leachate treatment cost savings of approximately $522,500 could be realized based on the following assumptions:

- Cell 11/12 slope area is approximately 10 acres

- Potential leachate generation roughly calculated at 555,000 gallons/acre/year based on annual average rainfall and snowfall
- It will take approximately 5 years to cover the Cell 11/12 slopes with waste
- A total of 16,500,000 gallons of storm water/snow melt would be diverted from the LCS based on reduced slope exposure, as follows:
    - Year 1 – 10 acres x 550,000 gallons/acre = 5,500,000 gallons
    - Year 2 – 8 acres x 550,000 gallons/acre = 4,400,000 gallons
    - Year 3 – 6 acres x 550,000 gallons/acre = 3,300,000 gallons
    - Year 4 – 4 acres x 550,000 gallons/acre = 2,200,000 gallons
    - Year 5 – 2 acres x 550,000 gallons/acre = 1,100,000 gallons
- Leachate treatment cost avoided = $0.045/gallon x 16,500,000 gallons = $742,500
- Scrim installation cost = $22,000/acre[1] x 10 acres = $220,000
- Potential cost savings = $522,500 for Cell 11/12 or approximately $52,250/acre

Cell 9 has approximately 5 acres of slope liner so assuming it will also take 5 years to cover the slopes with refuse, the potential cost savings for Cell 9 would be approximately $261,250 ($52,250/acres x 5 acres).

The actual cost savings would depend on how long the scrim is in place which is dependent on cell configuration, fill phasing and waste inflow rates. The above scenario is based on the scrim being in place for an average of 2.5 years with the break-even average time frame at 1.13 years.

Notes:

1. Potential leachate generation calculation based on historical climate data from 1981-2010; average annual rainfall total is 16.57 inches and the average annual snow fall is 74 inches for Anchorage Alaska. Snow to liquid ratio varies, a value of 10:1 was assumed; average annual snow fall equates 7.4 inches of water. The combined rain and snow fall equate to 23.97 inches of water, applied overran acre equates to 650,000 gallons per acre. It was assumed that approximately 15% of the water would evaporate, resulting in 550,000 gallons per acre used in the cost savings analysis.
2. Material and installation unit costs for a scrim cover and ballast system are: Dura-Scrim material $0.166/sq. ft. and installation $0.082/sq., ft., Wind Defender material $0.191/sq. ft. and installation $0.07/sq. ft. for a total cost of approximately $22,000/acre (source of prices is TT-AEG).

Revised Final Grading Plan: Tetra Tech has developed an alternative final grading plan which is similar in design to that discussed in Section 1.5, however, the slopes have been steepened to 2:1 horizontal to vertical (see Figure 4.2-2). This final grading plan provide an additional 9,680,000 cy of airspace as compared to the previous 2011 final grading plan (see Figure 1-14) and an additional 7,300,000 cy as compared to the 3:1 final grading plan (see Figure 1-15). Based on the 2:1 final grading plan there is approximately 37,570,000 cubic yards of gross remaining airspace (as of 2012). Assuming a 0.60 AUF, the remaining life of the landfill would be 52 to 65 years from 2017 and the anticipated closure date would be between 2070 and 2082 (Tables 4.2-2 and 4.2-3) based on projected disposal tonnages presented in Figure 1-13. In order to support the steeper final slope configuration, an alternative final cover design and corresponding slope stability analysis need to be performed.

Interim Storm Water Basins: Temporary lined storm water basins with pumps and diversion berms to minimize leachate generation may be needed as the landfill becomes fully lined. The landfill should continue to be designed and operated to promote storm water runoff and prevent ponding on daily and intermediate cover. Construction costs for basin construction can range from $50,000 to $100,000 per basin. Stormwater basin construction should be completed before adjacent cell excavation begins. The operating cost is estimated at $1,500 purchase price for a 3-inch gasoline-powered pump (300 gpm, fuel consumption 0.5 gal/hour) and minimal fuel consumption.

4.2.2 Anchorage Regional Landfill Expansion

Two expansion options have been considered for the ARL; a North Addition expansion area and a West Addition expansion area (see Figure 4.2-3). The following sections describe each expansion option. The North Addition expansion area is eliminated from further consideration at this time due to significant environmental, technical and operational constraints. Capacity and capital costs are estimated for the West Addition expansion area in addition to an assessment of permitting, technical and operational constraints.

4.2.2.1 North Addition Expansion Area

The north expansion area boundaries considered were the north boundary of the ARL, the Glenn Highway, Pole Line Road and extending approximately 2,500 feet north of the ARL, for a total area of approximately 285 acres (see Figure 4.2-3). The north expansion area consists of two plateaus bisected by Fossil Creek drainage which runs north-south. The following discusses the environmental constraints, land use and zoning, and required permitting (including involvement of key stakeholders) to be considered for the north expansion.

Environmental Impacts

- **Seismic.** The north expansion area is in low to moderate-low seismic hazard zones (Zones 1 and 2). MOA Geotechnical Advisory Commission (GAC) acts in an advisory capacity on issues relating to natural hazards risk mitigation, including in areas designated with high or very high (Zones 4 or 5) susceptibility to seismically induced ground failure per AMC 21.02.080. It is unlikely that expansion of the ARL in the north expansion area will require a review by the GAC, due to its hazard zoning (1 and 2).
- **Wetlands and Floodplains.** The north expansion area is not encumbered by wetlands and is not within a floodplain (see Figure 4.2-4). The portion of Fossil Creek that bisects the north expansion area is an ephemeral stream that flows west to Lake Kiowa. Coordination with the MOA Watershed Management Services (WMS) and the United States Army Corp of Engineers (USACE), including a Section 10-404 permit, will be required to realign this portion of Fossil Creek. A Section 401 Water Quality Certification is typically permitted concurrently with a USACE wetland permit.
- **Avalanche Hazards.** There is no data of historic avalanche zones in the north expansion area. The GAC acts in an advisory capacity regarding proposed development located in high or moderate snow avalanche hazard zones per AMC 21.02.080. It is unlikely that development of the north expansion area will require a review by the GAC.
- **AWWU Water Line.** The north expansion area is bisected by the AWWU Hiland Road Intertie (see Figure 4.2-5), which is a 24-inch diameter ductile iron transmission water main. Relocating a transmission main is a significant undertaking, typically at a cost of $1,000 per foot for pipe relocation. Dependent on location and extent of work, relocation of a booster station (#64) and/or pressure reducing valves may also be needed. These facilities can cost up to an estimated $2M. The Hiland Road Intertie was

constructed to serve the area east of the Glenn Highway, and any relocation of the waterline would have to tie in to this same location.

Land Use

- **Zoning.** The north expansion area is zoned Transition (TR) District and is surrounded by lands zoned TR District (see Figure 4.2-6). Industrial uses are considered a "noxious, injurious, or hazardous use" and are subject to a conditional use permit in the TR District. It is the MOA's intent to rezone parcels zoned TR District to a more appropriate classification, as decided by the Municipality. Until then, all development in the TR District is subject to the standards of AMC Title 21 as adopted in 2009 (Old Code). Per AMC 21.40.240, the intent of the TR District is to include suburban and rural areas that are not developing and are not expected to be developed in the immediate future along definitive land use lines. The permitted uses in these districts are intended to be as flexible as possible.
- **Applicable Area Plans.** The Chugiak-Eagle River Comprehensive Plan Update (CER Plan), adopted by the Anchorage Assembly in 2006, is a guiding document for the region, including the ARL and the north expansion area, that provides updated goals, objectives, policies, and strategies for development and growth in Chugiak-Eagle River. The CER Land Use Plan does not specifically classify the north expansion area but classifies the ARL as a Community Facility. The Community Facility classification is intended for active public and institutional uses. Section IV of the CER Plan, Public Facilities and Services, provides goals, objectives, and policies for Solid Waste and Recycling. The CER Plan states that the goal for solid waste and recycling is to "ensure the provision of safe, sanitary and environmentally clean solid waste collection and disposal services along with waste reduction, reuse, and recycling strategies."

Entitlements

- **Conditional Use.** As an Industrial use, a sanitary landfill is considered a noxious, injurious, or hazardous use, and therefore is a conditional use in the TR District. It is likely that the landfill is considered a de facto conditional use, but further coordination with the MOA Planning Department will need to be done if an expansion is pursued. A minor amendment to the de facto conditional use can be approved by the Planning Director, but major amendments require a public hearing and approval by the Planning and Zoning Commission.
- **Site Selection Process.** Per AMC 21.15.015 (Old Code), the Planning and Zoning Commission shall review and make recommendations regarding the selection of a site for a public facility, except where the location of the site is:
  - designated for the subject use on a municipal plan adopted by the Assembly;
  - subject to approval of a conditional use under this title.

  A site selection study will likely not be required, as the site expansion is subject to approval of a conditional use.
- **Subdivision.** If desired, the north expansion area may be replatted with the existing ARL parcel to result in one lot, in accordance with AMC 21.03.200C.

Permitting

The state of Alaska through the Alaska Department of Environmental Conservation (ADEC) has implemented an approved state program and regulations for solid waste management in Title 18, Chapter 60 of the Alaska

Administrative Code (18 AAC 60). Any changes to the ARL that may be considered for the ISWMP (including expansion, revised grading, capacity increase, additional ADCs) will likely involve a modification/revision to the existing Solid Waste Permit No. SW1A001-22 issued by the ADEC in accordance with 18-AAC-60. Additionally, the Anchorage Municipal Code (AMC) provides for regulations pertaining to landfill operations in Title 21, Chapter 21.05. Title 21, Chapter 21.05.060(E)(6) includes general requirements for landfills including set-backs, run-off containment and treatment, nuisance control and required compliance with 18 AAC 60.

Regarding federal standards for air emissions, the EPA has initiated Title 40 of the Code of Federal Regulations (40 CFR), Part 60, subpart XXX (effective date October 28, 2016) which updates the Standards of Performance for Municipal Solid Waste Landfills. The standards for municipal solid waste landfills applies to landfills that commence construction, reconstruction, or modification after July 17, 2014. The ARL is currently required to comply with 40 CFR, Title 60, subpart WWW pursuant to the site's Title V Air Quality Operating Permit. Should an expansion of the landfill be proposed that increases the current design capacity, the ARL would be required to comply with subpart XXX upon initiation of construction of expansion areas. Subpart XXX does not replace subpart WWW which compliance would also still be required.

Stakeholders

Key stakeholders to consider during a permitting and approval process for the north expansion area of the ARL include, but are not limited to the following:

- United States Army and Air Force, JBER, Department of Defense (DOD)
- Eklutna Native Corporation, Inc.
- The Native Village of Eklutna
- Bureau of Land Management
- Alaska Mental Health Trust
- Heritage Land Bank
- MOA Real Estate Services
- State of Alaska
- South Fork Community Council

A key stakeholder for seeking approval of an expansion to the ARL is JBER/DOD who is the lease holder for the expansion area. The time frame for processing such a request is significant, on the order of 15 years or more. A second key stakeholder is the Eklutna Native Corporation and compliance with the NALA, which is an agreement between the MOA, State and Eklutna Native Corporation that controls any land transfers from the military to private or public entities. Implementation of this agreement has been difficult since its inception and will add considerable legal and financial expense.

Technical (Design)/Operational Constraints

In a previous evaluation performed by SWS summarized in a memorandum dated October 27, 2015 entitled "Potential Expansion of the Anchorage Regional Landfill", the following significant constraints were identified for the northern expansion area:

- The western plateau, north of the AWWU water line, contains a CERCLA hazardous waste cleanup site and an ephemeral stream.
- The western plateau, south of the AWWU water line, is separated from the ARL topographically by the Fossil Creek drainage and would require significant improvements for access and separate leachate and landfill gas management systems which would add to the development costs.
- The eastern plateau is a potential for expansion; however, the AWWU water line and the location of the ARL administration facilities would require the landfill to be developed as isolated units instead of one contiguous facility increasing the development cost and limiting the potential airspace capacity.

The northern expansion area, therefore, is not considered a viable potential expansion area.

4.2.2.2 West Addition Expansion Area

The West Addition expansion area is a polygonal area bounded by the ARL property line on the east, the MEA power liner corridor on the north, Pole Line Road on the west and the Davis Highway on the south (see Figure 4.2-3). SWS maintains a long-term gravel storage pile on 49 acres in the eastern half of the West Addition expansion area. The Doyon Landfill Gas Power Plant is located in the southeast corner of this area. The southern portion of this parcel is predominantly upland plateau. The West Addition expansion area would be approximately 220 acres and would create approximately 40.4 mcy of airspace based on the floor grading and final grades prepared by Bristol Engineering Services Corporation which are shown on Figures 4.2-7 and 4.2-8. An estimated 45 years of additional site life would be provided with the West Addition expansion assuming a 0.8% population growth and AUF = 0.60 tons/cy (see Table 4.2-4 – Diminishing Capacity). Rough Order of Magnitude conceptual capital cost estimates were developed for the West Addition expansion (see Table 4.2-5) including closure and post-closure costs (in 2018 dollars).

The following discusses the environmental constraints, land use and zoning and required permitting and stakeholders to be considered for the West Addition expansion.

Environmental Impacts

- **Seismic.** The West Addition expansion area is in a low to moderate-low seismic hazard zone (Zones 1 and 2). The GAC acts in an advisory capacity on issues relating to natural hazards risk mitigation, including in areas designated with high or very high (Zones 4 or 5) susceptibility to seismically induced ground failure per AMC 21.02.080. It is unlikely that expansion of the ARL in the West Addition expansion area will require a review by the GAC, due to its hazard zoning (1 and 2).
- **Wetlands and Floodplains.** The West Addition expansion area is not encumbered by wetlands and is not within a floodplain (see Figure 4.2-4). Development of the West Addition expansion area will likely not impact Fossil Creek.
- **Avalanche Hazards.** There is no data of historic avalanche zones in the West Addition expansion area. The GAC acts in an advisory capacity regarding proposed development located in high or moderate snow avalanche hazard zones per AMC 21.02.080. It is unlikely that development of the West Addition expansion area will require a review by the GAC.

Land Use

- **Zoning.** The West Addition expansion area is zoned Transition (TR) District and is surrounded by lands zoned TR District (see Figure 4.2- 6). Industrial uses are considered a “noxious, injurious, or hazardous use” and are subject to a conditional use permit in the TR District. The TR District was not updated as part of the 2014 AMC Title 21 Rewrite adoption. It is the MOA’s intent to rezone parcels zoned TR District to a more appropriate classification, as decided by the Municipality. Until then, all development in the TR District is subject to the standards of AMC Title 21 as adopted in 2009 (Old Code). Per AMC 21.40.240, the intent of the TR District is to include suburban and rural areas that are not developing and are not expected to be developed in the immediate future along definitive land use lines. The permitted uses in these districts are intended to be as flexible as possible.
- **Applicable Area Plans.** The CER Land Use Plan classifies the West Addition expansion area as a Community and Facility use. The Community Facility classification is intended for active public and institutional uses. Section IV of the CER Plan, Public Facilities and Services, provides goals, objectives, and policies for Solid Waste and Recycling. The CER Plan states the goal for solid waste and recycling is to “ensure the provision of safe, sanitary and environmentally clean solid waste collection and disposal services along with waste reduction, reuse, and recycling strategies.”

Entitlements

- **Conditional Use.** As an Industrial use, a sanitary landfill is considered a noxious, injurious, or hazardous use, and therefore is a conditional use in the TR District. It is likely that the landfill is considered a de facto conditional use, but further coordination with the MOA Planning Department will need to be done if an expansion is pursued. A minor amendment to the de facto conditional use can be approved by the Planning Director, but major amendments require a public hearing and approval by the Planning and Zoning Commission.
- **Site Selection Process.** Per AMC 21.15.015 (Old Code), the Planning and Zoning Commission shall review and make recommendations regarding the selection of a site for a public facility, except where the location of the site is:
  - designated for the subject use on a municipal plan adopted by the assembly;
  - subject to approval of a conditional use under this title.

  A site selection study will likely not be required, as the site expansion is subject to approval of a conditional use.
- **Subdivision.** If desired, the West Addition expansion area may be replatted with the existing ARL parcel to result in one lot, in accordance with AMC 21.03.200C.

Permitting

As discussed in Section 2.2.1, a modification/revision to the existing Solid Waste Permit No. SW1A001-22 issued by the ADEC in accordance with 18-AAC-60 will most likely be required for the West Addition expansion as well as compliance with general requirements for landfills in Title 21 of the AMC. 40 CFR, Part 60 requirements for air emissions must also be complied with for the West Addition expansion.

Stakeholders

Key stakeholders to consider during a permitting and approval process for the West Addition expansion area of the ARL include, but are not limited to the following:

- United States Army and Air Force, JBER/DOD
- Eklutna Native Corporation, Inc.
- The Native Village of Eklutna
- Bureau of Land Management
- Alaska Mental Health Trust
- Heritage Land Bank
- MOA Real Estate Services
- State of Alaska
- South Fork Community Council

A key stakeholder for seeking approval of an expansion to the ARL is JBER/DOD who is the lease holder for the expansion area. The time frame for processing such a request is significant, on the order of 15 years or more. A second key stakeholder is the Eklutna Native Corporation and compliance with the NALA, which is an agreement between the MOA, State and Eklutna Native Corporation that controls any land transfers from the military to private or public entities. Implementation of this agreement has been difficult since its inception and will add considerable legal and financial expense. However, acquisition of this West Addition expansion area should be less challenging than the North Addition expansion area in that it was included in the original Congressional appropriation in 1986 and has already been approved in the NALA process as part of a lawsuit settlement brought by the Eklutna Native Corporation over landfill gas revenues.

Technical (Design)/Operational Constraints

In a previous evaluation performed by SWS summarized in a memorandum dated October 27, 2015 entitled "Potential Expansion of the Anchorage Regional Landfill", the following significant constraints were identified for the West Addition expansion area:

- A proposed leachate disposal pipeline is being considered that would extend from the existing leachate ponds located in the northwestern portion of the existing landfill along the entire western limit of the existing landfill. If a leachate disposal line is located in this area, the west expansion area would be impacted if separate fills are required to accommodate the alignment.
- Future height restrictions based on the Bryant Army Airfield clear zone may require modifications of the final grades.
- A significant stakeholder for approval of the expansion area is JBER.

Time Frame for Expansion Permitting

The time frame for expansion of the ARL is considered a long-term option due to the permitted remaining site life of the facility which is 2062 (high population growth projection) to 2070 (low population growth projection) based on the revised Final Grading Plan (2018 – see Figure 1-15) prepared by Tetra Tech and utilizing an airspace utilization factor (AUF) of 0.60. For planning purposes, the ARL expansion process should be initiated 20 to 25 years prior to the anticipated date that capacity is projected to be depleted to allow time for design, approvals, permitting and construction. The actual start date for expansion of the ARL may need to be adjusted should various ARL operations options and/or diversion programs be instated that prolong the site life of the facility.

4.2.3 Export of MOA Refuse

Once the ARL reaches its permitted capacity, export of MOA refuse may occur if a landfill expansion is not approved or if an alternative technology facility is not available for the MOA. Geographically, the next nearest landfill for the MOA, Matanuska-Susitna Borough, is located in Palmer, Alaska which is located approximately 27 miles north of the ARL. According to the 2014 landfill development plan, the Matanuska-Susitna Borough Central Landfill has 56 MCY of gross airspace or over 150 years of capacity. Once ARL reaches capacity in 2062 (high population growth) or 2070 (low population growth), and assuming an agreement could be reached with MSB, the waste could be exported in transfer trucks. It is estimated to cost approximately $11.75 per ton for trucking and $262 per ton for tipping (current MSW residential rate for waste generated outside the MatSu Borough) for a total disposal cost of $273.75 per ton. Trucking costs were based on the following: 34.6 miles one way, two hours round trip, $76.23/hour for a 5-axle truck (Caltrans Equipment Rental Rates), driver rate of $54.46 (prevailing wage) and a truck capacity of 22 tons.

4.2.4 Landfill Gas Utilization

4.2.4.1 Proposed LFG Utilization Options

The ARL has an active LFG GCCS in operation, with a current flow rate of approximately 2,400 scfm at a normalized methane content of 50 percent by volume (50% CH_4). The GCCS controls LFG generated by waste disposed at the ARL for environmental protection, but also provides fuel for a third-party electrical generating facility owned and operated by Doyon.

The future LFG recovery potential at the ARL will exceed the full processing capacity of the existing Doyon facility (2,400 scfm). A number of options outside the scope of the current Doyon contract have been reviewed to determine the potential viability and relative level of benefit to SWS as part of this ISWMP.

Four (4) utilization options for SWS beneficial use of LFG were considered, as noted below.

- Direct Thermal Use (Medium BTU);
- Electrical Generation;
- Compressed Natural Gas (CNG) Local; and,
- RNG Pipeline Injection.

Tetra Tech's high-level options evaluation discussed in Section 3.2 determined that LFG conversion to electrical generation and CNG local were the most viable options for continued development as they were the highest ranked options for the criteria used (achieved a score of 20 or more).

4.2.4.2 Selected LFG Utilization Options

As noted previously, the two primary options for LFG utilization were found to be Electrical Generation for export to JBER and CNG vehicle fuel generation for SWS usage. These options are explored in greater detail below.

Electrical Generation - Export

As part of discussions with SWS, it was learned that Doyon had expressed an interest in expanding their existing facility, to include two additional 2.8 MW generators. The addition of these generators would increase LFG consumption from the current level of approximately 2,000 scfm to approximately 3,500 scfm and increase the gross power output from 7 MW to approximately 12.6 MW (see Figure 4.2-10).

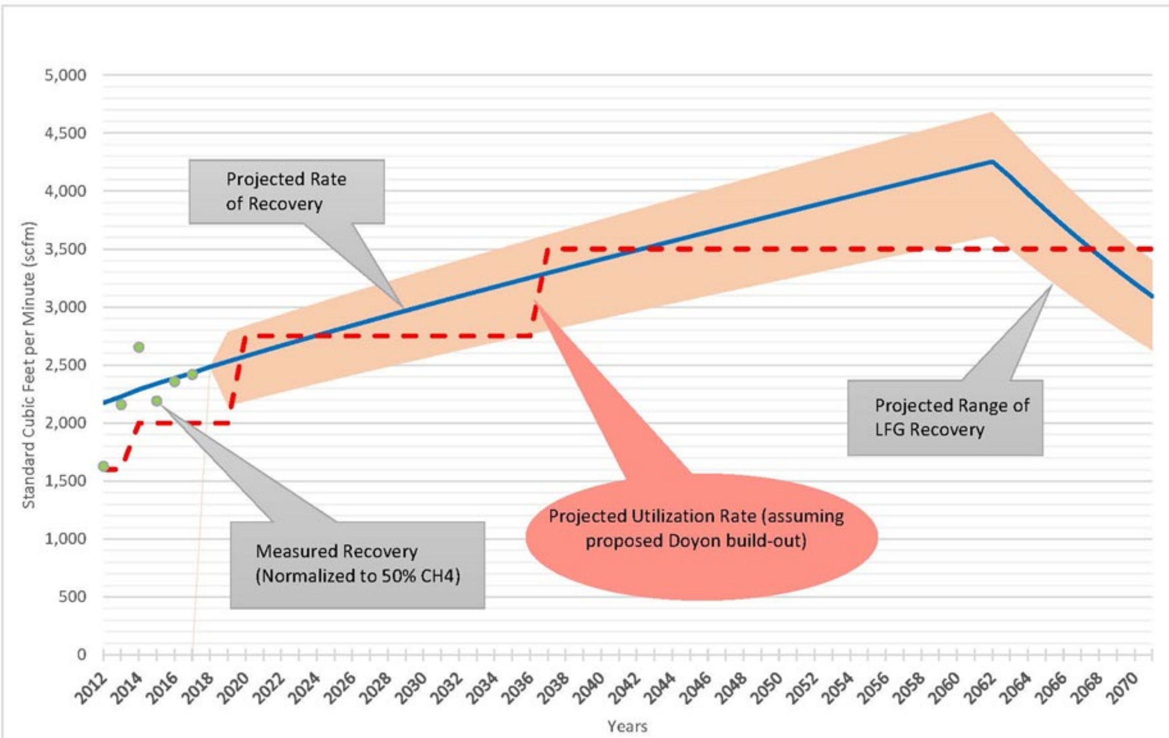


Figure 4.2-10: Landfill Gas Utilization Projection

It is understood that the current customer for generated electricity (JBER) has the capacity to take all existing and proposed generated power from the Doyon facility, and that Doyon is currently working towards the development of a long-term agreement with JBER in that regard.

Electrical Generation - Local

If surplus generated power is available for use by SWS, there are a number of applications that would potentially benefit from a source of on-site electrical power. Primary among these is the provision of electric power to an on-site leachate lift station or leachate treatment facility as an alternative to continued off-site trucking of leachate for disposal.

Excess electricity production could also be utilized to re-charge electrical vehicles for SWS via an on-site charging station.

These options presume the availability of excess electrical power at some future date, as well as the development of additional leachate management infrastructure.

CNG Local

If an expansion of the Doyon facility is not realized, the utilization of excess LFG for the production of renewable CNG vehicle fuel is also a viable option. An excess LFG rate of 400 scfm, projected to be available in 2019 if the Doyon facility is not expanded, would yield approximately 1,700 diesel gallon equivalents per day. The production of alternative fuel on-site would offset, in part, the diesel fuel currently utilized in tanker trucks hauling leachate to the off-site disposal facility or could be used to power transfer trucks between the CTS and ARL.

Leachate Evaporation

Leachate evaporation systems, fired by medium-BTU LFG, are efficient options for long-term liquids disposal. It is estimated that a system designed to treat 90,000 gallons per day (consisting of two units, each treating 40,000 to 45,000 gallons per day) would require approximately 1,600 SCFM of LFG @ 50% CH_4. The upper limit of projected peak generation in 2062 is 4,680 scfm and the lower limit is 3,615 scfm. Therefore, use of LFG to power a leachate treatment facility is only feasible if the Doyon facility is not expanded. Assuming the Doyon facility remains at its existing capacity, ARL could install one of these units, and operate it at full capacity, in approximately 2028, with the second unit installed in approximately 2049.

4.2.4.3 Recommendations

Based on discussions with SWS and input they received from JBER representatives during development of this ISWMP, JBER representative indicated that they would like to move forward with expanding the existing Doyon LFG-to-energy facility. Therefore, the proposed expansion of the existing Doyon electrical generating facility is currently proposed for the SWS ISWMP. This option provides a sound, long-term opportunity for beneficially utilizing the resource that LFG affords:

- The infrastructure is substantially in place, including the interconnect to JBER, requiring only select upgrades as generating capacity increases;
- Wellfield and site operations are already designed for this beneficial-use option;
- The option can be implemented as soon as the LFG reserves are available; and
- Doyon is a local company with interests in the community.

A key factor in the expansion of the existing Doyon electrical generating facility is the commercial electrical rate structure. JBER purchases primary power from ML&P who recently revised their rates, significantly reducing the base cost of power to a point that expansion of the LFGTE is not now attractive. It is unknown if this rate structure will be maintained in the future. As mentioned in Section 4.2.4.2, if the Doyon facility expansion is not realized for utilization of excess LFG then the feasibility of producing CNG vehicle fuel or a leachate lift station or treatment system fueled by medium-BTU LFG is recommended to be explored. The feasibility study of the best beneficial use of LFG should consider the rate of LFG required for the end use as well as the availability of fuel, revenue and cost savings potential as well as capital and operating costs. Currently, SWS is investigating a leachate evaporator system which may have additional costs to mitigate odor.

4.2.5 Leachate Processing

SWS considered various options for leachate management which included;

- Connecting to the JBER sanitary sewer system to deliver leachate directly to the municipal sanitary system for disposal through AWWU Asplund WWTP at Point Woronzof.
- Constructing a separate pipeline along the Glenn Highway to deliver leachate directly to the municipal sanitary system for disposal through AWWU Asplund WWTP at Point Woronzof.
- Constructing a conveyance to deliver leachate to AWWU's Eagle River wastewater treatment plant (ERWWTP)
- Deep well injection of leachate, and
- Leachate evaporation.

Deep well injection was eliminated because of uncertainties associated with seismicity in the area and high cost. Disposal through the ERWWTP was eliminated as the facility is a tertiary biological treatment system with a relatively low throughput and stringent effluent standards. Concerns were raised that introduction of leachate could upset the biological treatment process and/or result in exceedance to effluent discharge standards. While the two alternatives to pipe the leachate for treatment at the Asplund WWTP would eliminate the practice of hauling by truck, anticipated changing discharge standards to the POTW will require significant improvements to the leachate treatment system prior to disposal.

In the most recent Industrial Discharge Permit for disposal to the AWWU system, effluent standards for zinc were reduced from 12 mg/L to 5.62 mg/L. Historically, SWS was able to consistently meet the older standard for zinc however the discharge would only meet the more stringent standard about 80 percent of the time. The Asplund WWTP operates under a 301(h) waiver from the USEPA which allows the plant to discharge after primary treatment and disinfection. AWWU has indicated that to maintain their 301(h) waiver they must control total discharges of biochemical oxygen demand (BOD) and total suspended solids (TSS) from their WWTP. BOD and TSS concentrations common to ARL leachate are relatively high (in excess of 2,000 mg/l and 5,000 mg/l, respectively) it is likely that additional, much more stringent discharge limits may be imposed on leachate discharge in the near future for these parameters. Continued discharge of leachate to the AWWU system will likely require significant upgrade to the leachate treatment system.

SWS conducted a Treatability Study to determine what process changes would be needed to meet current and potential new discharge standards. The study determined that adding a step to allow settlement of suspended solids in a quiescent pond prior to loading was sufficient to consistently meet the new, more stringent zinc standard. This could be accomplished using the existing ponds; providing aeration in the primary pond and allowing effluent to overflow into the secondary still pond for settling prior to loading in the trucks. Because of the age of the existing blowers and liner systems, and the need for more efficient solids removal it is estimated that upgrades to the existing pond system will cost $4,225,000.

The Treatability Study also considered alternatives to significantly reduce BOD and TSS concentrations in the discharge. The study considered various enhanced aeration schemes, as well as submerged fixed film and moving bed bioreactors. These alternatives were found to cost between $12.2 and $15.2 million for the treatment upgrades only without consideration of hauling or volume reduction efforts.

The leachate evaporation alternative that was considered for this study included an installed capacity to evaporate up to 100,000 gallons of leachate per day. The study recognized that during peak leachate generation periods this capacity is not adequate to process all leachate produced and wold need to be augemented with continued hauling and discharge to the AWWU system. The proposed scheme would have the advantages that:

- While not eliminating truck hauling, the number of trips hauled would be significantly reduce

- The significant reduction in volume discharged to the AWWU system would eliminate the need for significant pretreatment of the leachate. AWWU indicated that potential BOD and TSS limitation would likely be imposed on a total loading basis, thus by reducing the total volume of discharge the total loading would be proportionately reduced. Because the enhanced zinc standard is a numeric limit, treatment to meet this standard would still be required.

- The evaporation system would utilize any landfill gas not sold to Doyon Utilities. The constructed system would include additional blower capacity to the GCCS for collection and control of landfill gas at the site.

The estimated cost to install the proposed evaporation system is $16,405,000

4.2.6 Landfill Entrance Building Improvements

The post-earthquake study of the Landfill Entrance Building evaluated the conceptual scope and cost of two options to restore the functionality of the building and bring it up to current code: 1) repair the heavily damaged maintenance and storage portion of the building and the non-structural damage in the administrative portion of the building; and 2) demolition and complete replacement of the entire building with one of equivalent pre-earthquake functionality. Whether the building is rehabilitated or replaced, all construction would be designed to meet current building codes as adopted by the State of Alaska. The assessment of the damage and cost to rehabilitate and repair is only conceptual and could be greater, as the true extent of repairs needed would only be uncovered during repair of the building. Below is a summary of the concepts identified and their planning-level cost:

Option 1: Repair of Existing Building

- Replacement and necessary demolition of damaged grout and concrete masonry unit (CMU) block.
- Replacement of damaged plywood sheathing in the roof diaphragm.
- Installation of new lateral resistance system for the maintenance and storage portion of building in the north-south direction of the building to meet current building codes, which would include six locations where CMU walls and concrete foundations will be demolished.
- Reinforcement of existing CMU shear walls, which would include demolition and repair of areas of concrete slabs and asphalt pavement, and excavation down to the top of the building's concrete footing.
- Repair to non-structural damage in the interior of the administration portion of the building.
- Replacement of overhead crane and new independent support structure installed.

The initial conceptual construction cost of building repair, including 30% contingency, 12% design budget, 6% construction administration budget, is approximately $6,210,000 (in 2019 dollars). See Appendix B for a more detailed breakdown of the cost estimate. This cost could increase as a greater extent of repair could present itself during construction of the repairs.

Option 2: Replacement of Building

- Demolition of the entire existing structure, including concrete slab and foundations.
- Conceptual new single-story building with two high-bay roofs at differing heights and a low bay administrative area with same footprint as the existing building.
- Framing system for gravity and lateral load resistance consisting of structural steel moment frames in both directions bearing on cast-in-place concrete foundations, and metal deck and roof framing designed for diaphragm shear as well as wind uplift pressures.

The expected construction cost of demolishing and replacing the existing building with one of equivalent functionality at the existing building, including 30% contingency, 12% design budget, and 6% construction administration budget, is approximately $10,780,000 (in 2019 dollars). See Appendix B for a more detailed breakdown of the cost estimate.

The preferred option is for replacement of the Landfill Entrance Building rather than repair for the following reasons:

- The full scope of repair to bring the existing building to current codes is unknown at this point, and its cost could be much greater than anticipated, resulting in higher budget risk.
- Repair of the building can take longer than anticipated, as the extent of repairs and subsequent design for the repairs will only be realized during construction, resulting in more schedule risk
- The earthquake resiliency of an entirely new building designed to current code and technologies would be higher than for a retrofitted existing building
- The Landfill Entrance Building serves critical functions for operations of the landfill, especially during recovery of disasters including future earthquakes, therefore its resiliency is of high importance
- Replacing the building could provide an opportunity to improve operation of the Landfill Entrance Building (not evaluated during assessment)

FEMA Funding

SWS has applied for FEMA funding for the demolition and replacement of the Landfill Entrance Building and for the SWS temporary maintenance facility.

To restore the function of the Landfill Entrance Building to the ARL, the recommended option is to demolish and replace the existing heavily damaged building in its entirety, replacing with a building of at least equivalent functionality and in compliance with current codes, with an estimated planning-level capital cost of approximately $10,780,000 (in 2019 dollars).

4.3 WASTE DIVERSION PROGRAMS

4.3.1 Introduction and Purpose

An assessment was performed of waste diversion options whose potential for diversion is based on metrics such as the total amount of waste disposed in Anchorage, the sectors that generate the various waste streams and the number of households. The assessment considered waste composition data that was estimated based on SWS waste disposal records, industry sources and results from communities that have similar service levels and northern climate (see Table 4.3-1).

Table 4.3-1: MOA Tonnage Metrics

Criteria	Metric	Comments
Annual Disposal Rate (tons/year)	330,000	Annual disposal recorded for 2016 (study baseline)
By Sector Breakdown of Disposal Rate: % (tons/year)		
Residential	35% (110,250)	Estimated from SWS waste disposal records.
Commercial	50% (157,500)	Estimated from SWS waste disposal records.
Self-Haul	10% (31,500)	Based on similar sized communities.
Construction & Demolition (C&D)	5% (15,750)	Estimate of residuals that bypass to material recycling at CRS.
Total MOA Housing Units	114,000	U.S. Census 2010; American Fact Finder
SWS Service Area		
Population	~60,000	Estimate from SWS staff.
Total Housing Units	~12,000	Estimate from SWS staff.

The distinct service areas for solid waste collection in the MOA will result in variations in levels of service throughout the MOA. SWS services the portion of Anchorage comprising the historic downtown, approximately 20% of MOA's population and approximately 12,000 housing units as shown in Figure 4.3-1.

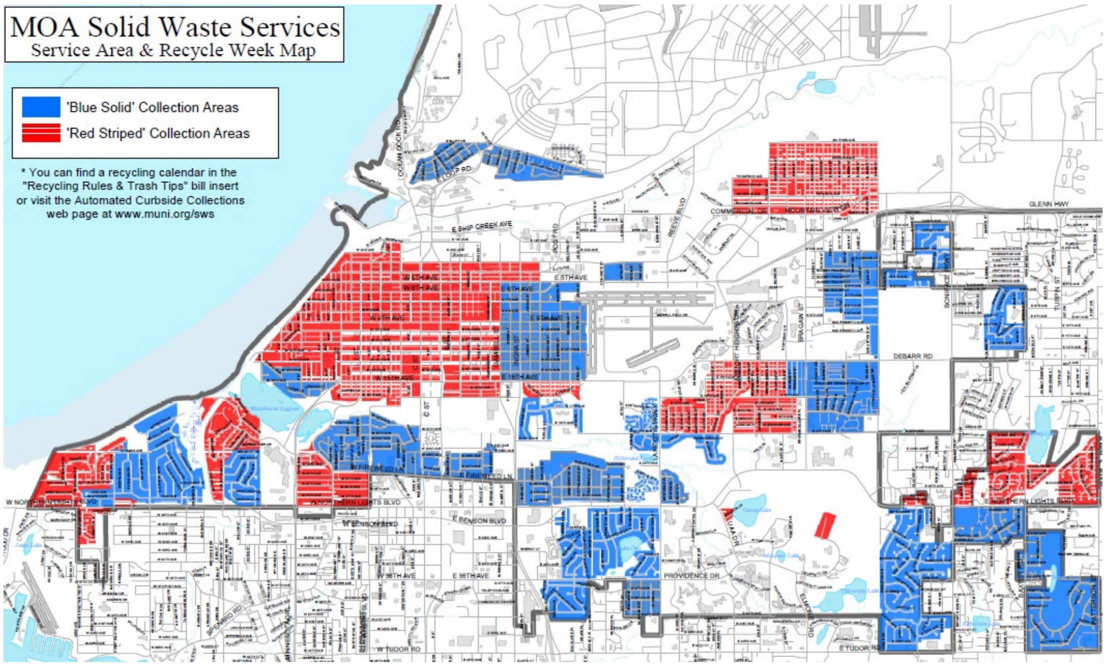
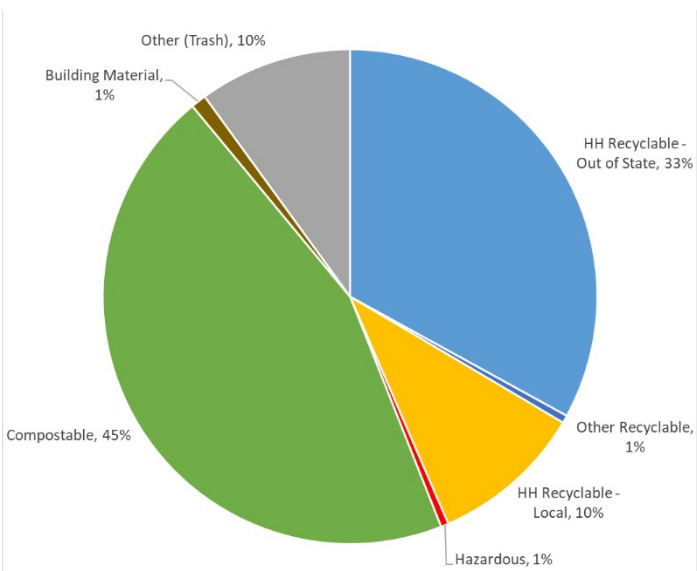


Figure 4.3-1: MOA SWS Service Area (available on the SWS website)



As discussed in Section 1.4, SWS has undertaken limited analysis of the composition of waste being disposed at the ARL. Based on information available from SWS and comparable jurisdictions with similar collection programs and climate, Tetra Tech has estimated the composition of waste in the MOA (see Figure 4.3-2).

Figure 4.3-2: Estimated Waste Composition Based on Comparable Jurisdictions

4.3.2 Options Analysis

Table 4.3-2 provides further analysis of the diversion options that were previously presented in Section 3.3 and were recommended for further evaluation. Further analysis considered technical feasibility (including difficulty of successfully implementing the option in the SWS service area and the greater MOA and factors of community acceptance), environmental impact and benefit, implementation cost, and disposal capacity effects for each option. These key evaluation criteria are defined below:

- **Technical Feasibility** is the degree of difficulty in successfully implementing the program. The ability to site or permit facilities and the technical expertise required to operate processes were taken into consideration. Generally, a low score indicates that the option requires specialized technical abilities that typically do not exist within municipal solid waste departments, an unproven technology, or an option that has proven difficult to implement in comparable jurisdictions or is highly sensitive to residential behavior. A medium score indicates that the option requires specialized training or skillsets that likely exist within SWS, a technology that is being used in multiple jurisdictions, or an option that is typically successful in jurisdictions with sufficient supportive resources. A high score indicates an option that continues or expands programs, facilities, and processes already in place in the MOA with potential for local partners and more likely community acceptance.

- **Environmental Impact and Benefits** are the positive results of the option with respect to protection of the environment. The elimination of dangerous substances which may impact landfill leachate, the relative reduction in greenhouse gasses (GHGs), and the potential to displace virgin material inputs through reduction/reuse/recycling are considered. A low score generally indicates few or indirect benefits such as displacing extraction of oil to manufacture plastics by increasing plastic recycling. A medium score indicates small measurable indirect benefits such as GHG reduction through alternative processing of putrescible materials. A high score indicates significant reductions in environmental impact through GHG reduction and proper management of harmful substances.

- **Implementation Cost** is based on an estimated per ton cost of managing material including the cost to transport materials to material markets, staff resources required, and budget for program implementation. Generally, a low score indicates a substantial cost with a per ton cost to manage the material greater than the standard tipping fee for disposal at ARL. A medium score indicates a cost approximately equivalent to the cost of disposal. A high score indicates an option with a nominal budget allocation or with a cost to manage materials less than the cost of disposal.

- **Disposal Capacity** is based on the calculated impact on disposal capacity based on the projected potential for diversion and estimated in-place density of material for the ARL (0.66 tons/cy). A low score indicates less than 15,000 yd^3 (10,000 tons) per year savings. A medium score indicates 15,000 yd^3 (10,000 tons) to 75,000 yd^3 (50,000 tons) per year savings. A high score indicates greater than 75,000 yd^3 (50,000 tons) per year savings.

Scoring of options and recommendations for inclusion in the SWS ISWMP are presented in Tables 4.3-2 and 4.3-3.

Table 4.3-2: Diversion Program Options Analysis

Program and Description	Recommended for SWS	Technical Feasibility	Environmental Impact and Benefits	Implementation Cost	Impact on Disposal Capacity[11]	Implementation Timeframe
Food Scraps Reduction, Prevention, Rescue, and Recovery Programs • Develop Food Scraps Reduction and Prevention Programs Targeted to Change Resident Behavior ○ SWS and MOA can align messaging with state-wide awareness campaigns to enhance outreach to community members and businesses, as well as raise awareness about the recent passage of House Bill 186 (An Act Relating to the Donation of Food; and Relating to Food Banks); and ○ SWS can direct interested community members and organizations to the municipal food security mini-grant program and other local organizations' (e.g. Food Bank of Alaska) food scraps reduction activities. • SWS and MOA can develop a "Love Food Hate Waste" style campaign like those occurring in other municipal regions to further increase awareness and knowledge of Food Scraps reduction and re-use. • SWS can partner with the Private Sector for Food Scraps Reduction, Prevention, Rescue, and Recovery. ○ MOA can assist in convening meetings of stakeholders involved in Food Bank of Alaska's distribution network to improve efficiency and capacity of systems to move food across the network; ○ MOA can annualize the food security mini-grant program and provide focus areas around Food Scraps reduction/re-use to promote grassroots initiatives; ○ MOA can develop a grant program to assist charitable organizations in purchasing food storage and transportation equipment to increase the distribution capacity of food assistance networks; and ○ MOA can continue to build on existing food security programs to encourage locally produced food, which reduces Food Scraps in processing and transportation from distant locations.	Yes	Programs can be developed and implemented by SWS staff in partnership with local organizations and other MOA departments to establish or expand collection, recovery and distribution networks for food rescue. Program specifics are mostly educational in nature and will help in reducing preventable food waste from being discarded and put into the landfill. These approaches are being used throughout North America to support food waste reduction and prevention which eliminate food waste before it has to be collected, processed, or disposed.	Reduced GHG production in the landfill is the primary environmental benefit due to reduction in organics decomposition. Direct impacts of these programs are likely minimal, but they provide an important community messaging and provide an opportunity to engage the public and change behaviors towards wasting edible food.	No substantial cost. A budget of approximately $10,000 is recommended to develop communication materials. A larger grant and event budget could be considered in the future but may be more appropriately funded by other MOA entities. SWS may want to dedicate some staff time on the order of 5% of one full-time employee (FTE) = $5K/yr. for program coordination.	Minimal impact on disposal capacity. Estimated capacity savings up to: 5,000 yd^3/yr. (3,300 tons/yr.)	Short (Year 1 to Year 5)
Score (High – 5, Medium – 3, Low – 1)	12	High	Low	High	Low	

[11] Density of material was assumed based on the compacted density for municipal solid waste or other materials as reported by the U.S. Environmental Protection Agency (2016). Available online: https://www.epa.gov/sites/production/files/2016-04/documents/volume_to_weight_conversion_factors_memorandum_04192016_508fnl.pdf

Program and Description	Recommended for SWS	Technical Feasibility	Environmental Impact and Benefits	Implementation Cost	Impact on Disposal Capacity[11]	Implementation Timeframe
Organics Diversion (Part 1) – Backyard Composting • Promote and Subsidize Backyard Composting	Yes	Programs can be developed and implemented by SWS staff in partnership with local organizations and other MOA departments. This program was undertaken in the past and was well received by residents that support this program. Those interested in the program likely received a composter previously. Can expect 10% of other households to participate with a well advertised program.	Reduced GHG production in the landfill is the primary environmental benefit. Due to the small impact on diversion, the direct impact of this program is minimal, but it provides an important opportunity to engage the public, change behaviors toward waste, and promote food security.	An annual composter sale or rebate program with a budget of $10,000 is recommended. A rebate program working in partnership with one or more local retailers would involve residents purchasing a composter from a store and submitting proof of purchase for a specified rebate. An additional training budget of $10,000 every three years should be allocated to train master composters. SWS may want to dedicate some staff time on the order of 5% of one FTE = $5K/yr. for program coordination.	Small impact on disposal capacity. Estimate for Pacific Northwest communities is about 500 lbs per year of organics per household is diverted through backyard composting. For a household count of 114,000 and a participation rate of 10%, the estimated diversion from backyard composting is about 2,850 tons/year.	Short (Year 1 to Year 5)
Score (High – 5, Medium – 3, Low – 1)	10	Medium	Low	High	Low	

Program and Description	Recommended for SWS	Technical Feasibility	Environmental Impact and Benefits	Implementation Cost	Impact on Disposal Capacity[11]	Implementation Timeframe
Organics Diversion (Part 2) – Residential Curbside Organics Collection • Implement Mixed Organics (food, yard and soiled paper) Curbside Collection ○ Collect mixed organics in the SWS Service Area; and ○ Collect mixed organics throughout the MOA. • Implement Yard and Garden Waste Curbside Collection	Yes	Programs and infrastructure can be implemented primarily by existing SWS staff and support from private sector haulers that are servicing single family residents. Organics processing assumed to be established and operated properly by the private sector and to a lesser degree by SWS. Technology consideration, type and costs discussed in Organics Diversion (Part 4). Public support is assumed to be modest for the additional collection stream. Diversion of yard and garden waste only offers a smaller opportunity for organics diversion. Market assessment for processed organics should be conducted to ensure the end products can be used and not disposed.	The main environmental benefit of residential organics collection and composting is GHG reduction at the landfill and increased waste diversion. Based on the potential for diversion of putrescible mixed organics, GHG generation could be significantly decreased and diversion rate could increase by 10%. GHG generation decreases would be less with a yard and garden waste only collection program.	Approximate cost for a market assessment is $50,000. The cost per ton of processing organics is included in Organics Diversion (Part 4) option. Collection of an additional material stream will require a third container and will increase collection costs per household by an estimated 50%. Collecting trash every other week (EOW) can reduce overall collection costs by 20-30% and will also encourage participation in organics diversion. Collection of yard and garden waste only would have a similar increase in collection costs per household. A yard and garden waste collection program could be seasonal from April to November. 0.5-1 FTE should be allocated to coordinate any new material collection program. This analysis assumes that SWS would implement an organics collection program on a cost-neutral basis where the additional cost of the service is charged to customers. Costs would depend on the details of the program including collection frequency and method of collection.	Medium impact on disposal capacity. This targets the organic fraction from the residential sector which is roughly 18% of the total annual waste disposed in the MOA (56,700 tons/year). Residential sector is 35% of waste disposed and organics make up more than 50% of the waste stream. Reasonable diversion performance should divert about 50% of the organics which equates to a range of about 25,000 to 30,000 tons/year for the entire MOA. For the SWS service area, diversion would represent 5,000 to 6,000 tons/year. Yard and garden waste diversion would have a medium impact on disposal capacity. Estimated capacity savings in the order of 16,000 tons/yr. for the entire MOA and 3,200 tons/yr. for just the SWS service area.	Short (Year 1 to Year 5)
Score (High – 5, Medium – 3, Low – 1)	12-14	Medium	High	Medium	Low (SWS) to Medium (MOA)	

TETRA TECH

Program and Description	Recommended for SWS	Technical Feasibility	Environmental Impact and Benefits	Implementation Cost	Impact on Disposal Capacity[11]	Implementation Timeframe
Organics Diversion (Part 3) – Commercial Organics Collection • Implement Food and Food-Soiled Paper Collection and Organics Processing	Yes Once residential organics diversion becomes standard practice.	Programs and infrastructure can be implemented primarily by existing SWS staff with support from private sector haulers. Organics processing assumed to be established and operated properly by the private sector or SWS. Technology consideration and selection discussed in Organics Diversion Part 4. Public support is assumed to be modest for the additional collection stream. Subject program targets the commercial sector which represents about 50% of the total waste disposed. Commercial customers might not support program but usually more amenable if rationale is justifiable and there is a level playing field for all commercial waste generators to participate in the program.	The main environmental benefit of commercial organics collection and composting is GHG reduction at the landfill and increased waste diversion. Based on the potential for diversion of putrescible material, GHG generation could be significantly decreased.	The per ton cost of processing organics is included in Organics Diversion (Part 4) option. Collection of an additional material stream will increase collection costs per customer. The commercial sector will likely need to pay double or triple what their current disposal costs are. 0.5 FTE should be allocated to coordinate any new material collection program. Market assessment for processed organics should be conducted to ensure the end products can be used and not disposed. Approximate cost for a market assessment is $50,000.	Medium impact on disposal capacity. Commercial sector represents 50% of waste disposed and assuming 50% of waste is organic in nature, the target material represents nearly 80,000 tons/yr., for the MOA Achieving a 50% capture rate for organics in the commercial sector stream would equate to 40,000 tons/yr., for the MOA. For the SWS areas, that could represent 8,000 tons/yr.	Medium (Year 6 to Year 10)
Score (High – 5, Medium – 3, Low – 1)	10-12	Medium	High	Low	Low (SWS) to Medium (MOA)	

Program and Description	Recommended for SWS	Technical Feasibility	Environmental Impact and Benefits	Implementation Cost	Impact on Disposal Capacity[11]	Implementation Timeframe
Organics Diversion (Part 4) – Increase Organics Processing Capacity and Facilities • Processing Capacity • Technology (Composting vs Anaerobic digestion) • Markets for end products • Public vs private sector ownership and operation	Yes	Organics processing capacity required to support Organics Diversion (Parts 2 and 3) programs for residential (approximately 30,000 tons/year) and commercial (approximately 40,000 tons/year) potential capture rate for MOA. Processing capacity should be on the order of 100,000 tons/year to accommodate peak months. Technologies for processing organics range from static piles to windrows to aerated piles to in-vessel aerated to in-vessel anaerobic digestion. Processing costs range from $20 per ton for simplest technologies (static piles/ windrows) to $120-200 per ton (anaerobic digestion). Site footprint also decreases with higher processing costs. A market assessment for processed organics should be conducted to ensure the end products can be used and not disposed. SWS should actively encourage and support the private sector in creating processing capacity in the region by assisting with locating sites in appropriately zoned and in remote lands, issuing an RFQ and subsequent tender for processing a guaranteed organics stream controlled by SWS, and partnering with other departments at the MOA and state authorities to use high quality compost for remediation, site restoration, and seeding projects. For a 70,000 ton/year feedstock of food and yard waste, approximately 50% or 35,000 tons of compost material could be generated.	This is a supporting option for an organics diversion program and should significantly reduce GHG emissions and increase disposal capacity at the landfill.	An organics collection program would require several staff to implement and supervise collection and public education, but no additional dedicated staff would be required if processing is a private facility. Relative processing cost by technology (based on design capacity of 100,000 tons/year): • Static Pile ($20-30/t) • Windrow ($30-40/t) • Aerated Pile ($40-50/t) • Covered aerated pile ($50-80/t) • In-vessel composting ($80 – 120/t) • Anaerobic digestion w/ composting ($120-200/t) • Co-digestion ($150-200/t) Approximate cost for a market assessment is $50,000.	As a supporting approach to organics diversion, this should have a significant effect on reducing disposal (up to 70,000 tons/yr. for total MOA) The facility could be built in stages to support the residential sector program in the short term and commercial sector program in the medium term. Or can be staged for SWS service areas first and then entire MOA.	Short (Year 1 to Year 5) for Residential Sector Medium (Year 6 to Year 10) for Commercial Sector
Score (High – 5, Medium – 3, Low – 1)	16	Medium	High	Medium	High	

Program and Description	Recommended for SWS	Technical Feasibility	Environmental Impact and Benefits	Implementation Cost	Impact on Disposal Capacity[11]	Implementation Timeframe
Recycling (Public Sector Operations) Mandate Standardized Government Building Recycling Programs • Approach 1: Increase Effectiveness of Existing Recycling Programs in Government Buildings ○ Categorize offices and facilities based on the types of recyclable materials generated through their operations. ○ Standardize the look and feel of recycling programs across offices. ○ Update or create communication resources for participating locations. ○ Develop an implementation plan for recycling program improvements. • Approach 2: Increase the Number of Government Offices and Facilities with Recycling Programs ○ Develop an implementation plan for bringing new recycling programs online. ○ Set a minimum standard for recycling services offered based on the recyclable materials generated. ○ Adopt green procurement practices to reduce disposal and increase recyclability of materials purchased	Yes	Small to moderate increases in collected recyclables can be absorbed into current operations within the MOA. Using available resources, SWS staff can update and standardize current recycling practices in place in government buildings to optimize capture and lead by example. Small changes to existing programs such as standardizing signage, color coding bins, and sharing updated communication materials has improved the quality of material received in similar programs. These techniques could also be adopted in the MOA to improve material quality and marketability.	Little environmental impact is anticipated. Improving capture of potentially hazardous materials such as batteries, paints, and chemicals will have a small net benefit to environmental protection at the ARL.	Small budget of $15,000/yr. is recommended to produce and provide standardized waste diversion signage and containers. Custodial staff will likely require some training. Staffing requirements estimated to be 0.25 FTE (full time allocation during the 3-month program roll-out).	Minimal impact on disposal capacity. Estimated capacity savings up to: 1,000 yd^3/yr. (660 tons/yr.).	Short (Year 1 to Year 5)
Score (High – 5, Medium – 3, Low – 1)	12	High	Low	High	Low	

Program and Description	Recommended for SWS	Technical Feasibility	Environmental Impact and Benefits	Implementation Cost	Impact on Disposal Capacity[11]	Implementation Timeframe
Recycling (Residential) – Curbside Collection • Mandatory Curbside Recycling for All Residences with Trash Collection ○ Increase recyclable materials collected from residences in the SWS Service Area; and ○ Mandate curbside recycling for all residences with trash collection outside of the SWS Service Area.	Yes Considered for implementation in the short to medium term once improvements to MRF processing infrastructure are available.	Recyclables are shipped to west coast processing facilities with subsidies from ALPAR, who coordinates the use of vans (shipping containers that hold recyclables) donated by Alaskan shipping companies. ALPAR was formed to support recycling programs throughout Alaska. The current system is not capable to handle growth from enhanced recycling collection programs. A MRF feasibility study (Appendix G) completed with input from WestRock shows that it is technically and financially feasible to build a modern MRF that suits the MOA's needs and meets new industry standards for recycling market. This new facility could then support any increases that could be achieved through mandated curbside recycling, for the entire MOA. Discussions with ALPAR are required to asses the potential for expanding existing programs. Public communication and education will be required to support the curbside recycling program. Community acceptance expected to be high in SWS areas. The rest of the MOA is regulated by the Regulatory Commission of Alaska for garbage collection. Recycling curbside collection is a voluntary subscription program in the remainder of the MOA so a mandate would need to undergo a legal review.	Anticipated environmental impact is primarily related to decreased disposal which will be partially off-set by increase in shipping to lower 48 states.	0.5 FTE allocation to manage the program long term. Vans are currently filled with mixed recyclables at WestRock/Anchorage Recycling Center before being shipped for processing. Shipping costs range from $200 per van (for ALPAR subsidized vans) to $3,500 per van for non-subsidized vans. Current arrangements are insufficient to transport recyclables for a curbside collection program to processing facilities in lower 48 states. The total cost increase for additional vans to ship materials from the MOA to the lower 48 states is estimated to range from $400,000 to $1,590,000 per year (based on approximately 500 vans). Expected revenue from processed recyclables is estimated to range from $1.8M to $7.8M per year. The net unit cost (per ton cost) for shipping processed recyclable materials ranges from a cost of $77 per ton to revenue $65 per ton. An additional cost/tipping fee for processing single stream mixed recyclables may be implemented to address current historical lows for recycling commodities but should be offset in the future as low contamination standards are met and average commodity prices from pre-China National Sword return. Mandating recycling requires discussions with ALPAR to asses the potential for updating or changing the existing programs in support of their mandate to support recycling in Alaska. It would also require a legal review to implement an ordinance or enact regulatory requirements to mandate curbside recycling throughout the MOA.	Residential waste represents about 35% of the MOA's total waste stream of which 30% is recyclable. Therefore, an estimated 10% of the total materials disposed in the MOA are potentially recyclable (33,000 tons/yr.). Mandatory curbside collection could potentially capture up to half of the available recyclables in the residential waste stream which equates to 16,000 tons/yr. (5% of total waste disposed in the MOA). Of the total likely captured recyclables approximately 6,000 tons/yr. is already collected by single stream curbside programs leaving 10,000 tons/yr. available. For the SWS Service Area, the potential capture rate is approximately 3,300 tons/yr. and the existing program collected approximately 1,800 tons in 2016, leaving approximately 1,500 tons/yr. available.	Short (Year 2 to Year 5)
Score (High – 5, Medium – 3, Low – 1)	14	High	Medium	Medium	Medium	

Program and Description	Recommended for SWS	Technical Feasibility	Environmental Impact and Benefits	Implementation Cost	Impact on Disposal Capacity[11]	Implementation Timeframe
Recycling (Residential & Commercial) – Commercial Sector • Expand Commercial Sector Recycling ○ Develop MRF processing infrastructure to support additional recycling processing ○ Develop Toolkits, Support, and Technical Assistance for Businesses; and ○ Mandate Recycling Strategy for Large Commercial Generators.	Yes Considered for implementation in the short to medium term once improvements to MRF processing infrastructure are available.	Like the discussion above, significant increases in recyclables collected will necessitate changes to the system for managing these materials. The current supply of donated vans available to ship recyclables is not sufficient to accommodate the additional 600+ vans estimated to be required with mandatory commercial recycling throughout the MOA. Discussions with ALPAR are required to asses the potential for updating or changing the existing programs in support of their mandate to support recycling in Alaska. It would also require a legal review to implement an ordinance or enact regulatory requirements to mandate services. A MRF feasibility study (Appendix G) completed with input from WestRock shows that it is technically and financially feasible to build a modern MRF that suits the MOA's needs and meets new industry standards for recycling markets. This new facility could then support any increases that could be achieved through mandated commercial recycling for the entire MOA.The MRF feasibility examined the current implications of the China Sword policy. The recycling industry is working to improve source separation collection programs and modernizing their processing facilities to address the standards set in the China Sword policy. Stakeholder engagement, education, and communication would be key to program implementation. Most other jurisdictions have rolled out mandatory programs through a staged approach beginning with large generators (large stores and institutions) and readily recyclable materials (cardboard) before expanding programs over a 5-year implementation period.	Anticipated environmental impact is primarily related to decreased disposal which will be partially off-set by increase in shipping to lower 48 states.	Additional collection costs would be charged to businesses through their hauling services. Likely an increase of 50-100%. 0.5 FTE allocation for program development and roll-out with 1 FTE allocation to manage the program long term. 1 FTE is recommended to implement enforcement of the mandatory program and provide minor technical assistance for businesses. The total cost increase for additional vans (600+) to ship materials from the MOA to the lower 48 is anticipated (without ALPAR support) to be over $2 million per year. This additional cost would likely be offset by revenues for commodities that could range from $1.8M to $7.8M. This assumes the per ton unsubsidized cost for shipping materials to be $60/ton (the current market rate) but could also be a revenue source based on historic market conditions. It is also likely that a discount transportation rate from ALPAR could be negotiated for some of the additional recyclables with a reasonable estimated cost in the order of $1,2M per year. The cost for shipping would be allocated to businesses through their service fees.	Recyclable materials make up about 30% of the disposal stream and commercial sector represents about 50% of the disposed waste. This equates to approximately 15% of the total materials disposed in the MOA (47,250 tons/yr.). If the commercial sector is able to capture about half of the available recyclables, that equates to 23,625 tons/yr. (7.5% of total waste disposed in the MOA). Of the total likely captured approximately 17,000 tons/yr. is already collected by single stream curbside programs leaving 6,625 tons/yr. available. For the SWS areas, commercial recycling would divert an additional 1,325 tons/yr.	Short to Medium (Year 3 to Year 8)

Program and Description	Recommended for SWS	Technical Feasibility	Environmental Impact and Benefits	Implementation Cost	Impact on Disposal Capacity[11]	Implementation Timeframe
Score (High – 5, Medium – 3, Low – 1)	14	High	Medium	Medium	Medium	
Recycling (Residential & Commercial) – Expand Material Categories • Expand Materials Collected through Existing Curbside Recycling	No	Increasing the number and type of materials is primarily dependent on the strength of the recycling collection program, processing capabilities and the markets for the commodities. Glass, expanded polystyrene (Styrofoam), and plastic bags are the materials that residents most often request being added to curbside collection programs. However, these materials often create problems with processing (i.e. clogging or damaging machinery or breaking and contaminating other materials). Expanding commercial collection of specified recyclables such as glass or cardboard can also be evaluated depending on markets. Expansion of the materials collected in Anchorage should be based on the materials accepted by processing facilities in the pacific northwest.	Anticipated environmental impact is primarily related to decreased disposal.	The cost of expanding collection programs, processing capabilities and markets for commodities to accept additional materials depends on the materials being considered and the method of collection. Expansion should take into consideration contaminants and how the new materials might affect collection, processing and end markets. Cost might be high because of additional effort/resources in the three areas above.	Impact of collection program changes on disposal capacity will depend on the materials selected for recycling. Likely to have low impact on diversion capacity	Long (Year 11 to Year 20)
Score (High – 5, Medium – 3, Low – 1)	6	Medium	Low	Low	Low	
Recycling (Residential & Commercial) – Material Disposal Surcharge • Material Disposal Surcharge to Support Recycling	Yes	Policies for certain material surcharges would need to be developed by SWS as well as changes to municipal codes/bylaws. Materials targeted for a surcharge fee should have alternative means of managing such as a modern MRF. Any surcharge program would require significant stakeholder engagement and education. Surcharge materials can include old corrugated cardboard (OCC), mixed paper and metal containers. Options/ infrastructure for collecting these materials need to be well established.	Little environmental impact is anticipated as a direct result of a policy change. Infrastructure required to enable residential and commercial sector to recycle material subject to surcharge. Environmental benefits are considered low since infrastructure is not well established.	0.5 FTE to develop the policy and conduct stakeholder engagement and education. Recycling programs are not mandated and feasibility of collecting, baling and shipping recyclables to markets is questionable. Cost to implement program are not high but cost to develop markets and infrastructure to support materials subject to surcharge will be significant.	Dependent on supporting existing recycling markets and infrastructure. Affect on disposal capacity can be noticeable with proper education, public outreach and enforcement. Since programs are not established, impact on disposal capacity is considered low.	Medium (Year 6 to Year 10)
Score (High – 5, Medium – 3, Low – 1)	8	Medium	Low	Medium	Low	

Program and Description	Recommended for SWS	Technical Feasibility	Environmental Impact and Benefits	Implementation Cost	Impact on Disposal Capacity[11]	Implementation Timeframe
Recycling and Organics (Residential & Commercial) – Tool Kit • Develop Commercial Waste Reduction Strategy and Toolkit	Yes	Toolkits represent educational materials that will help waste generators better divert recyclable materials including organics. Working with local organizations such as Alaska Forum's Green Star ® Program, SWS staff can increase support for local businesses and residents to reduce their waste and divert where options are available.	Little environmental impact is anticipated as a direct result of providing business support. Any additional material capture would be attributed to implementation of collection and diversion programs.	0.1 – 0.25 FTE to coordinate and develop the tool kit and present this material to stakeholders for information sharing. Cost should be under $15,000.	No direct impact on disposal capacity but will be important in supporting diversion programs for recyclables and organics.	Short (Year 1 to Year 5)
Score (High – 5, Medium – 3, Low – 1)	12	High	Low	High	Low	
Reuse and Recycle C&D Waste • Promote/Facilitate C&D Re-use programs (e.g. building material re-use centers) • Develop and Expand Thrift Store/Free Store/Reuse Center System	Yes	Working with local organizations such as Central Recycling Services, and reuse/thrift stores, SWS staff can promote C&D reuse and recycling through social media, collateral development and advertising. The need for a re-build-it center at an SWS or MOA facility should be assessed based on the availability (existence, and hours of operation) of similar services in the MOA. Feasibility is dependent on availability of appropriate space and a local organization to run the facility. Based on experience from municipalities across North America, SWS should not take responsibility for directly managing a facility as the level of diversion created from re-use is minimal.	Little environmental impact is anticipated as a direct result of providing business support. Any additional material capture would be attributed to implementation of collection and diversion programs.	Assumes facility run by others. 0.25 FTE for 3 months to coordinate material development. 0.1 FTE with long-term/ongoing promotion and coordination.	No direct impact on disposal capacity.	Short (Year 1 to Year 5)
Score (High – 5, Medium – 3, Low – 1)	12	High	Low	High	Low	

Program and Description	Recommended for SWS	Technical Feasibility	Environmental Impact and Benefits	Implementation Cost	Impact on Disposal Capacity[11]	Implementation Timeframe
Reuse and Recycle C&D Waste • Develop policies that support C&D recycling (e.g. minimum diversion for C&D projects) ○ Promote LEED and Green Build Standards through municipal procurement standards and municipal building codes; ○ Encourage deconstruction and recycling through permitting and financial incentives; and ○ Promote house moving as an alternative to demolition by streamlining permit process. ○ Promote use of recycled materials for construction activities.	Yes	Working with local stakeholders and MOA departments, SWS staff can guide development of policies to promote and support C&D recycling. Feasibility of diversion is primarily dependent on availability of recycling services for C&D waste in the MOA. Policies to promote recycling must be implemented in concert with programs to support markets for recycled C&D material and policies that support C&D material processing.	Little environmental impact is anticipated as a direct result of providing business support.	0.25 FTE for 9 months to coordinate procurement standards and policies.	No direct impact on disposal capacity.	Medium (Year 6 to Year 10)
Score (High – 5, Medium – 3, Low – 1)		High	Low	High	Low	
Increase Yard and Garden Waste Drop-Off • Expand Yard and Garden Waste Drop-Off to CTS, Girdwood, ARL for beneficial use	Yes	Yard waste drop off at SWS facilities could increase yard waste diversion by increasing convenience for residents which would also save airspace at the landfill. Refer to Organics Diversion (Part 4) option for processing facility options.	The main environmental impact of composting is GHG reduction. Based on the potential for diversion of yard and garden material, GHG generation could be decreased and available airspace could be increased at the ARL.	The per ton cost of processing organics through composting is $20 to $40 per ton plus transportation costs.	Low impact on disposal capacity. Estimated capacity savings on the order of 1,425 yd^3/yr. (950 tons/yr.)	Short (Year 1 to Year 5)
Score (High – 5, Medium – 3, Low – 1)	10	High	Low	Medium	Low	

Program and Description	Recommended for SWS	Technical Feasibility	Environmental Impact and Benefits	Implementation Cost	Impact on Disposal Capacity[11]	Implementation Timeframe
Increase Bulky Item Diversion • Partner with the Private Sector to recycle/ process mattresses and bulky items ○ Develop a mattress and bulky furniture diversion plan; and ○ Encourage development of processing businesses/markets for mattresses and bulky items.	Yes	Working with stakeholders, SWS staff could develop a diversion plan for mattresses and bulky items including support of developing mattress and bulky item processing businesses. Bans or surcharges on disposal of these materials should be considered in the plan. Based on the outcome of the plan, SWS may issue an RFQ for mattress or other bulky item recycling in the MOA. Mattress recycling is typically a simple low-tech disassembly process that sorts the major material components of the mattresses for recycling (textiles, metal/springs, and wood). In its RFQ, SWS should outline the opportunity for partnership and any supportive policies that would increase financial feasibility such as the MOA's recycling rebate provision allowing residue to be landfilled at ARL at a discount.	Environmental benefit associated with saving virgin materials and saving landfill airspace. Efficiencies due to sustainable management of resources will be realized.	The total cost increase for additional vans to ship recyclable materials from the MOA to the lower 48 states is anticipated to be less than $5,500 per year (approximately 30 vans). The net cost for mattress recycling is highly dependent on the strength of material markets, in particular the value of steel springs and textiles. Up to 0.25 FTE allocation to develop a plan and issue an RFP for processing	Minimal impact on disposal capacity. Estimated capacity savings up to: 660 tons/yr. Bulky items have low density and take up plenty of airspace. Steel coils also create problems for landfill machinery such as compactors. Due to density, effect of disposal capacity considered medium.	Long (Year 11 to Year 20)
Score (High – 5, Medium – 3, Low – 1)	11	High	Low	Medium	Medium	
Increase Tire Diversion • Explore the use of tire crumb in local manufacturing; and • Consider using processed tires as refuse derived fuel. • Consider other alternative uses for tires.	Yes	Working with local stakeholders, SWS staff could assess the potential for tire recycling in the MOA. Tires have been successfully remanufactured into various commercial products including playground mats and padding for animal beds. Alternately if waste-to-energy technology is contemplated for the MOA, waste tires can provide a high BTU feedstock. SWS estimates that the total tire disposal is 3,500 tons/yr. to 4,000 tons/yr.	Little environmental impact is anticipated. Efficiencies due to sustainable management of resources will be realized.	The cost to manage tires will depend on their ultimate use. Based on collection and incentive programs in other jurisdictions, the estimated cost to produce a shredded tire product is $30-$50/ton.	Minimal impact on disposal capacity but will reduce landfill issues from tires. Estimated capacity savings is 3,000 tons/yr. (80% of annual average tonnage disposed).	Medium (Year 6 to Year 10)
Score (High – 5, Medium – 3, Low – 1)	10	Medium	Low	Medium	Medium	

Table 4.3-3: Supporting Programs Options Analysis

Program and Description	Recommended for SWS	Discussion	Implementation Timeframe
Communication, Education, Monitoring, and Promotion Establish Community Based Social Marketing framework for Promotion and Education	Yes	Community-based social marketing (CBSM) is an approach to program promotion and education that results in high rates of effective participation and long-term behavior change. The CBSM process centers on uncovering barriers that inhibit individuals from engaging in sustainable behaviors, identifying tools that have been effective in fostering and maintaining behavior change, then piloting on a small portion of the community followed by ongoing evaluation once the program has been implemented community-wide	Short (Year 1 to Year 5)
Communication, Education, Monitoring, and Promotion Develop Metrics and Waste Diversion Promotion and Recognition Program (i.e. track performance by community and create a diversion competition)	Yes	In addition to enforcement of policies, some jurisdictions have successfully implemented positive incentive programs through community competitions, recognition of star performers, and proactive communication with residents and businesses.	Short (Year 1 to Year 5)
Communication, Education, Monitoring, and Promotion Develop Standardized Signage, Branding, and Color Coding for Region	Yes	Consistent signage, branding, and color coding throughout the MOA will aid in public understanding and use of diversion services throughout the community. A brand consists of a name, logo, slogan, term, design or any combination of these elements used to identify a product, service or organization. An SWS Waste Diversion brand would be carried through all aspects of public communication including handouts, the SWS website, social media, advertisements, and signage.	Short (Year 1 to Year 5)
Communication, Education, Monitoring, and Promotion Promote Zero Waste or "Waste as a Resource" Through Community Engagement Programs and Events	Yes	As a component of any updates to SWS' communication and marketing materials, the idea of waste as a resource and working toward zero waste can be introduced to help residents understand the value of waste reduction and diversion. In 2015, the U.S. Conference of Mayors adopted a resolution in support of municipal zero waste principles and a hierarchy of materials management[12]. The resolution provides useful language and information to guide SWS' definition of these ideas.	Short (Year 1 to Year 5)
Policies and Measurement Tools Conduct Annual Integrated Solid Waste Master Plan Reporting	Yes	Annual reporting should be completed to share successes with the community and provide consistent data measuring on SWS' progress on implementing recommendations and meeting goals.	Short (Year 1 to Year 5)
Policies and Measurement Tools Perform Regular Waste Composition Audits (every 3-5 years)	Yes	MOA should conduct a comprehensive baseline and subsequent multi-season waste composition studies on a regular basis (every 3 to 5 years) to assess the success of current waste diversion programs and policies and identify opportunities for additional diversion. A statistically significant number of samples should be sorted from key sectors including residential curbside collection, self-haul/drop-off, Commercial sector, and C&D. More frequent measurement may be completed to assess particular programs.	Short (Year 1 to Year 5)
Policies and Measurement Tools Lobby State Government to Create Extended Producer Responsibility Programs (e.g. Bottle Deposits, Mattresses, HHW, Electronics, etc.)	Yes	Extended Producer Responsibility (EPR) is an approach that aims to shift the responsibility for end-of-life management of products (physically and economically) to the producer and away from local governments. This starts with a policy that evolves into an approach that creates an incentive for producers to include environmental considerations in design of products. There are currently no major EPR policies in place in Alaska, but these policies are gaining traction across North America as they provide consistent funding and provision of services pegged to specific performance metrics.	Short (Year 1 to Year 5)
Policies and Measurement Tools Develop Green Procurement Policy for MOA Government Contracts	Yes	A sustainable or "green" procurement policy that provides guidance to employees and departments to make purchasing decisions. Working with other MOA departments, SWS staff can encourage policies that prioritize the reduction of consumption, use of durable goods, ahead of choosing items with 100% recycled content.	Short (Year 1 to Year 5)

[12] At its 83rd Annual Meeting, the United States Conference of Mayors adopted a resolution supporting zero waste and a hierarchy of materials management. Available online https://www.usmayors.org/the-conference/resolutions/?category=b83aReso050&meeting=83rd%20Annual%20Meeting

4.3.3 Summary

Tables 4.3-4 through 4.3-6 present options recommended (short, medium, and long term) for implementation as part of the SWS ISWMP. Potential impact on disposal capacity is shown by option and cumulative where applicable.

Table 4.3-4: Short-Term Recommended Diversion Program Options (Years 1-5)

Program	Impact on Disposal Capacity SWS Area Only	Impact on Disposal Capacity All MOA
Food Scraps Reduction, Prevention, Rescue, and Recovery Programs	660 tons/yr.	3,300 tons/yr.
Organics Diversion (Part 1) – Backyard Composting	570 tons/yr.	2,850 tons/yr.
Organics Diversion (Part 2) – Residential Curbside Organics Collection	6,000 tons/yr. (3,200 tons/yr. yard and garden only)	30,000 tons/yr. (16,000 tons/yr. yard and garden only)
Organics Diversion (Part 4) – Increase Organics Processing Capacity and Facilities (Residential)	N/A	N/A
Recycling (Public Sector Operations)	200 yd³/yr. (1320 tons/yr.)	660 tons/yr.
Recycling (SF Residential) – Mandatory Curbside Collection	1,500 tons/yr.	10,000 t/yr.
Recycling (MF Residential & Commercial) – Mandatory Service	1,325 tons/yr.	23,625 tons/yr.
Recycling and Organics (Residential & Commercial) – Tool Kit	N/A	N/A
Reuse and Recycle C&D Waste	N/A	N/A
Increase Yard and Garden Waste Drop-Off	190 tons/yr.	950 tons/yr.
Community Education, Monitoring and Promotion	N/A	N/A
Policies and Measurement Tools	N/A	N/A
Short Term – Capacity Savings (tons/year) for Diversion Options	**11,565 tons/yr. (17.5% diversion for SWS) -1.05 lbs./capita/day**	**71,385 tons/yr. (21.6% diversion for MOA) -1.3 lbs./capita/day**

Note: Organics Diversion (Part 4) option is not included in cumulative capacity savings as it is accounted for in Organics Diversion (Parts 2 and 3).

Table 4.3-5: Medium-Term Recommended Diversion Program Options (Years 6-10)

Program	Impact on Disposal Capacity SWS Area Only	Impact on Disposal Capacity
Organics Diversion (Part 3) – Commercial Organics Collection	8,000 tons/yr.	40,000 tons/yr.
Organics Diversion (Part 4) – Increase Organics Processing Capacity and Facilities (Commercial)	N/A	N/A
Material Disposal Surcharge	N/A	N/A
Reuse and Recycle C&D Waste	N/A	N/A
Increase Tire Diversion	3,000 tons/yr.	3,000 tons/yr.
Community Education, Monitoring and Promotion	N/A	N/A
Policies and Measurement Tools	N/A	N/A
Medium Term – Capacity Savings (tons/year) for Diversion Options	**11,000 tons/yr. (17% diversion for SWS) -0.91 lbs./capita/day**	**43,000 tons/yr. (13% diversion) -0.78 lbs./capita/day**

Note: Organics Diversion (Part 4) option is not included in cumulative capacity savings as it is accounted for in Organics Diversion (Parts 2 and 3).

Table 4.3-6: Long-Term Recommended Diversion Program Options (Year 11 and Beyond)

Program	Impact on Disposal Capacity SWS Area Only	Impact on Disposal Capacity
Recycling (Residential & Commercial) – Expand Material Categories	N/A	N/A
Increase Bulky Item Diversion	120 tons/yr.	600 tons/yr.
Community Education, Monitoring and Promotion	N/A	N/A
Policies and Measurement Tools	N/A	N/A
Long Term – Capacity Savings (tons/year) for Diversion Options	**120 tons/yr. (less than 1% diversion) -0.002 lbs./capita/day**	**600 tons/yr. (less than 1% diversion) -0.01 lbs./capita/day**

Based on the above recommended diversion programs, the diversion potential is 17.5% in the short term, an additional 17% in the medium term, and less than one percent in the long term. The SWS' current Strategic Plan has a recycle goal of 25% by 2020 for its service area. Considering the curbside recycling rate was approximately 16% in 2016 for the SWS service area, the SWS' Strategic Plan goal can be achieved in the short term with the potential to achieve over 40% by 2028. The MOA overall recycling rate was 7% in 2016 and if the above recommendations are implemented for the entire MOA, a diversion rate on the order of 15 to 20% can be achieved in the short-term and over 30% in the mid-term.

Table 4.3-7 summarizes the anticipated daily per capita disposal rate for those living within the SWS Service Area following implementation of all programs as measured from the 2016 baseline of 6.1 lbs./capita/day.

Table 4.3-7: Anticipated Daily Per Capita Disposal Rate of People Living Within the SWS Service Area

Timeframe	Daily SWS Disposal Rate if Programs Implemented in SWS Area Only
Short	5.0 lbs./capita/day
Medium	4.1 lbs./capita/day
Long	4.1 lbs./capita/day

Table 4.3-8 summarizes the anticipated daily per capita disposal rate averaged throughout the MOA, providing anticipated rates based on program coverage. This table reflects the per capita disposal rate reduction reality of collection programs only implemented in the SWS Service Area diverting less than those including the entire MOA.

Table 4.3-8: Anticipated Daily Per Capita Disposal Rate Throughout the MOA

Timeframe	Daily Disposal if Collection Programs are Only Implemented in SWS Area	Daily Disposal if Programs are Implemented Throughout the MOA
Short	5.9 lbs./capita/day	5.0 lbs./capita/day
Medium	5.7 lbs./capita/day	4.1 lbs./capita/day
Long	5.7 lbs./capita/day	4.1 lbs./capita/day

Large-scale recycling collection programs have not been recommended at this time due to market uncertainty and instability created by the China Sword policy. In response, the waste and recycling industry and government agencies in North America have signaled that they will work together to redevelop sustainable markets to process recyclables domestically. As these domestic markets come on line in the medium term and with review of regulatory and legal constraints in mandating programs within the SWS service area and municipality-wide, SWS should re-evaluate the feasibility (including community support) of increasing recycling collection throughout the MOA.

4.4 ALTERNATIVE TECHNOLOGIES

An initial Alternative Technologies Assessment (Assessment) was conducted as requested by the SWS and is included in Appendix F to the ISWMP. The Assessment provides information on alternative technologies that could be used to process the MOA's MSW. Alternative technologies for managing MSW are those technologies that are technically more advanced, produce beneficial end products and/or are more protective of the environment than traditional landfill disposal practices. In the case of the MOA, these facilities could use different technologies for processing MSW that would divert materials from the ARL, thereby, extending the life of the landfill which is a valuable resource for the community.

The objective of the Assessment was to provide an overview of the various landfill disposal alternative technologies and the permitting and financial considerations associated with implementing those technologies to divert materials from the landfill. The Assessment also involves examining the feedstock, the amount of MSW and the types of available materials that could be processed. Two types of alternative technologies – thermal treatment (see Figures 4.4-1 and 4.4-2) and biological processing technologies (see Figures 4.4-3, 4.4-4 and 4.4-5) were evaluated. Both types of technologies would process MSW and convert the materials into usable end-products, such as energy and soil amendments. A high-level financial analysis was performed for selected scenarios based on waste composition data and analysis of waste flows from various generators in the Anchorage area.

Section 2.2.2.1 presents descriptions of anaerobic digestion and gasification technology types and industry trends in developing alternative technologies facilities. The types of technologies that were evaluated in the Assessment are as follows:

Thermal Treatment Technologies

- Mass Burn Waste-to-Energy;
- Controlled Air or Hybrid Gasification;
- Gasification; and
- Other Technologies (i.e., pyrolysis, plasma arc gasification.

Figure 4.4-1: Gasification Plant

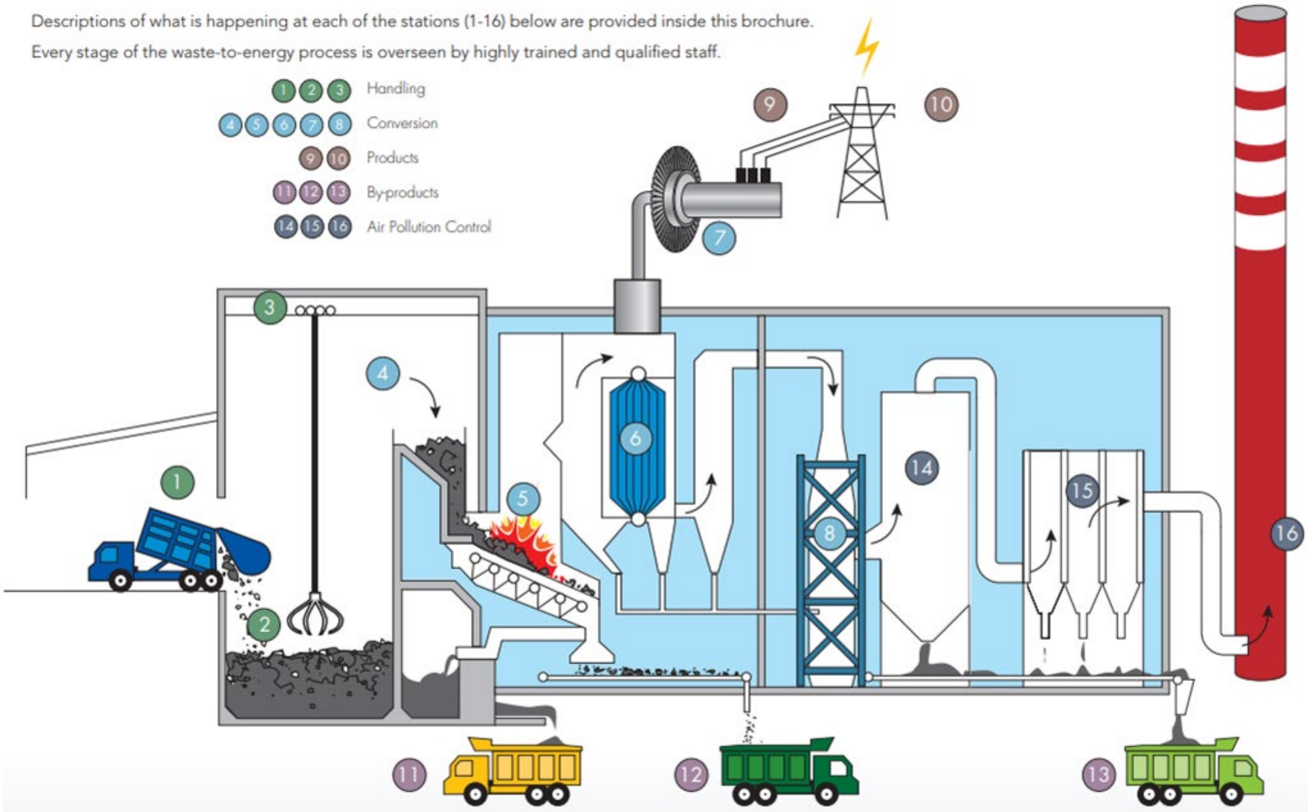


Figure 4.4-2: Mass Burn Waste to Energy Facility Diagram

Organic Processing Technologies

- Windrow Composting;
- Aerated Static Pile;
- Membrane Covered Aerated Static Pile;
- In-Vessel Composting; and
- Anaerobic Digestion

Figure 4.4-3: Windrow Composting

Figure 4.4-4: Membrane Covered Aerated Static Pile

Figure 4.4-5: Example of Garage Style Dry Anaerobic Digestion

The two types of alternative technologies that were evaluated are designed to handle very different types of feedstocks and waste types. In general, thermal treatment technologies process most all MSW materials, while biological processing technologies target the organic fraction of MSW (such as food waste, yard, and paper towels). Both types of technologies require some pre-processing and pre-sorting of material to enhance the technology conversion. These pre-processing and pre-sorting operations may be accomplished by mechanical means (e.g. trommel screening and separation) or at the source generators (e.g. source separation programs). Furthermore, the two types of technologies vary in the end-product such as in the form of energy (electricity, heat, power, liquid fuel) and products (e.g. compost). A key consideration in selecting a technology is identifying the customer or end-user (i.e. markets) for the products created.

This evaluation and findings were developed for SWS' consideration for potential alternatives to landfilling in the mid-term and long-term planning horizon. Numerous factors were presented that must be considered in determining the feasibility and applicability of alternative technologies, such as collection and pre-processing of feedstock, economics, environmental impacts and benefits, permitting and available end markets/users.

For the mid-term planning horizon (5 to 10 years), existing composting facility capacity can be expanded, or a new facility can be established and operated by the private sector like many facilities in North America. It is indicative that the compost operator would be supported by initiatives for diverting organics in the SWS and greater MOA service areas. In the long-term, an Anaerobic Digestion facility or Waste-to-Energy facility could be considered, particularly if a landfill expansion is deemed infeasible. During conceptual planning for the CTS, a Conceptual Site Plan No. 2B (see Figure 4.1-2) was prepared with a footprint for a future alternative technology facility on the eastern Wal Mart property. Significant zoning and land use requirements must be met to site an Incinerator or Composting/Anaerobic Digestion facility in this location (see Section 4.1.5). These types of facilities are identified in I-2 zoning designations and the existing zoning in the eastern Wal Mart property is zoned I-1. Another option for an alternative technology is a co-digestion facility to meet the needs of AWWU and SWS, or a waste-to-energy facility that could process MSW and biosolids.

A White Paper Report on the Development of a Waste-to-Energy Project for the Municipality of Anchorage, Alaska was prepared in September 2019 (included in Appendix H) which included a pro forma model, pre-feasibility study review and findings that a WTE facility in the MOA should be considered further. A more detailed Feasibility Study was proposed that evaluates regulatory, environmental and social impact studies;

engineering and geotechnical review of potential sites; waste collection and transportation studies, detailing implementation time line including procurement, financing and permitting discussions and further refining of the pro-forma model. Recommended next steps for future planning included:

- Securing Waste Flow Control;
- Conducting a Waste Composition Study;
- Developing a Project Team;
- Negotiating a Power Purchase Agreement;
- Selecting a Facility Site and Path to Permitting;
- Permitting Discussions;
- Deciding on Facility Construction Procurement; and,
- Facility Financing.

Detailed discussion of the pro-forma and next steps for evaluating the development of a WTE project is included in Appendix H. The ISWMP includes the steps above as well as projected construction cost in the short- and medium-term recommendations tables included in Section 5.0. Once a determination is made to move forward with a WTE project, implementation of the project would include intermediate steps of securing put or pay contracts, energy market contract, preliminary design and environmental permits; procurement; plant construction and operation.

5.0 RECOMMENDATIONS

The ISWMP prepared for the SWS provides a roadmap to optimize SWS's solid waste management system and assets through improved operational efficiencies, capital improvements and new practices/programs that increase landfill life, improve safety and customer service, protect the environment and increase waste reduction, reuse and recycling of materials that are currently disposed of as waste. Recommended strategies for short, medium and long-term system planning periods were developed as a collaboration between SWS staff, Tetra Tech and DOWL consultants, and the SWRAC.

A revised final grading plan was prepared for the ARL resulting in a gross remaining airspace of 30.3 million cubic yards (as of 2017). Utilizing population growth projections from the Anchorage 2040 Land Use Plan, future site life projections ranged from 2062 to 2070.

Issues and opportunities identified for the ISWMP in Sections 1.0 and 2.0 included aging (30+ years) assets at the CTS creating safety issues and operational/customer service constraints, capacity increase opportunities at the ARL and low diversion rates due to lack of local markets and regulatory constraints for the MOA.

Several options for each system component (ARL, CTS and diversion programs) were evaluated in Section 3.0 of the ISWMP for the following criteria:

- Capacity Savings;
- Capital/O&M Costs;
- Revenue Generation Potential;
- Technical Feasibility;
- Permitting Feasibility; and,
- Environmental Impacts.

The above criteria were ranked for each option identified utilizing high, medium and low scores; resulting in a total score for each option. More detailed evaluations were then performed on the highest ranked options for the ARL, CTS and Diversion Programs, including a review of potential technology alternatives to landfill disposal, which findings are presented in Section 4.0 of the ISWMP.

Recommendations for short, medium and long-term strategies were developed to optimize disposal capacity through landfill operational improvements, diversion programs and alternative technologies and to optimize CTS operations with new and expanded facilities and services. Table 5-1 presents a summary of the recommendations with associated cost and benefit for the short (Years 1 to 5), medium (Years 6 to 10) and long-term (Year 11 and beyond) planning periods.

Table 5-1: SWS ISWMP Recommendations Summary

Recommendations	Capital Cost (2018 $)	Annual Cost (2018 $)	Capacity/Cost Savings
Short Term Recommendations (0 to 5 Years)			
Anchorage Regional Landfill Improvements			
Alternative Daily Cover (reusable geosynthetic tarps)	Initial Purchase = $50,000	Annual Replacement = $13,000/year	104,200 cy/year (63,000 tons/year)
Alternative Final Cover Design/Slope Stability Analysis	$10,000 to $25,000		7,300,000cy[13]
Landfill Master Development Plan[14]	$50,000 to $75,000		Not Applicable (N/A)
Temporary Scrim Covers		$22,000/year	<$52,250/Year>[15]
Reduced Refuse Cell (7.5 acres)	$2,950,000		<$600,000>[16]
Leachate Evaporator (if Landfill Gas-to-Energy facility is not expanded)	Installation = $16,400,000	Annual Operating Expenses = $140,000/Year 1 FTE ($115,000)/year for Operations	<$1,125,000/Year>[17]
Modify and upgrade leachate lagoons for enhanced zinc removal	$4,225,000		N/A
Landfill Entrance Building Replacement[18]	$10,780,000		N/A
Central Transfer Station			
Conceptual Plan No. 2A[19]	$81,026,000 to $106,239,000		N/A
Material Recovery Facility			
New Material Recovery Facility	$27,500,000 to $29,500,000		<$70,000/Year

[13] Based on additional capacity potential with 2:1 versus 3:1 final slopes between benches.
[14] Includes fill sequencing plans, soil management plan, interim and permanent storm water improvement plans, leachate reduction design and operations measures and capital improvement budget/schedule for full build-out of ARL.
[15] Reduced leachate management costs.
[16] Delayed capital improvement costs with reduced cell size.
[17] Cost savings based on system processing 100,000 gallons/day; estimated $0.045/gallon avoided leachate management costs (250 days/yr.).
[18] Landfill Entrance Building replacement cost shown in 2019 dollars and includes 30% contingency, 12% design budget, and 6% construction administration budget (see Appendix B for detailed cost)
[19] Includes property acquisition and capital improvements shown in 2018 dollars (see Appendix E, Attachment 3 for detailed cost).

Recommendations	Capital Cost (2018 $)	Annual Cost (2018 $)	Capacity/Cost Savings
Short Term Recommendations (0 to 5 Years) Continued			
Alternative Technology			
Alternative Technology Feasibility Study	$100,000 to $150,000		
Waste to Energy (Mass-Burn Incinerator) Implementation Steps (Develop Project Team)	$25,000 Secure Waste Flow Control $50,000 Negotiate Power Purchase Agreement $150,000 Siting Study/Permitting Discussions	$1,000,000/year	
Diversion			
Organics Diversion • Food Scraps Reduction, Prevention, Rescue, and Recovery Programs • Backyard Composting • Residential Curbside Organics Collection • Increase Organics Processing Capacity and Facilities • Increase Yard and Garden Waste Drop-Off	$50,000 Market Assessment $20 to $200/ton for processing 20 to 30% increase in Residential Collection Costs	$10,000/year rebate budget $10,000 (every 3 years) training budget 0.5 to 1.0 FTE ($50,000 to $100,000)/year to coordinate	6,230 tons/year for SWS service area
Public Sector Recycling • Approach 1: Increase Effectiveness of Existing Recycling Programs in Government Buildings • Approach 2: Increase the Number of Government Offices and Facilities with Recycling Programs		$15,000/year for standardized waste diversion signage and containers 0.25 FTE ($25,000)/year during program roll-out	1,320 tons/year for SWS
Residential & Commercial Recycling • Develop Commercial Waste Reduction Strategy and Toolkit		$15,000/year for standardized waste diversion signage and containers 0.1 to 0.25 FTE ($10,000 to $25,000)/year to coordinate and develop tool kit	N/A
Construction & Demolition (C&D) Recycling & Reuse • Promote/Facilitate C& D Reuse Programs • Develop and Expand Thrift Store/Free Store/Reuse Center System	0.25 FTE for 3 months ($25,000) to coordinate development	0.1 FTE ($10,000)/year long-term/ongoing promotion	N/A

Recommendations	Capital Cost (2018 $)	Annual Cost (2018 $)	Capacity/Cost Savings
Short Term Recommendations (0 to 5 Years) Continued			
Diversion			
Supporting Programs • Disaster Debris Plan • Organics Market Analysis • Plans and Strategies • Communication, Education, Monitoring and Promotion • Policies and Measurement Tools	$40,000 for Development	$25,000 annually for education and communication programs $100,000 every three years for waste composition studies 1 FTE ($100,000)/year	N/A
Total	**$143,431,000 to $170,734,000** One-Time Costs (construction/program implementation)	**$1,586,666 to $1,651,666** Annual Cost	**7,300,000 cy one-time** **70,550 tons/year** Capacity Savings **$600,000 One-Time** **$1,247,250/year** Cost Savings
Medium-Term Recommendations (6 to 10 Years) Continued			
Anchorage Regional Landfill			
Landfill Expansion Potential/Permitting Requirements[20]	$250,000 to $500,000		
Additional Refuse Cell (assumes reduced size of 7.5 acres)	$3,000,000		
Alternative Technologies			
Waste to Energy (Mass-Burn Incinerator) Implementation Steps	$100,000 Facility Construction Procurement $50,000 Facility Budgeting and Financing Determination $300M-$400M Facility Construction	$1,000,000/year	

[20] Evaluate potential for approval of Westerly expansion of ARL with JBER and NALA considerations.

Recommendations	Capital Cost (2018 $)	Annual Cost (2018 $)	Capacity Savings
Medium-Term Recommendations (6 to 10 Years) Continued			
Diversion			
Organics Diversion • Commercial Organics Collection • Evaluate Recycling Market Conditions • Increase Organics Processing Capacity and Facilities	$50,000 Market Assessment $20 to $200/ton for processing 30% increase in Residential Collection Costs	0.5 FTE ($50,000)/year to coordinate	8,000 tons/year
Construction & Demolition Recycling • Develop Policies that Support C&D Recycling (e.g., minimum diversion for C&D projects)	0.25 FTE for 9 months ($18,750) to coordinate procurement standards and policies		N/A
Increase Tire Diversion			3,000 tons/year
Supporting Programs • Organics Market Analysis • Plans and Strategies • Communication, Education, Monitoring and Promotion • Policies and Measurement Tools		$25,000 annually for additional education and communication programs	N/A
Total	**$303,378,750 to $403,628,750** **One-Time Cost (construction/program implementation)**	**$1,075,000** **Annual Cost**[21]	**11,000 tons/year** **Capacity Savings**

[21] Additional annual cost over short-term recommendation annual recurring cost.

Recommendations	Capital Cost (2018 $)	Annual Cost (2018 $)	Capacity Savings
Long-Term Recommendations (11+ Years)			
Anchorage Regional Landfill			
Plan for ARL Reaching Capacity[22]	$250,000 to $500,000		40 million cy ARL Expansion or 66,000 to 200,000 tons per year[23] Alternative Technology
Additional Refuse Cells (assumes two at 7.5 acres)	$6,000,000		<$600,000>[24]
Diversion			
Organics and Recycling Diversion Pending re-evaluation of market conditions, shipping opportunities, and regulatory/legal changes to expand recycling throughout MOA.	$50,000 to $100,000 Market and Regulatory/Legal Assessment		
Residential & Commercial Recycling • Increase Bulky Item Diversion		$5,500/year for additional vans to ship recyclables to lower 48 states 0.25 FTE ($25,000)/year to develop	120 tons/year
Supporting Programs • Organics Market Analysis • Communication, Education, Monitoring and Promotion • Policies and Measurement Tools		$25,000 annually for additional education and communication programs	N/A
Total	**$6.3 to $6.6M** One-Time Cost (construction/program implementation)	**$55,500** Annual Cost[25]	**40 million cy One-Time 66,120 to 200,120 tons per year** Capacity Savings **$600,000** One-Time Cost Savings

[22] Implement permitting process for ARL expansion or alternative technology facility at least 20 to 25 years prior to ARL reaching capacity.
[23] Potential Capacity Savings based on 2016 Annual Tonnage (330,000 tons per year).
[24] Delayed capital improvement costs with reduced cell size.
[25] Additional annual cost over short and medium-term recommendations annual recurring cost.

The SWS ISWMP recommendations provide for increased landfill life, revenue generation and renewable energy potential, cost savings, improved customer service, safety and operational efficiencies, environmental protection and increased diversion resulting in:

- **Preserving landfill life by 30% to 40% or up to 20 additional years** (to 2090) through use of alternative daily covers and steepening of final fill slopes with an alternative final cover design;
- **Revenue and electricity generation of an additional 5.6 MW** if the existing landfill gas to electricity plant at the ARL is expanded or;
- **Reduction in refuse-to-soil ratio** to **3.5:1** through use of alternative daily covers (SWS Strategic Plan goal is 1.4:1);
- **Reduction in leachate generation and associated costs** through use of scrim covers, separate wet weather operations, less permeable daily cover (reduce/eliminate use of snow), and interim storm water management;
- **Reduction in leachate treatment costs** if landfill gas utilized for leachate evaporation as an alternative to LFGTE plant expansion (if deemed infeasible due to reduced base cost of power);
- New CTS transfer station, administration, maintenance and warm storage buildings and public drop-off facilities to replace 30+ year assets provide **improved safety, customer service, efficiency and materials management**;
- New property acquisition for CTS **prevents a 2- to 3- year shutdown of existing facility** for improvements, **allows for future uses by other MOA departments** (i.e. grit management facility at existing transfer station and additional warm storage and administration building space) and **controls adjacent uses** that may impact future CTS operations;
- New Material Recovery Facility to meet new industry standards for recycling markets can **support increased diversion through mandatory recycling programs.**
- **Increase in SWS service area diversion rate in the short-term from 16% to 27% and reduced per capita disposal from 6.1 to 5.4 lbs./day** through food scraps reduction, organics collection/drop-off programs, expanded compost facility capacity and end market development, public sector recycling, community outreach and education programs (including tool kits), Construction & Demolition (C & D) reuse and recycling;
- **Increase in SWS service area diversion rate in the medium-term by an additional 17% to over 40% by 2028 and reduced per capita disposal to 4.6 lbs./day** through expanded commercial organics, community outreach and education programs, increasing organics processing capacity and facilities and reuse/recycling of C & D waste;
- **Potential 20% to 90% reduction in landfill disposal (by volume)** could be achieved with technology alternatives (biological and thermal respectively) if deemed feasible in future study;
- **Potential for additional 40 million cubic yards of landfill capacity or 45 additional years** if expansion of the ARL to the west is deemed permittable; and

- **Increase in SWS diversion rate in the long-term** through expanding and improving residential curbside recycling and bulky item reuse/recycling. Assessment of market demand, increases in back-haul capacity and legal/regulatory authority to increase recycling throughout the MOA is needed to significantly increase diversion rates in the long-term.

Programmatic recommendations have been made for assessment of recycling markets; feasibility studies of expanding organics infrastructure capacity, landfill expansion permitting/approvals, further evaluation of alternative technologies; and expansion of recycling programs in the future throughout the MOA (with changes in legal/regulatory authorities as well as increased back-haul potential). Engineering recommendations include preparation of a Landfill Master Development Plan that includes future fill phasing, soil management, interim and permanent storm water improvements, capital improvement budgets/schedule, revised final cover design, and slope stability analysis to provide cost savings and additional landfill life. Engineering feasibility studies are also recommended for the best use of excess landfill gas and for management of leachate.

The SWS ISWMP recommendations for short, medium and long-term strategies address the solid waste management needs of the MOA for over the next 100 years. In October 2018, the MOA Assembly authorized SWS to proceed with acquisition of the Wal Mart property adjacent to the CTS in order to provide for new and upgraded facilities to meet future needs. Periodic updates of the ISWMP are recommended to assess progress, needs and changed conditions over time.

TABLES

TABLE 1-4
ANCHORAGE REGIONAL LANDFILL
REMAINING CAPACITY
(HIGH POPULATION GROWTH)

DATA	
Population Growth	High Growth
Airspace Utilization Factor[1]	0.60 tons/cy
Aerial Topo Date	9/26/17
Remaining Capacity[2]	30,270,000 CY

YEAR[3]	MUNICIPAL SOLID WASTE (TONS)	AIRSPACE CONSUMED (CY)[4]	CUMULATIVE VOLUME (CY)	REMAINING CAPACITY (CY)[5]
2017	83,481	139,135	139,135	30,130,865
2018	320,894	534,823	673,959	29,596,041
2019	324,424	540,706	1,214,665	29,055,335
2020	327,992	546,654	1,761,319	28,508,681
2021	331,600	552,667	2,313,986	27,956,014
2022	335,248	558,747	2,872,733	27,397,267
2023	338,936	564,893	3,437,625	26,832,375
2024	342,664	571,107	4,008,732	26,261,268
2025	346,433	577,389	4,586,121	25,683,879
2026	350,244	583,740	5,169,861	25,100,139
2027	354,097	590,161	5,760,022	24,509,978
2028	357,992	596,653	6,356,675	23,913,325
2029	361,930	603,216	6,959,891	23,310,109
2030	365,911	609,851	7,569,742	22,700,258
2031	369,936	616,560	8,186,302	22,083,698
2032	374,005	623,342	8,809,644	21,460,356
2033	378,119	630,199	9,439,843	20,830,157
2034	382,279	637,131	10,076,974	20,193,026
2035	386,484	644,139	10,721,113	19,548,887
2036	390,735	651,225	11,372,338	18,897,662
2037	395,033	658,388	12,030,727	18,239,273
2038	399,378	665,631	12,696,357	17,573,643
2039	403,772	672,953	13,369,310	16,900,690
2040	408,213	680,355	14,049,665	16,220,335
2041	412,703	687,839	14,737,504	15,532,496
2042	417,243	695,405	15,432,909	14,837,091
2043	421,833	703,055	16,135,964	14,134,036
2044	426,473	710,788	16,846,752	13,423,248
2045	431,164	718,607	17,565,359	12,704,641
2046	435,907	726,512	18,291,871	11,978,129
2047	440,702	734,503	19,026,374	11,243,626
2048	445,550	742,583	19,768,957	10,501,043
2049	450,451	750,751	20,519,708	9,750,292
2050	455,406	759,009	21,278,718	8,991,282
2051	460,415	767,359	22,046,077	8,223,923
2052	465,480	775,800	22,821,876	7,448,124
2053	470,600	784,333	23,606,209	6,663,791
2054	475,777	792,961	24,399,170	5,870,830
2055	481,010	801,684	25,200,854	5,069,146
2056	486,301	810,502	26,011,356	4,258,644
2057	491,651	819,418	26,830,774	3,439,226
2058	497,059	828,431	27,659,205	2,610,795
2059	502,526	837,544	28,496,749	1,773,251
2060	508,054	846,757	29,343,506	926,494
2061	513,643	856,071	30,199,577	70,423
2062	519,293	865,488	31,065,065	-795,065

Notes
1) Airspace utilization factor is based on the annual actual which is calculated by dividing the tonnage added since 10/14/2014 by the difference in volume in the active fill areas since 10/14/2014.
2) The remaining capacity as of 9/26/17 topo and the revised final grading plan (3:1 slopes in between benches, subtracted out 2' thick final cover section, and accounts for updated air field height restrictions)
3) Based on projected tonnage disposal for 2017, 317,402 tons, pro-rated for the partial year.
4) The tonnage is converted to cubic yards using the airspace utilization factor and accounts for daily and intermediate cover
5) Remaining capacity at the end of the year.

TABLE 1-5
ANCHORAGE REGIONAL LANDFILL
REMAINING CAPACITY
(LOW POPULATION GROWTH)

DATA		
Population Growth	Low Growth	
Airspace Utilization Factor[1]	0.60	tons/cy
Aerial Topo Date	9/26/17	
Remaining Capacity[2]	30,270,000	CY

YEAR[3]	MUNICIPAL SOLID WASTE (TONS)	AIRSPACE CONSUMED (CY)[4]	CUMULATIVE VOLUME (CY)	REMAINING CAPACITY (CY)[5]
2017	82,821	138,034	138,034	30,131,966
2018	315,836	526,393	664,427	29,605,573
2019	316,783	527,972	1,192,399	29,077,601
2020	317,733	529,556	1,721,954	28,548,046
2021	318,687	531,144	2,253,099	28,016,901
2022	319,643	532,738	2,785,837	27,484,163
2023	320,602	534,336	3,320,173	26,949,827
2024	321,563	535,939	3,856,112	26,413,888
2025	322,528	537,547	4,393,659	25,876,341
2026	323,496	539,159	4,932,818	25,337,182
2027	324,466	540,777	5,473,595	24,796,405
2028	325,440	542,399	6,015,994	24,254,006
2029	326,416	544,026	6,560,021	23,709,979
2030	327,395	545,659	7,105,679	23,164,321
2031	328,377	547,296	7,652,975	22,617,025
2032	329,362	548,937	8,201,912	22,068,088
2033	330,351	550,584	8,752,497	21,517,503
2034	331,342	552,236	9,304,733	20,965,267
2035	332,336	553,893	9,858,625	20,411,375
2036	333,333	555,554	10,414,180	19,855,820
2037	334,333	557,221	10,971,401	19,298,599
2038	335,336	558,893	11,530,293	18,739,707
2039	336,342	560,569	12,090,863	18,179,137
2040	337,351	562,251	12,653,114	17,616,886
2041	338,363	563,938	13,217,052	17,052,948
2042	339,378	565,630	13,782,681	16,487,319
2043	340,396	567,327	14,350,008	15,919,992
2044	341,417	569,029	14,919,036	15,350,964
2045	342,441	570,736	15,489,772	14,780,228
2046	343,469	572,448	16,062,220	14,207,780
2047	344,499	574,165	16,636,385	13,633,615
2048	345,533	575,888	17,212,273	13,057,727
2049	346,569	577,615	17,789,888	12,480,112
2050	347,609	579,348	18,369,236	11,900,764
2051	348,652	581,086	18,950,322	11,319,678
2052	349,698	582,829	19,533,152	10,736,848
2053	350,747	584,578	20,117,730	10,152,270
2054	351,799	586,332	20,704,062	9,565,938
2055	352,854	588,091	21,292,152	8,977,848
2056	353,913	589,855	21,882,007	8,387,993
2057	354,975	591,625	22,473,632	7,796,368
2058	356,040	593,399	23,067,031	7,202,969
2059	357,108	595,180	23,662,211	6,607,789
2060	358,179	596,965	24,259,176	6,010,824
2061	359,254	598,756	24,857,932	5,412,068
2062	360,331	600,552	25,458,484	4,811,516
2063	361,412	602,354	26,060,838	4,209,162
2064	362,497	604,161	26,664,999	3,605,001
2065	363,584	605,974	27,270,973	2,999,027
2066	364,675	607,791	27,878,764	2,391,236
2067	365,769	609,615	28,488,379	1,781,621
2068	366,866	611,444	29,099,823	1,170,177
2069	367,967	613,278	29,713,100	556,900
2070	369,071	615,118	30,328,218	-58,218

Notes
1) Airspace utilization factor is based on the annual actual which is calculated by dividing the tonnage added since 10/14/2014 by the difference in volume in the active fill areas since 10/14/2014.
2) The remaining capacity as of 9/26/17 topo and the revised final grading plan (3:1 slopes in between benches, subtracted out 2' thick final cover section, and accounts for updated air field height restrictions)
3) Based on projected tonnage disposal for 2017, 314,890 tons, pro-rated for the partial year.
4) The tonnage is converted to cubic yards using the airspace utilization factor and accounts for daily and intermediate cover
5) Remaining capacity at the end of the year.

TABLE 4.2-2
ANCHORAGE REGIONAL LANDFILL
REVISED GRADING PLAN WITH 2:1 SLOPES
REMAINING CAPACITY
(HIGH POPULATION GROWTH)

DATA		
Population Growth	High Growth	
Airspace Utilization Factor[1]	0.60	tons/cy
Aerial Topo Date	9/26/17	
Remaining Capacity[2]	37,570,000	CY

YEAR[3]	MUNICIPAL SOLID WASTE (TONS)	AIRSPACE CONSUMED (CY)[4]	CUMULATIVE VOLUME (CY)	REMAINING CAPACITY (CY)[5]
2017	83,481	139,135	139,135	37,430,865
2018	320,894	534,823	673,959	36,896,041
2019	324,424	540,706	1,214,665	36,355,335
2020	327,992	546,654	1,761,319	35,808,681
2021	331,600	552,667	2,313,986	35,256,014
2022	335,248	558,747	2,872,733	34,697,267
2023	338,936	564,893	3,437,625	34,132,375
2024	342,664	571,107	4,008,732	33,561,268
2025	346,433	577,389	4,586,121	32,983,879
2026	350,244	583,740	5,169,861	32,400,139
2027	354,097	590,161	5,760,022	31,809,978
2028	357,992	596,653	6,356,675	31,213,325
2029	361,930	603,216	6,959,891	30,610,109
2030	365,911	609,851	7,569,742	30,000,258
2031	369,936	616,560	8,186,302	29,383,698
2032	374,005	623,342	8,809,644	28,760,356
2033	378,119	630,199	9,439,843	28,130,157
2034	382,279	637,131	10,076,974	27,493,026
2035	386,484	644,139	10,721,113	26,848,887
2036	390,735	651,225	11,372,338	26,197,662
2037	395,033	658,388	12,030,727	25,539,273
2038	399,378	665,631	12,696,357	24,873,643
2039	403,772	672,953	13,369,310	24,200,690
2040	408,213	680,355	14,049,665	23,520,335
2041	412,703	687,839	14,737,504	22,832,496
2042	417,243	695,405	15,432,909	22,137,091
2043	421,833	703,055	16,135,964	21,434,036
2044	426,473	710,788	16,846,752	20,723,248
2045	431,164	718,607	17,565,359	20,004,641
2046	435,907	726,512	18,291,871	19,278,129
2047	440,702	734,503	19,026,374	18,543,626
2048	445,550	742,583	19,768,957	17,801,043
2049	450,451	750,751	20,519,708	17,050,292
2050	455,406	759,009	21,278,718	16,291,282
2051	460,415	767,359	22,046,077	15,523,923
2052	465,480	775,800	22,821,876	14,748,124
2053	470,600	784,333	23,606,209	13,963,791
2054	475,777	792,961	24,399,170	13,170,830
2055	481,010	801,684	25,200,854	12,369,146
2056	486,301	810,502	26,011,356	11,558,644
2057	491,651	819,418	26,830,774	10,739,226
2058	497,059	828,431	27,659,205	9,910,795
2059	502,526	837,544	28,496,749	9,073,251
2060	508,054	846,757	29,343,506	8,226,494
2061	513,643	856,071	30,199,577	7,370,423
2062	519,293	865,488	31,065,065	6,504,935
2063	525,005	875,008	31,940,073	5,629,927
2064	530,780	884,634	32,824,707	4,745,293
2065	536,619	894,364	33,719,071	3,850,929
2066	542,521	904,202	34,623,274	2,946,726
2067	548,489	914,149	35,537,423	2,032,577
2068	554,523	924,204	36,461,627	1,108,373
2069	560,622	934,371	37,395,998	174,002
2070	566,789	944,649	38,340,646	-770,646

Notes
1) Airspace utilization factor is based on the annual actual which is calculated by dividing the tonnage added since 10/14/2014 by the difference in volume in the active fill areas since 10/14/2014.
2) The remaining capacity as of 9/26/17 topo and the conceptual final grading plan (2:1 slopes in between benches, subtracted out 2' thick final cover section, and accounts for updated air field height restrictions)
3) Based on projected tonnage disposal for 2017, 317,402 tons, pro-rated for the partial year.
4) The tonnage is converted to cubic yards using the airspace utilization factor and accounts for daily and intermediate cover
5) Remaining capacity at the end of the year.

TABLE 4.2-3
ANCHORAGE REGIONAL LANDFILL
REVISED GRADING PLAN WITH 2:1 SLOPES
REMAINING CAPACITY
(LOW POPULATION GROWTH)

DATA	
Population Growth	Low Growth
Airspace Utilization Factor[1]	0.60 tons/cy
Aerial Topo Date	9/26/17
Remaining Capacity[2]	37,570,000 CY

YEAR[3]	MUNICIPAL SOLID WASTE (TONS)	AIRSPACE CONSUMED (CY)[4]	CUMULATIVE VOLUME (CY)	REMAINING CAPACITY (CY)[5]
2017	82,821	138,034	138,034	37,431,966
2018	315,836	526,393	664,427	36,905,573
2019	316,783	527,972	1,192,399	36,377,601
2020	317,733	529,556	1,721,954	35,848,046
2021	318,687	531,144	2,253,099	35,316,901
2022	319,643	532,738	2,785,837	34,784,163
2023	320,602	534,336	3,320,173	34,249,827
2024	321,563	535,939	3,856,112	33,713,888
2025	322,528	537,547	4,393,659	33,176,341
2026	323,496	539,159	4,932,818	32,637,182
2027	324,466	540,777	5,473,595	32,096,405
2028	325,440	542,399	6,015,994	31,554,006
2029	326,416	544,026	6,560,021	31,009,979
2030	327,395	545,659	7,105,679	30,464,321
2031	328,377	547,296	7,652,975	29,917,025
2032	329,362	548,937	8,201,912	29,368,088
2033	330,351	550,584	8,752,497	28,817,503
2034	331,342	552,236	9,304,733	28,265,267
2035	332,336	553,893	9,858,625	27,711,375
2036	333,333	555,554	10,414,180	27,155,820
2037	334,333	557,221	10,971,401	26,598,599
2038	335,336	558,893	11,530,293	26,039,707
2039	336,342	560,569	12,090,863	25,479,137
2040	337,351	562,251	12,653,114	24,916,886
2041	338,363	563,938	13,217,052	24,352,948
2042	339,378	565,630	13,782,681	23,787,319
2043	340,396	567,327	14,350,008	23,219,992
2044	341,417	569,029	14,919,036	22,650,964
2045	342,441	570,736	15,489,772	22,080,228
2046	343,469	572,448	16,062,220	21,507,780
2047	344,499	574,165	16,636,385	20,933,615
2048	345,533	575,888	17,212,273	20,357,727
2049	346,569	577,615	17,789,888	19,780,112
2050	347,609	579,348	18,369,236	19,200,764
2051	348,652	581,086	18,950,322	18,619,678
2052	349,698	582,829	19,533,152	18,036,848
2053	350,747	584,578	20,117,730	17,452,270
2054	351,799	586,332	20,704,062	16,865,938
2055	352,854	588,091	21,292,152	16,277,848
2056	353,913	589,855	21,882,007	15,687,993
2057	354,975	591,625	22,473,632	15,096,368
2058	356,040	593,399	23,067,031	14,502,969
2059	357,108	595,180	23,662,211	13,907,789
2060	358,179	596,965	24,259,176	13,310,824
2061	359,254	598,756	24,857,932	12,712,068
2062	360,331	600,552	25,458,484	12,111,516
2063	361,412	602,354	26,060,838	11,509,162
2064	362,497	604,161	26,664,999	10,905,001
2065	363,584	605,974	27,270,973	10,299,027
2066	364,675	607,791	27,878,764	9,691,236
2067	365,769	609,615	28,488,379	9,081,621
2068	366,866	611,444	29,099,823	8,470,177
2069	367,967	613,278	29,713,100	7,856,900
2070	369,071	615,118	30,328,218	7,241,782
2071	370,178	616,963	30,945,181	6,624,819
2072	371,288	618,814	31,563,995	6,006,005
2073	372,402	620,670	32,184,666	5,385,334
2074	373,520	622,533	32,807,198	4,762,802
2075	374,640	624,400	33,431,599	4,138,401
2076	375,764	626,273	34,057,872	3,512,128
2077	376,891	628,152	34,686,024	2,883,976
2078	378,022	630,037	35,316,061	2,253,939
2079	379,156	631,927	35,947,987	1,622,013
2080	380,293	633,822	36,581,810	988,190
2081	381,434	635,724	37,217,534	352,466
2082	382,579	637,631	37,855,165	-285,165

Notes

1) Airspace utilization factor is based on the annual actual which is calculated by dividing the tonnage added since 10/14/2014 by the difference in volume in the active fill areas since 10/14/2014.
2) The remaining capacity as of 9/26/17 topo and the conceptual final grading plan (2:1 slopes in between benches, subtracted out 2' thick final cover section, and accounts for updated air field height restrictions)
3) Based on projected tonnage disposal for 2017, 314,890 tons, pro-rated for the partial year.
4) The tonnage is converted to cubic yards using the airspace utilization factor and accounts for daily and intermediate cover
5) Remaining capacity at the end of the year.

TABLE 4.2-4
ANCHORAGE REGIONAL LANDFILL
WEST ADDITION EXPANSION
REMAINING CAPACITY

DATA		
Population Growth[1]	0.8%	Base
Airspace Utilization Factor[2]	0.60	tons/cy
Wester Expansion Capacity[3]	40,350,000	CY

YEAR	MUNICIPAL SOLID WASTE (TONS)	AIRSPACE CONSUMED (CY)[4]	CUMULATIVE VOLUME (CY)	REMAINING CAPACITY (CY)[5]
2061	449,348	748,914	748,914	39,601,086
2062	452,943	754,905	1,503,819	38,846,181
2063	456,567	760,944	2,264,763	38,085,237
2064	460,219	767,032	3,031,795	37,318,205
2065	463,901	773,168	3,804,964	36,545,036
2066	467,612	779,354	4,584,317	35,765,683
2067	471,353	785,588	5,369,906	34,980,094
2068	475,124	791,873	6,161,779	34,188,221
2069	478,925	798,208	6,959,987	33,390,013
2070	482,756	804,594	7,764,580	32,585,420
2071	486,618	811,030	8,575,611	31,774,389
2072	490,511	817,519	9,393,130	30,956,870
2073	494,435	824,059	10,217,189	30,132,811
2074	498,391	830,651	11,047,840	29,302,160
2075	502,378	837,297	11,885,136	28,464,864
2076	506,397	843,995	12,729,131	27,620,869
2077	510,448	850,747	13,579,878	26,770,122
2078	514,532	857,553	14,437,431	25,912,569
2079	518,648	864,413	15,301,844	25,048,156
2080	522,797	871,329	16,173,173	24,176,827
2081	526,980	878,299	17,051,472	23,298,528
2082	531,195	885,326	17,936,798	22,413,202
2083	535,445	892,408	18,829,206	21,520,794
2084	539,728	899,547	19,728,754	20,621,246
2085	544,046	906,744	20,635,498	19,714,502
2086	548,399	913,998	21,549,495	18,800,505
2087	552,786	921,310	22,470,805	17,879,195
2088	557,208	928,680	23,399,485	16,950,515
2089	561,666	936,110	24,335,595	16,014,405
2090	566,159	943,599	25,279,194	15,070,806
2091	570,688	951,147	26,230,341	14,119,659
2092	575,254	958,757	27,189,098	13,160,902
2093	579,856	966,427	28,155,524	12,194,476
2094	584,495	974,158	29,129,682	11,220,318
2095	589,171	981,951	30,111,634	10,238,366
2096	593,884	989,807	31,101,441	9,248,559
2097	598,635	997,725	32,099,166	8,250,834
2098	603,424	1,005,707	33,104,873	7,245,127
2099	608,252	1,013,753	34,118,626	6,231,374
2100	613,118	1,021,863	35,140,489	5,209,511
2101	618,023	1,030,038	36,170,527	4,179,473
2102	622,967	1,038,278	37,208,805	3,141,195
2103	627,951	1,046,584	38,255,389	2,094,611
2104	632,974	1,054,957	39,310,346	1,039,654
2105	638,038	1,063,397	40,373,743	-23,743
2106	643,142	1,071,904	41,445,646	-1,095,646

Notes

1) Population growth was obtained from the Anchorage 2040 Land Use Plan.
2) Airspace utilization factor is based on the annual actual which is calculated by dividing the tonnage added since 10/14/2014 by the difference in volume in the active fill areas since 10/14/2014.
3) The western expansion capacity is based on the design prepared by Bristol Engineering Services, 2011 and modified to tie into the 2018 3:1 ARL final grading and the up-dated clear zone restrictions for Bryant Army Airfield.
4) The tonnage is converted to cubic yards using the airspace utilization factor and accounts for daily and intermediate cover
5) Remaining capacity at the end of the year.

TABLE 4.2-5

ANCHORAGE REGIONAL LANDFILL

WEST ADDITION EXPANSION COST ESTIMATE (ROUGH ORDER OF MAGNITUDE)

Item	Quantity	Unit	Unit Cost	Total (2018 $)
Liner Construction[1]	175	AC	$ 300,000	$ 52,500,000
Civil Improvements[2]	175	AC	$ 50,000	$ 8,750,000
Basin[3]	1	LS	$ 4,000,000	$ 4,000,000
LCRS Pond[4]	1	LS	$ 1,500,000	$ 1,500,000
Excavation[5]	21,500,000	CY	$ 4.00	$ 86,000,000
Fill[6]	700,000	CY	$ 6.00	$ 4,200,000
Design[7]	1	LS	$ 10,987,000	$ 10,987,000
Construction Management[8]	1	LS	$ 15,695,000	$ 15,695,000
Construction Quality Assurance[9]	1	LS	$ 9,417,000	$ 9,417,000
Closure Costs[10]	175	AC	$ 330,000	$ 57,750,000
30-yr Post Closure Costs[10]	30	YR	$ 1,269,000	$ 38,070,000
			Total[11]	$ 288,869,000

Notes:

1) Liner costs based on Cell 11-12 and include: subgrade preparation, liner system and drain layer material.

2) Civil improvements include: temporary and perimeter drainage & access, hydroseeding, BMPs and SWPPP compliance.

3) Costs includes excavation and concrete, could be reduced if concrete was not required.

4) Costs based on liner construction costs (see note 1), includes CM and CQA, assumes pound is approximately 3 acres and will require approximately 130,000 CY of excavation.

5) Costs are based on Cell 11/12 General Excavation including haul and placement.

6) Fill necessary to construct perimeter berms, cost based on Cell 11/12 structural backfill costs.

7) Design costs assumed to be approximately 7% of the total capital improvement costs.

8) CM cost assumed to be approximately 10% of capital improvement costs.

8) CCA cost assumed to be approximately 6% of capital improvement costs.

10) The closure and post closure cost estimates are based on the 2015 Closure/Post-Closure Care Cost Estimates for Anchorage Regional Landfill prepared by HDR, Inc, see report for all cost assumptions.

11) Cost does not include: land purchasing, permitting, operations, landfill gas, or leachate treatment. Assumes existing infrastructure such as scales, admin and operations buildings will be utilized.

FIGURES

BASE TERRAIN MAPS:
2017 AERIAL TOPOGRAPHY BY KODAK MAPPING. FLIGHT DATE 9/26/17

N

0 200 400

SCALE:1''= 400'

REFERENCE: SOURCE, "BRISTOL ENGINEERING SERVICES CORPORATION", 3-16-2018.

G:\DWG\ANCHORAGE\ARL WESTERN EXPANSION\CAD\SHEET FILES\FIGURES\C-807 CONCEPTUAL FINAL GRADE 2011

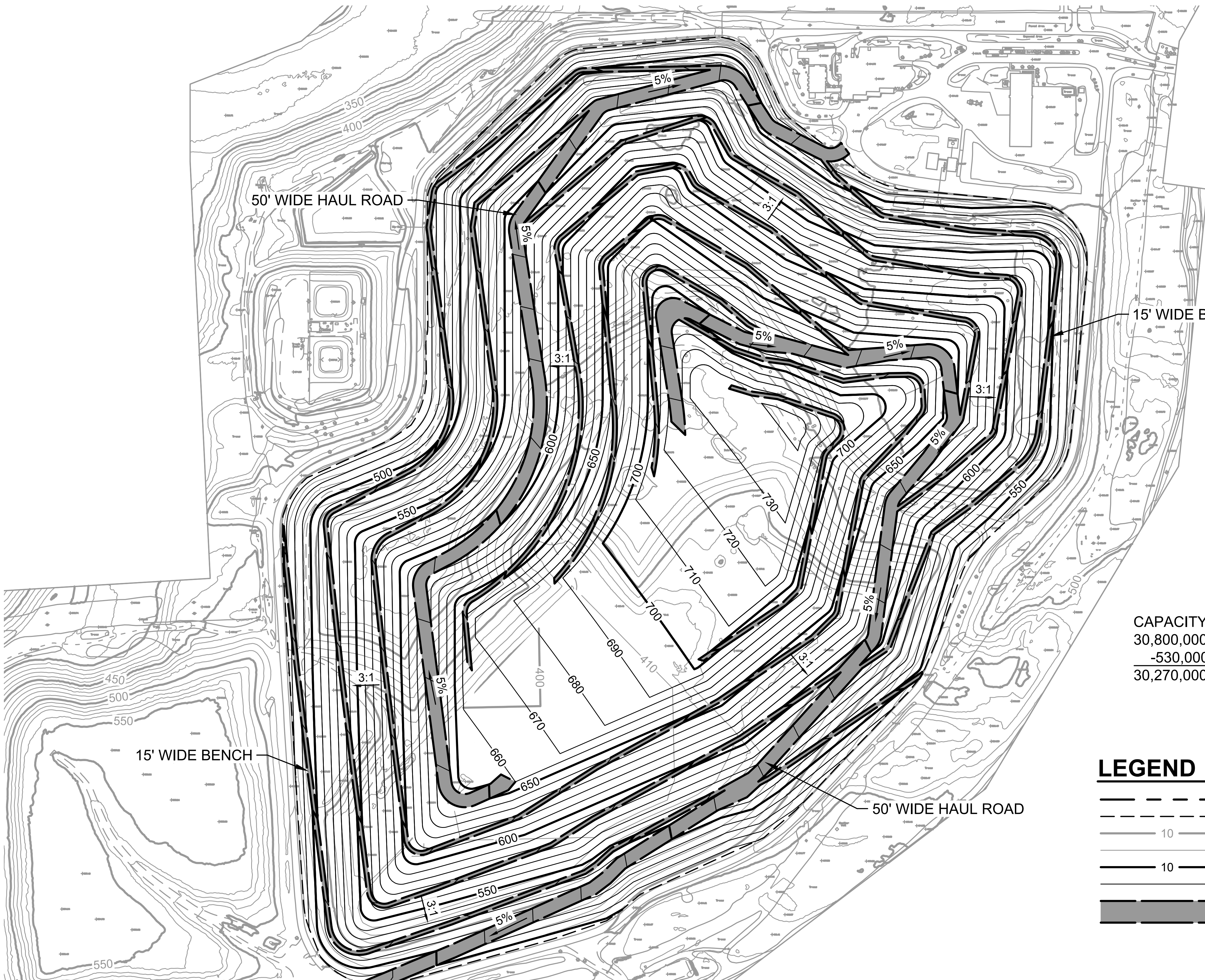
TETRA TECH
1360 Valley Vista Drive, Diamond Bar, CA 91765
TEL 909.860.7777 FAX 909.860.8017

ANCHORAGE REGIONAL LANDFILL

2011 CONCEPTUAL FINAL CAP GRADING PLAN

FIGURE NO.

1-14



CAPACITY:
30,800,000 CY GROSS AIRSPACE
-530,000 CY FINAL COVER (ASSUME 2' THICK)
30,270,000 CY NET AIRSPACE

LEGEND

- APPROXIMATE LIMIT OF PROPERTY LINE
- LIMIT OF GRADING
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- PROPOSED ROAD AND BENCH

TOPOGRAPHY OF DATE: 9/26/17

G:\dwg\Anchorage\ARL Western Expansion\CAD\Sheet Files\Figures\Final Grading Plan 3-1 Slope

FIGURE NO. 1-15

ANCHORAGE REGIONAL LANDFILL
FINAL GRADING PLAN 3:1 SLOPE

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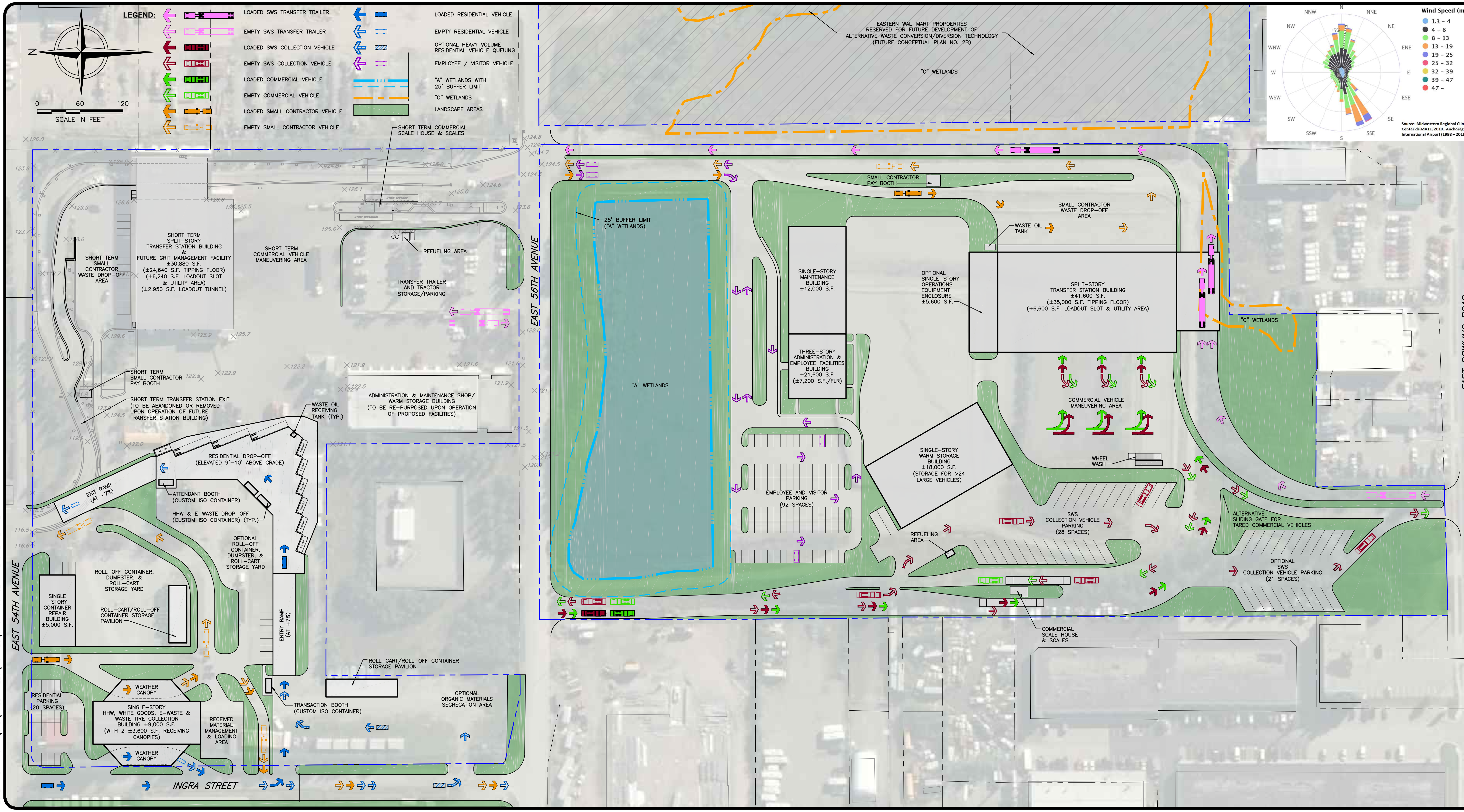

G:\DWG\ANCHORAGE\ARL WESTERN EXPANSION\CAD\SHEET FILES\FIGURES\C-800 CONCEPTUAL SITE PLAN 2A-FIG4.1-1

TETRA TECH
1360 Valley Vista Drive, Diamond Bar, CA 91765
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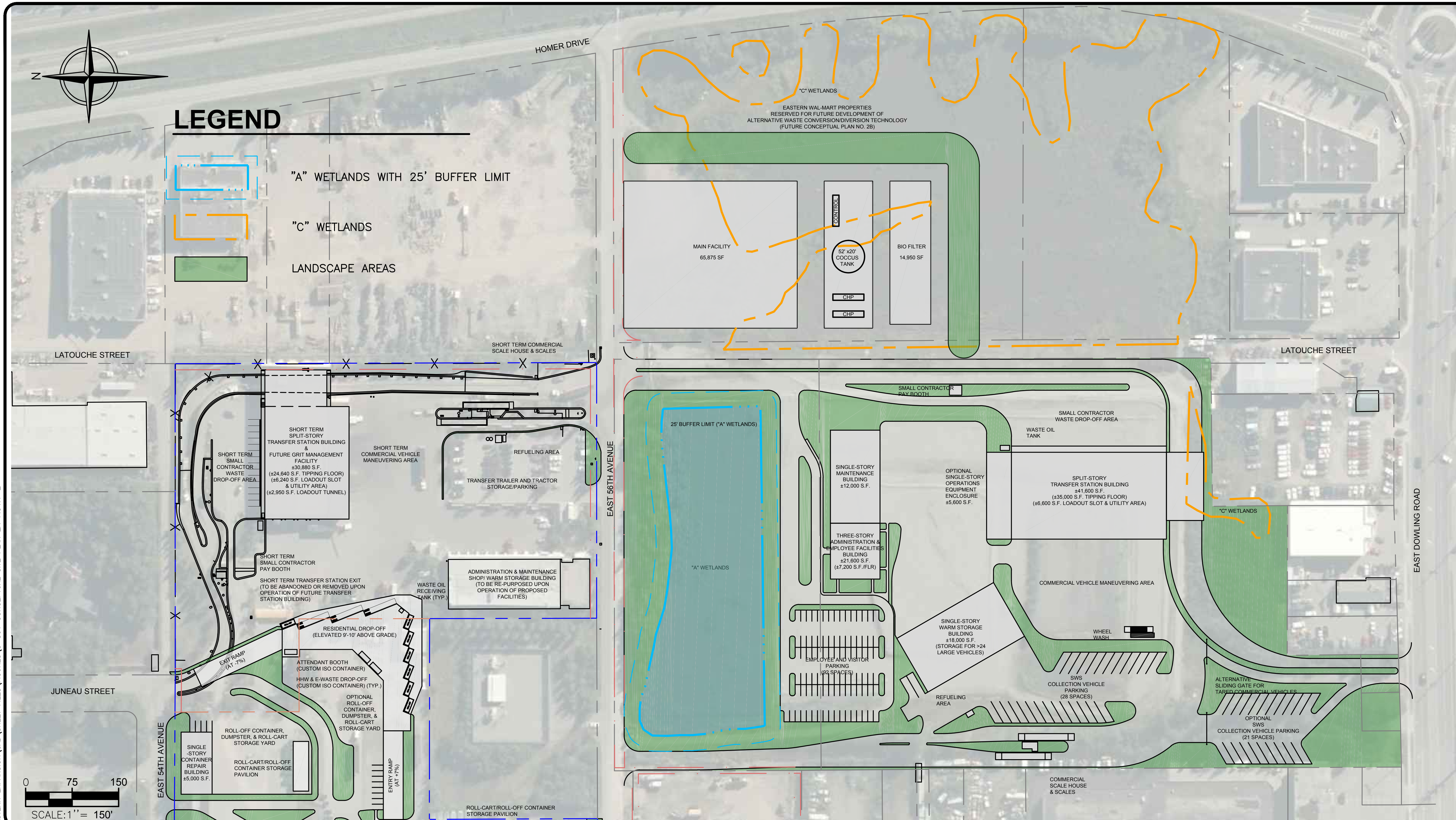
CONCEPTUAL SITE PLAN NO. 2A

FACILITY EXPANSION - SOUTHERN WAL-MART PROPERTY ACQUISITION

FIGURE NO. 4.1-1



G:\DWG\ANCHORAGE\ARL WESTERN EXPANSION\CAD\SHEET FILES\FIGURES\C-801 CONCEPTUAL SITE PLAN 2A-FIG4.1-2

TETRA TECH
1360 Valley Vista Drive, Diamond Bar, CA 91765
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CONCEPTUAL SITE PLAN NO. 2B

POTENTIAL ALTERNATIVE TECHNOLOGY FACILITY LAYOUT ON EAST WAL-MART PROPERTY

FIGURE NO. **4.1-2**

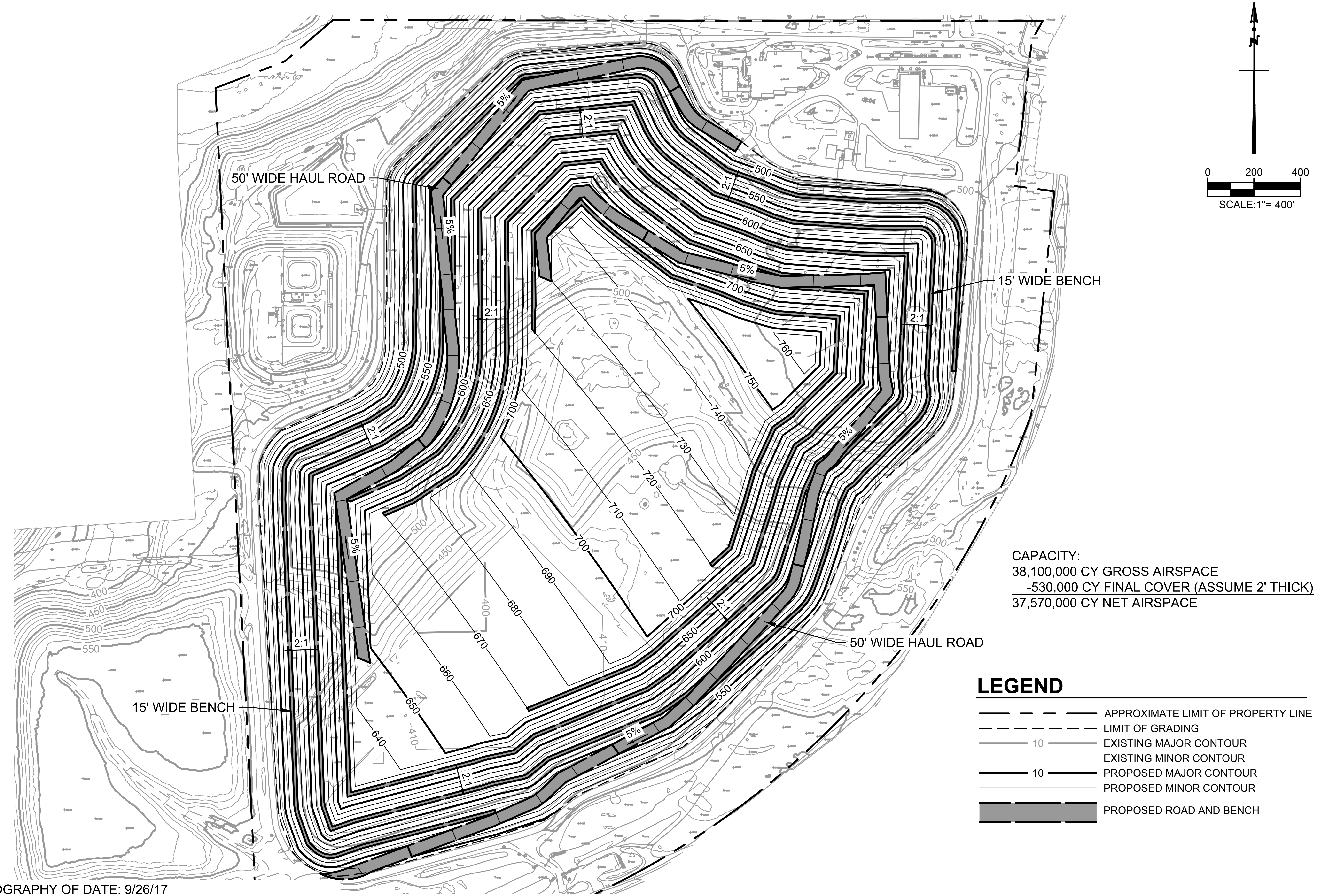

FIGURE NO. 4.2-2

ANCHORAGE REGIONAL LANDFILL

FINAL GRADING PLAN 2:1 SLOPE

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TEL 909.860.7777 FAX 909.860.8017

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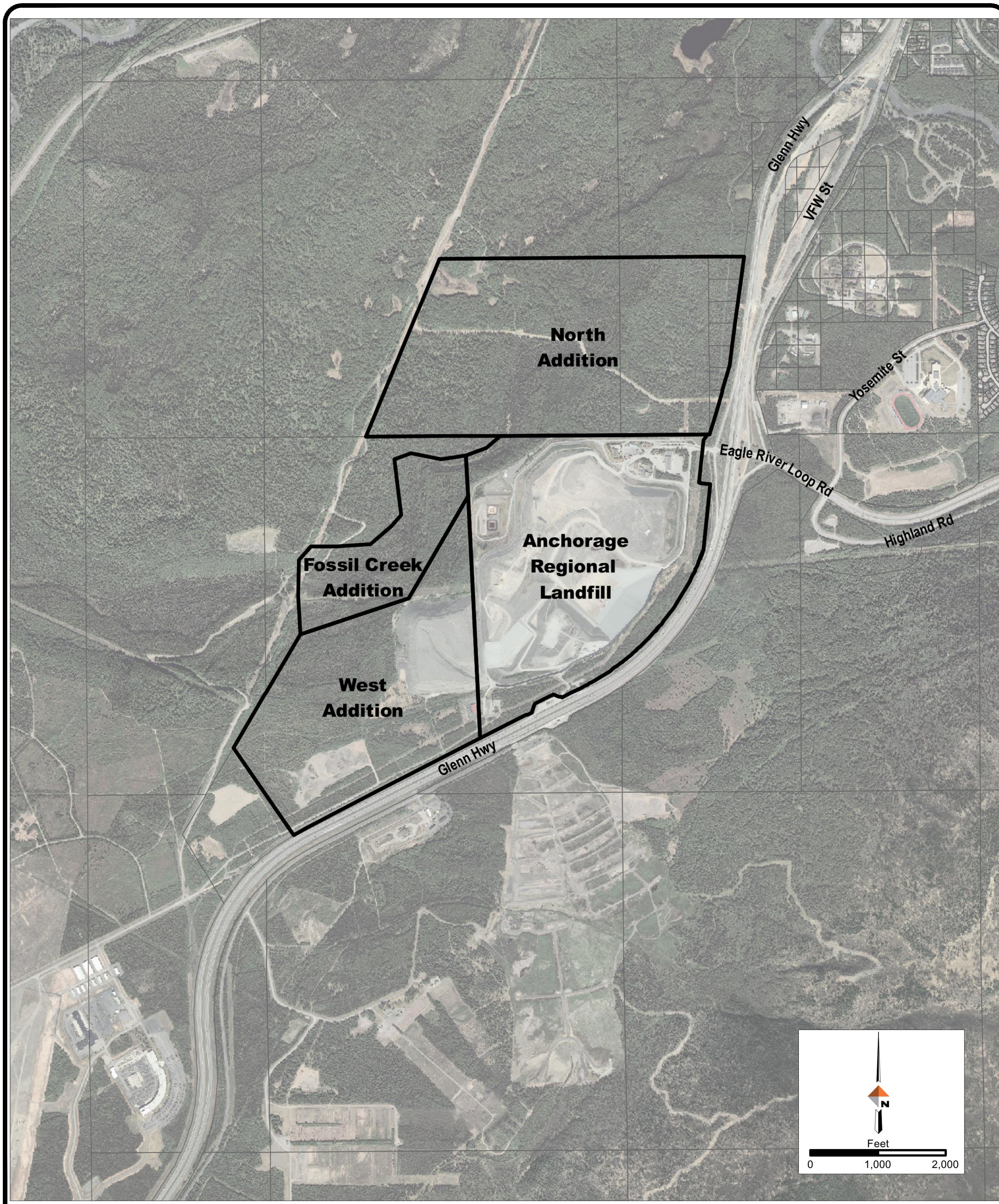

G:\DWG\ANCHORAGE\ARL WESTERN EXPANSION\CAD\SHEET FILES\FIGURES\C-803 ARL SITE MAP.DWG 9/21/2018 11:05 AM

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1360 Valley Vista Drive, Diamond Bar, CA 91765
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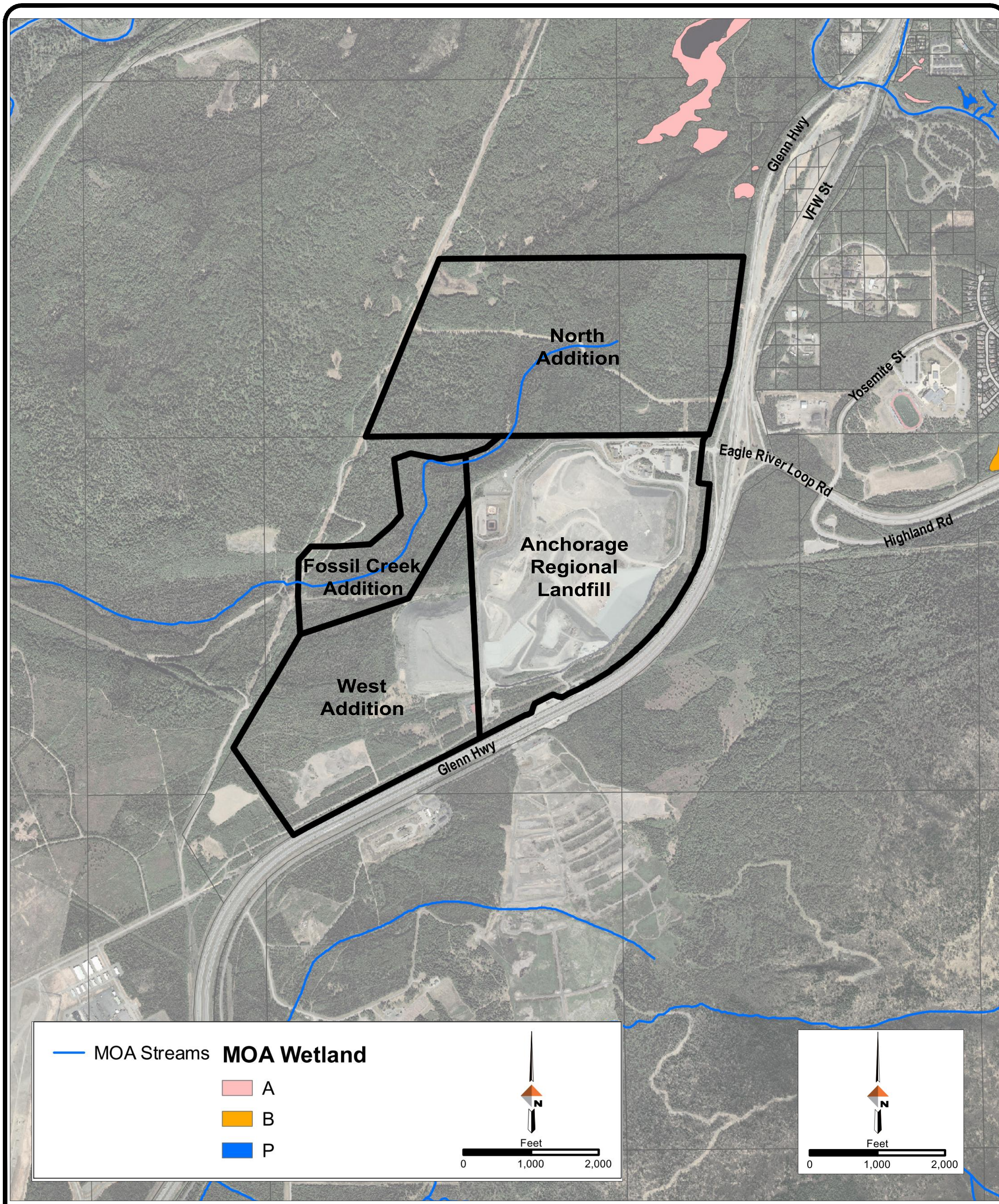
SWS INTEGRATED SOLID WASTE MASTER PLAN

ARL EXPANSION AREAS

FIGURE NO.

4.2-3



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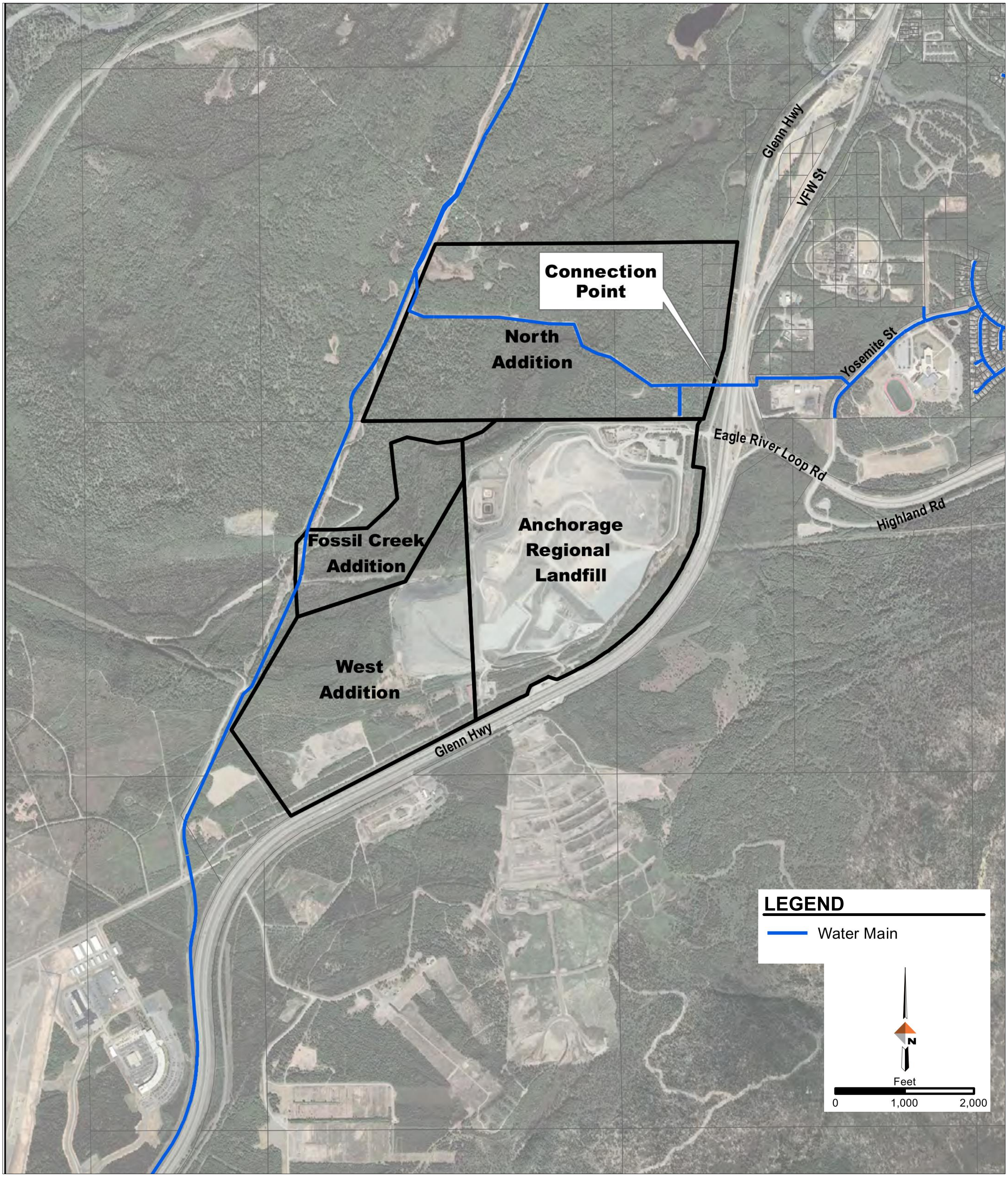
TETRA TECH
1360 Valley Vista Drive, Diamond Bar, CA 91765
TEL 909.860.7777 FAX 909.860.8017

SWS INTEGRATED SOLID WASTE MASTER PLAN

ARL WETLANDS MAP

FIGURE NO.

4.2-4



G:\DWG\ANCHORAGE\EARL WESTERN EXPANSION\CAD\SHEET FILES\FIGURES\C-806 AWWU WATER LINE.DWG 9/21/2018 11:06 AM

TETRA TECH
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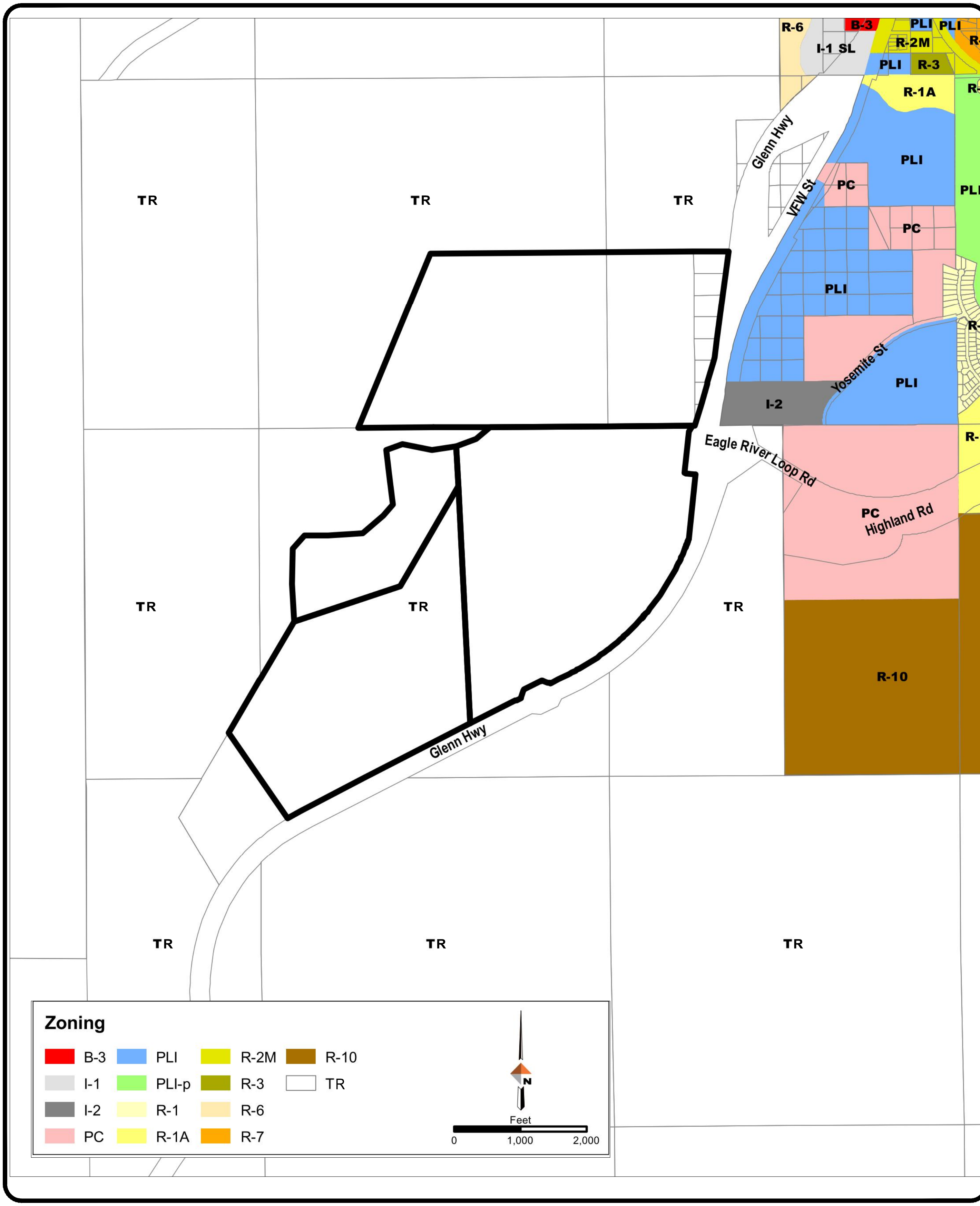
SWS INTEGRATED SOLID WASTE MASTER PLAN

AWWU WATER LINE

FIGURE NO.

4.2-5



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TETRA TECH

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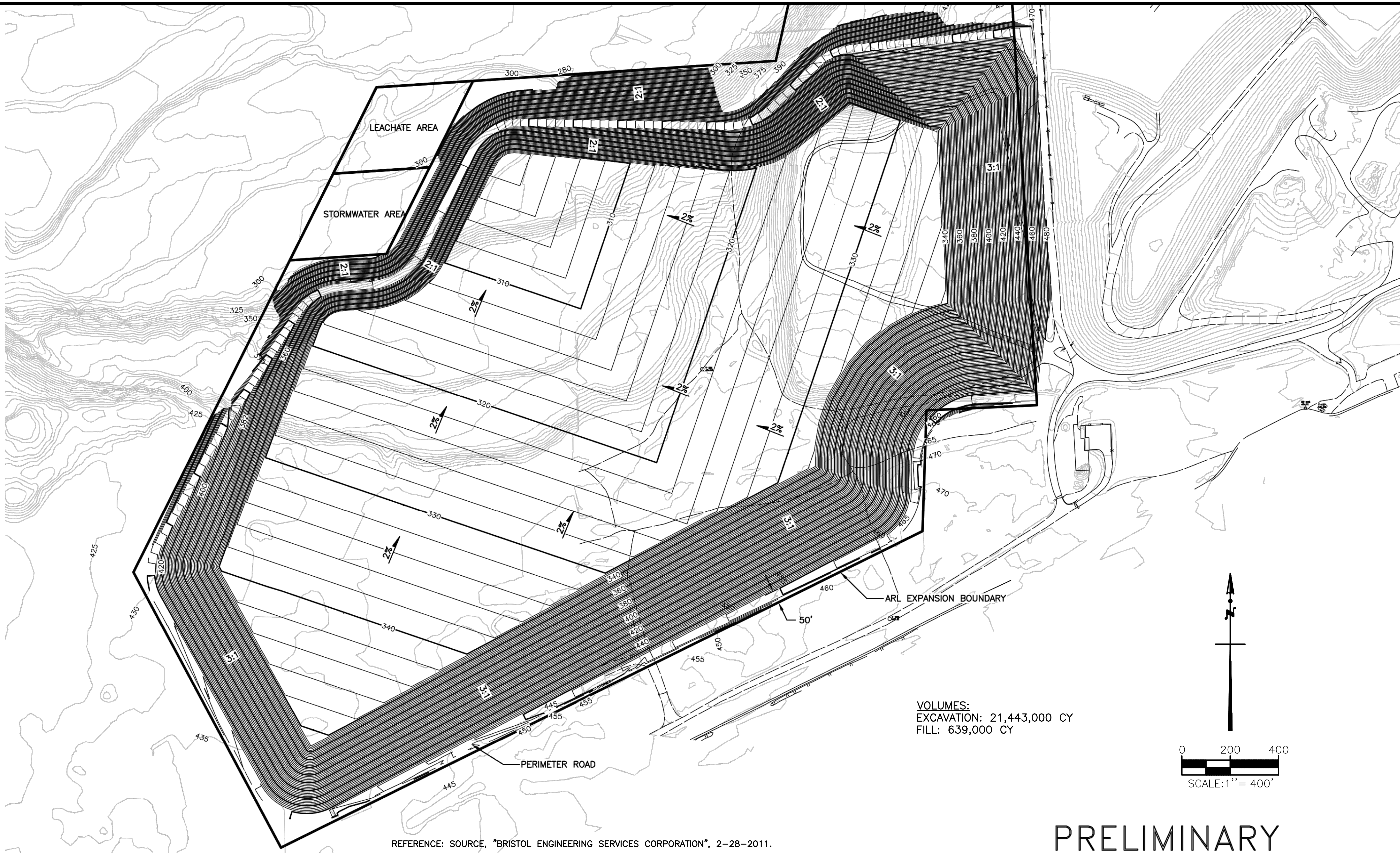
SWS INTEGRATED SOLID WASTE MASTER PLAN

ARL ZONING MAP

FIGURE NO.

4.2-6



G:\DWG\ANCHORAGE\ARL WESTERN EXPANSION\CAD\SHEET FILES\FIGURES\C-802 CONCEPTUAL FLOOR GRADING

TETRA TECH
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ANCHORAGE REGIONAL LANDFILL
WEST ADDITION EXPANSION AREA

CONCEPTUAL FUTURE EXPANSION
FLOOR GRADING

FIGURE NO.
4.2-7

APPENDIX A

STAKEHOLDER INTERVIEW NOTES

SWS INTEGRATED SW MASTER PLAN INTERVIEWS

MUNICIPALITY OF ANCHORAGE (MOA), SOLID WASTE SERVICES (SWS)
DEVELOPMENT OF AN INTEGRATED SOLID WASTE MASTER PLAN (ISWMP)

CTS PRE-MEETING
Wednesday, November 15, 2017
9:00 a.m. Alaska Time Zone

Central Transfer Station (CTS) Conference Room
1111 E. 56th Avenue, Anchorage, AK

Attendees:
Tetra Tech: Christine Arbogast, Andrew Schellberg
SWS: Mark Madden, Jack McAllister, Shane Christiansen

5 types of traffic at CTS:

- Light Commercial
- Heavy Commercial
- Residential (diagonal roll offs) HHW, bag waste, bulky white goods
- Transfer Rigs
- Employee

Options for CTS: expand or move

Remove public recycling receptacles.
AAA Storage area can go.
Trailers are for Emergency Management department.
Warehouse for cart storage is desired.

Tetra Tech BAS
1360 Valley Vista Drive, Diamond Bar, CA 91765
Tel 909.860.7777 Fax 909.396.9777 www.tetratech.com

TETRA TECH

SWS INTEGRATED SW MASTER PLAN INTERVIEWS

MUNICIPALITY OF ANCHORAGE (MOA), SOLID WASTE SERVICES (SWS)
DEVELOPMENT OF AN INTEGRATED SOLID WASTE MASTER PLAN (ISWMP)

Central Recycling Services (CRS) Meeting
Tuesday, November 14, 2017
8:00 a.m. to 9:00 a.m. Alaska Time Zone

Central Transfer Station (CTS) Conference Room
1111 E. 56th Avenue, Anchorage, AK

Attendees:
Central Recycling Services (CRS): Shane Durand and Donna Mears
SWS: Mark Spafford, Mark Madden, Suzanna Caldwell
Tetra Tech: Christine Arbogast, Caleb Moore, Andrew Schellberg, Lauren Quan
DOWL: Michelle McNulty

Background
Central Environmental Inc. (CEI) operates the CRS.
CEI operates in 26 states.
Started with crushing concrete (since 2000's), small steel recycling began in mid-2000.

In 2009, started C&D Recycling.
Mixed Construction Debris, Glass, Asphalt, concrete.

In 2012 – Opened Monofill in Fairbanks, 80 acres, 12,000 tpy.
Unlined, inerts → permitted for friable, non-friable asbestos.
No concrete crushing, ferrous/non-ferrous metals.

Contracts with oil companies for ferrous/non-ferrous recycling.
Styrofoam sheets can be reused.

Building new scrap metal yard in 2018 including ferrous, non-ferrous, electronics, wire-stripping (oilfield wire that could only be shipped to Texas) recycling.
Tub grinding gypsum.
C&D facility tip fees double that of landfill.
C&D is not supposed to go to CTS... supposed to go to ARL directly, must drive past CRS to get there.
SSI 6000 shredder, screen, tub grinder, finger screens, horizontal compactor, tire baler.

Markets

Tapered down mixed C&D (wood is a big component with no market).
Were shipping to pellet factory but can't do that anymore due to timber specifications difficult to meet.
Have looked at options.
Have primary/secondary shredding facilities.
If had 3x as much wood, it could be sent to Waste-to-Energy Plant.
Need to be at 20,000 tpy; now at 5,000 tpy.
Don't have an economical way to deal with residuals.
NIMBY problems with a local monofill facility.

Ferrous shipped by rail - 10 to 12k to get a Gondola to AK, 4 to 5 k to ship out.
Purchased AcuLoader container (10 to 15 containers/day → goes to mill in mainland directly).

Fines from C&D residuals have been used for Alternative Daily Cover (ADC) in place of gravel–has been a challenge last 2 yrs as tip fees have increased.
Glass, concrete, asphalt have secondary buyers.
100% recycled glass used for water & sewer batting for AWWU. This is the first year they've used all the glass. Commercial glass collection hasn't restarted since there was no end market.
Plastics are occasionally shipped but it's at a premium.
Facility takes 75% of demolition waste in town (80-90% of the state's).

Market Forces

Military has 50% diversion goal.
Had LEED incentive for a few months, LEED materials from Fairbanks are brought to Anchorage.
Coal fired power plant ($1/ton for coal).
State has program for recyclables.
Ferrous/nonferrous/rubble/tires/Styrofoam/cardboard/clean wood/mixed rigid plastics & HDPE pulled out on line.
Lumber companies give away wood chips.
Have salvager (6 to 8 weeks).
Habitat for Humanity is only competition – residential.
Limitations on certain wastes: Landfill has 1-5ppm PCB limit so it's getting shipped out of state
Waste component is hauled out because facilities don't want to test ($300-$450/ton).
Only 2 Class I landfills.
No municipal or state diversion goals.
Most waste stream is from large industrial programs.
Can resell salvageable products (have 1 person to remarket salvageable stuff).

Fostering End Markets

Need support from Municipality on purchasing and specifications for end-markets for materials.
Change in onerous specifications and requirements.
Develop purchasing and specifications for use of recycled products.
Asphalt shingle recycling requirements.

Commercial collection of glass-
Contractor adjustments; need work to get contractors on board with using reuse products, MSDS requirements.
Baling shredded tires 12" minus.
Want markets for tires (can resell OTRs that get retreaded by tire shops), wood, ADC, plastics.

Determining waste stream characteristics would be helpful; SWS has some data for 2010 to 2013.
Large recycling contracts have grown.

TETRA TECH

SWS INTEGRATED SW MASTER PLAN INTERVIEWS

MUNICIPALITY OF ANCHORAGE (MOA), SOLID WASTE SERVICES (SWS)
DEVELOPMENT OF AN INTEGRATED SOLID WASTE MASTER PLAN (ISWMP)

SWS Solid Waste Action Group (SWAG)
Tuesday, November 14, 2017
9:00 a.m. to 11:00 a.m. Alaska Time Zone

Central Transfer Station (CTS) Conference Room
1111 E. 56th Avenue, Anchorage, AK

Attendees:
SWS: Mark Spafford, Mark Madden, Suzanna Caldwell
Tetra Tech: Christine Arbogast, Caleb Moore, Andrew Schellberg, Lauren Quan
DOWL: Michelle McNulty

Name	Position	Contact Info
Mark Spafford	Director	907-343-6289
Suzanna Caldwell	Recycling Coordinator, Public info	907-529-9073
Leif Peterson	Commercial Collections	907-355-7630
Martin Bethke	Collections Leadman	907-317-6861
Mike Rhodes	Civil Engineer	907-428-0569
Bryan Protzman	Journeyman Operator @Anchorage LF	907-230-6741
Timothy Kelly	Finance Manager	907-343-6287
Mark Madden	Mgr. Engineering/Planning	907-428-2000
Ian Goodwin	Working Foreman @ Anchorage Landfill	907-428-1027
Jack McAllister	Working Foreman of CTS	907-343-6261
Shane Christiansen	Eng. Plan.	907-428-1064
Mariah (Maria?) Alexander	Accounts Payable	907-343-6277
Rory Hausser	Lead Mechanic	907-744-7384
Mark Spafford	GM	907-343-6289
Glen Haasl	Superintendent Disposal	907-428-0864
Patty Kilson	Admin Officer (Mark's asst)	907-343-6276
Alana (Molina?) Naats	Customer Service	907-343-6254
Birgitta Kyttle	Customer Service	907-343-6251
Raymond leHaur	Parts Expediter	907-343-6259
Evalu Filitaula	General Foreman Refuse Collection	907-343-6258
Mariah (Maria?) Kai Green	Utility Mng. Specialist, KPI Reporting	907-343-6251
Michelle McNulty	DOWL	907-562-2000
Christine Arbogast	Tetra Tech	909-860-7777
Andrew Schellberg	Tetra Tech	845-695-0203

Caleb Moore	Tetra Tech	951-836-2485
Lauren Quan	Tetra Tech	909-860-7777

SWAG members worked on the Strategic Plan over the past year: working on finalizing the plan.
This is opportunity to speak up on system changes to consider in SWMP.

<u>Diversion from Landfill</u>
Community compost program – drop off at CTS and ARL
- Private company collects and composts.

Yard waste collection program – curbside collection
- Taken to wood lot for ADC.
- 122 residents involved in that program; diverted 22 tons.

Costs for curbside recyclables collection incorporated into rate approval for 2008 automated collection.
Curbside recycling – in SWS service area (16% have opted out), Every-Other-Week service.
People opt out because of responsibility for additional cart (replacement cost $75), lots of rental properties and high density residential, MF landlords don't want to be responsible for carts and contamination.
Mandatory service area includes multi-family, (mid-town Fairview) high density concerns with contaminants.
Multiplexes are now served by SWS 96 gallon recycle carts or mixed paper/cardboard dumpster.
No additional fee for recycling service in garbage collection bill.
$18/month; 32-gal carts $36.50/month; 45-gal cart every other week $14/mo.
AW charges additional $14.75/month; $40/3 months for 96 gallon.
Challenges: people aren't careful, glass ends up in recycling bin.
Alaska Waste charges an additional fee for recyclables collection.
Recycle Boost Pilot was conducted with Alaska Waste – green waste was collected during summer → some retention 122/800 participants.
Soil & Water Conservation Service pays $15/load for mulch from green waste.
Wood lots for trees/branches/brush; wood chips are given away.

If SWS is to improve recycling across the MOA, have to work with MOA at administration level.
Food scrap recycling program – residents given buckets, food waste collection is popular with those who use it.
Backyard Composting Bins – SWS had a vendor who previously sold them at $50/a piece.
Soil & Water Conservation Service→ selling bins at wood lot.
Food waste contactor sends to their own compost facility. Lack of compost end products is an issue.

Potential for co-digestion with AWWU.
At landfill 20% C&D; 80% MSW; get loads of pallets, timber .
Loads of pallets, dimensional lumber, trying to use for ADC.
Compost facility in Seward.

Landfill Capacity Optimization
Team to review compaction; Alternative Daily Cover (last 10 yrs). Slope recovery has been performed as slopes settle from 3:1 to 8:1.
Leachate prevention – divert water surface down slope. Snow removal into ponds, finer material used on slope as stabilizer for slopes.
Try to keep stormwater outside and don't have discharge permit (infiltration ponds).
Discussed potential for partial final closure on slopes to prevent surface water infiltration or temporary final covers (geosynthetic covers – 40 mil) .

Stormwater drains and ponds are utilized.

2/3 of landfill gas is collected and converted to electricity.
DOYON has done numerous studies on how to use gas but there are restrictions.
55% methane content; landfill gas collection efficiency (assume LANDGEM 75% to 80% default).
For vertical/horizontal wells utilize tire chips/rock for backfill.

White goods separated at the LF.
Divert pallets, wood chip crates, white goods.
Moving trucks drop off office furniture.

Landfill Expansion Opportunities
SWS to identify areas adjacent to landfill, a large portion of which was originally allocated for the landfill.
Building vertically vs horizontally.
Land from military to be evaluated to expand LF.
Military has buffer requirements for training → monitor over time.
Landfill: Reuse center, mulch center, truckloads of pallets, trucks from furniture/moving companies.

1 to 4 USDA contractors are used to mitigate birds (eagles) from interfering with military operations ($160k/year).
From 1989-2009, no rate change.
Since 2009, 3 rate increases.
$45/ton, $55/ton, $58/ton.
Landfill rates in nearby municipalities are at $125/ton.
Can charge double price for waste delivered from outside of MOA.

Central Transfer Station Site design to be evaluated → traffic, floor space.

On residential side, dumping on Saturday is a circulation, queuing issue. Saturdays are busiest (Monday, Friday, Saturday busy in summer) [Noon – closing, 10:30-2:30]

Hazardous material collection, Recycle bins.

Transfer Station has 8 bays on public side (16 can dump at a time).

Commercial side not as bad, but has limitations.

Scales breaking down/failures are an issue. Scale replacement to be evaluated.

Hand off-loading slows everything down.

1/3 of residential have 5'x8' double axle trailers.

There is no indoor workshop for the disposal utility (transfer utility has maintenance at CTS).

TETRA TECH

SWS INTEGRATED SW MASTER PLAN INTERVIEWS

MUNICIPALITY OF ANCHORAGE (MOA), SOLID WASTE SERVICES (SWS)
DEVELOPMENT OF AN INTEGRATED SOLID WASTE MASTER PLAN (ISWMP)

Alaska Waste/Waste Connections
Tuesday, November 14, 2017
11:00 a.m. to 12:00 p.m. Alaska Time Zone

Central Transfer Station (CTS) Conference Room
1111 E. 56th Avenue, Anchorage, AK

Attendees:
Alaska Waste (AW)/Waste Connections: Kurt Froenig
SWS: Mark Spafford, Mark Madden, Suzanna Caldwell
Tetra Tech: Christine Arbogast, Caleb Moore, Andrew Schellberg, Lauren Quan
DOWL: Michelle McNulty

AW is in 94% of Alaska; heavily invested in Alaska.
Partnered with SWS on bio-diesel and Recycling Coordinator position with school district.
SWS provided grant for curb-side recycling pilot program (plastics, paper, aluminum, cardboard) Pilot program (5k grant) for 3 mos. of free recycling; covered 90 customers with 69% retention.
Phase II of pilot is half-way through. Larger grant to cover 830 new customers.
There are 57,000 residential customers in AW service area.
AW rates governed by Regulatory Commission (RCA) who is responsible for consistent and fair rates; regulates MSW. RCA main focus is Consumer Protection, stays out of disposal and recycling.
Need to file tariff and obtain certificate with RCA if generate >$300k of revenues; some tariff boundaries are exclusive.
Challenge for recycling is collection vehicles and staffing.

Commercial Recycling
Partnership with West Rock for recyclables which are baled and shipped out.
Route density is key → if more participated, cost would be less.
West Rock back-hauls with containers, bales and ships to lower 48 states.
If huge increase in recycling, need to pay for trucks, personnel, back-haul.
Currently service 2 recycling routes daily, about 400 customers/week.
Small organics collection; partnering with a farm in Palmer that feeds food scraps to pigs; manure goes to compost.
Recycling will continue to grow, but will be slow. 20% commercial customers have recycling.

Customers willing to do it, if free.
Competitors in ICI roll-off (30% to competitors).
If MOA passed an ordinance, AW can petition RCA to adjust rates to comply. MOA would have to pass an ordinance to have mandatory recycling (Alaska Waste can request an emergency change to RCA).
Assembly is the economic regulator for SWS service area vs RCA for AW.
Changes from the Assembly are political, not regulatory.
AW collects roll-offs and compactors in SWS areas.
CTS – would want more flexibility in hours, dedicated lanes. Facility is run well, bypass/fastpass lane is good (now have tare weights on file).
At landfill, have thought of RFID and unattended lane.

SWS INTEGRATED SW MASTER PLAN INTERVIEWS

MUNICIPALITY OF ANCHORAGE (MOA), SOLID WASTE SERVICES (SWS)
DEVELOPMENT OF AN INTEGRATED SOLID WASTE MASTER PLAN (ISWMP)

Alaskans for Litter Prevention & Recycling (ALPAR)
Tuesday, November 14, 2017
2:00 p.m. to 3:00 p.m. Alaska Time Zone

Central Transfer Station (CTS) Conference Room
1111 E. 56th Avenue, Anchorage, AK

Attendees:
ALPAR: Mary Fisher
SWS: Mark Spafford, Mark Madden, Suzanna Caldwell
Tetra Tech: Christine Arbogast, Caleb Moore, Andrew Schellberg, Lauren Quan
DOWL: Michelle McNulty

ALPAR established 1984 as a non-profit organization (501c3 non-profit status).
ALPAR assists with free/reduced cost shipping. Low-cost/free shipping of recyclables to Seattle. ALPAR provides majority of free vans to move materials to Seattle. Before 1983 low-cost shipping was not solidified. Shippers have been involved in moving materials to Seattle since ARC inception.
Recyclers have to pay for each van used, minimum $63/van.
Vans set on market value of recyclables.
Did run into a threshold of vans previously but negotiated more vans a few years ago.
Anchorage Recycling Center (started n 1978 – volunteer run) is a partner.
Water Carriers working with ARC; solidified agreements.
ALPAR works to manage the donations equitably between recipients and donors.
Level of donations depend on the people running the donor company.
25 to 26,000 tons per year of recyclables backhauled → ARC.
Valley, Fairbanks, and Key Nine – compete with Anchorage for back-haul container space.
ALPAR involved in other recycling programs such as litter prevention programs, rail belt outreach, and electronics recycled by Total Reclaim.
Major stores have their own back-haul agreements to ship to lower 48 (Walmart, Safeway, Fred Meyers, Home Depot).
Expensive to move things north; back-haul off-sets costs.
A few years ago, capacity was reached, but threshold was raised.
1130 containers committed to ALPAR for the whole rail-belt system (2 year agreement with most, Matson 500 on a 1 year agreement); 1050 were used last year.

Donors are big competing companies. Primary funding is from back-haul fee charged.
MOA grant funds, BP/Conoco Phillips funding Xmas tree recycling, glass recycling, litter patrols, wharfage (what shippers pay for donated vans) reimbursement ($40,000/yr).
Provide grants to communities $90 to $100k/yr.
Players always change (companies change hands). With open-ended agreement, recyclers can do what they want on backs of shippers.
ALPAR has worked tirelessly to develop markets for glass locally. In 2012, CRS took glass for use as recycled glass aggregate (1200 tpy).
ALPAR paying for collection.
EPR/deposit programs in state? There was talk in the 80's. Bottle deposit reform was to address litter which ALPAR replaced. Subsidize about $2.8M costs for shipping (Pepsi, Coke, Tote, Mattson).
There are vans full of paper now because it doesn't have a place to go.

TETRA TECH

SWS INTEGRATED SW MASTER PLAN INTERVIEWS

MUNICIPALITY OF ANCHORAGE (MOA), SOLID WASTE SERVICES (SWS)
DEVELOPMENT OF AN INTEGRATED SOLID WASTE MASTER PLAN (ISWMP)

Mara Kimmel, First Lady of Anchorage
Tuesday, November 14, 2017
83:30 p.m. to 4:15 p.m. Alaska Time Zone

City Hall – Municipal Manager's Conference Room
652 West 6th Avenue, Anchorage, AK

Attendees:
Mara Kimmel
SWS: Mark Spafford, Mark Madden, Suzanna Caldwell
Tetra Tech: Christine Arbogast, Caleb Moore, Andrew Schellberg, Lauren Quan
DOWL: Michelle McNulty

MOA has Resilience Strategy Team – inter-disciplinary team.
Mara appreciates willingness of SWS to be innovative and willing to expand services/responsibilities.
Adaptability, flexibility and expandability are important considerations for Master Plan.
Working with Mark and Suzanna on resilience team in MOA. Look at broader questions of resilience within the City.
Want to be a community of innovation
Energy and Food Security → maximizing production is an important topic. USEPA food waste highest & best use.
Should work across departments.
Want this study to build on the other work happening in the City.
Food Bank of Alaska. There is current lack of collaboration from institution to institution.
SWS – improve web-site to be used for matching of donors.
Alaska Materials Exchange.
Buy Nothing Facebook exchange.
Curbside Composting.
Building school community gardens.
Capture energy from waste.
Locate composting facility near community gardens (i.e. Mountain View).
Responsiveness to address Food Insecurity.
Focus on reuse of materials (glass in roadways).
Look at process and products.
Simbrosis→North by North.
Anchorage is state's hub and administration is willing to think beyond.

Energy report prepared for city recommended hiring an Energy position → inter-departmental funding of that position.
Anchorage 2040 Plan – just got adopted.
Equity and justice.
2-Cross Cutting plans shaping Anchorage future:

- Anchorage: Welcoming And REsilient → AWARE (equity & inclusivity).
- Climate Action Plan (going to neighborhoods).

April is the roll out for AWARE plan.
SWS collections knows neighborhoods best.
There is also a new Transit Plan.
Working with local museum (resilience summit).
Sustainability and Waste Services. How to bring this notion of sustainability into the City.
Recycling, Composting, Electric trucks.
Looking at what happens in other cities (i.e. Canada and San Diego).
Mountain View – most ethnically diverse in USA, average income is half the rest of Anchorage
Participation and markets are key.
Pushing on innovation.
Taxes are not good; regulatory requirements is better approach.
Be expansive and innovative.

TETRA TECH

SWS INTEGRATED SW MASTER PLAN INTERVIEWS

MUNICIPALITY OF ANCHORAGE (MOA), SOLID WASTE SERVICES (SWS)
DEVELOPMENT OF AN INTEGRATED SOLID WASTE MASTER PLAN (ISWMP)

Mayor Ethan Berkowitz
Tuesday, November 14, 2017
4:30 p.m. to 5:00 p.m. Alaska Time Zone

City Hall – Mayor's Office
652 West 6th Avenue, Anchorage, AK

Attendees:
Mayor Ethan Berkowitz
SWS: Mark Spafford, Mark Madden, Suzanna Caldwell
Tetra Tech: Christine Arbogast, Caleb Moore, Andrew Schellberg, Lauren Quan
DOWL: Michelle McNulty

Be as bold as we can. That is the right thing to do. Shouldn't be afraid to do things we haven't done before and push the envelope of innovation.
Want to think of waste as a resource.
Responsible to be good stewards of resources.
We have fiscal responsibility to use things more efficiently.
Willing to explore any concept.
Starting recycling coordinator position with Anchorage School District (partnership with Alaska Waste).
Glass →converted to pipe bedding. Economies of scale.
There is an education component to waste management.
Associate goals with programs.
Bring other departments in (have them use compost/recycled materials; Extended Producer Responsibility).
Develop markets. Natural gas is cheap here.
Are there bio-mass markets? In rural Alaska they do burn pellets and incinerate waste.
$.15-.20/kwh for energy in Anchorage
Digestion/co-digestion opportunities at wastewater treatment plant?

SWS INTEGRATED SW MASTER PLAN INTERVIEWS

MUNICIPALITY OF ANCHORAGE (MOA), SOLID WASTE SERVICES (SWS)
DEVELOPMENT OF AN INTEGRATED SOLID WASTE MASTER PLAN (ISWMP)

West Rock/Anchorage Recycling Center (ARC)
Wednesday, November 15, 2017
10:00 a.m. to 11:00 a.m. Alaska Time Zone

Central Transfer Station (CTS) Conference Room
1111 E. 56th Avenue, Anchorage, AK

Attendees:
West Rock: Randy Virgin
SWS: Mark Spafford, Mark Madden, Suzanna Caldwell
Tetra Tech: Christine Arbogast, Andrew Schellberg, Lauren Quan
DOWL: Michelle McNulty

Interview with Randy Virgin, West Rock

What is going on with recyclables markets now?
In flux. China "ban" on imports (multi-year effort since 2011). Things were being handled the wrong way. China is redefining contamination levels and stepping up enforcement.
Used to allow up to 5% contamination for mixed paper, but with no enforcement; so usually 10%. No previous incentive to reduce contamination.
Proposed mixed paper and plastics enforcement orders have been issued (differing interpretation).
*Redefining Mixed Paper, establishing new contamination limits (1%) and enforcing import licenses → within 60 days.
Fiber markets impact is known.
Cardboard→local processing →local receivers.

Have been looking at other markets (Indonesia, etc.).
Sort lines and pricing of Residential Mixed recycling will be heavily impacted.
On plastic side, not sure what is happening.
Consolidation for main consumer grades.

Source separated materials get shipped to mills.
Paper mills are in Pacific NW, paper mills from Tacoma, Washington.
Therme Kool takes newspaper locally where it's made into insulation.
Mixed recyclables get shipped to MRFs.
West Rock owns facility in Portland, OR.
When markets are down, movement is key.
$30/ton difference between source separated and comingled recyclables.

Anchorage produces better comingled recyclables (lesser contamination).
In 2009, instituted no glass or plastics. MOA did great job of educating public.
ARC processes 180 to 200 tpm comingled recyclables.

Medium to small stores → OCC dumpsters, mixed paper and OCC only
700 to 800 tpm is OCC.
2000 tpm capacity (have conveyor and baler); can buy new baler with capacity to expand.
Limited current storage.
Freight is bottle neck. Depend on Tote and Matson and ARC is lowest priority.
Limit on subsidized trailers. Cost goes up significantly, if not subsidized.
24,000 tpy shipped now; can push up to 30,000 tpy.
Hard to get trailers at this time of year.
Glass not shipped. One company in Anchorage crushes glass for use in construction.
Don't have much local demand for end-products.
Insulation company in MOA buys OCC; market competitive; consume about 4,000 tpy; only a couple of truckloads.
Most of ARC volume is paper, need paper mills.

- Local Markets
  - Glass
  - Newspaper recycling/cardboard – market price (-)
    - 4,000t/yr total (2 trailers/mo.)
  - WestRock not likely to invest in MRF
  - Small communities consolidated an ARC
    - MOA – 180-200t/mo Dropbus at RC
      - AK-300t/mo. Cardboard bins
    - Most OCC is going from big stores already.
      - AK has mixed paper/Cardboard only.
    - RC leases the facility.

In Tacoma, cost is $27M for building a new MRF. Sorting or constructing MRF is high entry.
Large volume of OCC from Walmart, Safeway, and Karrs sent directly to facilities in Tacoma.

There does not seem to be huge potential for increasing costs for recycling. In 2008, SWS proposed $8/ton recycling fee then $3/ton was approved then reduced to $1.50/ton (per Mark Madden). MOA is predominantly an anti-tax/fee population.

High level of resistance for paying extra for recycling.

TETRA TECH

SWS INTEGRATED SW MASTER PLAN INTERVIEWS

MUNICIPALITY OF ANCHORAGE (MOA), SOLID WASTE SERVICES (SWS)
DEVELOPMENT OF AN INTEGRATED SOLID WASTE MASTER PLAN (ISWMP)

Solid Waste & Recycling Advisory Committee (SWRAC)
Wednesday, November 15, 2017
11:30 a.m. to 1:00 p.m. Alaska Time Zone

Central Transfer Station (CTS) Conference Room
1111 E. 56th Avenue, Anchorage, AK

Attendees:
SWRAC Members: Radika Krishna (Anchorage Community Land Trust), Claire Boersma (Rogers Park Community Group), Dan Frank (Environmental Consultant), Brett Jokela (AWWU General Manager), Aaron Dotson (University of Alaska, Associate Professor), Dr. Aaron Kusano (Physician, previous IT consultant)

Public Members: Donna Mears, Central Recycling Services (CRS/EMI)

SWS: Patty Kelson, Mark Spafford, Mark Madden, Suzanna Caldwell

Tetra Tech: Christine Arbogast, Wilbert Yang, Andrew Schellberg, Lauren Quan

DOWL: Michelle McNulty

11:35 Meeting called to order

Minutes of 10-25-17 – Approved, with one error corrected, date of next meeting.
Public Appearance Requests? Donna Mears wishes everyone "Happy America Recycles Day!"
After introductions all around **Mark Spafford** addressed the group; he let us know that nothing is off limits, there are no sacred cows and he is encouraging open dialogue. Do not be afraid to speak up!

Christine from Tetra Tech gave opening words: It was very encouraging to hear the Mayor say the same thing. It shows that we have support from upper management. Tetra Tech is looking for ideas for improvement, efficiency, programs, etc. Their team has also met with Mara Kimmel (First Lady) which was a very encouraging meeting. We do have that "top cover".

Slide Presentation:
- Purpose of the Integrated Solid Waste Management Plan

- Have already met with stakeholders: CRS, ALPAR, RockTenn, Alaska Waste, the Mayor, Mara Kimmel, and Bill Falsey (Municipal Manager), the SWRAC and Solid Waste Action Group (SWAG).
- Tomorrow they will be meeting with the Assembly Enterprise committee
- Follow up with SWRAC in March of 2018

Open for suggestions, comments, efficiencies, programs, etc.

Claire – It's nice to have motivated leadership, however feels that we still seem to be struggling with safety.
Brett – It's good to see SWS trying new and different things. Likes the emphasis on diversion and maximizing airspace.
Mark M – most of this group is IN the SWS service area as opposed to the SWAG group where most of the employees live outside the SWS service area.
Claire -Comment re: Curbside vs alley service when SWS transitioned to Automated pick up. Customers in her neighborhood (Rogers Park) where very happy with SWS working with them. SWS had originally stated that all would be serviced curbside but met with them and agreed to alley pick up. They love being able to use the alleys.
Radhika – Lived in a 6-plex so used a large dumpster and had no interaction with SWS – they worked through the landlord.
SWS is now offering commercial recycling, but in the high density neighborhoods there are barriers due code enforcement and parking spaces. These are barriers to increasing recycling rates in those neighborhoods.
Claire – more customer outreach is needed:
- Keep alleys clear
- Proper use of recycling bins
- Bear cart information
- New opportunities

Aaron K – It's hard to talk to neighbors who don't participate in recycling. It just makes sense to do it.
Dan – more education is needed to encourage recycling.
Aaron K – We need to get the public to realize that our landfill is a resource, a finite resource.
Radhika – interacting between municipal departments is difficult and not very intuitive; plowing, street clean up, ML&P for wiring. Also trying to get public cans; Parks and Rec pick up public cans in parks, People Mover at bus stops, downtown is picked up by a public entity.
Brett – lives in a townhouse – curbside works great! There is always room for improvement such as things not accepted like glass. They have a commercial groundskeeper so he doesn't know what happens to their yard waste.
Aaron D – AK Waste, in comparison, is less effective at collecting recycling. He liked the pilot program where SWS assisted AK Waste with funding to increase recycling rates.
Mark S – The Mayor would rather use a carrot to encourage recycling, but is not opposed to using a bat if needed. We need to focus on programs, operations, and strategies to extend the life of the landfill. We can do collections of yard waste and food waste, but what is the impact? Do people want a big cart to have to keep/store?
Dan – in other areas they use smaller bins, not big carts like SWS is using.
Mark M – in Colorado it's the same thing. Trucks could be sectioned to accept different materials. It is more efficient when actually picking up garbage, but less so when you

have to drive all over to deliver different recyclables to various facilities. Glass is considered a contaminate in mixed recycling.
Mark S – We have a problem with the general public not understanding backhaul wharfage.
Christine – recycle rates will can increase through public outreach.
Brett – does not think mandatory recycling will work here.
Claire - the Alaska population has issues (a discussion ensued about how Alaskans want everything but don't want to pay for anything followed up with discussion on bottle deposits)
Dan – has anybody talked with Green Star? Donna replied that they are now a part of the AK Forum on the Environment.
Christine changed conversation to discuss CTS – need to improve queuing, layout, they got a lot of information from the CTS crew they spoke with. Discussion ensued.
Radhika – Large item pick up is a problem with collections. People push items into the street so right-of-way will pick them up.
Dan – is this a common problem in other areas?
Andrew responded: Yes, in rural areas more than in city areas. Camera technology has gotten pretty good; can get license plates – some areas have even set up a task force to deal with the problem of illegal dumping like when dumped outside the gates.

A discussion took place about the former A-Z Guide that used to be published and mailed to citizens in the MOA area. It was shut down about four years ago because of an assembly member who thought it didn't make sense to use postage and paper to promote recycling. They wanted it to be sent electronically only/and placed on our web page. Which we did, but many people want the hard copy, or at least parts of it, to put up on fridge or bulletin board.

Radhika – how many customers does SWS serve that are NOT communicating with SWS? But are only communicating through a landlord?
Dan – should safety issues/cost be included in this plan?
Mark M – there are two things we are doing right now; a Strategic Plan and a Master Plan. The Strategic Plan is where we will be documenting our safety through the use of KPI's. This meeting is for input into the Master Plan.
There was more discussion about SWRAC input into this plan.
Claire – There is a survey that comes from each community council that goes to the Assembly; SWS could get in on that to reach out to the community and find out what is important to the neighborhoods we serve.
Radhika – four neighborhood plans were passed in the last few years by the Assembly. We could include SWS in those plans going forward. It shows the municipality how communities want to move forward, however, it's more of a wish list and not law. Neighborhoods can create/write their own plans that are formally adopted by the city and incorporated in the MOA comprehensive plan.
Mark M – We were involved in the Title 21 rewrite in regards to dumpster enclosures although the process was bad. It took us a year to get on the list to contribute to a plan for the dumpster enclosures and placement.
Claire – we should evaluate expansion alternatives
Christine – thanks all for the good input. It is a very different perspective than what they have been getting from other stakeholders.
Brett – sludge – we want to turn that from a waste product to a resource. We don't have the answer yet, but would like to in the future.

Claire – how does the railbelt master electric grid plan affect our gas-to-energy plant?
Mark M – MEA, MLP and Chugach Electric have all built new plants.
Christine – Tetra Tech will be providing interim memos at the next regular meeting.

Next Meeting is set for: 01/17/2018

Meeting adjourned at 1:05pm

TETRA TECH

SWS INTEGRATED SW MASTER PLAN INTERVIEWS

MUNICIPALITY OF ANCHORAGE (MOA), SOLID WASTE SERVICES (SWS)
DEVELOPMENT OF AN INTEGRATED SOLID WASTE MASTER PLAN (ISWMP)

Bill Falsey, Municipal Manager
Wednesday, November 15, 2017
4:00 p.m. to 5:00 p.m. Alaska Time Zone

City Hall – Municipal Manager's Conference Room
652 West 6th Avenue, Anchorage, AK

Attendees:
Bill Falsey, Municipal Manager
SWS: Mark Spafford, Mark Madden, Suzanna Caldwell
Tetra Tech: Christine Arbogast, Wilbert Yang, Andrew Schellberg, Lauren Quan
DOWL: Michelle McNulty

Tetra Tech has met with Mayor Ethan Berkowitz and Mara Kimmel, First Lady of Anchorage.

The ISWMP will consider the next 5 to 50 yrs of solid waste management including diversion programs.

Currently no clear guidance on diversion.
Bill had positive feedback on SWS Strategic Plan having Key Performance Indicators.
Need to identify problems attempting to solve (i.e., capacity at landfill, deferred maintenance, upgrading of facilities); unfinished business; untapped opportunity; what to do with landfill after it closes.
In 80's, every potential site mapped for new landfill location→ almost all are gone.
Need to be positioned for ARL #2 when time comes.
In 2008, rates were subsidized for curbside recycling to increase diversion (SWS diverts about 160 tpm – 4 transfer trucks).

Collection Utility saves $20/ton by dropping material at ARC instead of CTS tip floor.

When AW sets rates, garbage rates are separate from recycling (so not subsidized).
Garbage rates for AW are regulated by RCA. Until 2009, no one cared about recycling.
SWS thought it a good thing to do for community and it was the only way to get automated collection approved.
How much of collections is subsidized by tipping fees?

- Guess – 50%

Bill would like to push curbside recycling for everyone.

For ISWMP, try to associate to each alternative the diversion quantity and impact on conserving capacity.
Need markets for alternative technologies to disposal.
WTE: Cost impact, no energy market
Need to optimize capacity and position MOA for what comes next

Do we want to look at boundaries for the service area?
- Boundaries are only guidelines right now

May not see a huge change initially. But if you can do “this”, it will make “this” difference down the road.

TETRA TECH

SWS INTEGRATED SW MASTER PLAN INTERVIEWS

MUNICIPALITY OF ANCHORAGE (MOA), SOLID WASTE SERVICES (SWS)
DEVELOPMENT OF AN INTEGRATED SOLID WASTE MASTER PLAN (ISWMP)

Enterprise and Utility Oversight Committee Meeting
Thursday, November 16, 2017
11:00 a.m. to 12:00 p.m. Alaska Time Zone

City Hall – Mayor's Conference Room
652 West 6th Avenue, Anchorage, AK

Attendees:
SWS: Mark Spafford, Mark Madden, Suzanna Caldwell
Tetra Tech: Christine Arbogast, Lauren Quan

Assembly Enterprise Committee:

Discussed see-saw of supply and demand for recyclable material.
Quickest win was with AWWU using 3 year stockpile of crushed glass for pipe bedding material.
Would like to cite and replicate what AWWU has done using recycled glass (i.e., also used as grippers on walkways).
How should other municipal agencies be required to use recycled material?
Extended Producer Responsibility policies is an option but need to consider cost impacts.
Explore potential for expanding ARL per original 1982 NALA proposed boundaries.

APPENDIX B

SWS LANDFILL ENTRANCE BUILDING REPAIR/REPLACEMENT COST ANALYSIS

Municipality of Anchorage
Solid Waste Services
Landfill Entrance Building
Repair/Replacement Cost Analysis

COFFMAN ENGINEERS
800 F Street Anchorage, Alaska 99501
(907) 276-6664

19 July 2019

Table of Contents

Scope of Work

An assessment of the structural integrity of the MOA's Solid Waste Services Landfill Entrance facility was performed in response to the magnitude 7.0 earthquake that took place in Southcentral Alaska in November 2018. The assessment determined that the building received significant damage during the earthquake that has rendered the building largely unusable. This narrative includes two options for restoring pre-earthquake functionality to the facility. The first option is to rehabilitate the heavily damaged maintenance/storage portion of the building and repair the damage to the administrative portion of the building. The second option is to demolish the entire building and provide a replacement building that will provide equivalent functionality.

Existing System

The primary function of the facility is for vehicle maintenance and storage with administrative offices attached. This facility is essential to the operation of SWS, especially during the adverse winter weather conditions associated with the Alaska region. The building was constructed in 1987. The current building consists of a single-story high-bay storage and maintenance shop with a low-bay administrative area located on the north end. The structure is constructed with a low sloped Modified Bitumen roof over open web wood truss joists. In the maintenance/storage portion of the building the roof joists are supported by CMU bearing/shear walls. The administrative portion of the building is constructed of a combination of CMU and wood bearing/shear walls. A 12-inch CMU fire wall separates the warm storage and maintenance shop from the administrative area. There are 8 overhead doors on each side of the warm storage portion, and 3 overhead doors on each side of the maintenance shop for a total of 22 overhead doors.

Repair of Existing Building

The repair of the existing building would require repair to the damaged CMU block, installation of a new lateral system for the maintenance/storage portion of the building, reinforcement of the existing CMU shear walls and repair to the non-structural damage in the interior of the administrative portion of the building.

The cost estimate assumes all construction would be to meet current building codes as adopted by the State of Alaska. The true extent of damage to the CMU blocks, CMU shear walls and steel reinforcement can only be determined during repair, and therefore may require additional repair and associated costs not included in the estimate for the rehabilitation of the existing building.

Maintenance/Storage Area Repair

The damage to the CMU block on the maintenance/storage portion of the building would be repaired in two ways. For tight (less than a ¼-inch wide) cracking, pressure injected epoxy will be used to fill the cracks and bond the CMU back together. There are multiple products available for repair of CMU blocks with pressure injected epoxy. For more substantial damage, the damaged CMU blocks will be demolished back to sound grout or removed entirely. Should not enough sound grout remain, all the damaged CMU will be demolished, leaving only the existing reinforcing steel. The demolished CMU and grout will be replaced with a repair mortar similar to Planitop 15.

Buckling was observed in the roof diaphragm. The damaged portion of the existing plywood sheathing of the roof diaphragm will be replaced and the existing roofing material will be removed to complete a thorough investigation of the rest of the roof diaphragm. It is currently estimated that only ten percent of the diaphragm sheathing will need to be replaced. The true extent of damage to the roof diaphragm can only be determined during repair, and therefore may require additional repair and associated costs is not included in the estimate for the rehabilitation of the existing building.

New Lateral Resistance System

From a review of the structural drawings for the building, there is no identifiable lateral resistance system in the maintenance/storage portion of the building in the north-south direction that would be the criteria of the current building codes. To meet current building codes a new lateral resistance system will need to be installed in the north-south direction. To provide lateral resistance for the maintenance/storage portion of the building, three steel rigid frames will be installed on each side of the building. At the six locations where the steel rigid frames are to be installed, the CMU walls and concrete foundations will be demolished. To tie the steel frames together and transfer the lateral loads from the roof diaphragm a steel collector will be installed along the top of the CMU wall and attached with post-installed CMU anchors. An architectural finish to match the existing will be installed over the steel frames.

Existing Lateral System Reinforcement

To mitigate damage in the future, a fiber reinforced polymer (FRP) product will be applied to each existing CMU shear wall (see drawings in appendix B). The installation of the FRP will require the demolition and repair of the following:

- AC pavement at the south end of the building
- Approximately 8-feet of concrete slab on south and north ends of the storage area
- The entire concrete slab in the maintenance area along with the in-slab heating system

The ground will need to be excavated down to the top of the concrete footing and surface preparation of the CMU wall surface will need to be accomplished.

Administrative Area Repair

The administrative area will remain and will require repair of architectural finishes to bring that portion of the building back into pre-earthquake condition. The repairs to the existing structure are expected to consist of the following:

- Drywall repair of roughly 10% of the interior walls,
- New floor and wall tiling in both the men's and women's locker rooms,
- New plumbing fixtures in the men's locker room.
- Repairs to minor cracking in existing concrete slab which will require replacement of the existing vinyl flooring.

The true extent of damage to the Administrative area of the building can only be determined during repair, and therefore may require additional repair and associated costs not included in the estimate for the rehabilitation of the existing building.

Overhead Crane

The existing overhead crane in the vehicle maintenance area is supported on the existing CMU shear walls. Due the amount of movement in the building it is anticipated the crane will need to be replaced and new independent support structure will be required.

Replacement of Building

The replacement building will be designed to meet current building, plumbing and HVAC codes. The proposed replacement structure will be a single-story building with two high-bay roofs at differing heights and a low bay administrative area with the same footprint as the old building.

Demolition/Repair

The entire structure, including the concrete slab and foundations, will be demolished; this includes the administrative area, warm storage and maintenance shop.

New System

Framing System for Gravity Load Resistance

The gravity framing system for the administrative area, warm storage and maintenance shop will consist of a structural steel frame bearing on cast-in-place concrete foundations. The roof structure assembly will consist of 1.5-inch corrugated metal deck supported by custom structural steel trusses. Roof trusses will be supported by wide flange steel girders. Columns supporting the girders will be wide flange steel, located in the wall. The roof will have a low, gable sloped profile to provide primary roof drainage.

Framing System for Lateral Load Resistance

For the administrative area, warm storage and maintenance shop areas the lateral force resisting system will start at the flexible metal deck diaphragm, attached to steel roof framing with mechanical fasteners designed for diaphragm shear as well as wind uplift pressures. Metal deck diaphragm shear will be transferred to steel moment frames in both directions.

Foundations

The building foundation will be a conventional shallow foundation system with reinforced concrete spread footings. Continuous strip footings will be provided around the building perimeter and larger, isolated spread footings will be used to resist column point loads.

Slab-on-Grade

A concrete slab-on-grade will be provided throughout the building. Due to the vehicle traffic in the warm storage and maintenance shop, the slabs will be designed to resist HS-20 wheel loads. Typical slab-on-grade for vehicle traffic will be 8-inches thick with #4 rebar @ 12" on center and in the administrative area the slab-on-grade will be 4-inches thick with #4 rebar @ 12" on center. The slab will be designed to accommodate trench drains and sumps. Housekeeping pads will be provided for support of large floor supported equipment.

Exterior Walls

The exterior walls for the entire building will be metal studs with insulated metal panel siding. The insulated metal panels will bear on a steel ledger attached to the footing with post-installed concrete anchors.

Interior Walls

An interior partition wall will be provided to divide the warm storage area and the maintenance shop. The partition wall will be metal studs covered with an 8-foot plywood wainscot and gypsum wallboard to the ceiling. A 1-hour rated wall will be provided to separate the maintenance shop from the administrative area. All interior walls in the administrative area will be metal studs covered with gypsum wallboard.

Administrative Area

The replacement administrative area will replicate the existing administrative area in layout and finish.

Special Structures

A total of 22 new overhead doors will be installed to accommodate the building. The basis of design will be vertical fabric folding doors, by Megadoor.

Heating, Ventilating and Air Conditioning (HVAC)

The HVAC system will provide adequate ventilation air to maintain acceptable indoor air quality, as well as provide heat during cold temperatures. The existing building includes the following: air compressor, air handling unit, waste oil heaters, oil waste separator, and high bay unit heaters. Similar equipment will be used in the new building. The waste oil heaters and unit heaters could possibly be relocated to the new building.

Plumbing

Compressed air and cold water will be supplied throughout the warm storage and maintenance shop. Air and water drops will occur between every other overhead door (approximately 30-foot intervals) and at the end walls.

Fire Suppression

Complete automatic sprinkler protection will be provided throughout the facility with a wet pipe sprinkler system.

Vehicle Exhaust Collection System

A new vehicle exhaust collection system will be provided for the vehicle maintenance bay.

Overhead Crane

A new overhead crane matching the existing overhead crane’s capacity will be provided in the replacement building.

Other

Miscellaneous systems to be accounted for in the replacement building include:

- Hot water pressure washing system,
- Compressor with piped distribution system,
- Distributed oil and lubricant dispensing system,
- Waste oil heating system,
- Floor drain system with oil-water separator system.

Cost Estimate

A construction cost estimate for both options was performed by HMS Inc. based on the narrative above.

Repair Option

The expected construction costs to rehabilitate the existing structure and bring it into compliance with current design building codes is estimated to be $6,206,323. Included in the cost estimate is a 35% contingency, 12% design budget and 6% construction administration budget. For the FEMA calculation on the determination of replacement or repair, the estimated cost is $3,718,554. This estimate excludes contingency, design budget and construction administration along with the other exclusions that FEMA requires for the analysis.

Replacement Option

The expected construction costs to replace the existing structure with similarly sized building that provides all the same function is estimated to be $10,784,819. Included in the cost estimate is a 30% contingency, 12% design budget and 6% construction administration budget. For the FEMA calculation on the determination of replacement or repair, the estimated cost is $6,006,112. This estimate excludes contingency, design budget and construction administration along with the other exclusions that FEMA requires for the analysis.

Appendix A: Photos

Photo 1: Typical Tight Cracking in CMU Blocks

Photo 2: Typical CMU Blowout at CMU Columns

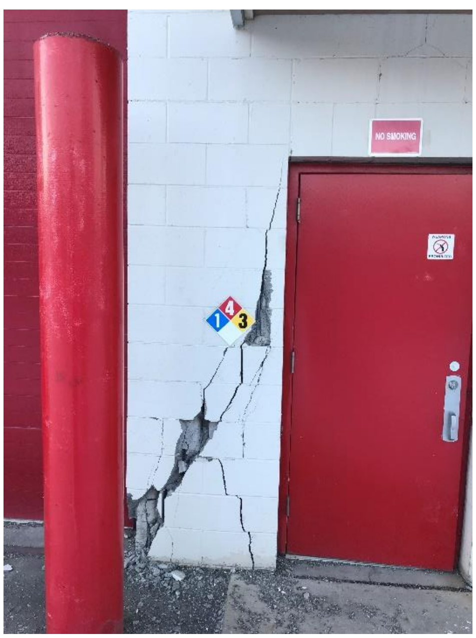


Photo 3: Significant CMU Block Damage to East Wall Near Administrative Area

Photo 4: Mortar Failure Above Overhead Door #2

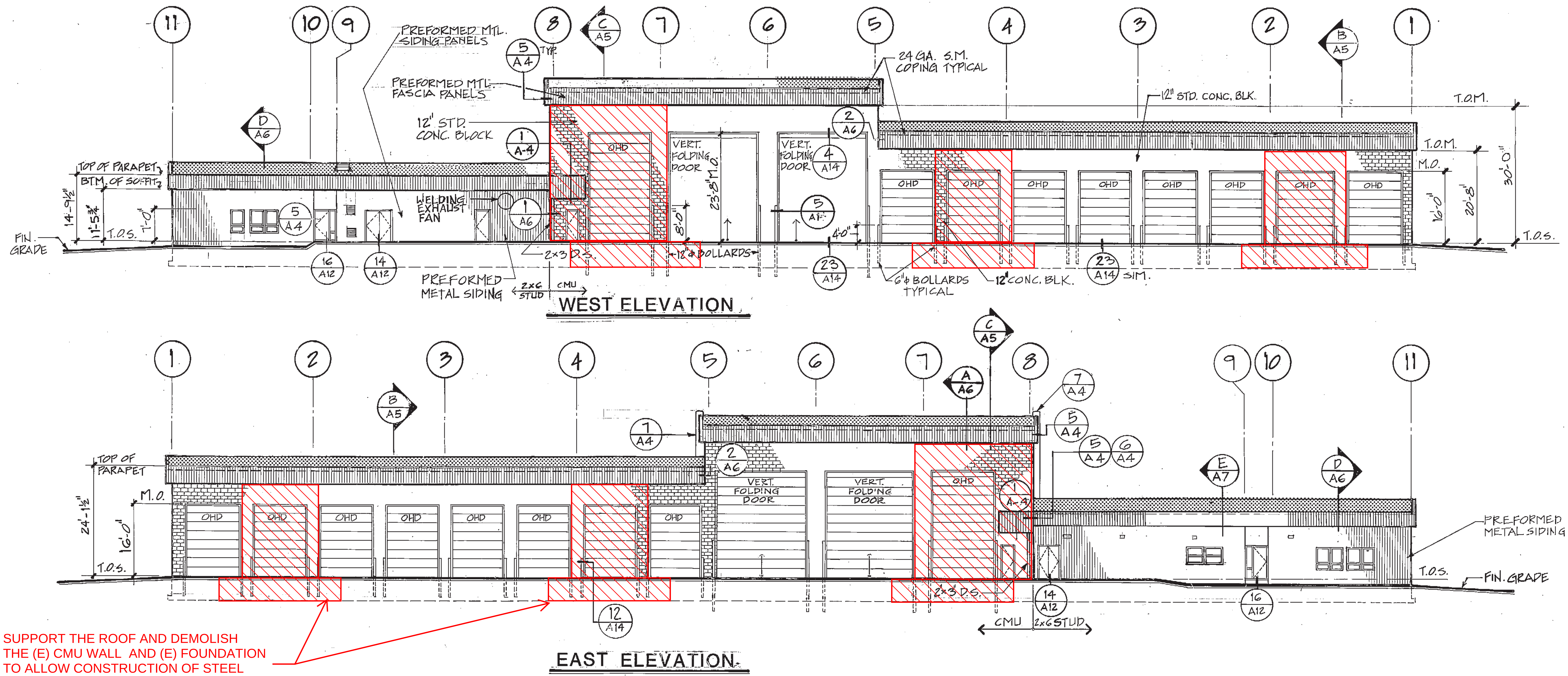
Photo 5: CMU Damage in Southwest Corner of Building

Photo 6: Typical Interior Drywall Damage

Photo 7: Typical Interior Floor Tile Damage

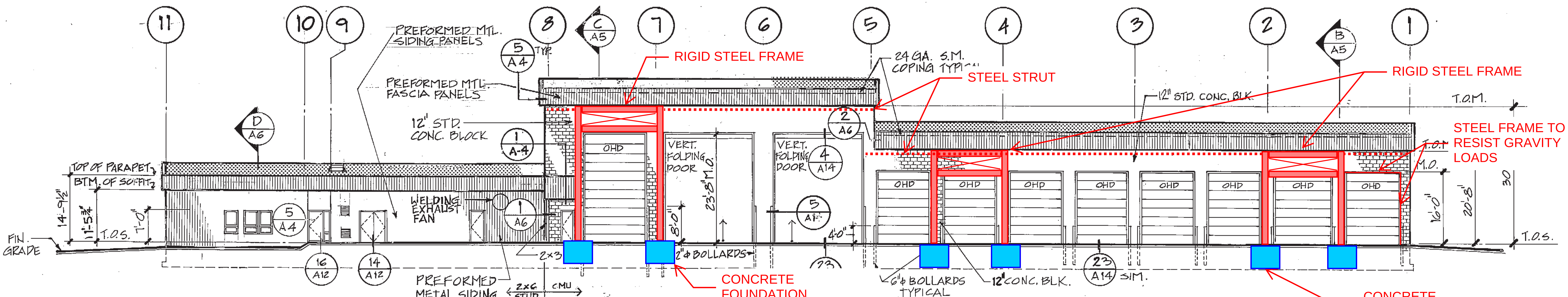
Photo 8: Typical Interior Wall Tile Damage

Appendix B: Repair Drawings

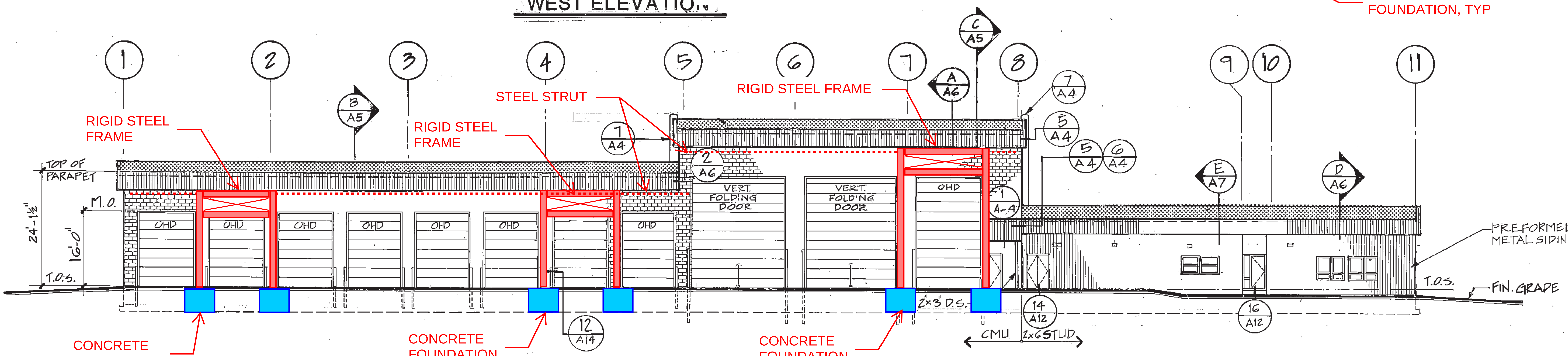


SUPPORT THE ROOF AND DEMOLISH THE (E) CMU WALL AND (E) FOUNDATION TO ALLOW CONSTRUCTION OF STEEL RIGID FRAME AND FOUNDATION

SK-1



WEST ELEVATION



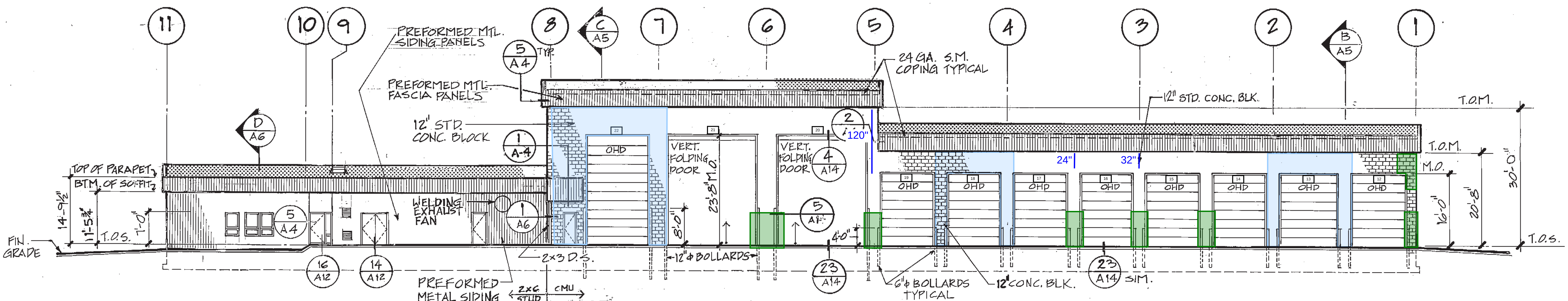
EAST ELEVATION

SK-2

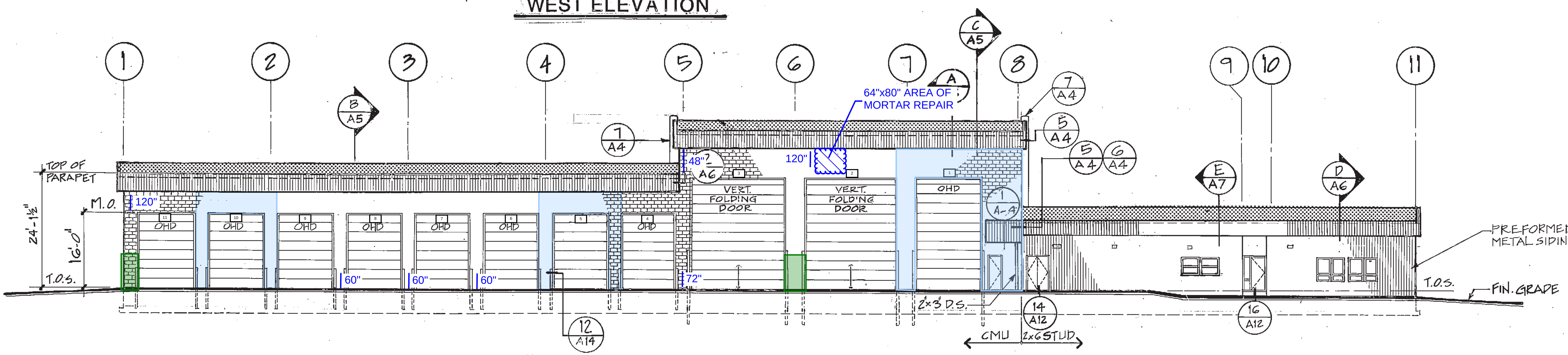
CRACKED CMU IS TO BE REPAIRED WITH PRESSURE INJECTED EPOXY

DAMAGED AND CRACKED CMU BLOCK IS TO BE DEMOLISHED BACK TO SOUND GROUT/BLOCK AND REPAIRED USING A PRODUCT SIMILAR TO PLANITOP 15

AREA TO BE DEMOLISHED FOR STEEL RIGID FRAME INSTALLATION



WEST ELEVATION

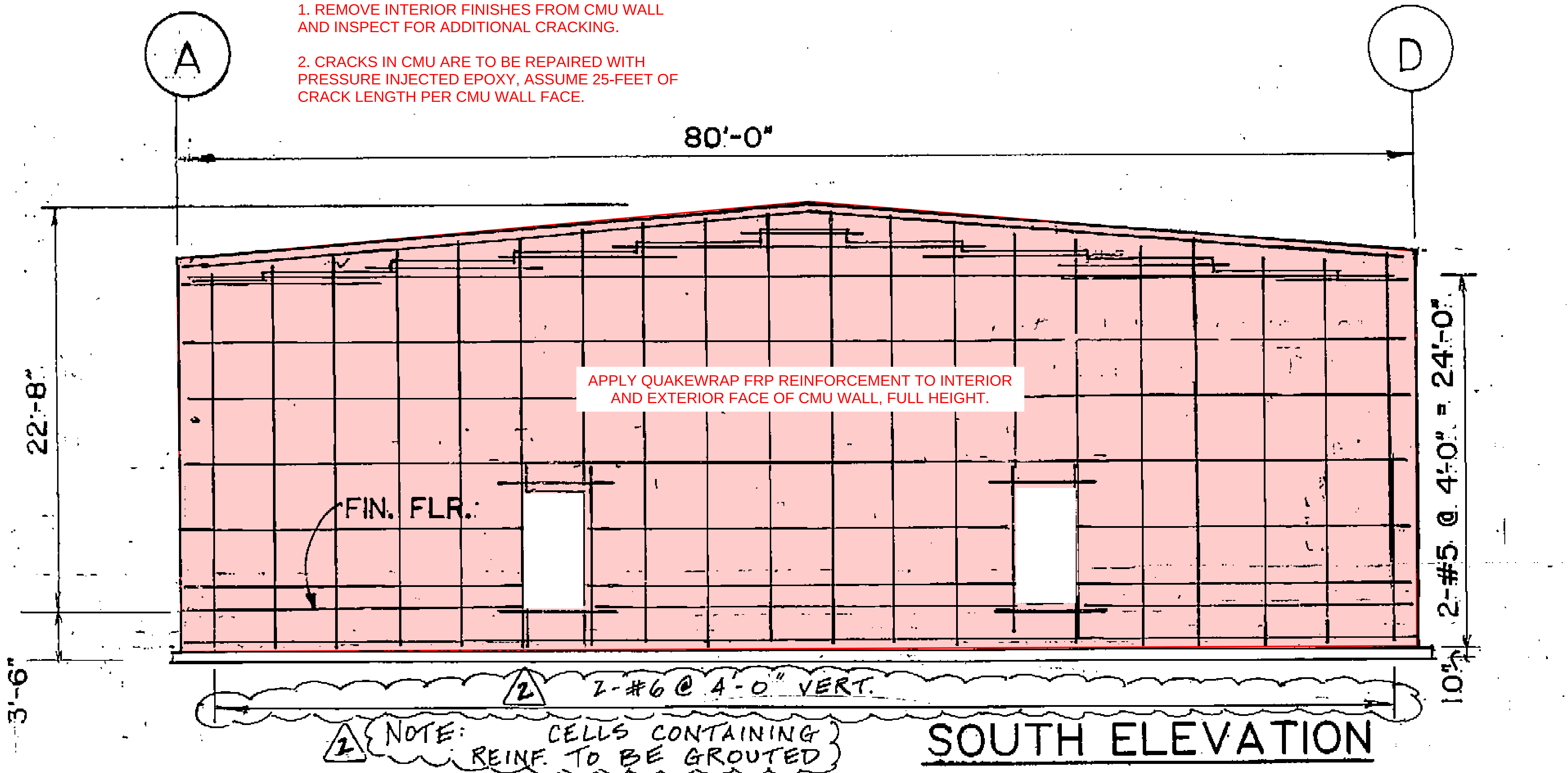


EAST ELEVATION

SK-3

NOTES;
1. REMOVE INTERIOR FINISHES FROM CMU WALL AND INSPECT FOR ADDITIONAL CRACKING.

2. CRACKS IN CMU ARE TO BE REPAIRED WITH PRESSURE INJECTED EPOXY, ASSUME 25-FEET OF CRACK LENGTH PER CMU WALL FACE.

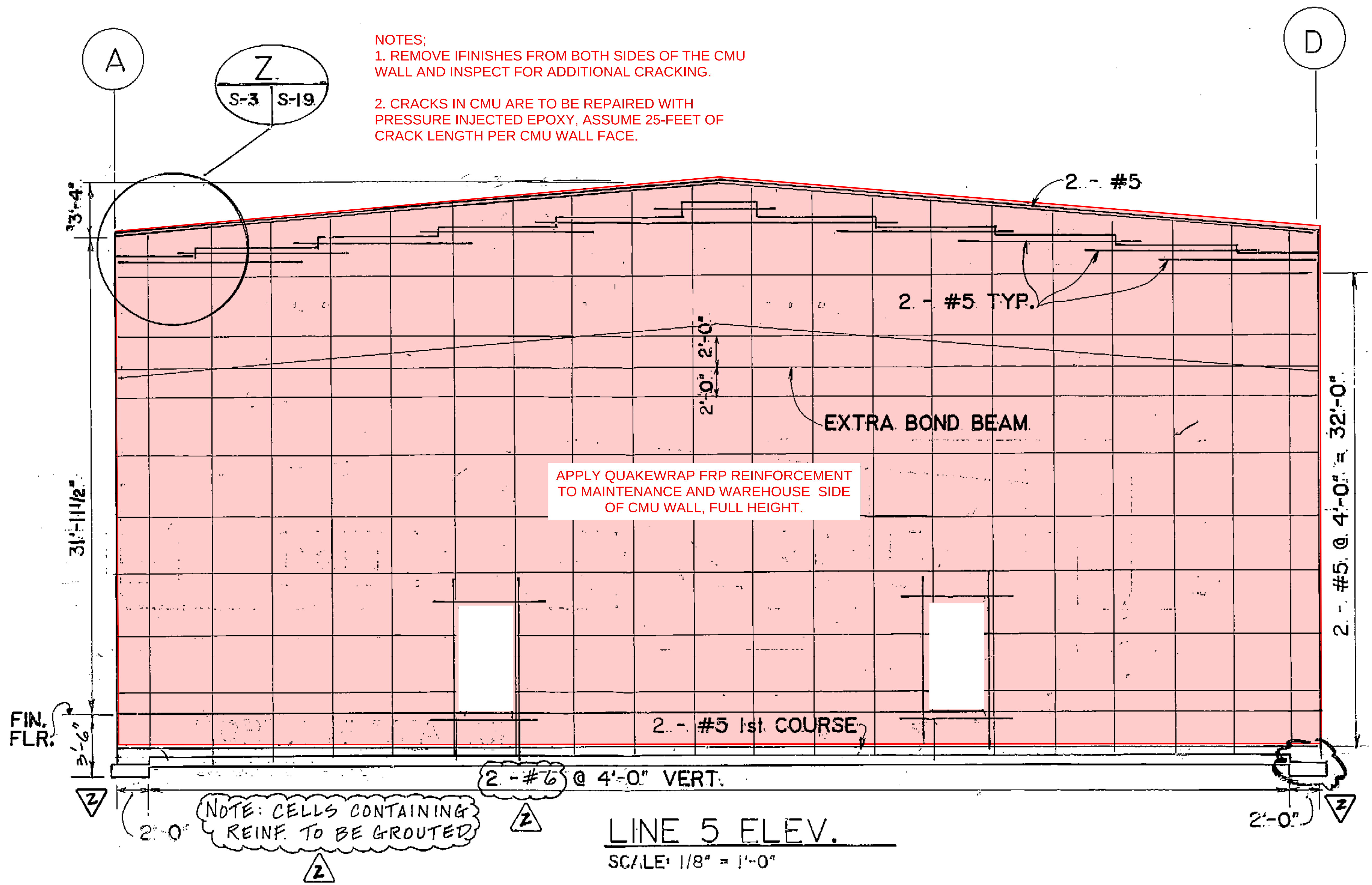


SOUTH ELEVATION

SCALE: 3/32" = 1'-0"

NOTES;
1. REMOVE IFINISHES FROM BOTH SIDES OF THE CMU WALL AND INSPECT FOR ADDITIONAL CRACKING.

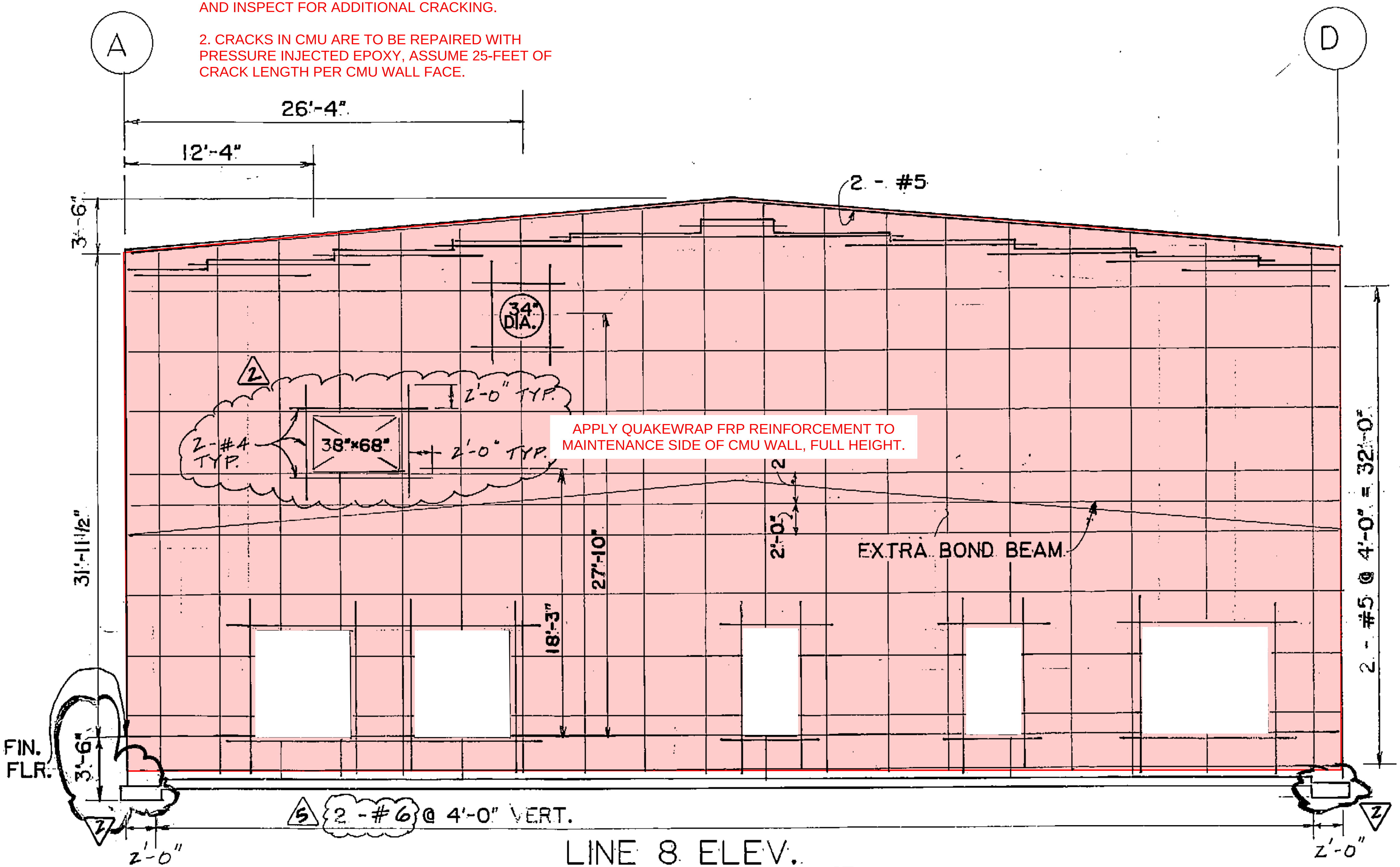
2. CRACKS IN CMU ARE TO BE REPAIRED WITH PRESSURE INJECTED EPOXY, ASSUME 25-FEET OF CRACK LENGTH PER CMU WALL FACE.



LINE 5 ELEV.
SCALE: 1/8" = 1'-0"

NOTES;
1. REMOVE INTERIOR FINISHES FROM CMU WALL AND INSPECT FOR ADDITIONAL CRACKING.

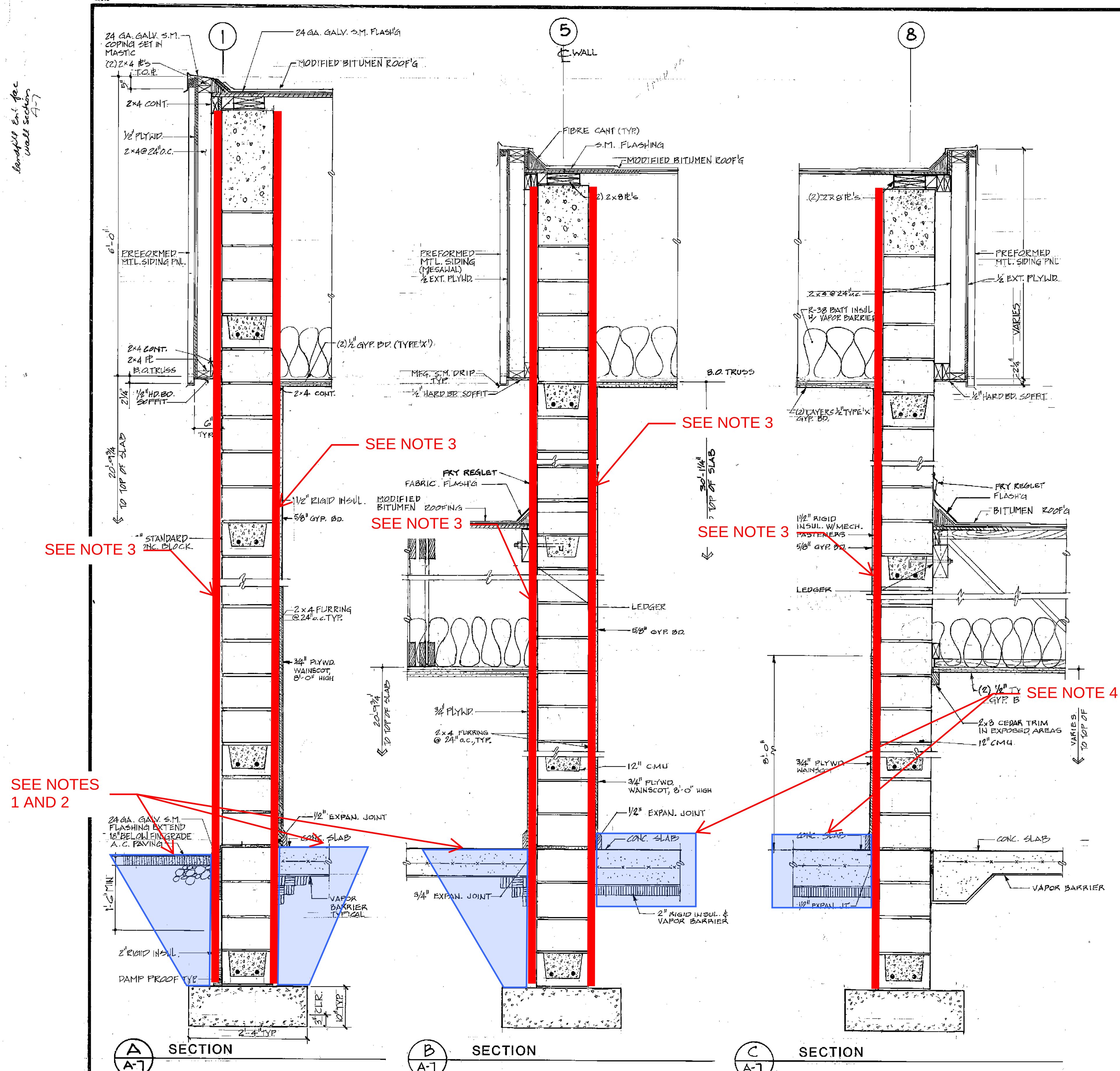
2. CRACKS IN CMU ARE TO BE REPAIRED WITH PRESSURE INJECTED EPOXY, ASSUME 25-FEET OF CRACK LENGTH PER CMU WALL FACE.



LINE 8 ELEV.

SCALE: 1/8" = 1'-0"

SK-6



NOTES;

1. DEMOLISH (E) AC PAVEMENT OR CONCRETE SLAB TO ALLOW EXCAVATION TO TOP OF CONCRETE FOOTING.

2. EXCAVATE CMU WALL TO TOP OF CONCRETE FOOTING, REMOVE INSULATION (WHERE PRESENT) AND PREPARE THE CMU WALL FOR QUAKEWRAP FRP REINFOCEMENT.

3. APPLY QUAKEWRAP REINFORCEMENT CMU WALLS AS SHOWN IN DETAILS A, B AND C.

4. MAINTENANCE AREA CONCRETE SLAB IS TO BE DEMOLISHED COMPLETELY.

5. BACKFILL EXCAVATION AND REPAIR (E) AC PAVEMENT OR CONCRETE SLAB TO MATCH EXISTING.

ARCTIC ENGINEERS INC.
ANCHORAGE, ALASKA

PROJECT NO.	86-010-02 MOA
DESIGNED :	RBM
DRAWN :	WAP, AKF
CHECKED :	
DATE :	FEBRUARY 24, 1987
SCALE :	1"=1'-0"

NO.	REVISION	DATE	BY

MUNICIPALITY OF ANCHORAGE SOLID WASTE SERVICES

SOLID WASTE TRANSFER FACILITY
Landfill Entrance Facility
MAINTENANCE SHOP/ADMINISTRATION BUILDING
WALL SECTIONS

SK-7

SHEET 27 OF 85

Appendix C: Repair Cost Estimate

CONCEPTUAL DESIGN SUBMITTAL
CONSTRUCTION COST ESTIMATE (REVISION 5)

LANDFILL ENTRANCE FACILITY
REPAIR MAINTENANCE SHOP AND WARM STORAGE
BUILDING AREAS - FULL ESTIMATE
ANCHORAGE, ALASKA

PREPARED FOR:

Coffman Engineers
800 F Street
Anchorage, Alaska 99501

April 24, 2019

HMS inc

4103 Minnesota Drive • Anchorage, Alaska 99503 p: 907.561.1653 • f: 907.562.0420 • e: mail@hmsalaska.com

HMS Project No.: 19002-B

NOTES REGARDING THE PREPARATION OF THIS ESTIMATE

DRAWINGS AND DOCUMENTS

Level of Documents:	(4) page narrative and as-built drawings
Date:	January 11, 2019
Provided By:	Coffman Engineers of Anchorage, Alaska
Note:	This estimate incorporates design comments received February 19, 2019 and April 22, 2019

RATES

Pricing is based on current material, equipment and freight costs.

Labor Rates:	A.S. Title 36 working 60 hours per week
Premium Time:	16.70%

BIDDING ASSUMPTIONS

Contract:	Standard construction contract without restrictive bidding clauses
Bidding Situation:	Competitive bids assumed
Bid Date:	February 2020
Start of Construction:	Summer 2020
Months to Complete:	Within (4) months completion

EXCLUDED COSTS

1. Administrative and management costs
2. Furniture, furnishings and equipment (except those specifically included)
3. Remediation of contaminated soils or abatement of any hazardous materials, if found during construction
4. Work to the remainder of the building except as specifically noted in the estimate

NOTES REGARDING THE PREPARATION OF THIS ESTIMATE (Continued)

GENERAL

When included in HMS Inc.'s scope of services, opinions or estimates of probable construction costs are prepared on the basis of HMS Inc.'s experience and qualifications and represent HMS Inc.'s judgment as a professional generally familiar with the industry. However, since HMS Inc. has no control over the cost of labor, materials, equipment or services furnished by others, over contractor's methods of determining prices, or over competitive bidding or market conditions, HMS Inc. cannot and does not guarantee that proposals, bids, or actual construction cost will not vary from HMS Inc.'s opinions or estimates of probable construction cost.

This estimate assumes normal escalation based on the current economic climate. While the global economic downturn appears to be moderating, it remains unclear how its effects and subsequent economic recovery will affect construction costs. HMS Inc. will continue to monitor this, as well as other international, domestic and local events, and the resulting construction climate, and will adjust costs and contingencies as deemed appropriate.

GROSS FLOOR AREA

Total GFA: 15,360 SF

HMS Project No.: 19002-B

CONCEPTUAL DESIGN COST SUMMARY

		Material	*Labor*	*Total*
01 - SITE WORK		$ 38,929	$ 186,402	$ 225,331
02 - SUBSTRUCTURE		78,049	113,272	191,321
03 - SUPERSTRUCTURE		151,949	156,558	308,507
04 - EXTERIOR CLOSURE		1,077,403	490,862	1,568,265
05 - ROOF SYSTEMS		88,903	71,098	160,001
06 - INTERIOR CONSTRUCTION		64,124	187,770	251,894
07 - CONVEYING SYSTEMS		56,250	12,195	68,445
08 - MECHANICAL		41,542	71,136	112,678
09 - ELECTRICAL		3,240	12,604	15,844
10 - EQUIPMENT		0	0	0
11 - SPECIAL CONSTRUCTION		0	0	0
SUBTOTAL:		*$ 1,600,389*	*$ 1,301,897*	*$ 2,902,286*
GENERAL CONDITIONS, OVERHEAD AND PROFIT	25.00%			725,572
BONDS AND INSURANCES	2.50%			90,696
ESTIMATOR'S CONTINGENCY	35.00%			1,301,494
ESCALATION TO THE PROPOSED BID DATE OF FEBRUARY 2020 AT THE RATE OF 3.50% PER ANNUM	3.50%			175,702
TOTAL ESTIMATED CONSTRUCTION COST:				***$ 5,195,750***
COST PER SQUARE FOOT:				*$ 338.26*
GROSS FLOOR AREA:				*15,360*

HMS Project No.: 19002-B

CONCEPTUAL DESIGN COST SUMMARY

		Material	Labor	Total
DESIGN FEE	12.00%			$ 623,490
PLAN REVIEW & PERMITTING	1.20%			62,349
BIDDING EXPENSE	0.25%			12,989
CONSTRUCTION ADMINISTRATION	6.00%			311,745
TOTAL ESTIMATED CONSTRUCTION COST:				***$ 6,206,323***
COST PER SQUARE FOOT:				*$ 404.06*
GROSS FLOOR AREA:				*15,360*

HMS Project No.: 19002-B

ELEMENTAL SUMMARY

Element	*Material*	*Labor*	*Total Material/Labor*	*Total Cost*	*Cost per SF*
01 - SITE WORK				*$ 225,331*	*$ 14.67*
011 - Hazmat Abatement	$ 0	$ 0	$ 0		0.00
012 - Site Preparation	13,664	160,465	174,129		11.34
013 - Site Improvements	25,265	25,937	51,202		3.33
014 - Site Mechanical	0	0	0		0.00
015 - Site Electrical	0	0	0		0.00
02 - SUBSTRUCTURE				*$ 191,321*	*$ 12.46*
021 - Standard Foundations	$ 20,515	$ 33,188	$ 53,703		3.50
022 - Slab on Grade	57,534	80,084	137,618		8.96
023 - Basement	0	0	0		0.00
024 - Special Foundations	0	0	0		0.00
03 - SUPERSTRUCTURE				*$ 308,507*	*$ 20.09*
031 - Floor Construction	$ 0	$ 0	$ 0		0.00
032 - Roof Construction	151,949	156,558	308,507		20.09
033 - Stair Construction	0	0	0		0.00
04 - EXTERIOR CLOSURE				*$ 1,568,265*	*$ 102.10*
041 - Exterior Walls	$ 615,488	$ 401,003	$ 1,016,491		66.18
042 - Exterior Doors and Windows	461,915	89,859	551,774		35.92
05 - ROOF SYSTEMS				*$ 160,001*	*$ 10.42*
051 - Roofing	$ 88,903	$ 71,098	$ 160,001		10.42
052 - Skylights	0	0	0		0.00
06 - INTERIOR CONSTRUCTION				*$ 251,894*	*$ 16.40*
061 - Partitions and Doors	$ 0	$ 0	$ 0		0.00
062 - Interior Finishes	64,124	187,770	251,894		16.40
063 - Specialties	0	0	0		0.00

HMS Project No.: 19002-B

ELEMENTAL SUMMARY

Element	*Material*	*Labor*	*Total Material/Labor*	*Total Cost*	*Cost per SF*
07 - CONVEYING SYSTEMS	*$ 56,250*	*$ 12,195*		*$ 68,445*	*$ 4.46*
08 - MECHANICAL				*$ 112,678*	*$ 7.34*
081 - Plumbing	$ 25,356	$ 40,676	$ 66,032		4.30
082 - HVAC	16,186	30,460	46,646		3.04
083 - Fire Protection	0	0	0		0.00
084 - Special Mechanical Systems	0	0	0		0.00
09 - ELECTRICAL				*$ 15,844*	*$ 1.03*
091 - Service and Distribution	$ 0	$ 0	$ 0		0.00
092 - Lighting and Power	3,240	12,604	15,844		1.03
093 - Special Electrical Systems	0	0	0		0.00
10 - EQUIPMENT				*$ 0*	*$ 0.00*
101 - Fixed and Movable Equipment	$ 0	$ 0	$ 0		0.00
102 - Furnishings	0	0	0		0.00
11 - SPECIAL CONSTRUCTION	*$ 0*	*$ 0*		*$ 0*	*$ 0.00*
SUBTOTAL DIRECT WORK:	***$ 1,600,389***	***$ 1,301,897***		***$ 2,902,286***	
GENERAL REQUIREMENTS AND CONTINGENCIES				*$ 2,293,464*	*$ 149.31*
General Conditions, Overhead and Profit		25.00%	725,572		47.24
Bonds and Insurances		2.50%	90,696		5.90
Estimator's Contingency		35.00%	1,301,494		84.73
Escalation to the Proposed Bid Date of February 2020 at the Rate of 3.50% Per Annum		3.50%	175,702		11.44
SUBTOTAL GENERAL REQUIREMENTS AND CONTINGENCIES:				***$ 5,195,750***	

HMS Project No.: 19002-B

ELEMENTAL SUMMARY

Element	*Material*	*Labor*	*Total Material/Labor*	*Total Cost*	*Cost per SF*
SOFT COSTS				*$ 1,010,573*	*$ 65.79*
Design Fee		12.00%	623,490		40.59
Plan Review & Permitting		1.20%	62,349		4.06
Bidding Expense		0.25%	12,989		0.85
Construction Administration		6.00%	311,745		20.30
TOTAL ESTIMATED CONSTRUCTION COST:				***$ 6,206,323***	***$404.06 /SF***
GROSS FLOOR AREA:					*15,360 SF*

HMS Project No.: 19002-B

01 - SITE WORK ***012 - Site Preparation***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
Saw cut paving at areas of substructure repair	300	LF	0.25	75	0.75	225	1.00	300
Saw cut slab on grade at areas of substructure repair	540	LF	0.78	421	4.15	2,241	4.93	2,662
Demolish paving at areas of substructure repair	2,000	SF	0.22	440	0.50	1,000	0.72	1,440
Drain and cap radiant heat feed/return	2	EA	15.00	30	75.00	150	90.00	180
Demolish slab on grade at areas of repair and quake wrap install, including entire maintenance bay	8,254	SF			4.25	35,080	4.25	35,080
Demolish trench drain	59	LF			6.00	354	6.00	354
Excavate and backfill to footings	678	CY	3.50	2,373	16.50	11,187	20.00	13,560
Remove 14'0"x24'0" sectional overhead door	2	EA			425.00	850	425.00	850
Remove 19'0"x24'0" fabric doors	4	EA			550.00	2,200	550.00	2,200
Remove 12'0"x16'0"' sectional overhead door	16	EA			375.00	6,000	375.00	6,000
Remove 3'0"x7'0" man door assembly - complete	8	EA			63.00	504	63.00	504
Remove 3'0"x7'0" double door assembly	3	EA			85.00	255	85.00	255
Saw cut 12" CMU wall	684	LF	0.84	575	3.50	2,394	4.34	2,969
Break and remove CMU wall and foundation wall	3,148	SF			2.25	7,083	2.25	7,083

HMS Project No.: 19002-B

01 - SITE WORK ***012 - Site Preparation***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
Remove canopy assembly	16	LF			15.00	240	15.00	240
Temporary shoring	380	LF	8.50	3,230	6.50	2,470	15.00	5,700
Break and remove existing strip footing	168	LF			6.50	1,092	6.50	1,092
Remove wood furring at exterior wall	11,124	SF			0.52	5,784	0.52	5,784
Remove 1.5" rigid insulation at exterior wall	2,988	SF			0.26	777	0.26	777
Remove 3/4" plywood at exterior wall	2,988	SF			0.35	1,046	0.35	1,046
Remove 5/8" gypsum wall board at exterior wall	8,136	SF			0.30	2,441	0.30	2,441
Remove pipe bollards at areas of repair	54	EA	5.00	270	26.00	1,404	31.00	1,674
Remove ceramic floor and wall tile at men's and woman's locker rooms	1,434	SF			1.95	2,796	1.95	2,796
Demolish existing roofing	22,080	SF			1.75	38,640	1.75	38,640
Demolish damaged 3/4" plywood roof decking (10% of area)	2,208	SF			1.15	2,539	1.15	2,539
Dispose of debris	25	LDS	250.00	6,250	350.00	8,750	600.00	15,000
SUBTOTAL:				*$ 13,664*		*$ 137,502*		*$ 151,166*
Labor Premium Time	16.70%					22,963		22,963
TOTAL ESTIMATED COST:				***$ 13,664***		***$ 160,465***		***$ 174,129***

HMS Project No.: 19002-B

01 - SITE WORK ***013 - Site Improvements***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
EXTERIOR IMPROVEMENTS								
Recut paving	300	LF	0.25	75	0.75	225	1.00	300
Patch paving at areas of excavation	2,000	SF	2.20	4,400	1.55	3,100	3.75	7,500
Pipe bollards	54	EA	385.00	20,790	350.00	18,900	735.00	39,690
SUBTOTAL:				*$ 25,265*		*$ 22,225*		*$ 47,490*
Labor Premium Time	16.70%					3,712		3,712
TOTAL ESTIMATED COST:				***$ 25,265***		***$ 25,937***		***$ 51,202***

HMS Project No.: 19002-B

02 - SUBSTRUCTURE ***021 - Standard Foundations***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
PAD FOUNDATIONS AT COLUMNS								
Concrete at footings	12	CY	135.00	1,620	90.00	1,080	225.00	2,700
Concrete at foundation walls	19	CY	135.00	2,565	100.00	1,900	235.00	4,465
Concrete at pilasters	4	CY	135.00	540	120.00	480	255.00	1,020
Form footings	72	SF	1.80	130	4.80	346	6.60	476
Form foundation walls	1,128	SF	2.10	2,369	5.90	6,655	8.00	9,024
Form pilasters	288	SF	2.40	691	6.25	1,800	8.65	2,491
Reinforcing steel	3,720	SF	0.70	2,604	0.70	2,604	1.40	5,208
Dowel new to existing substructure	288	EA	22.50	6,480	39.00	11,232	61.50	17,712
Pump concrete	35	CY	45.00	1,575			45.00	1,575
2" rigid insulation	564	SF	1.05	592	0.50	282	1.55	874
Membrane waterproofing	582	SF	1.70	989	2.55	1,484	4.25	2,473
Embedded anchor bolts at frame columns	48	EA	7.50	360	12.00	576	19.50	936
SUBTOTAL:				*$ 20,515*		*$ 28,439*		*$ 48,954*
Labor Premium Time	16.70%					4,749		4,749
TOTAL ESTIMATED COST:				***$ 20,515***		***$ 33,188***		***$ 53,703***

HMS Project No.: 19002-B

02 - SUBSTRUCTURE *022 - Slab on Grade*	QUANTITY	UNIT	MATERIAL RATE $	MATERIAL TOTAL $	LABOR RATE $	LABOR TOTAL $	TOTAL UNIT RATE $	TOTAL MATERIAL/LABOR $
SLAB ON GRADE								
Finish grade for slab	8,254	SF			0.10	825	0.10	825
Vapor retarder	8,254	SF	0.08	660	0.12	990	0.20	1,650
2"rigid installation under slab	5,664	SF	1.05	5,947	0.85	4,814	1.90	10,761
Concrete	203	CY	135.00	27,405	85.00	17,255	220.00	44,660
Reinforcing steel	16,240	LBS	0.70	11,368	0.70	11,368	1.40	22,736
Dowel new to existing slab	708	EA	13.50	9,558	28.00	19,824	41.50	29,382
Cure and finish	8,254	SF	0.30	2,476	1.25	10,318	1.55	12,794
Remove and reinstall steel bearing plates	39,634	LBS			0.07	2,774	0.07	2,774
Control joints	800	LF	0.15	120	0.57	456	0.72	576
SUBTOTAL:				*$ 57,534*		*$ 68,624*		*$ 126,158*
Labor Premium Time	16.70%					11,460		11,460
TOTAL ESTIMATED COST:				***$ 57,534***		***$ 80,084***		***$ 137,618***

HMS Project No.: 19002-B

03 - SUPERSTRUCTURE ***032 - Roof Construction***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
Temporary shoring allowance	15,360	SF	4.50	69,120	4.00	61,440	8.50	130,560
W-beam rigid steel frame	26,680	LBS	1.95	52,026	1.65	44,022	3.60	96,048
Tube steel bracing	1,900	LBS	2.05	3,895	1.70	3,230	3.75	7,125
Channel steel struts bolted to CMU	11,520	LBS	1.95	22,464	1.50	17,280	3.45	39,744
New 3/4" plywood roof deck	2,208	SF	1.30	2,870	1.25	2,760	2.55	5,630
3/4"x6" expansion anchors	384	EA	2.75	1,056	12.00	4,608	14.75	5,664
New canopy construction	37	SF	14.00	518	22.00	814	36.00	1,332
SUBTOTAL:				*$ 151,949*		*$ 134,154*		*$ 286,103*
Labor Premium Time	16.70%					22,404		22,404
TOTAL ESTIMATED COST:				***$ 151,949***		***$ 156,558***		***$ 308,507***

HMS Project No.: 19002-B

04 - EXTERIOR CLOSURE ***041 - Exterior Walls***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
Repair mortar at areas of removed CMU (blue)	1,628	SF	19.55	31,827	11.50	18,722	31.05	50,549
Mortar repair (green)	270	SF	9.50	2,565	6.50	1,755	16.00	4,320
Clean wall surface at Quakewrap repair	14,106	SF			1.15	16,222	1.15	16,222
Quakewrap reinforcement	14,106	SF	31.75	447,866	14.50	204,537	46.25	652,403
Allow for removal/ reinstall of wall mounted items for Quakewrap installation	1	LOT	3500.00	3,500	6500.00	6,500	10000.00	10,000
Epoxy injection crack repair	150	LF	15.00	2,250	35.00	5,250	50.00	7,500
Paint new and existing exterior of building including new overhead doors	14,606	SF	0.30	4,382	1.50	21,909	1.80	26,291
SUBTOTAL:				*$ 492,390*		*$ 274,895*		*$ 767,285*
Labor Premium Time	16.70%					45,907		45,907
SUBTOTAL:				*$ 492,390*		*$ 320,802*		*$ 813,192*
Subcontractor's Overhead and Profit on Material and Labor	25.00%			123,098		80,201		203,299
TOTAL ESTIMATED COST:				***$ 615,488***		***$ 401,003***		***$ 1,016,491***

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04 - EXTERIOR CLOSURE ***042 - Exterior Doors and Windows***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
New 3'0"x7'0" hollow metal door assembly	8	EA	1150.00	9,200	650.00	5,200	1800.00	14,400
New 14'0"x24'0" sectional overhead door	2	EA	10566.00	21,132	2600.00	5,200	13166.00	26,332
New 12'0"x16'0" sectional overhead door	16	EA	6200.00	99,200	2400.00	38,400	8600.00	137,600
New 19'0"x24'0" fabric doors	4	EA	60000.00	240,000	3200.00	12,800	63200.00	252,800
SUBTOTAL:				*$ 369,532*		*$ 61,600*		*$ 431,132*
Labor Premium Time	16.70%					10,287		10,287
SUBTOTAL:				*$ 369,532*		*$ 71,887*		*$ 441,419*
Subcontractor's Overhead and Profit on Material and Labor	25.00%			92,383		17,972		110,355
TOTAL ESTIMATED COST:				***$ 461,915***		***$ 89,859***		***$ 551,774***

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05 - ROOF SYSTEMS ***051 - Roofing***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
Modified bitumen roofing assembly, complete	22,118	SF	3.25	71,884	2.30	50,871	5.55	122,755
24 gauge perimeter flashing (flashing only)	903	LF	4.20	3,793	3.20	2,890	7.40	6,683
Roof/wall flashing	176	LF	3.80	669	3.20	563	7.00	1,232
Roofing detail at penetration	42	EA	78.00	3,276	65.00	2,730	143.00	6,006
Seismic joint cover with insulation and blocking	160	LF	41.00	6,560	13.00	2,080	54.00	8,640
Temporary fall protection railings	716	LF	3.80	2,721	2.50	1,790	6.30	4,511
SUBTOTAL:				*$ 88,903*		*$ 60,924*		*$ 149,827*
Labor Premium Time	16.70%					10,174		10,174
TOTAL ESTIMATED COST:				***$ 88,903***		***$ 71,098***		***$ 160,001***

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06 - INTERIOR CONSTRUCTION ***062 - Interior Finishes***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
2"x4" furring	11,122	SF	0.75	8,342	1.40	15,571	2.15	23,913
1 1/2" rigid insulation	2,988	SF	0.80	2,390	0.85	2,540	1.65	4,930
3/4" plywood wainscot	2,988	SF	1.25	3,735	1.10	3,287	2.35	7,022
5/8" moisture resistant gypsum wallboard	8,136	SF	0.85	6,916	1.50	12,204	2.35	19,120
Repair or replace gypsum wall board ceiling (2 each 1/2" layers)	1,500	SF	1.50	2,250	4.30	6,450	5.80	8,700
Paint all walls, ceilings and overhead doors at maintenance and storage	30,957	SF	0.30	9,287	1.50	46,436	1.80	55,723
Reinstall single door assembly	6	EA	50.00	300	350.00	2,100	400.00	2,400
Reinstall double door assembly	3	EA	75.00	225	375.00	1,125	450.00	1,350
Patch/paint existing admin area	14,121	SF	0.35	4,942	1.60	22,594	1.95	27,536
Remove/reinstall ACT ceiling assembly	1,500	SF	0.50	750	3.25	4,875	3.75	5,625
Clean and seal concrete slab on grade	14,940	SF	0.45	6,723	1.35	20,169	1.80	26,892
Ceramic floor tile	814	SF	8.50	6,919	6.50	5,291	15.00	12,210
Ceramic wall tile	620	SF	8.50	5,270	7.50	4,650	16.00	9,920
Scaffolding	8,100	SF	0.75	6,075	1.68	13,608	2.43	19,683
SUBTOTAL:				*$ 64,124*		*$ 160,900*		*$ 225,024*

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06 - INTERIOR CONSTRUCTION 062 - Interior Finishes	QUANTITY	UNIT	MATERIAL RATE $	MATERIAL TOTAL $	LABOR RATE $	LABOR TOTAL $	TOTAL UNIT RATE $	TOTAL MATERIAL/LABOR $
Labor Premium Time	16.70%					26,870		26,870
TOTAL ESTIMATED COST:				***$ 64,124***		***$ 187,770***		***$ 251,894***

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07 - CONVEYING SYSTEMS	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
Remove existing bridge crane	1	EA	250.00	250	2800.00	2,800	3050.00	3,050
10 ton (assumed), 40'0" span overhead bridge crane	1	EA	56000.00	56,000	7650.00	7,650	63650.00	63,650
SUBTOTAL:				*$ 56,250*		*$ 10,450*		*$ 66,700*
Labor Premium Time	16.70%					1,745		1,745
TOTAL ESTIMATED COST:				***$ 56,250***		***$ 12,195***		***$ 68,445***

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08 - MECHANICAL ***081 - Plumbing***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
Relocate roof drains, compressed air piping, water piping and related as required to perform work (allowance)	1	LOT	15000.00	15,000	25000.00	25,000	40000.00	40,000
Remove toilets	3	EA			77.50	233	77.50	233
Remove urinals	3	EA			77.50	233	77.50	233
Reinstall toilets	3	EA	710.00	2,130	180.00	540	890.00	2,670
Reinstall urinals	3	EA	750.00	2,250	180.00	540	930.00	2,790
Replace waste oil sump	1	EA	1750.00	1,750	2500.00	2,500	4250.00	4,250
SUBTOTAL:				*$ 21,130*		*$ 29,046*		*$ 50,176*
Labor Premium Time	16.70%					4,851		4,851
SUBTOTAL:				*$ 21,130*		*$ 33,897*		*$ 55,027*
Subcontractor's Overhead and Profit on Material and Labor	20.00%			4,226		6,779		11,005
TOTAL ESTIMATED COST:				***$ 25,356***		***$ 40,676***		***$ 66,032***

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08 - MECHANICAL ***082 - HVAC***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
Remove radiant heat manifold	4	EA			115.00	460	115.00	460
Pex tubing at new maintenance bay slab	7,660	LF	1.06	8,120	2.35	18,001	3.41	26,121
2" diameter copper piping existing radiant heat supply and return	8	EA	18.00	144	76.00	608	94.00	752
New glycol	150	GAL	13.50	2,025	1.50	225	15.00	2,250
New radiant heat manifolds	4	EA	750.00	3,000	175.00	700	925.00	3,700
Repair/reinstall damaged duct at admin	265	LBS	0.75	199	3.80	1,007	4.55	1,206
Test and balance	1	LOT			750.00	750	750.00	750
SUBTOTAL:				*$ 13,488*		*$ 21,751*		*$ 35,239*
Labor Premium Time	16.70%					3,632		3,632
SUBTOTAL:				*$ 13,488*		*$ 25,383*		*$ 38,871*
Subcontractor's Overhead and Profit on Material and Labor	20.00%			2,698		5,077		7,775
TOTAL ESTIMATED COST:				***$ 16,186***		***$ 30,460***		***$ 46,646***

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09 - ELECTRICAL ***092 - Lighting and Power***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
Remove/support/reinstall door controls and 120 volt power at areas of column repair	18	EA	150.00	2,700	500.00	9,000	650.00	11,700
SUBTOTAL:				*$ 2,700*		*$ 9,000*		*$ 11,700*
Labor Premium Time	16.70%					1,503		1,503
SUBTOTAL:				*$ 2,700*		*$ 10,503*		*$ 13,203*
Subcontractor's Overhead and Profit on Material and Labor	20.00%			540		2,101		2,641
TOTAL ESTIMATED COST:				***$ 3,240***		***$ 12,604***		***$ 15,844***

Appendix D: Repair Cost Estimate

(FEMA 50% Calculation Determination)

HMS Project No. 19002-B

CONCEPTUAL DESIGN SUBMITTAL
CONSTRUCTION COST ESTIMATE (REVISION 5)

LANDFILL ENTRANCE FACILITY
REPAIR MAINTENANCE SHOP AND WARM STORAGE
BUILDING AREAS - 50% EQUATION ESTIMATE
ANCHORAGE, ALASKA

PREPARED FOR:

Coffman Engineers
800 F Street
Anchorage, Alaska 99501

April 24, 2019

HMS inc

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HMS Project No.: 19002-B

NOTES REGARDING THE PREPARATION OF THIS ESTIMATE

DRAWINGS AND DOCUMENTS

Level of Documents:	(4) page narrative and as-built drawings
Date:	January 11, 2019
Provided By:	Coffman Engineers of Anchorage, Alaska
Note:	This estimate incorporates design comments received February 19, 2019 and April 22, 2019

RATES

Pricing is based on current material, equipment and freight costs.

Labor Rates:	A.S. Title 36 working 60 hours per week
Premium Time:	16.70%

BIDDING ASSUMPTIONS

Contract:	Standard construction contract without restrictive bidding clauses
Bidding Situation:	Competitive bids assumed
Bid Date:	February 2020
Start of Construction:	Summer 2020
Months to Complete:	Within (4) months completion

EXCLUDED COSTS

1. Administrative and management costs
2. Furniture, furnishings and equipment (except those specifically included)
3. Remediation of contaminated soils or abatement of any hazardous materials, if found during construction
4. Work to the remainder of the building except as specifically noted in the estimate
5. Soft costs including design, plan review, permitting, bidding expense, and CA services
6. Estimators contingency
7. Cost escalation

HMS Project No.: 19002-B

NOTES REGARDING THE PREPARATION OF THIS ESTIMATE (Continued)

GENERAL

When included in HMS Inc.'s scope of services, opinions or estimates of probable construction costs are prepared on the basis of HMS Inc.'s experience and qualifications and represent HMS Inc.'s judgment as a professional generally familiar with the industry. However, since HMS Inc. has no control over the cost of labor, materials, equipment or services furnished by others, over contractor's methods of determining prices, or over competitive bidding or market conditions, HMS Inc. cannot and does not guarantee that proposals, bids, or actual construction cost will not vary from HMS Inc.'s opinions or estimates of probable construction cost.

This estimate assumes normal escalation based on the current economic climate. While the global economic downturn appears to be moderating, it remains unclear how its effects and subsequent economic recovery will affect construction costs. HMS Inc. will continue to monitor this, as well as other international, domestic and local events, and the resulting construction climate, and will adjust costs and contingencies as deemed appropriate.

GROSS FLOOR AREA

Total GFA: 15,360 SF

HMS Project No.: 19002-B

CONCEPTUAL DESIGN COST SUMMARY

		Material	*Labor*	*Total*
01 - SITE WORK		$ 38,929	$ 186,402	$ 225,331
02 - SUBSTRUCTURE		78,049	113,272	191,321
03 - SUPERSTRUCTURE		151,949	156,558	308,507
04 - EXTERIOR CLOSURE		1,077,403	490,862	1,568,265
05 - ROOF SYSTEMS		88,903	71,098	160,001
06 - INTERIOR CONSTRUCTION		64,124	187,770	251,894
07 - CONVEYING SYSTEMS		56,250	12,195	68,445
08 - MECHANICAL		41,542	71,136	112,678
09 - ELECTRICAL		3,240	12,604	15,844
10 - EQUIPMENT		0	0	0
11 - SPECIAL CONSTRUCTION		0	0	0
SUBTOTAL:		*$ 1,600,389*	*$ 1,301,897*	*$ 2,902,286*
GENERAL CONDITIONS, OVERHEAD AND PROFIT	25.00%			725,572
BONDS AND INSURANCES	2.50%			90,696
TOTAL ESTIMATED CONSTRUCTION COST:				***$ 3,718,554***
COST PER SQUARE FOOT:				*$ 242.09*
GROSS FLOOR AREA:				*15,360*

HMS Project No.: 19002-B

ELEMENTAL SUMMARY

Element	*Material*	*Labor*	*Total Material/Labor*	*Total Cost*	*Cost per SF*
01 - SITE WORK				*$ 225,331*	*$ 14.67*
011 - Hazmat Abatement	$ 0	$ 0	$ 0		0.00
012 - Site Preparation	13,664	160,465	174,129		11.34
013 - Site Improvements	25,265	25,937	51,202		3.33
014 - Site Mechanical	0	0	0		0.00
015 - Site Electrical	0	0	0		0.00
02 - SUBSTRUCTURE				*$ 191,321*	*$ 12.46*
021 - Standard Foundations	$ 20,515	$ 33,188	$ 53,703		3.50
022 - Slab on Grade	57,534	80,084	137,618		8.96
023 - Basement	0	0	0		0.00
024 - Special Foundations	0	0	0		0.00
03 - SUPERSTRUCTURE				*$ 308,507*	*$ 20.09*
031 - Floor Construction	$ 0	$ 0	$ 0		0.00
032 - Roof Construction	151,949	156,558	308,507		20.09
033 - Stair Construction	0	0	0		0.00
04 - EXTERIOR CLOSURE				*$ 1,568,265*	*$ 102.10*
041 - Exterior Walls	$ 615,488	$ 401,003	$ 1,016,491		66.18
042 - Exterior Doors and Windows	461,915	89,859	551,774		35.92
05 - ROOF SYSTEMS				*$ 160,001*	*$ 10.42*
051 - Roofing	$ 88,903	$ 71,098	$ 160,001		10.42
052 - Skylights	0	0	0		0.00
06 - INTERIOR CONSTRUCTION				*$ 251,894*	*$ 16.40*
061 - Partitions and Doors	$ 0	$ 0	$ 0		0.00
062 - Interior Finishes	64,124	187,770	251,894		16.40
063 - Specialties	0	0	0		0.00

HMS Project No.: 19002-B

ELEMENTAL SUMMARY

Element	*Material*	*Labor*	*Total Material/Labor*	*Total Cost*	*Cost per SF*
07 - CONVEYING SYSTEMS	*$ 56,250*	*$ 12,195*		*$ 68,445*	*$ 4.46*
08 - MECHANICAL				*$ 112,678*	*$ 7.34*
081 - Plumbing	$ 25,356	$ 40,676	$ 66,032		4.30
082 - HVAC	16,186	30,460	46,646		3.04
083 - Fire Protection	0	0	0		0.00
084 - Special Mechanical Systems	0	0	0		0.00
09 - ELECTRICAL				*$ 15,844*	*$ 1.03*
091 - Service and Distribution	$ 0	$ 0	$ 0		0.00
092 - Lighting and Power	3,240	12,604	15,844		1.03
093 - Special Electrical Systems	0	0	0		0.00
10 - EQUIPMENT				*$ 0*	*$ 0.00*
101 - Fixed and Movable Equipment	$ 0	$ 0	$ 0		0.00
102 - Furnishings	0	0	0		0.00
11 - SPECIAL CONSTRUCTION	*$ 0*	*$ 0*		*$ 0*	*$ 0.00*
SUBTOTAL DIRECT WORK:	***$ 1,600,389***	***$ 1,301,897***		***$ 2,902,286***	
GENERAL REQUIREMENTS AND CONTINGENCIES				*$ 816,268*	*$ 53.14*
General Conditions, Overhead and Profit		25.00%	725,572		47.24
Bonds and Insurances		2.50%	90,696		5.90
TOTAL ESTIMATED CONSTRUCTION COST:				***$ 3,718,554***	***$242.09 /SF***
GROSS FLOOR AREA:					*15,360 SF*

HMS Project No.: 19002-B

01 - SITE WORK ***012 - Site Preparation***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
Saw cut paving at areas of substructure repair	300	LF	0.25	75	0.75	225	1.00	300
Saw cut slab on grade at areas of substructure repair	540	LF	0.78	421	4.15	2,241	4.93	2,662
Demolish paving at areas of substructure repair	2,000	SF	0.22	440	0.50	1,000	0.72	1,440
Drain and cap radiant heat feed/return	2	EA	15.00	30	75.00	150	90.00	180
Demolish slab on grade at areas of repair and quake wrap install, including entire maintenance bay	8,254	SF			4.25	35,080	4.25	35,080
Demolish trench drain	59	LF			6.00	354	6.00	354
Excavate and backfill to footings	678	CY	3.50	2,373	16.50	11,187	20.00	13,560
Remove 14'0"x24'0" sectional overhead door, salvage for reinstallation	2	EA			425.00	850	425.00	850
Remove 19'0"x24'0" fabric doors	4	EA			550.00	2,200	550.00	2,200
Remove 12'0"x16'0" sectional overhead door	16	EA			375.00	6,000	375.00	6,000
Remove 3'0"x7'0" man door assembly - complete	8	EA			63.00	504	63.00	504
Remove 3'0"x7'0" double door assembly	3	EA			85.00	255	85.00	255
Saw cut 12" CMU wall	684	LF	0.84	575	3.50	2,394	4.34	2,969
Break and remove CMU wall and foundation wall	3,148	SF			2.25	7,083	2.25	7,083

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01 - SITE WORK ***012 - Site Preparation***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
Remove canopy assembly	16	LF			15.00	240	15.00	240
Temporary shoring	380	LF	8.50	3,230	6.50	2,470	15.00	5,700
Break and remove existing strip footing	168	LF			6.50	1,092	6.50	1,092
Remove wood furring at exterior wall	11,124	SF			0.52	5,784	0.52	5,784
Remove 1.5" rigid insulation at exterior wall	2,988	SF			0.26	777	0.26	777
Remove 3/4" plywood at exterior wall	2,988	SF			0.35	1,046	0.35	1,046
Remove 5/8" gypsum wall board at exterior wall	8,136	SF			0.30	2,441	0.30	2,441
Remove pipe bollards at areas of repair	54	EA	5.00	270	26.00	1,404	31.00	1,674
Remove ceramic floor and wall tile at mens and womens locker rooms	1,434	SF			1.95	2,796	1.95	2,796
Demolish existing roofing	22,080	SF			1.75	38,640	1.75	38,640
Demolish damaged 3/4" plywood roof decking (10% of area)	2,208	SF			1.15	2,539	1.15	2,539
Dispose of debris	25	LDS	250.00	6,250	350.00	8,750	600.00	15,000
SUBTOTAL:				*$ 13,664*		*$ 137,502*		*$ 151,166*
Labor Premium Time	16.70%					22,963		22,963
TOTAL ESTIMATED COST:				***$ 13,664***		***$ 160,465***		***$ 174,129***

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01 - SITE WORK ***013 - Site Improvements***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
<u>EXTERIOR IMPROVEMENTS</u>								
Recut paving	300	LF	0.25	75	0.75	225	1.00	300
Patch paving at areas of excavation	2,000	SF	2.20	4,400	1.55	3,100	3.75	7,500
Pipe bollards	54	EA	385.00	20,790	350.00	18,900	735.00	39,690
SUBTOTAL:				*$ 25,265*		*$ 22,225*		*$ 47,490*
Labor Premium Time	16.70%					3,712		3,712
TOTAL ESTIMATED COST:				***$ 25,265***		***$ 25,937***		***$ 51,202***

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02 - SUBSTRUCTURE ***021 - Standard Foundations***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
PAD FOUNDATIONS AT COLUMNS								
Concrete at footings	12	CY	135.00	1,620	90.00	1,080	225.00	2,700
Concrete at foundation walls	19	CY	135.00	2,565	100.00	1,900	235.00	4,465
Concrete at pilasters	4	CY	135.00	540	120.00	480	255.00	1,020
Form footings	72	SF	1.80	130	4.80	346	6.60	476
Form foundation walls	1,128	SF	2.10	2,369	5.90	6,655	8.00	9,024
Form pilasters	288	SF	2.40	691	6.25	1,800	8.65	2,491
Reinforcing steel	3,720	SF	0.70	2,604	0.70	2,604	1.40	5,208
Dowel new to existing substructure	288	EA	22.50	6,480	39.00	11,232	61.50	17,712
Pump concrete	35	CY	45.00	1,575			45.00	1,575
2" rigid insulation	564	SF	1.05	592	0.50	282	1.55	874
Membrane waterproofing	582	SF	1.70	989	2.55	1,484	4.25	2,473
Embedded anchor bolts at frame columns	48	EA	7.50	360	12.00	576	19.50	936
SUBTOTAL:				*$ 20,515*		*$ 28,439*		*$ 48,954*
Labor Premium Time	16.70%					4,749		4,749
TOTAL ESTIMATED COST:				***$ 20,515***		***$ 33,188***		***$ 53,703***

HMS Project No.: 19002-B

02 - SUBSTRUCTURE ***022 - Slab on Grade***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
SLAB ON GRADE								
Finish grade for slab	8,254	SF			0.10	825	0.10	825
Vapor retarder	8,254	SF	0.08	660	0.12	990	0.20	1,650
2" rgid installation under slab	5,664	SF	1.05	5,947	0.85	4,814	1.90	10,761
Concrete	203	CY	135.00	27,405	85.00	17,255	220.00	44,660
Reinforcing steel	16,240	LBS	0.70	11,368	0.70	11,368	1.40	22,736
Dowel new to existing slab	708	EA	13.50	9,558	28.00	19,824	41.50	29,382
Cure and finish	8,254	SF	0.30	2,476	1.25	10,318	1.55	12,794
Remove and reinstall steel bearing plates	39,634	LBS			0.07	2,774	0.07	2,774
Control joints	800	LF	0.15	120	0.57	456	0.72	576
SUBTOTAL:				*$ 57,534*		*$ 68,624*		*$ 126,158*
Labor Premium Time	16.70%					11,460		11,460
TOTAL ESTIMATED COST:				***$ 57,534***		***$ 80,084***		***$ 137,618***

HMS Project No.: 19002-B

03 - SUPERSTRUCTURE ***032 - Roof Construction***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
Temporary shoring allowance	15,360	SF	4.50	69,120	4.00	61,440	8.50	130,560
W-beam rigid steel frame	26,680	LBS	1.95	52,026	1.65	44,022	3.60	96,048
Tube steel bracing	1,900	LBS	2.05	3,895	1.70	3,230	3.75	7,125
Channel steel struts bolted to CMU	11,520	LBS	1.95	22,464	1.50	17,280	3.45	39,744
New 3/4" plywood roof deck	2,208	SF	1.30	2,870	1.25	2,760	2.55	5,630
3/4"x6" expansion anchors	384	EA	2.75	1,056	12.00	4,608	14.75	5,664
New canopy construction	37	SF	14.00	518	22.00	814	36.00	1,332
SUBTOTAL:				*$ 151,949*		*$ 134,154*		*$ 286,103*
Labor Premium Time	16.70%					22,404		22,404
TOTAL ESTIMATED COST:				***$ 151,949***		***$ 156,558***		***$ 308,507***

HMS Project No.: 19002-B

04 - EXTERIOR CLOSURE			MATERIAL		LABOR		TOTAL	TOTAL
041 - Exterior Walls	*QUANTITY*	*UNIT*	*RATE $*	*TOTAL $*	*RATE $*	*TOTAL $*	*UNIT RATE $*	*MATERIAL/LABOR $*
Repair mortar at areas of removed CMU (blue)	1,628	SF	19.55	31,827	11.50	18,722	31.05	50,549
Mortar repair (green)	270	SF	9.50	2,565	6.50	1,755	16.00	4,320
Clean wall surface at Quakewrap repair	14,106	SF			1.15	16,222	1.15	16,222
Quakewrap reinforcement	14,106	SF	31.75	447,866	14.50	204,537	46.25	652,403
Allow for removal/reinstallation of wall mounted items for Quakewrap installation	1	LOT	3500.00	3,500	6500.00	6,500	10000.00	10,000
Epoxy injection crack repair	150	LF	15.00	2,250	35.00	5,250	50.00	7,500
Paint new and existing exterior of building including overhead doors	14,606	SF	0.30	4,382	1.50	21,909	1.80	26,291
SUBTOTAL:				*$ 492,390*		*$ 274,895*		*$ 767,285*
Labor Premium Time	16.70%					45,907		45,907
SUBTOTAL:				*$ 492,390*		*$ 320,802*		*$ 813,192*
Subcontractor's Overhead and Profit on Material and Labor	25.00%			123,098		80,201		203,299
TOTAL ESTIMATED COST:				***$ 615,488***		***$ 401,003***		***$ 1,016,491***

HMS Project No.: 19002-B

04 - EXTERIOR CLOSURE **042 - Exterior Doors and Windows**	QUANTITY	UNIT	MATERIAL RATE $	MATERIAL TOTAL $	LABOR RATE $	LABOR TOTAL $	TOTAL UNIT RATE $	TOTAL MATERIAL/LABOR $
New 3'0"x7'0" hollow metal door assembly	8	EA	1150.00	9,200	650.00	5,200	1800.00	14,400
New 14'0"x24'0" sectional overhead door	2	EA	10566.00	21,132	2600.00	5,200	13166.00	26,332
New 12'0"x16'0" sectional overhead door	16	EA	6200.00	99,200	2400.00	38,400	8600.00	137,600
New 19'0"x24'0" fabric doors	4	EA	60000.00	240,000	3200.00	12,800	63200.00	252,800
SUBTOTAL:				*$ 369,532*		*$ 61,600*		*$ 431,132*
Labor Premium Time	16.70%					10,287		10,287
SUBTOTAL:				*$ 369,532*		*$ 71,887*		*$ 441,419*
Subcontractor's Overhead and Profit on Material and Labor	25.00%			92,383		17,972		110,355
TOTAL ESTIMATED COST:				***$ 461,915***		***$ 89,859***		***$ 551,774***

HMS Project No.: 19002-B

05 - ROOF SYSTEMS			MATERIAL		LABOR		TOTAL	TOTAL
051 - Roofing	QUANTITY	UNIT	RATE $	TOTAL $	RATE $	TOTAL $	UNIT RATE $	MATERIAL/LABOR $
Modified bitumen roofing assembly, complete	22,118	SF	3.25	71,884	2.30	50,871	5.55	122,755
24 gauge perimeter flashing (flashing only)	903	LF	4.20	3,793	3.20	2,890	7.40	6,683
Roof/wall flashing	176	LF	3.80	669	3.20	563	7.00	1,232
Roofing detail at penetration	42	EA	78.00	3,276	65.00	2,730	143.00	6,006
Seismic joint cover with insulation and blocking	160	LF	41.00	6,560	13.00	2,080	54.00	8,640
Temporary fall protection railings	716	LF	3.80	2,721	2.50	1,790	6.30	4,511
SUBTOTAL:				*$ 88,903*		*$ 60,924*		*$ 149,827*
Labor Premium Time	16.70%					10,174		10,174
TOTAL ESTIMATED COST:				***$ 88,903***		***$ 71,098***		***$ 160,001***

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06 - INTERIOR CONSTRUCTION			*MATERIAL*		*LABOR*		*TOTAL*	*TOTAL*
062 - Interior Finishes	*QUANTITY*	*UNIT*	*RATE $*	*TOTAL $*	*RATE $*	*TOTAL $*	*UNIT RATE $*	*MATERIAL/LABOR $*
2"x4" furring	11,122	SF	0.75	8,342	1.40	15,571	2.15	23,913
1 1/2" rigid insulation	2,988	SF	0.80	2,390	0.85	2,540	1.65	4,930
3/4" plywood wainscot	2,988	SF	1.25	3,735	1.10	3,287	2.35	7,022
5/8" moisture resistant gypsum wallboard	8,136	SF	0.85	6,916	1.50	12,204	2.35	19,120
Repair or replace gypsum wall board ceiling (2 each 1/2" layers)	1,500	SF	1.50	2,250	4.30	6,450	5.80	8,700
Paint all walls, ceilings and overhead doors at maintenance and storage	30,957	SF	0.30	9,287	1.50	46,436	1.80	55,723
Ceramic floor tile	814	SF	8.50	6,919	6.50	5,291	15.00	12,210
Ceramic wall tile	620	SF	8.50	5,270	7.50	4,650	16.00	9,920
Patch/paint existing admin area	14,121	SF	0.35	4,942	1.60	22,594	1.95	27,536
Remove/reinstall ACT ceiling assembly	1,500	SF	0.50	750	3.25	4,875	3.75	5,625
Reinstall single door assembly	6	EA	50.00	300	350.00	2,100	400.00	2,400
Reinstall double door assembly	3	EA	75.00	225	375.00	1,125	450.00	1,350
Clean and seal concrete slab on grade	14,940	SF	0.45	6,723	1.35	20,169	1.80	26,892
Scaffolding	8,100	SF	0.75	6,075	1.68	13,608	2.43	19,683
SUBTOTAL:				*$ 64,124*		*$ 160,900*		*$ 225,024*

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06 - INTERIOR CONSTRUCTION ***062 - Interior Finishes***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
Labor Premium Time	16.70%					26,870		26,870
TOTAL ESTIMATED COST:				***$ 64,124***		***$ 187,770***		***$ 251,894***

HMS Project No.: 19002-B

07 - CONVEYING SYSTEMS	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
Remove existing bridge crane	1	EA	250.00	250	2800.00	2,800	3050.00	3,050
10 to (assumed), 40'0" span overhead bridge crane	1	EA	56000.00	56,000	7650.00	7,650	63650.00	63,650
SUBTOTAL:				*$ 56,250*		*$ 10,450*		*$ 66,700*
Labor Premium Time	16.70%					1,745		1,745
TOTAL ESTIMATED COST:				***$ 56,250***		***$ 12,195***		***$ 68,445***

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08 - MECHANICAL ***081 - Plumbing***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
Relocate roof drains, compressed air piping, water piping and related as required to perform work (allowance)	1	LOT	15000.00	15,000	25000.00	25,000	40000.00	40,000
Rmove toilets	3	EA			77.50	233	77.50	233
Remove urinals	3	EA			77.50	233	77.50	233
Reinstall toilets	3	EA	710.00	2,130	180.00	540	890.00	2,670
Reinstall urinals	3	EA	750.00	2,250	180.00	540	930.00	2,790
Replace waste oil sump	1	EA	1750.00	1,750	2500.00	2,500	4250.00	4,250
SUBTOTAL:				*$ 21,130*		*$ 29,046*		*$ 50,176*
Labor Premium Time	16.70%					4,851		4,851
SUBTOTAL:				*$ 21,130*		*$ 33,897*		*$ 55,027*
Subcontractor's Overhead and Profit on Material and Labor	20.00%			4,226		6,779		11,005
TOTAL ESTIMATED COST:				***$ 25,356***		***$ 40,676***		***$ 66,032***

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08 - MECHANICAL ***082 - HVAC***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
Remove radiant heat manifold	4	EA			115.00	460	115.00	460
Pex tubing at new maintenance bay slab	7,660	LF	1.06	8,120	2.35	18,001	3.41	26,121
2" diameter copper pipe to existing radiant heat supply and return	8	LF	18.00	144	76.00	608	94.00	752
New glycol	150	GAL	13.50	2,025	1.50	225	15.00	2,250
New radiant heat manifolds	4	EA	750.00	3,000	175.00	700	925.00	3,700
Repair/reinstall damaged duct at admin	265	LBS	0.75	199	3.80	1,007	4.55	1,206
Test and balance	1	LOT			750.00	750	750.00	750
SUBTOTAL:				*$ 13,488*		*$ 21,751*		*$ 35,239*
Labor Premium Time	16.70%					3,632		3,632
SUBTOTAL:				*$ 13,488*		*$ 25,383*		*$ 38,871*
Subcontractor's Overhead and Profit on Material and Labor	20.00%			2,698		5,077		7,775
TOTAL ESTIMATED COST:				***$ 16,186***		***$ 30,460***		***$ 46,646***

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09 - ELECTRICAL ***092 - Lighting and Power***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
Remove/support/reinstall door controls and 120 volt power at areas of column repair	18	EA	150.00	2,700	500.00	9,000	650.00	11,700
SUBTOTAL:				*$ 2,700*		*$ 9,000*		*$ 11,700*
Labor Premium Time	16.70%					1,503		1,503
SUBTOTAL:				*$ 2,700*		*$ 10,503*		*$ 13,203*
Subcontractor's Overhead and Profit on Material and Labor	20.00%			540		2,101		2,641
TOTAL ESTIMATED COST:				***$ 3,240***		***$ 12,604***		***$ 15,844***

Appendix E: Replacement Cost Estimate

HMS Project No.19002-A

CONCEPTUAL DESIGN SUBMITTAL
CONSTRUCTION COST ESTIMATE (REVISION 2)

REPLACE COMPLETE LANDFILL ENTRANCE FACILITY - FULL ESTIMATE
ANCHORAGE, ALASKA

PREPARED FOR:

Coffman Engineers
800 F Street
Anchorage, Alaska 99501

July 17, 2019

HMS Inc

4103 Minnesota Drive • Anchorage, Alaska 99503 p: 907.561.1653 • f: 907.562.0420 • e: mail@hmsalaska.com

NOTES REGARDING THE PREPARATION OF THIS ESTIMATE

DRAWINGS AND DOCUMENTS

Level of Documents:	(4) page narrative and as-built drawings and review notes received 3-26-19
Date:	January 11, 2019
Provided By:	Coffman Engineering of Anchorage, Alaska

RATES

Pricing is based on current material, equipment and freight costs.

Labor Rates:	A.S. Title 36 working 60 hours per week
Premium Time:	16.70%

BIDDING ASSUMPTIONS

Contract:	Standard construction contract without restrictive bidding clauses
Bidding Situation:	Competitive bids assumed
Bid Date:	February 2020
Start of Construction:	Summer 2020
Months to Complete:	Within (6) months completion

EXCLUDED COSTS

1. Administrative and management costs
2. Furniture, furnishings and equipment (except those specifically included)
3. Remediation of contaminated soils or abatement of any hazardous materials, if found during construction
4. Work to remainder of the building except as specifically noted in the estimate
5. Building site work and demolition
6. Soft costs including design, plan review, permitting, bidding expense, and CA services

NOTES REGARDING THE PREPARATION OF THIS ESTIMATE (Continued)

GENERAL

When included in HMS Inc.'s scope of services, opinions or estimates of probable construction costs are prepared on the basis of HMS Inc.'s experience and qualifications and represent HMS Inc.'s judgment as a professional generally familiar with the industry. However, since HMS Inc. has no control over the cost of labor, materials, equipment or services furnished by others, over contractor's methods of determining prices, or over competitive bidding or market conditions, HMS Inc. cannot and does not guarantee that proposals, bids, or actual construction cost will not vary from HMS Inc.'s opinions or estimates of probable construction cost.

This estimate assumes normal escalation based on the current economic climate. HMS Inc. will continue to monitor international, domestic and local events, and the resulting construction climate, and will adjust costs and contingencies as deemed appropriate. This estimate does not include costs for tariff increases on foreign goods currently slated for March 2019 or increased tariffs resulting from cost growth for the Port of Anchorage improvements.

GROSS FLOOR AREA

Total GFA: 22,080 SF

Project No.: 19002-A

CONCEPTUAL DESIGN COST SUMMARY

		Material	*Labor*	*Total*
01 - SITE WORK		$ 200,035	$ 349,588	$ 549,623
02 - SUBSTRUCTURE		232,593	267,991	500,584
03 - SUPERSTRUCTURE		820,721	714,441	1,535,162
04 - EXTERIOR CLOSURE		504,306	291,454	795,760
05 - ROOF SYSTEMS		203,826	145,156	348,982
06 - INTERIOR CONSTRUCTION		133,740	170,654	304,394
07 - CONVEYING SYSTEMS		56,000	8,928	64,928
08 - MECHANICAL		440,924	421,029	861,953
09 - ELECTRICAL		153,741	122,193	275,934
10 - EQUIPMENT		0	0	0
11 - SPECIAL CONSTRUCTION		0	0	0
SUBTOTAL:		*$ 2,745,886*	*$ 2,491,434*	*$ 5,237,320*
GENERAL CONDITIONS, OVERHEAD AND PROFIT	25.00%			1,309,330
BONDS AND INSURANCES	2.50%			163,666
ESTIMATOR'S CONTINGENCY	30.00%			2,013,095
ESCALATION TO THE PROPOSED BID DATE OF FEBRUARY 2020 AT THE RATE OF 3.50% PER ANNUM	3.50%			305,319
TOTAL ESTIMATED CONSTRUCTION COST:				***$ 9,028,730***
COST PER SQUARE FOOT:				*$ 408.91 /SF*
GROSS FLOOR AREA:				*22,080 SF*

Project No.: 19002-A

CONCEPTUAL DESIGN COST SUMMARY

		Material	Labor	Total
DESIGN FEE	12.00%			$ 1,083,448
PLAN REVIEW & PERMITTING	1.20%			108,345
BIDDING EXPENSE	0.25%			22,572
CONSTRUCTION ADMINISTRATION	6.00%			541,724
TOTAL ESTIMATED CONSTRUCTION COST:				***$ 10,784,819***
COST PER SQUARE FOOT:				*$ 488.44*
GROSS FLOOR AREA:				*22,080*

Project No.: 19002-A

ELEMENTAL SUMMARY

Element	*Material*	*Labor*	*Total Material/Labor*	*Total Cost*	*Cost per SF*
01 - SITE WORK				*$ 549,623*	*$ 24.89*
011 - Site Demolition	$ 150,435	$ 299,277	$ 449,712		20.37
012 - Site Preparation	0	0	0		0.00
013 - Site Improvements	49,600	50,311	99,911		4.52
014 - Site Mechanical	0	0	0		0.00
015 - Site Electrical	0	0	0		0.00
02 - SUBSTRUCTURE				*$ 500,584*	*$ 22.67*
021 - Standard Foundations	$ 79,624	$ 125,721	$ 205,345		9.30
022 - Slab on Grade	152,969	142,270	295,239		13.37
023 - Basement	0	0	0		0.00
024 - Special Foundations	0	0	0		0.00
03 - SUPERSTRUCTURE				*$ 1,535,162*	*$ 69.53*
031 - Floor Construction	$ 88,690	$ 80,780	$ 169,470		7.68
032 - Roof Construction	732,031	633,661	1,365,692		61.85
033 - Stair Construction	0	0	0		0.00
04 - EXTERIOR CLOSURE				*$ 795,760*	*$ 36.04*
041 - Exterior Walls	$ 189,265	$ 217,756	$ 407,021		18.43
042 - Exterior Doors and Windows	315,041	73,698	388,739		17.61
05 - ROOF SYSTEMS				*$ 348,982*	*$ 15.81*
051 - Roofing	$ 203,826	$ 145,156	$ 348,982		15.81
052 - Skylights	0	0	0		0.00
06 - INTERIOR CONSTRUCTION				*$ 304,394*	*$ 13.79*
061 - Partitions and Doors	$ 76,672	$ 66,855	$ 143,527		6.50
062 - Interior Finishes	54,553	102,388	156,941		7.11
063 - Specialties	2,515	1,411	3,926		0.18

Project No.: 19002-A

ELEMENTAL SUMMARY

Element	*Material*	*Labor*	*Total Material/Labor*	*Total Cost*	*Cost per SF*
07 - CONVEYING SYSTEMS	*$ 56,000*	*$ 8,928*		*$ 64,928*	*$ 2.94*
08 - MECHANICAL				*$ 861,953*	*$ 39.04*
081 - Plumbing	$ 119,167	$ 71,176	$ 190,343		8.62
082 - HVAC	181,194	208,667	389,861		17.66
083 - Fire Protection	60,366	82,134	142,500		6.45
084 - Special Mechanical Systems	80,197	59,052	139,249		6.31
09 - ELECTRICAL				*$ 275,934*	*$ 12.50*
091 - Service and Distribution	$ 42,240	$ 23,527	$ 65,767		2.98
092 - Lighting and Power	91,562	61,384	152,946		6.93
093 - Special Electrical Systems	19,939	37,282	57,221		2.59
10 - EQUIPMENT				*$ 0*	*$ 0.00*
101 - Fixed and Movable Equipment	$ 0	$ 0	$ 0		0.00
102 - Furnishings	0	0	0		0.00
11 - SPECIAL CONSTRUCTION	*$ 0*	*$ 0*		*$ 0*	*$ 0.00*
SUBTOTAL DIRECT WORK:	***$ 2,745,886***	***$ 2,491,434***		***$ 5,237,320***	
GENERAL REQUIREMENTS AND CONTINGENCIES				*$ 3,791,410*	*$ 171.71*
General Conditions, Overhead and Profit		25.00%	1,309,330		59.30
Bonds and Insurances		2.50%	163,666		7.41
Estimator's Contingency		30.00%	2,013,095		91.17
Escalation to the Proposed Bid Date of February 2020 at the Rate of 3.50% Per Annum		3.50%	305,319		13.83
SUBTOTAL GENERAL REQUIREMENTS AND CONTINGENCIES:				***$ 9,028,730***	

Project No.: 19002-A

ELEMENTAL SUMMARY

Element	*Material*	*Labor*	*Total Material/Labor*	*Total Cost*	*Cost per SF*	
SOFT COSTS				*$ 1,756,089*	*$ 79.53*	
Design Fee		12.00%	1,083,448		49.07	
Plan Review & Permitting		1.20%	108,345		4.91	
Bidding Expense		0.25%	22,572		1.02	
Construction Administration		6.00%	541,724		24.53	
TOTAL ESTIMATED CONSTRUCTION COST:				***$ 10,784,819***	***$488.44***	***/SF***
GROSS FLOOR AREA:					*22,080*	*SF*

Project No.: 19002-A

01 - SITE WORK ***011 - Demolition***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
Demolish CMU building, complete	461,932	CF	0.17	78,528	0.28	129,341	0.45	207,869
Demolish wood framed structure	114,240	CF	0.19	21,706	0.24	27,418	0.43	49,124
Remove pipe bollards	88	EA	5.00	440	26.00	2,288	31.00	2,728
Demolish existing building substructure	22,080	SF			0.65	14,352	0.65	14,352
Demolish existing 4" to 6" slab on grade	16,433	SF	0.57	9,367	1.56	25,635	2.13	35,002
Demolish existing 8" slab on grade	5,680	EA	0.60	3,408	0.20	1,136	0.80	4,544
Remove pipe bollards	88	EA			35.00	3,080	35.00	3,080
Saw cut, break and remove asphalt paving	6,500	SF	0.22	1,430	0.50	3,250	0.72	4,680
Saw cut, break and remove sidewalk	200	SF	0.28	56	1.25	250	1.53	306
Dispose of debris	142	LDS	250.00	35,500	350.00	49,700	600.00	85,200
SUBTOTAL:				*$ 150,435*		*$ 256,450*		*$ 406,885*
Labor Premium Time	16.70%					42,827		42,827
TOTAL ESTIMATED COST:				***$ 150,435***		***$ 299,277***		***$ 449,712***

Project No.: 19002-A

01 - SITE WORK ***013 - Site Improvements***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
2" paving patch at building perimeter	6,975	SF	2.20	15,345	1.55	10,811	3.75	26,156
Recut asphalt edge prior to repaving	500	LF	0.25	125	1.75	875	2.00	1,000
Joint existing paving	500	LF	0.50	250	1.25	625	1.75	875
Pipe bollards (all)	88	EA	385.00	33,880	350.00	30,800	735.00	64,680
SUBTOTAL:				*$ 49,600*		*$ 43,111*		*$ 92,711*
Labor Premium Time	16.70%					7,200		7,200
TOTAL ESTIMATED COST:				***$ 49,600***		***$ 50,311***		***$ 99,911***

Project No.: 19002-A

02 - SUBSTRUCTURE ***021 - Standard Foundations***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
Excavate and backfill for bases and foundation	736	CY	3.50	2,576	10.50	7,728	14.00	10,304
Concrete footings	80	CY	135.00	10,800	90.00	7,200	225.00	18,000
Concrete pilasters	9	CY	135.00	1,215	105.00	945	240.00	2,160
Concrete stem walls	85	CY	135.00	11,475	100.00	8,500	235.00	19,975
Concrete waste (5%)	9	CY	135.00	1,215	85.00	765	220.00	1,980
Pump concrete	183	CY	45.00	8,235			45.00	8,235
Bar reinforcement	16,980	LBS	0.70	11,886	0.70	11,886	1.40	23,772
Formwork to footing and bases	2,039	SF	1.80	3,670	4.80	9,787	6.60	13,457
Formwork to pilasters	840	SF	2.20	1,848	6.50	5,460	8.70	7,308
Form work to walls	6,944	SF	2.10	14,582	5.90	40,970	8.00	55,552
MISCELLANEOUS								
Embedded anchor bolts at column bases	140	EA	7.50	1,050	12.00	1,680	19.50	2,730
2" rigid insulation to stem walls	3,534	SF	1.05	3,711	0.50	1,767	1.55	5,478
Membrane dampproofing to walls and foundation	4,330	SF	1.70	7,361	2.55	11,042	4.25	18,403
SUBTOTAL:				*$ 79,624*		*$ 107,730*		*$ 187,354*

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02 - SUBSTRUCTURE			*MATERIAL*		*LABOR*		*TOTAL*	*TOTAL*
021 - Standard Foundations	*QUANTITY*	*UNIT*	*RATE $*	*TOTAL $*	*RATE $*	*TOTAL $*	*UNIT RATE $*	*MATERIAL/LABOR $*
Labor Premium Time	16.70%					17,991		17,991
TOTAL ESTIMATED COST:				***$ 79,624***		***$ 125,721***		***$ 205,345***

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02 - SUBSTRUCTURE ***022 - Slab on Grade***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
4" leveling course, compacted	304	CY	30.00	9,120	8.50	2,584	38.50	11,704
10 mil vapor retarder	21,125	SF	0.10	2,113	0.12	2,535	0.22	4,648
Concrete slab	406	CY	135.00	54,810	82.50	33,495	217.50	88,305
12"x8" thickened slab tie beams	20	CY	135.00	2,700	85.00	1,700	220.00	4,400
2" rigid insulation at area of radiant heat	5,695	CY	1.05	5,980	0.50	2,848	1.55	8,828
Concrete waste (5%)	21	CY	135.00	2,835	82.50	1,733	217.50	4,568
Pump concrete	447	CY	45.00	20,115			45.00	20,115
Cure and finish slabs	21,216	SF	0.30	6,365	1.30	27,581	1.60	33,946
Bar reinforcement	34,130	LBS	0.70	23,891	0.55	18,772	1.25	42,663
Trench drain assembly	167	LF	145.00	24,215	170.00	28,390	315.00	52,605
Saw cut for construction joint and fill with polyurethane compound filler	842	LF	0.98	825	2.70	2,273	3.68	3,098
SUBTOTAL:				*$ 152,969*		*$ 121,911*		*$ 274,880*
Labor Premium Time	16.70%					20,359		20,359
TOTAL ESTIMATED COST:				***$ 152,969***		***$ 142,270***		***$ 295,239***

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03 - SUPERSTRUCTURE ***031 - Floor Construction***	*QUANTITY*	*UNIT*	*MATERIAL* *RATE* *$*	*MATERIAL* *TOTAL* *$*	*LABOR* *RATE* *$*	*LABOR* *TOTAL* *$*	*TOTAL* *UNIT RATE* *$*	*TOTAL* *MATERIAL/LABOR* *$*
<u>MECHANICAL MEZZANINE</u>								
Structure	5,000	LBS	1.95	9,750	1.50	7,500	3.45	17,250
Guardrail	54	LF	47.00	2,538	17.50	945	64.50	3,483
Metal ladder with cage	19	VLF	85.00	1,615	48.00	912	133.00	2,527
Metal decking	330	SF	2.68	884	1.35	446	4.03	1,330
Concrete	4	CY	135.00	540	120.00	480	255.00	1,020
Concrete pump	4	CY	45.00	180			45.00	180
Cure and finish	330	SF	0.30	99	1.50	495	1.80	594
<u>BRIDGE CRANE STRUCTURE</u>								
Tube steel columns	7,400	LBS	1.95	14,430	1.50	11,100	3.45	25,530
Base plates and anchor bolts	8	EA	45.00	360	65.00	520	110.00	880
W-beam crane rails	15,600	LBS	1.80	28,080	1.40	21,840	3.20	49,920
W-beam corbel	750	LBS	1.80	1,350	1.50	1,125	3.30	2,475
Tube steel bracing	3,949	LBS	1.95	7,701	1.65	6,516	3.60	14,217
ASCE #40 rail welded to crane rail	6,000	LBS	1.80	10,800	1.50	9,000	3.30	19,800

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03 - SUPERSTRUCTURE ***031 - Floor Construction***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
<u>BRIDGE CRANE STRUCTURE (Continued)</u>								
Miscellaneous bracing fittings, connections and fasteners	5,055	LBS	2.05	10,363	1.65	8,341	3.70	18,704
SUBTOTAL:				*$ 88,690*		*$ 69,220*		*$ 157,910*
Labor Premium Time	16.70%					11,560		11,560
TOTAL ESTIMATED COST:				***$ 88,690***		***$ 80,780***		***$ 169,470***

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03 - SUPERSTRUCTURE ***032 - Roof Construction***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
Structural steel (22,896 SF at 15 lbs.)	343,440	LBS	1.95	669,708	1.50	515,160	3.45	1,184,868
1 1/2"x20 gauge metal decking	22,896	SF	2.70	61,819	1.20	27,475	3.90	89,294
Exterior mounted access ladder	12	VLF	42.00	504	29.00	348	71.00	852
SUBTOTAL:				*$ 732,031*		*$ 542,983*		*$ 1,275,014*
Labor Premium Time	16.70%					90,678		90,678
TOTAL ESTIMATED COST:				***$ 732,031***		***$ 633,661***		***$ 1,365,692***

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04 - EXTERIOR CLOSURE ***041 - Exterior Walls***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
6" steel studs, 16" o/c including tracks at walls	14,766	SF	2.80	41,345	1.70	25,102	4.50	66,447
4" insulated siding panels and trims	14,766	SF	9.23	136,290	8.26	121,967	17.49	258,257
Weather barrier	14,766	SF	0.38	5,611	0.72	10,632	1.10	16,243
10 mil vapor retarder	14,766	SF	0.10	1,477	1.60	23,626	1.70	25,103
5/8" gypsum wall board	2,972	SF	0.65	1,932	1.50	4,458	2.15	6,390
Seismic joint	90	LF	29.00	2,610	9.00	810	38.00	3,420
SUBTOTAL:				*$ 189,265*		*$ 186,595*		*$ 375,860*
Labor Premium Time	16.70%					31,161		31,161
TOTAL ESTIMATED COST:				***$ 189,265***		***$ 217,756***		***$ 407,021***

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04 - EXTERIOR CLOSURE ***042 - Exterior Doors and Windows***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
20'0"x23'8" vertical lift fabric doors	4	EA	24600.00	98,400	4500.00	18,000	29100.00	116,400
12'0"x23'8" vertical lift fabric doors	2	EA	14768.00	29,536	2700.00	5,400	17468.00	34,936
12'0"x16'0" vertical lift fabric doors	16	EA	9920.00	158,720	1800.00	28,800	11720.00	187,520
3'0"x7'0" hollow metal double door assemblies, complete	2	EA	1755.00	3,510	850.00	1,700	2605.00	5,210
3'0"x7'0" hollow metal single door assemblies, complete	5	EA	1150.00	5,750	650.00	3,250	1800.00	9,000
3'0"x7'0" hollow metal single door assemblies, complete, with half lite	3	EA	1305.00	3,915	680.00	2,040	1985.00	5,955
Aluminum windows and side lites	322	SF	45.00	14,490	12.00	3,864	57.00	18,354
Exterior louvers	15	SF	48.00	720	6.50	98	54.50	818
SUBTOTAL:				*$ 315,041*		*$ 63,152*		*$ 378,193*
Labor Premium Time	16.70%					10,546		10,546
TOTAL ESTIMATED COST:				***$ 315,041***		***$ 73,698***		***$ 388,739***

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05 - ROOF SYSTEMS			*MATERIAL*		*LABOR*		*TOTAL*	*TOTAL*
051 - Roofing	*QUANTITY*	*UNIT*	*RATE $*	*TOTAL $*	*RATE $*	*TOTAL $*	*UNIT RATE $*	*MATERIAL/LABOR $*
1/2" substrate thermal barrier	22,900	SF	0.70	16,030	0.65	14,885	1.35	30,915
(2) layers 4" rigid insulation, staggered joints	22,900	SF	3.60	82,440	1.10	25,190	4.70	107,630
Extra for tapered insulation at crickets	2,080	SF	0.85	1,768	0.50	1,040	1.35	2,808
1/2" cover board	22,900	SF	0.70	16,030	0.65	14,885	1.35	30,915
60 mil membrane	22,900	SF	2.85	65,265	2.40	54,960	5.25	120,225
60 mil membrane at vertical surfaces	1,180	SF	2.85	3,363	3.10	3,658	5.95	7,021
Metal cap flashings, blockings, and sealant	874	LF	5.70	4,982	3.50	3,059	9.20	8,041
Roof/wall flashings	321	LF	3.80	1,220	3.20	1,027	7.00	2,247
Roof drain flashings	24	EA	78.00	1,872	65.00	1,560	143.00	3,432
Roof hatch	1	EA	1575.00	1,575	250.00	250	1825.00	1,825
9" bellow type seismic joint cover with batt insulation and wood blockings	160	LF	41.00	6,560	13.00	2,080	54.00	8,640
Temporary fall protection railings	716	LF	3.80	2,721	2.50	1,790	6.30	4,511
SUBTOTAL:				*$ 203,826*		*$ 124,384*		*$ 328,210*
Labor Premium Time	16.70%					20,772		20,772
TOTAL ESTIMATED COST:				***$ 203,826***		***$ 145,156***		***$ 348,982***

06 - INTERIOR CONSTRUCTION ***061 - Partitions and Doors***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
PARTITIONS								
8" metal studs	2,086	SF	1.65	3,442	1.45	3,025	3.10	6,467
6" metal studs	6,732	SF	1.30	8,752	1.30	8,752	2.60	17,504
3 5/8" metal studs	3,009	SF	1.10	3,310	1.20	3,611	2.30	6,921
2"x6" blocking/backing	50	LF	0.80	40	1.50	75	2.30	115
5/8" Type X gypboard, each side	20,120	SF	0.65	13,078	1.50	30,180	2.15	43,258
Sound batts	8,300	SF	0.54	4,482	0.35	2,905	0.89	7,387
Operable partition	200	SF	86.50	17,300	3.50	700	90.00	18,000
ACCESS PANELS								
12"x12" access panels	2	EA	82.00	164	50.00	100	132.00	264
24"x24" access panels	2	EA	162.00	324	75.00	150	237.00	474
DOORS								
6'0"x7'0" double door frames	4	EA	280.00	1,120	150.00	600	430.00	1,720
3'0"x7'0" hollow metal door frames	18	EA	140.00	2,520	80.00	1,440	220.00	3,960
3'0"x7'0" double doors	4	PRS	1350.00	5,400	75.00	300	1425.00	5,700

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06 - INTERIOR CONSTRUCTION 061 - Partitions and Doors	QUANTITY	UNIT	MATERIAL RATE $	MATERIAL TOTAL $	LABOR RATE $	LABOR TOTAL $	TOTAL UNIT RATE $	TOTAL MATERIAL/LABOR $
DOORS (Continued)								
3'0"x7'0" single doors	18	EA	410.00	7,380	65.00	1,170	475.00	8,550
Hardware sets to single doors	18	EA	350.00	6,300	160.00	2,880	510.00	9,180
Hardware sets to double doors	4	EA	675.00	2,700	350.00	1,400	1025.00	4,100
Add for fire rating	6	EA	60.00	360			60.00	360
SUBTOTAL:				*$ 76,672*		*$ 57,288*		*$ 133,960*
Labor Premium Time	16.70%					9,567		9,567
TOTAL ESTIMATED COST:				***$ 76,672***		***$ 66,855***		***$ 143,527***

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06 - INTERIOR CONSTRUCTION ***062 - Interior Finishes***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
Sheet vinyl flooring	2,453	SF	4.70	11,529	2.95	7,236	7.65	18,765
Ceramic floor tile	814	SF	8.50	6,919	6.50	5,291	15.00	12,210
Slip resistant rubber floor	837	SF	7.00	5,859	1.55	1,297	8.55	7,156
Concrete sealer and hardener at bays and mezzanine	16,612	SF	0.35	5,814	0.85	14,120	1.20	19,934
4" base	1,600	LF	1.20	1,920	1.45	2,320	2.65	4,240
Ceramic wall tile	620	SF	8.50	5,270	7.50	4,650	16.00	9,920
Paint gypboard including inner face of exterior walls	23,100	SF	0.25	5,775	1.55	35,805	1.80	41,580
Touch up steel	1	LOT	1500.00	1,500	3500.00	3,500	5000.00	5,000
2'0"x4'0" ACT with seismic bracing	3,290	SF	2.70	8,883	2.20	7,238	4.90	16,121
Paint exposed ceilings	2,296	SF	0.25	574	1.55	3,559	1.80	4,133
Stain/paint doors and frames	1,700	SF	0.30	510	1.60	2,720	1.90	3,230
SUBTOTAL:				*$ 54,553*		*$ 87,736*		*$ 142,289*
Labor Premium Time	16.70%					14,652		14,652
TOTAL ESTIMATED COST:				***$ 54,553***		***$ 102,388***		***$ 156,941***

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06 - INTERIOR CONSTRUCTION ***063 - Specialties***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
<u>ACCESSORIES</u>								
18"x24" mirrors	5	EA	137.00	685	40.00	200	177.00	885
Toilet paper dispensers	4	EA	39.00	156	28.00	112	67.00	268
Toilet seat cover dispensers	4	EA	69.00	276	30.00	120	99.00	396
Paper towel dispensers	5	EA	60.00	300	30.00	150	90.00	450
Mop hook strip	1	EA	75.00	75	35.00	35	110.00	110
Soap dispensers	5	EA	47.00	235	28.00	140	75.00	375
12" grab bars	2	EA	28.00	56	30.00	60	58.00	116
30" grab bars	2	EA	43.00	86	35.00	70	78.00	156
42" grab bars	2	EA	57.00	114	35.00	70	92.00	184
Fire extinguishers with cabinet	2	EA	142.00	284	70.00	140	212.00	424
Bracket mounted fire extinguishers	4	EA	62.00	248	28.00	112	90.00	360
SUBTOTAL:				*$ 2,515*		*$ 1,209*		*$ 3,724*
Labor Premium Time	16.70%					202		202
TOTAL ESTIMATED COST:				***$ 2,515***		***$ 1,411***		***$ 3,926***

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07 - CONVEYING SYSTEMS	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
10 ton (assumed), 40'0" span overhead bridge crane	1	EA	56000.00	56,000	7650.00	7,650	63650.00	63,650
SUBTOTAL:				*$ 56,000*		*$ 7,650*		*$ 63,650*
Labor Premium Time	16.70%					1,278		1,278
TOTAL ESTIMATED COST:				***$ 56,000***		***$ 8,928***		***$ 64,928***

08 - MECHANICAL ***081 - Plumbing***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
75 gallon per minute oil/water separator	1	EA	16100.00	16,100	650.00	650	16750.00	16,750
Water closets	4	EA	740.00	2,960	220.00	880	960.00	3,840
Urinal	3	EA	950.00	2,850	220.00	660	1170.00	3,510
Emergency eye wash	1	EA	1100.00	1,100	350.00	350	1450.00	1,450
Janitor sink	1	EA	625.00	625	215.00	215	840.00	840
60" semicircular wash fountain	1	EA	5350.00	5,350	500.00	500	5850.00	5,850
Lavatory	1	EA	450.00	450	190.00	190	640.00	640
36"x40"shower cubical assembly	3	EA	1750.00	5,250	495.00	1,485	2245.00	6,735
Single kitchen sink	1	EA	680.00	680	221.00	221	901.00	901
Double kitchen sink	1	EA	985.00	985	221.00	221	1206.00	1,206
Plumbing rough-ins for new fixtures	8	EA	660.00	5,280	975.00	7,800	1635.00	13,080
Rough-ins for drains and bibs	12	EA	230.00	2,760	540.00	6,480	770.00	9,240
Trench drains	175	LF	176.00	30,800	15.50	2,713	191.50	33,513
Floor drains	8	EA	112.00	896	120.00	960	232.00	1,856
Freeze proof hose bibs	4	EA	75.00	300	95.00	380	170.00	680

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08 - MECHANICAL ***081 - Plumbing***	*QUANTITY*	*UNIT*	*MATERIAL*		*LABOR*		*TOTAL*	*TOTAL*
			RATE $	*TOTAL $*	*RATE $*	*TOTAL $*	*UNIT RATE $*	*MATERIAL/LABOR $*
Roof drains and overflows with leaders and heat trace	24	EA	955.00	22,920	1130.00	27,120	2085.00	50,040
SUBTOTAL:				*$ 99,306*		*$ 50,825*		*$ 150,131*
Labor Premium Time	16.70%					8,488		8,488
SUBTOTAL:				*$ 99,306*		*$ 59,313*		*$ 158,619*
Subcontractor's Overhead and Profit on Material and Labor	20.00%			19,861		11,863		31,724
TOTAL ESTIMATED COST:				***$ 119,167***		***$ 71,176***		***$ 190,343***

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08 - MECHANICAL / *082 - HVAC*	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
HEATING								
GHU-1: 1,320 CFM, 1/15 HP, 100 MBH gas fired unit heaters	4	EA	950.00	3,800	280.00	1,120	1230.00	4,920
Radiant heat manifolds	4	EA	750.00	3,000	150.00	600	900.00	3,600
PEX tubing at slab	7,823	LF	1.65	12,908	1.55	12,126	3.20	25,034
Drain/dispose existing glycol	200	GAL			0.65	130	0.65	130
New glycol fluid	200	GAL	13.50	2,700	2.50	500	16.00	3,200
Testing and balancing	32	HRS			180.00	5,760	180.00	5,760
Hydronic piping (allowance)	100	LF	21.00	2,100	16.50	1,650	37.50	3,750
Valves, fittings and devices	1	LOT	1500.00	1,500	2500.00	2,500	4000.00	4,000
Heating at admin space	6,700	SF	3.75	25,125	4.50	30,150	8.25	55,275
VENTILATION								
GHU-2: 12,000 CFM, 7.5 HP gas heating unit	1	EA	7650.00	7,650	1200.00	1,200	8850.00	8,850
EF-2: 2,500 CFM roof mounted exhauster, including cap and damper	4	EA	1750.00	7,000	350.00	1,400	2100.00	8,400
Ductwork	3,760	LBS	3.20	12,032	4.15	15,604	7.35	27,636

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08 - MECHANICAL ***082 - HVAC***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
VENTILATION (Continued)								
Grilles and diffusers	8	EA	85.00	680	35.00	280	120.00	960
Thermostats at shops	5	EA	95.00	475	55.00	275	150.00	750
DDC controls at admin area	6,700	SF	3.25	21,775	2.95	19,765	6.20	41,540
Ventilation at admin area	6,700	SF	7.50	50,250	8.35	55,945	15.85	106,195
SUBTOTAL:				*$ 150,995*		*$ 149,005*		*$ 300,000*
Labor Premium Time	16.70%					24,884		24,884
SUBTOTAL:				*$ 150,995*		*$ 173,889*		*$ 324,884*
Subcontractor's Overhead and Profit on Material and Labor	20.00%			30,199		34,778		64,977
TOTAL ESTIMATED COST:				***$ 181,194***		***$ 208,667***		***$ 389,861***

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08 - MECHANICAL **083 - Fire Protection**	QUANTITY	UNIT	MATERIAL RATE $	MATERIAL TOTAL $	LABOR RATE $	LABOR TOTAL $	TOTAL UNIT RATE $	TOTAL MATERIAL/LABOR $
Riser assembly	1	EA	4200.00	4,200	3500.00	3,500	7700.00	7,700
Wet pipe fire protection system	22,060	SF	1.75	38,605	2.50	55,150	4.25	93,755
Design fee	1	LOT	7500.00	7,500			7500.00	7,500
SUBTOTAL:				*$ 50,305*		*$ 58,650*		*$ 108,955*
Labor Premium Time	16.70%					9,795		9,795
SUBTOTAL:				*$ 50,305*		*$ 68,445*		*$ 118,750*
Subcontractor's Overhead and Profit on Material and Labor	20.00%			10,061		13,689		23,750
TOTAL ESTIMATED COST:				***$ 60,366***		***$ 82,134***		***$ 142,500***

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08 - MECHANICAL ***084 - Special Mechanical Systems***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
GAS PIPING								
2 1/2" with fittings	60	LF	17.50	1,050	24.00	1,440	41.50	2,490
2" gas pipe with fittings	210	LF	12.75	2,678	22.00	4,620	34.75	7,298
1 1/4" gas pipe with fittings	70	LF	6.50	455	16.50	1,155	23.00	1,610
1" gas pipe with fittings	30	LF	5.50	165	15.00	450	20.50	615
3/4" gas pipe with fittings	60	LF	4.95	297	4.20	252	9.15	549
1/2" gas pipe with fittings	10	LF	4.50	45	4.00	40	8.50	85
Equipment connection	5	EA	15.00	75	35.00	175	50.00	250
WASTE OIL SYSTEM								
Relocate existing waste oil heat system (allowance)	1	LOT	1500.00	1,500	2500.00	2,500	4000.00	4,000
COMPRESSED AIR SYSTEM								
Compressed air drop assemblies	20	EA	250.00	5,000	175.00	3,500	425.00	8,500
Compressed air piping	500	LF	6.50	3,250	16.50	8,250	23.00	11,500
Compressor	1	EA	2800.00	2,800	275.00	275	3075.00	3,075

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08 - MECHANICAL ***084 - Special Mechanical Systems***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
VEHICLE EXHAUST SYSTEM								
Ductwork	500	LBS	3.20	1,600	4.15	2,075	7.35	3,675
Flex hose drops	80	LF	35.00	2,800	9.00	720	44.00	3,520
Stack/pipe connection	4	EA	285.00	1,140	75.00	300	360.00	1,440
LUBE SYSTEM								
Lube/oil hose reels assembly, (3) reel types with pumps	4	EA	10400.00	41,600	3600.00	14,400	14000.00	56,000
5/8" lube oil piping	480	LF	4.95	2,376	4.20	2,016	9.15	4,392
SUBTOTAL:				*$ 66,831*		*$ 42,168*		*$ 108,999*
Labor Premium Time	16.70%					7,042		7,042
SUBTOTAL:				*$ 66,831*		*$ 49,210*		*$ 116,041*
Subcontractor's Overhead and Profit on Material and Labor	20.00%			13,366		9,842		23,208
TOTAL ESTIMATED COST:				***$ 80,197***		***$ 59,052***		***$ 139,249***

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09 - ELECTRICAL ***091 - Service and Distribution***	*QUANTITY*	*UNIT*	*MATERIAL*		*LABOR*		*TOTAL*	*TOTAL*
			RATE $	*TOTAL $*	*RATE $*	*TOTAL $*	*UNIT RATE $*	*MATERIAL/LABOR $*
New service and distribution	800	AMPS	44.00	35,200	21.00	16,800	65.00	52,000
SUBTOTAL:				*$ 35,200*		*$ 16,800*		*$ 52,000*
Labor Premium Time	16.70%					2,806		2,806
SUBTOTAL:				*$ 35,200*		*$ 19,606*		*$ 54,806*
Subcontractor's Overhead and Profit on Material and Labor	20.00%			7,040		3,921		10,961
TOTAL ESTIMATED COST:				***$ 42,240***		***$ 23,527***		***$ 65,767***

09 - ELECTRICAL ***092 - Lighting and Power***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
LED exterior wall packs	6	EA	750.00	4,500	225.00	1,350	975.00	5,850
LED exterior wall packs at admin	10	EA	385.00	3,850	205.00	2,050	590.00	5,900
Hi-bay LED fixtures	40	EA	850.00	34,000	285.00	11,400	1135.00	45,400
Movable, adjustable task lights for vehicle repair under lift	4	EA	350.00	1,400	125.00	500	475.00	1,900
Admin area LED lighting	85	EA	185.00	15,725	105.00	8,925	290.00	24,650
Exit signs	9	EA	173.00	1,557	346.00	3,114	519.00	4,671
Emergency wall packs	13	EA	267.00	3,471	125.00	1,625	392.00	5,096
Single pole switches	27	EA	12.00	324	37.00	999	49.00	1,323
Three-way switches	15	EA	18.00	270	39.00	585	57.00	855
Weather proof GFCI duplex receptacles	11	EA	28.00	308	220.00	2,420	248.00	2,728
GFCI duplex receptacles	8	EA	18.00	144	45.00	360	63.00	504
Duplex receptacles	85	EA	12.00	1,020	40.00	3,400	52.00	4,420
Motor starter/disconnect switch for auto lift (assumed)	4	EA	1150.00	4,600	425.00	1,700	1575.00	6,300
7.5 HP motor connection	1	EA	225.00	225	210.00	210	435.00	435

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09 - ELECTRICAL ***092 - Lighting and Power***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
20 HP motor connection	1	EA	360.00	360	400.00	400	760.00	760
Thermal switch and connection for miscellaneous fans, pump, overhead door, etc.	41	EA	48.00	1,968	95.00	3,895	143.00	5,863
Overhead electric cord reels (assumed)	4	EA	645.00	2,580	225.00	900	870.00	3,480
SUBTOTAL:				*$ 76,302*		*$ 43,833*		*$ 120,135*
Labor Premium Time	16.70%					7,320		7,320
SUBTOTAL:				*$ 76,302*		*$ 51,153*		*$ 127,455*
Subcontractor's Overhead and Profit on Material and Labor	20.00%			15,260		10,231		25,491
TOTAL ESTIMATED COST:				***$ 91,562***		***$ 61,384***		***$ 152,946***

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09 - ELECTRICAL ***093 - Special Electrical Systems***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
(4) jack telephone/data receptacles (assumed)	14	EA	18.00	252	52.00	728	70.00	980
Radio outlets	4	EA	12.00	48	40.00	160	52.00	208
Voice/data cabling	3,600	LF	1.90	6,840	2.35	8,460	4.25	15,300
Fire alarm pull station	7	EA	75.00	525	95.00	665	170.00	1,190
Smoke detectors	12	EA	145.00	1,740	105.00	1,260	250.00	3,000
Heat detectors	5	EA	231.00	1,155	91.00	455	322.00	1,610
Horn/strobe	12	EA	143.00	1,716	120.00	1,440	263.00	3,156
Weatherproof horn/strobe	2	EA	155.00	310	145.00	290	300.00	600
3/4" diameter EMT conduit	1,320	LF	1.25	1,650	5.20	6,864	6.45	8,514
Alarm wiring	2,200	LF	0.65	1,430	1.25	2,750	1.90	4,180
MISCELLANEOUS								
Test and tag all electrical systems	1	LOT	250.00	250	1250.00	1,250	1500.00	1,500
Electrical mobilization/demobilization, submittals, etc.	1	EA	700.00	700	2300.00	2,300	3000.00	3,000
SUBTOTAL:				*$ 16,616*		*$ 26,622*		*$ 43,238*

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09 - ELECTRICAL ***093 - Special Electrical Systems***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
Labor Premium Time	16.70%					4,446		4,446
SUBTOTAL:				*$ 16,616*		*$ 31,068*		*$ 47,684*
Subcontractor's Overhead and Profit on Material and Labor	20.00%			3,323		6,214		9,537
TOTAL ESTIMATED COST:				***$ 19,939***		***$ 37,282***		***$ 57,221***

Appendix F: Replacement Cost Estimate

(FEMA 50% Calculation Determination)

HMS Project No.19002-A

CONCEPTUAL DESIGN SUBMITTAL
CONSTRUCTION COST ESTIMATE (REVISION 1)

REPLACE COMPLETE LANDFILL ENTRANCE FACILITY - 50% EQUATION ESTIMATE
ANCHORAGE, ALASKA

PREPARED FOR:

Coffman Engineers
800 F Street
Anchorage, Alaska 99501

April 15, 2019

HMS Inc

4103 Minnesota Drive • Anchorage, Alaska 99503   p: 907.561.1653 • f: 907.562.0420 • e: mail@hmsalaska.com

Project No.: 19002-A

NOTES REGARDING THE PREPARATION OF THIS ESTIMATE

DRAWINGS AND DOCUMENTS

Level of Documents: (4) page narrative and as-built drawings and review notes received 3-26-19
Date: January 11, 2019
Provided By: Coffman Engineering of Anchorage, Alaska

RATES

Pricing is based on current material, equipment and freight costs.

Labor Rates: A.S. Title 36 working 60 hours per week
Premium Time: 16.70%

BIDDING ASSUMPTIONS

Contract: Standard construction contract without restrictive bidding clauses
Bidding Situation: Competitive bids assumed
Bid Date: February 2020
Start of Construction: Summer 2020
Months to Complete: Within (6) months completion

EXCLUDED COSTS

1. Administrative and management costs
2. Furniture, furnishings and equipment (except those specifically included)
3. Remediation of contaminated soils or abatement of any hazardous materials, if found during construction
4. Work to remainder of the building except as specifically noted in the estimate
5. Building site work and demolition
6. Soft costs including design, plan review, permitting, bidding expense, and CA services
7. Estimators contingency
8. Cost escalation

Project No.: 19002-A

NOTES REGARDING THE PREPARATION OF THIS ESTIMATE (Continued)

GENERAL

When included in HMS Inc.'s scope of services, opinions or estimates of probable construction costs are prepared on the basis of HMS Inc.'s experience and qualifications and represent HMS Inc.'s judgment as a professional generally familiar with the industry. However, since HMS Inc. has no control over the cost of labor, materials, equipment or services furnished by others, over contractor's methods of determining prices, or over competitive bidding or market conditions, HMS Inc. cannot and does not guarantee that proposals, bids, or actual construction cost will not vary from HMS Inc.'s opinions or estimates of probable construction cost.

This estimate assumes normal escalation based on the current economic climate. HMS Inc. will continue to monitor international, domestic and local events, and the resulting construction climate, and will adjust costs and contingencies as deemed appropriate. This estimate does not include costs for tariff increases on foreign goods currently slated for March 2019 or increased tariffs resulting from cost growth for the Port of Anchorage improvements.

GROSS FLOOR AREA

Total GFA: 22,080 SF

Project No.: 19002-A

CONCEPTUAL DESIGN COST SUMMARY

		Material	*Labor*	*Total*
01 - SITE WORK		$ 0	$ 0	$ 0
02 - SUBSTRUCTURE		232,593	267,991	500,584
03 - SUPERSTRUCTURE		820,721	714,441	1,535,162
04 - EXTERIOR CLOSURE		504,306	291,454	795,760
05 - ROOF SYSTEMS		203,826	145,156	348,982
06 - INTERIOR CONSTRUCTION		133,740	170,654	304,394
07 - CONVEYING SYSTEMS		56,000	8,928	64,928
08 - MECHANICAL		440,924	421,029	861,953
09 - ELECTRICAL		153,741	122,193	275,934
10 - EQUIPMENT		0	0	0
11 - SPECIAL CONSTRUCTION		0	0	0
SUBTOTAL:		*$ 2,545,851*	*$ 2,141,846*	*$ 4,687,697*
GENERAL CONDITIONS, OVERHEAD AND PROFIT	25.00%			1,171,924
BONDS AND INSURANCES	2.50%			146,491
TOTAL ESTIMATED CONSTRUCTION COST:				***$ 6,006,112***
COST PER SQUARE FOOT:				*$ 272.02 /SF*
GROSS FLOOR AREA:				*22,080 SF*

Project No.: 19002-A

ELEMENTAL SUMMARY

Element	*Material*	*Labor*	*Total Material/Labor*	*Total Cost*	*Cost per SF*
01 - SITE WORK				*$ 0*	*$ 0.00*
011 - Site Demolition	$ 0	$ 0	$ 0		0.00
012 - Site Preparation	0	0	0		0.00
013 - Site Improvements	0	0	0		0.00
014 - Site Mechanical	0	0	0		0.00
015 - Site Electrical	0	0	0		0.00
02 - SUBSTRUCTURE				*$ 500,584*	*$ 22.67*
021 - Standard Foundations	$ 79,624	$ 125,721	$ 205,345		9.30
022 - Slab on Grade	152,969	142,270	295,239		13.37
023 - Basement	0	0	0		0.00
024 - Special Foundations	0	0	0		0.00
03 - SUPERSTRUCTURE				*$ 1,535,162*	*$ 69.53*
031 - Floor Construction	$ 88,690	$ 80,780	$ 169,470		7.68
032 - Roof Construction	732,031	633,661	1,365,692		61.85
033 - Stair Construction	0	0	0		0.00
04 - EXTERIOR CLOSURE				*$ 795,760*	*$ 36.04*
041 - Exterior Walls	$ 189,265	$ 217,756	$ 407,021		18.43
042 - Exterior Doors and Windows	315,041	73,698	388,739		17.61
05 - ROOF SYSTEMS				*$ 348,982*	*$ 15.81*
051 - Roofing	$ 203,826	$ 145,156	$ 348,982		15.81
052 - Skylights	0	0	0		0.00
06 - INTERIOR CONSTRUCTION				*$ 304,394*	*$ 13.79*
061 - Partitions and Doors	$ 76,672	$ 66,855	$ 143,527		6.50
062 - Interior Finishes	54,553	102,388	156,941		7.11
063 - Specialties	2,515	1,411	3,926		0.18

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ELEMENTAL SUMMARY

Element	Material	Labor	Total Material/Labor	Total Cost	Cost per SF
07 - CONVEYING SYSTEMS	*$ 56,000*	*$ 8,928*		*$ 64,928*	*$ 2.94*
08 - MECHANICAL				*$ 861,953*	*$ 39.04*
081 - Plumbing	$ 119,167	$ 71,176	$ 190,343		8.62
082 - HVAC	181,194	208,667	389,861		17.66
083 - Fire Protection	60,366	82,134	142,500		6.45
084 - Special Mechanical Systems	80,197	59,052	139,249		6.31
09 - ELECTRICAL				*$ 275,934*	*$ 12.50*
091 - Service and Distribution	$ 42,240	$ 23,527	$ 65,767		2.98
092 - Lighting and Power	91,562	61,384	152,946		6.93
093 - Special Electrical Systems	19,939	37,282	57,221		2.59
10 - EQUIPMENT				*$ 0*	*$ 0.00*
101 - Fixed and Movable Equipment	$ 0	$ 0	$ 0		0.00
102 - Furnishings	0	0	0		0.00
11 - SPECIAL CONSTRUCTION	*$ 0*	*$ 0*		*$ 0*	*$ 0.00*
SUBTOTAL DIRECT WORK:	***$ 2,545,851***	***$ 2,141,846***		***$ 4,687,697***	
GENERAL REQUIREMENTS AND CONTINGENCIES				*$ 1,318,415*	*$ 59.71*
General Conditions, Overhead and Profit		25.00%	1,171,924		53.08
Bonds and Insurances		2.50%	146,491		6.63
TOTAL ESTIMATED CONSTRUCTION COST:				***$ 6,006,112***	***$272.02 /SF***
GROSS FLOOR AREA:					*22,080 SF*

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02 - SUBSTRUCTURE ***021 - Standard Foundations***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
Excavate and backfill for bases and foundation	736	CY	3.50	2,576	10.50	7,728	14.00	10,304
Concrete footings	80	CY	135.00	10,800	90.00	7,200	225.00	18,000
Concrete pilasters	9	CY	135.00	1,215	105.00	945	240.00	2,160
Concrete stem walls	85	CY	135.00	11,475	100.00	8,500	235.00	19,975
Concrete waste (5%)	9	CY	135.00	1,215	85.00	765	220.00	1,980
Pump concrete	183	CY	45.00	8,235			45.00	8,235
Bar reinforcement	16,980	LBS	0.70	11,886	0.70	11,886	1.40	23,772
Formwork to footing and bases	2,039	SF	1.80	3,670	4.80	9,787	6.60	13,457
Formwork to pilasters	840	SF	2.20	1,848	6.50	5,460	8.70	7,308
Form work to walls	6,944	SF	2.10	14,582	5.90	40,970	8.00	55,552
MISCELLANEOUS								
Embedded anchor bolts at column bases	140	EA	7.50	1,050	12.00	1,680	19.50	2,730
2" rigid insulation to stem walls	3,534	SF	1.05	3,711	0.50	1,767	1.55	5,478
Membrane dampproofing to walls and foundation	4,330	SF	1.70	7,361	2.55	11,042	4.25	18,403
SUBTOTAL:				*$ 79,624*		*$ 107,730*		*$ 187,354*

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02 - SUBSTRUCTURE ***021 - Standard Foundations***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
Labor Premium Time	16.70%					17,991		17,991
TOTAL ESTIMATED COST:				***$ 79,624***		***$ 125,721***		***$ 205,345***

Project No.: 19002-A

02 - SUBSTRUCTURE ***022 - Slab on Grade***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
4" leveling course, compacted	304	CY	30.00	9,120	8.50	2,584	38.50	11,704
10 mil vapor retarder	21,125	SF	0.10	2,113	0.12	2,535	0.22	4,648
Concrete slab	406	CY	135.00	54,810	82.50	33,495	217.50	88,305
12"x8" thickened slab tie beams	20	CY	135.00	2,700	85.00	1,700	220.00	4,400
2" rigid insulation at area of radiant heat	5,695	CY	1.05	5,980	0.50	2,848	1.55	8,828
Concrete waste (5%)	21	CY	135.00	2,835	82.50	1,733	217.50	4,568
Pump concrete	447	CY	45.00	20,115			45.00	20,115
Cure and finish slabs	21,216	SF	0.30	6,365	1.30	27,581	1.60	33,946
Bar reinforcement	34,130	LBS	0.70	23,891	0.55	18,772	1.25	42,663
Trench drain assembly	167	LF	145.00	24,215	170.00	28,390	315.00	52,605
Saw cut for construction joint and fill with polyurethane compound filler	842	LF	0.98	825	2.70	2,273	3.68	3,098
SUBTOTAL:				*$ 152,969*		*$ 121,911*		*$ 274,880*
Labor Premium Time	16.70%					20,359		20,359
TOTAL ESTIMATED COST:				***$ 152,969***		***$ 142,270***		***$ 295,239***

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03 - SUPERSTRUCTURE ***031 - Floor Construction***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
<u>MECHANICAL MEZZANINE</u>								
Structure	5,000	LBS	1.95	9,750	1.50	7,500	3.45	17,250
Guardrail	54	LF	47.00	2,538	17.50	945	64.50	3,483
Metal ladder with cage	19	VLF	85.00	1,615	48.00	912	133.00	2,527
Metal decking	330	SF	2.68	884	1.35	446	4.03	1,330
Concrete	4	CY	135.00	540	120.00	480	255.00	1,020
Concrete pump	4	CY	45.00	180			45.00	180
Cure and finish	330	SF	0.30	99	1.50	495	1.80	594
<u>BRIDGE CRANE STRUCTURE</u>								
Tube steel columns	7,400	LBS	1.95	14,430	1.50	11,100	3.45	25,530
Base plates and anchor bolts	8	EA	45.00	360	65.00	520	110.00	880
W-beam crane rails	15,600	LBS	1.80	28,080	1.40	21,840	3.20	49,920
W-beam corbel	750	LBS	1.80	1,350	1.50	1,125	3.30	2,475
Tube steel bracing	3,949	LBS	1.95	7,701	1.65	6,516	3.60	14,217
ASCE #40 rail welded to crane rail	6,000	LBS	1.80	10,800	1.50	9,000	3.30	19,800

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03 - SUPERSTRUCTURE 031 - Floor Construction	QUANTITY	UNIT	MATERIAL RATE $	MATERIAL TOTAL $	LABOR RATE $	LABOR TOTAL $	TOTAL UNIT RATE $	TOTAL MATERIAL/LABOR $
BRIDGE CRANE STRUCTURE (Continued)								
Miscellaneous bracing fittings, connections and fasteners	5,055	LBS	2.05	10,363	1.65	8,341	3.70	18,704
SUBTOTAL:				*$ 88,690*		*$ 69,220*		*$ 157,910*
Labor Premium Time	16.70%					11,560		11,560
TOTAL ESTIMATED COST:				***$ 88,690***		***$ 80,780***		***$ 169,470***

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03 - SUPERSTRUCTURE ***032 - Roof Construction***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
Structural steel (22,896 SF at 15 lbs.)	343,440	LBS	1.95	669,708	1.50	515,160	3.45	1,184,868
1 1/2"x20 gauge metal decking	22,896	SF	2.70	61,819	1.20	27,475	3.90	89,294
Exterior mounted access ladder	12	VLF	42.00	504	29.00	348	71.00	852
SUBTOTAL:				*$ 732,031*		*$ 542,983*		*$ 1,275,014*
Labor Premium Time	16.70%					90,678		90,678
TOTAL ESTIMATED COST:				***$ 732,031***		***$ 633,661***		***$ 1,365,692***

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04 - EXTERIOR CLOSURE ***041 - Exterior Walls***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
6" steel studs, 16" o/c including tracks at walls	14,766	SF	2.80	41,345	1.70	25,102	4.50	66,447
4" insulated siding panels and trims	14,766	SF	9.23	136,290	8.26	121,967	17.49	258,257
Weather barrier	14,766	SF	0.38	5,611	0.72	10,632	1.10	16,243
10 mil vapor retarder	14,766	SF	0.10	1,477	1.60	23,626	1.70	25,103
5/8" gypsum wall board	2,972	SF	0.65	1,932	1.50	4,458	2.15	6,390
Seismic joint	90	LF	29.00	2,610	9.00	810	38.00	3,420
SUBTOTAL:				*$ 189,265*		*$ 186,595*		*$ 375,860*
Labor Premium Time	16.70%					31,161		31,161
TOTAL ESTIMATED COST:				***$ 189,265***		***$ 217,756***		***$ 407,021***

Project No.: 19002-A

04 - EXTERIOR CLOSURE 042 - Exterior Doors and Windows	QUANTITY	UNIT	MATERIAL RATE $	MATERIAL TOTAL $	LABOR RATE $	LABOR TOTAL $	TOTAL UNIT RATE $	TOTAL MATERIAL/LABOR $
20'0"x23'8" vertical lift fabric doors	4	EA	24600.00	98,400	4500.00	18,000	29100.00	116,400
12'0"x23'8" vertical lift fabric doors	2	EA	14768.00	29,536	2700.00	5,400	17468.00	34,936
12'0"x16'0" vertical lift fabric doors	16	EA	9920.00	158,720	1800.00	28,800	11720.00	187,520
3'0"x7'0" hollow metal double door assemblies, complete	2	EA	1755.00	3,510	850.00	1,700	2605.00	5,210
3'0"x7'0" hollow metal single door assemblies, complete	5	EA	1150.00	5,750	650.00	3,250	1800.00	9,000
3'0"x7'0" hollow metal single door assemblies, complete, with half lite	3	EA	1305.00	3,915	680.00	2,040	1985.00	5,955
Aluminum windows and side lites	322	SF	45.00	14,490	12.00	3,864	57.00	18,354
Exterior louvers	15	SF	48.00	720	6.50	98	54.50	818
SUBTOTAL:				*$ 315,041*		*$ 63,152*		*$ 378,193*
Labor Premium Time	16.70%					10,546		10,546
TOTAL ESTIMATED COST:				***$ 315,041***		***$ 73,698***		***$ 388,739***

Project No.: 19002-A

05 - ROOF SYSTEMS ***051 - Roofing***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
1/2" substrate thermal barrier	22,900	SF	0.70	16,030	0.65	14,885	1.35	30,915
(2) layers 4" rigid insulation, staggered joints	22,900	SF	3.60	82,440	1.10	25,190	4.70	107,630
Extra for tapered insulation at crickets	2,080	SF	0.85	1,768	0.50	1,040	1.35	2,808
1/2" cover board	22,900	SF	0.70	16,030	0.65	14,885	1.35	30,915
60 mil membrane	22,900	SF	2.85	65,265	2.40	54,960	5.25	120,225
60 mil membrane at vertical surfaces	1,180	SF	2.85	3,363	3.10	3,658	5.95	7,021
Metal cap flashings, blockings, and sealant	874	LF	5.70	4,982	3.50	3,059	9.20	8,041
Roof/wall flashings	321	LF	3.80	1,220	3.20	1,027	7.00	2,247
Roof drain flashings	24	EA	78.00	1,872	65.00	1,560	143.00	3,432
Roof hatch	1	EA	1575.00	1,575	250.00	250	1825.00	1,825
9" bellow type seismic joint cover with batt insulation and wood blockings	160	LF	41.00	6,560	13.00	2,080	54.00	8,640
Temporary fall protection railings	716	LF	3.80	2,721	2.50	1,790	6.30	4,511
SUBTOTAL:				*$ 203,826*		*$ 124,384*		*$ 328,210*
Labor Premium Time	16.70%					20,772		20,772
TOTAL ESTIMATED COST:				***$ 203,826***		***$ 145,156***		***$ 348,982***

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06 - INTERIOR CONSTRUCTION ***061 - Partitions and Doors***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
PARTITIONS								
8" metal studs	2,086	SF	1.65	3,442	1.45	3,025	3.10	6,467
6" metal studs	6,732	SF	1.30	8,752	1.30	8,752	2.60	17,504
3 5/8" metal studs	3,009	SF	1.10	3,310	1.20	3,611	2.30	6,921
2"x6" blocking/backing	50	LF	0.80	40	1.50	75	2.30	115
5/8" Type X gypboard, each side	20,120	SF	0.65	13,078	1.50	30,180	2.15	43,258
Sound batts	8,300	SF	0.54	4,482	0.35	2,905	0.89	7,387
Operable partition	200	SF	86.50	17,300	3.50	700	90.00	18,000
ACCESS PANELS								
12"x12" access panels	2	EA	82.00	164	50.00	100	132.00	264
24"x24" access panels	2	EA	162.00	324	75.00	150	237.00	474
DOORS								
6'0"x7'0" double door frames	4	EA	280.00	1,120	150.00	600	430.00	1,720
3'0"x7'0" hollow metal door frames	18	EA	140.00	2,520	80.00	1,440	220.00	3,960
3'0"x7'0" double doors	4	PRS	1350.00	5,400	75.00	300	1425.00	5,700

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06 - INTERIOR CONSTRUCTION ***061 - Partitions and Doors***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
DOORS (Continued)								
3'0"x7'0" single doors	18	EA	410.00	7,380	65.00	1,170	475.00	8,550
Hardware sets to single doors	18	EA	350.00	6,300	160.00	2,880	510.00	9,180
Hardware sets to double doors	4	EA	675.00	2,700	350.00	1,400	1025.00	4,100
Add for fire rating	6	EA	60.00	360			60.00	360
SUBTOTAL:				*$ 76,672*		*$ 57,288*		*$ 133,960*
Labor Premium Time	16.70%					9,567		9,567
TOTAL ESTIMATED COST:				***$ 76,672***		***$ 66,855***		***$ 143,527***

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06 - INTERIOR CONSTRUCTION **062 - Interior Finishes**	QUANTITY	UNIT	MATERIAL RATE $	MATERIAL TOTAL $	LABOR RATE $	LABOR TOTAL $	TOTAL UNIT RATE $	TOTAL MATERIAL/LABOR $
Sheet vinyl flooring	2,453	SF	4.70	11,529	2.95	7,236	7.65	18,765
Ceramic floor tile	814	SF	8.50	6,919	6.50	5,291	15.00	12,210
Slip resistant rubber floor	837	SF	7.00	5,859	1.55	1,297	8.55	7,156
Concrete sealer and hardener at bays and mezzanine	16,612	SF	0.35	5,814	0.85	14,120	1.20	19,934
4" base	1,600	LF	1.20	1,920	1.45	2,320	2.65	4,240
Ceramic wall tile	620	SF	8.50	5,270	7.50	4,650	16.00	9,920
Paint gypboard including inner face of exterior walls	23,100	SF	0.25	5,775	1.55	35,805	1.80	41,580
Touch up steel	1	LOT	1500.00	1,500	3500.00	3,500	5000.00	5,000
2'0"x4'0" ACT with seismic bracing	3,290	SF	2.70	8,883	2.20	7,238	4.90	16,121
Paint exposed ceilings	2,296	SF	0.25	574	1.55	3,559	1.80	4,133
Stain/paint doors and frames	1,700	SF	0.30	510	1.60	2,720	1.90	3,230
SUBTOTAL:				*$ 54,553*		*$ 87,736*		*$ 142,289*
Labor Premium Time	16.70%					14,652		14,652
TOTAL ESTIMATED COST:				***$ 54,553***		***$ 102,388***		***$ 156,941***

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06 - INTERIOR CONSTRUCTION **063 - Specialties**	QUANTITY	UNIT	MATERIAL RATE $	MATERIAL TOTAL $	LABOR RATE $	LABOR TOTAL $	TOTAL UNIT RATE $	TOTAL MATERIAL/LABOR $
ACCESSORIES								
18"x24" mirrors	5	EA	137.00	685	40.00	200	177.00	885
Toilet paper dispensers	4	EA	39.00	156	28.00	112	67.00	268
Toilet seat cover dispensers	4	EA	69.00	276	30.00	120	99.00	396
Paper towel dispensers	5	EA	60.00	300	30.00	150	90.00	450
Mop hook strip	1	EA	75.00	75	35.00	35	110.00	110
Soap dispensers	5	EA	47.00	235	28.00	140	75.00	375
12" grab bars	2	EA	28.00	56	30.00	60	58.00	116
30" grab bars	2	EA	43.00	86	35.00	70	78.00	156
42" grab bars	2	EA	57.00	114	35.00	70	92.00	184
Fire extinguishers with cabinet	2	EA	142.00	284	70.00	140	212.00	424
Bracket mounted fire extinguishers	4	EA	62.00	248	28.00	112	90.00	360
SUBTOTAL:				*$ 2,515*		*$ 1,209*		*$ 3,724*
Labor Premium Time	16.70%					202		202
TOTAL ESTIMATED COST:				***$ 2,515***		***$ 1,411***		***$ 3,926***

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07 - CONVEYING SYSTEMS	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
10 ton (assumed), 40'0" span overhead bridge crane	1	EA	56000.00	56,000	7650.00	7,650	63650.00	63,650
SUBTOTAL:				*$ 56,000*		*$ 7,650*		*$ 63,650*
Labor Premium Time	16.70%					1,278		1,278
TOTAL ESTIMATED COST:				***$ 56,000***		***$ 8,928***		***$ 64,928***

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08 - MECHANICAL ***081 - Plumbing***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
75 gallon per minute oil/water separator	1	EA	16100.00	16,100	650.00	650	16750.00	16,750
Water closets	4	EA	740.00	2,960	220.00	880	960.00	3,840
Urinal	3	EA	950.00	2,850	220.00	660	1170.00	3,510
Emergency eye wash	1	EA	1100.00	1,100	350.00	350	1450.00	1,450
Janitor sink	1	EA	625.00	625	215.00	215	840.00	840
60" semicircular wash fountain	1	EA	5350.00	5,350	500.00	500	5850.00	5,850
Lavatory	1	EA	450.00	450	190.00	190	640.00	640
36"x40"shower cubical assembly	3	EA	1750.00	5,250	495.00	1,485	2245.00	6,735
Single kitchen sink	1	EA	680.00	680	221.00	221	901.00	901
Double kitchen sink	1	EA	985.00	985	221.00	221	1206.00	1,206
Plumbing rough-ins for new fixtures	8	EA	660.00	5,280	975.00	7,800	1635.00	13,080
Rough-ins for drains and bibs	12	EA	230.00	2,760	540.00	6,480	770.00	9,240
Trench drains	175	LF	176.00	30,800	15.50	2,713	191.50	33,513
Floor drains	8	EA	112.00	896	120.00	960	232.00	1,856
Freeze proof hose bibs	4	EA	75.00	300	95.00	380	170.00	680

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08 - MECHANICAL **081 - Plumbing**	QUANTITY	UNIT	MATERIAL RATE $	MATERIAL TOTAL $	LABOR RATE $	LABOR TOTAL $	TOTAL UNIT RATE $	TOTAL MATERIAL/LABOR $
Roof drains and overflows with leaders and heat trace	24	EA	955.00	22,920	1130.00	27,120	2085.00	50,040
SUBTOTAL:				*$ 99,306*		*$ 50,825*		*$ 150,131*
Labor Premium Time	16.70%					8,488		8,488
SUBTOTAL:				*$ 99,306*		*$ 59,313*		*$ 158,619*
Subcontractor's Overhead and Profit on Material and Labor	20.00%			19,861		11,863		31,724
TOTAL ESTIMATED COST:				***$ 119,167***		***$ 71,176***		***$ 190,343***

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08 - MECHANICAL **082 - HVAC**	QUANTITY	UNIT	MATERIAL RATE $	MATERIAL TOTAL $	LABOR RATE $	LABOR TOTAL $	TOTAL UNIT RATE $	TOTAL MATERIAL/LABOR $
HEATING								
GHU-1: 1,320 CFM, 1/15 HP, 100 MBH gas fired unit heaters	4	EA	950.00	3,800	280.00	1,120	1230.00	4,920
Radiant heat manifolds	4	EA	750.00	3,000	150.00	600	900.00	3,600
PEX tubing at slab	7,823	LF	1.65	12,908	1.55	12,126	3.20	25,034
Drain/dispose existing glycol	200	GAL			0.65	130	0.65	130
New glycol fluid	200	GAL	13.50	2,700	2.50	500	16.00	3,200
Testing and balancing	32	HRS			180.00	5,760	180.00	5,760
Hydronic piping (allowance)	100	LF	21.00	2,100	16.50	1,650	37.50	3,750
Valves, fittings and devices	1	LOT	1500.00	1,500	2500.00	2,500	4000.00	4,000
Heating at admin space	6,700	SF	3.75	25,125	4.50	30,150	8.25	55,275
VENTILATION								
GHU-2: 12,000 CFM, 7.5 HP gas heating unit	1	EA	7650.00	7,650	1200.00	1,200	8850.00	8,850
EF-2: 2,500 CFM roof mounted exhauster, including cap and damper	4	EA	1750.00	7,000	350.00	1,400	2100.00	8,400
Ductwork	3,760	LBS	3.20	12,032	4.15	15,604	7.35	27,636

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08 - MECHANICAL ***082 - HVAC***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
VENTILATION (Continued)								
Grilles and diffusers	8	EA	85.00	680	35.00	280	120.00	960
Thermostats at shops	5	EA	95.00	475	55.00	275	150.00	750
DDC controls at admin area	6,700	SF	3.25	21,775	2.95	19,765	6.20	41,540
Ventilation at admin area	6,700	SF	7.50	50,250	8.35	55,945	15.85	106,195
SUBTOTAL:				*$ 150,995*		*$ 149,005*		*$ 300,000*
Labor Premium Time	16.70%					24,884		24,884
SUBTOTAL:				*$ 150,995*		*$ 173,889*		*$ 324,884*
Subcontractor's Overhead and Profit on Material and Labor	20.00%			30,199		34,778		64,977
TOTAL ESTIMATED COST:				***$ 181,194***		***$ 208,667***		***$ 389,861***

08 - MECHANICAL ***083 - Fire Protection***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
Riser assembly	1	EA	4200.00	4,200	3500.00	3,500	7700.00	7,700
Wet pipe fire protection system	22,060	SF	1.75	38,605	2.50	55,150	4.25	93,755
Design fee	1	LOT	7500.00	7,500			7500.00	7,500
SUBTOTAL:				*$ 50,305*		*$ 58,650*		*$ 108,955*
Labor Premium Time	16.70%					9,795		9,795
SUBTOTAL:				*$ 50,305*		*$ 68,445*		*$ 118,750*
Subcontractor's Overhead and Profit on Material and Labor	20.00%			10,061		13,689		23,750
TOTAL ESTIMATED COST:				***$ 60,366***		***$ 82,134***		***$ 142,500***

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08 - MECHANICAL ***084 - Special Mechanical Systems***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
GAS PIPING								
2 1/2" with fittings	60	LF	17.50	1,050	24.00	1,440	41.50	2,490
2" gas pipe with fittings	210	LF	12.75	2,678	22.00	4,620	34.75	7,298
1 1/4" gas pipe with fittings	70	LF	6.50	455	16.50	1,155	23.00	1,610
1" gas pipe with fittings	30	LF	5.50	165	15.00	450	20.50	615
3/4" gas pipe with fittings	60	LF	4.95	297	4.20	252	9.15	549
1/2" gas pipe with fittings	10	LF	4.50	45	4.00	40	8.50	85
Equipment connection	5	EA	15.00	75	35.00	175	50.00	250
WASTE OIL SYSTEM								
Relocate existing waste oil heat system (allowance)	1	LOT	1500.00	1,500	2500.00	2,500	4000.00	4,000
COMPRESSED AIR SYSTEM								
Compressed air drop assemblies	20	EA	250.00	5,000	175.00	3,500	425.00	8,500
Compressed air piping	500	LF	6.50	3,250	16.50	8,250	23.00	11,500
Compressor	1	EA	2800.00	2,800	275.00	275	3075.00	3,075

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08 - MECHANICAL ***084 - Special Mechanical Systems***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
VEHICLE EXHAUST SYSTEM								
Ductwork	500	LBS	3.20	1,600	4.15	2,075	7.35	3,675
Flex hose drops	80	LF	35.00	2,800	9.00	720	44.00	3,520
Stack/pipe connection	4	EA	285.00	1,140	75.00	300	360.00	1,440
LUBE SYSTEM								
Lube/oil hose reels assembly, (3) reel types with pumps	4	EA	10400.00	41,600	3600.00	14,400	14000.00	56,000
5/8" lube oil piping	480	LF	4.95	2,376	4.20	2,016	9.15	4,392
SUBTOTAL:				*$ 66,831*		*$ 42,168*		*$ 108,999*
Labor Premium Time	16.70%					7,042		7,042
SUBTOTAL:				*$ 66,831*		*$ 49,210*		*$ 116,041*
Subcontractor's Overhead and Profit on Material and Labor	20.00%			13,366		9,842		23,208
TOTAL ESTIMATED COST:				***$ 80,197***		***$ 59,052***		***$ 139,249***

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09 - ELECTRICAL ***091 - Service and Distribution***	*QUANTITY*	*UNIT*	*MATERIAL*		*LABOR*		*TOTAL*	*TOTAL*
			RATE $	*TOTAL $*	*RATE $*	*TOTAL $*	*UNIT RATE $*	*MATERIAL/LABOR $*
New service and distribution	800	AMPS	44.00	35,200	21.00	16,800	65.00	52,000
SUBTOTAL:				*$ 35,200*		*$ 16,800*		*$ 52,000*
Labor Premium Time	16.70%					2,806		2,806
SUBTOTAL:				*$ 35,200*		*$ 19,606*		*$ 54,806*
Subcontractor's Overhead and Profit on Material and Labor	20.00%			7,040		3,921		10,961
TOTAL ESTIMATED COST:				***$ 42,240***		***$ 23,527***		***$ 65,767***

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09 - ELECTRICAL ***092 - Lighting and Power***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
LED exterior wall packs	6	EA	750.00	4,500	225.00	1,350	975.00	5,850
LED exterior wall packs at admin	10	EA	385.00	3,850	205.00	2,050	590.00	5,900
Hi-bay LED fixtures	40	EA	850.00	34,000	285.00	11,400	1135.00	45,400
Movable, adjustable task lights for vehicle repair under lift	4	EA	350.00	1,400	125.00	500	475.00	1,900
Admin area LED lighting	85	EA	185.00	15,725	105.00	8,925	290.00	24,650
Exit signs	9	EA	173.00	1,557	346.00	3,114	519.00	4,671
Emergency wall packs	13	EA	267.00	3,471	125.00	1,625	392.00	5,096
Single pole switches	27	EA	12.00	324	37.00	999	49.00	1,323
Three-way switches	15	EA	18.00	270	39.00	585	57.00	855
Weather proof GFCI duplex receptacles	11	EA	28.00	308	220.00	2,420	248.00	2,728
GFCI duplex receptacles	8	EA	18.00	144	45.00	360	63.00	504
Duplex receptacles	85	EA	12.00	1,020	40.00	3,400	52.00	4,420
Motor starter/disconnect switch for auto lift (assumed)	4	EA	1150.00	4,600	425.00	1,700	1575.00	6,300
7.5 HP motor connection	1	EA	225.00	225	210.00	210	435.00	435

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09 - ELECTRICAL ***092 - Lighting and Power***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
20 HP motor connection	1	EA	360.00	360	400.00	400	760.00	760
Thermal switch and connection for miscellaneous fans, pump, overhead door, etc.	41	EA	48.00	1,968	95.00	3,895	143.00	5,863
Overhead electric cord reels (assumed)	4	EA	645.00	2,580	225.00	900	870.00	3,480
SUBTOTAL:				*$ 76,302*		*$ 43,833*		*$ 120,135*
Labor Premium Time	16.70%					7,320		7,320
SUBTOTAL:				*$ 76,302*		*$ 51,153*		*$ 127,455*
Subcontractor's Overhead and Profit on Material and Labor	20.00%			15,260		10,231		25,491
TOTAL ESTIMATED COST:				***$ 91,562***		***$ 61,384***		***$ 152,946***

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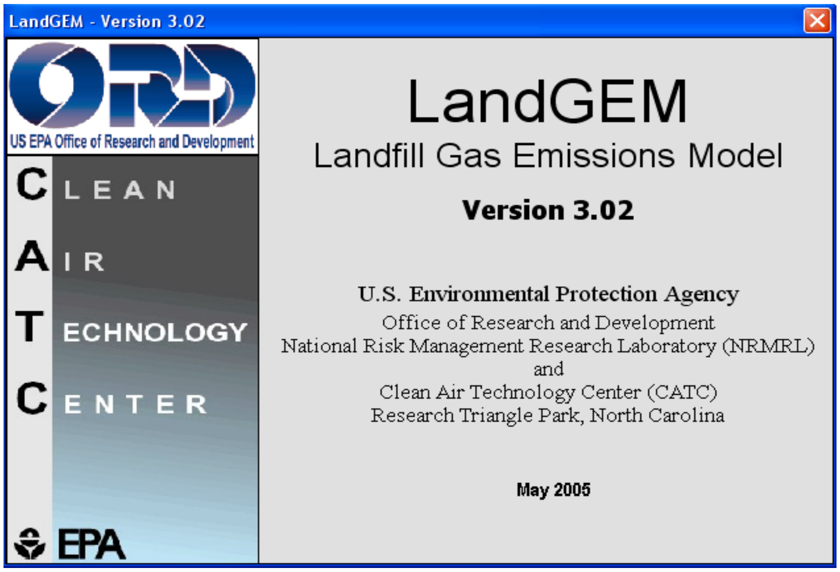
09 - ELECTRICAL ***093 - Special Electrical Systems***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
(4) jack telephone/data receptacles (assumed)	14	EA	18.00	252	52.00	728	70.00	980
Radio outlets	4	EA	12.00	48	40.00	160	52.00	208
Voice/data cabling	3,600	LF	1.90	6,840	2.35	8,460	4.25	15,300
Fire alarm pull station	7	EA	75.00	525	95.00	665	170.00	1,190
Smoke detectors	12	EA	145.00	1,740	105.00	1,260	250.00	3,000
Heat detectors	5	EA	231.00	1,155	91.00	455	322.00	1,610
Horn/strobe	12	EA	143.00	1,716	120.00	1,440	263.00	3,156
Weatherproof horn/strobe	2	EA	155.00	310	145.00	290	300.00	600
3/4" diameter EMT conduit	1,320	LF	1.25	1,650	5.20	6,864	6.45	8,514
Alarm wiring	2,200	LF	0.65	1,430	1.25	2,750	1.90	4,180
MISCELLANEOUS								
Test and tag all electrical systems	1	LOT	250.00	250	1250.00	1,250	1500.00	1,500
Electrical mobilization/demobilization, submittals, etc.	1	EA	700.00	700	2300.00	2,300	3000.00	3,000
SUBTOTAL:				*$ 16,616*		*$ 26,622*		*$ 43,238*

Project No.: 19002-A

09 - ELECTRICAL ***093 - Special Electrical Systems***	*QUANTITY*	*UNIT*	*MATERIAL RATE $*	*MATERIAL TOTAL $*	*LABOR RATE $*	*LABOR TOTAL $*	*TOTAL UNIT RATE $*	*TOTAL MATERIAL/LABOR $*
Labor Premium Time	16.70%					4,446		4,446
SUBTOTAL:				*$ 16,616*		*$ 31,068*		*$ 47,684*
Subcontractor's Overhead and Profit on Material and Labor	20.00%			3,323		6,214		9,537
TOTAL ESTIMATED COST:				***$ 19,939***		***$ 37,282***		***$ 57,221***

APPENDIX C

LFG RECOVERY PROJECTION AND BACKGROUND INFORMATION USED FOR MODELING



Summary Report

Landfill Name or Identifier: MOA LFG Recovery Potential

Date: Monday, January 15, 2018

Description/Comments:

About LandGEM:

First-Order Decomposition Rate Equation:

$$Q_{CH_4} = \sum_{i=1}^{n} \sum_{j=0.1}^{1} k L_o \left(\frac{M_i}{10} \right) e^{-k t_{ij}}$$

Where,

Q_{CH4} = annual methane generation in the year of the calculation *(m^3/year)*

i = 1-year time increment

n = (year of the calculation) - (initial year of waste acceptance)

j = 0.1-year time increment

k = methane generation rate *($year^{-1}$)*

L_o = potential methane generation capacity *(m^3/Mg)*

M_i = mass of waste accepted in the i^{th} year *(Mg)*

t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year (*decimal years*, e.g., 3.2 years)

LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at http://www.epa.gov/ttnatw01/landfill/landflpg.html.

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate. Defaults for estimating emissions for this type of operation are being developed to include in LandGEM along with defaults for convential landfills (no leachate or liquid additions) for developing emission inventories and determining CAA applicability. Refer to the Web site identified above for future updates.

Input Review

LANDFILL CHARACTERISTICS

Landfill Open Year	**1987**	
Landfill Closure Year (with 80-year limit)	**2061**	
Actual Closure Year (without limit)	***2061***	
Have Model Calculate Closure Year?	**No**	
Waste Design Capacity	**25,207,182**	*short tons*

MODEL PARAMETERS

Methane Generation Rate, k	**0.036**	*year* $^{-1}$
Potential Methane Generation Capacity, L_o	**100**	m^3 */Mg*
NMOC Concentration	**4,000**	*ppmv as hexane*
Methane Content	**50**	*% by volume*

GASES / POLLUTANTS SELECTED

Gas / Pollutant #1:	**Total landfill gas**
Gas / Pollutant #2:	**Methane**
Gas / Pollutant #3:	**Carbon dioxide**
Gas / Pollutant #4:	**NMOC**

WASTE ACCEPTANCE RATES

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
1987	27,410	30,151	0	0
1988	202,020	222,222	27,410	30,151
1989	209,942	230,936	229,430	252,373
1990	221,947	244,142	439,372	483,309
1991	218,408	240,249	661,319	727,451
1992	246,919	271,611	879,727	967,700
1993	245,128	269,641	1,126,646	1,239,311
1994	256,562	282,218	1,371,775	1,508,952
1995	263,974	290,371	1,628,336	1,791,170
1996	257,168	282,885	1,892,310	2,081,541
1997	276,625	304,287	2,149,478	2,364,426
1998	274,545	301,999	2,426,103	2,668,713
1999	307,756	338,532	2,700,647	2,970,712
2000	307,948	338,743	3,008,404	3,309,244
2001	306,440	337,084	3,316,352	3,647,987
2002	333,821	367,203	3,622,792	3,985,071
2003	313,648	345,013	3,956,613	4,352,274
2004	324,351	356,786	4,270,261	4,697,287
2005	321,439	353,583	4,594,612	5,054,073
2006	318,926	350,819	4,916,051	5,407,656
2007	321,869	354,056	5,234,977	5,758,475
2008	302,083	332,291	5,556,846	6,112,531
2009	289,870	318,857	5,858,929	6,444,822
2010	284,632	313,095	6,148,799	6,763,679
2011	275,878	303,466	6,433,431	7,076,774
2012	293,371	322,708	6,709,309	7,380,240
2013	277,388	305,127	7,002,680	7,702,948
2014	272,149	299,364	7,280,068	8,008,075
2015	267,343	294,078	7,552,217	8,307,439
2016	294,718	324,190	7,819,561	8,601,517
2017	281,938	310,131	8,114,279	8,925,707
2018	284,193	312,612	8,396,216	9,235,838
2019	286,467	315,113	8,680,410	9,548,450
2020	288,758	317,634	8,966,876	9,863,564
2021	291,069	320,175	9,255,635	10,181,198
2022	293,397	322,737	9,546,703	10,501,373
2023	295,744	325,319	9,840,100	10,824,110
2024	298,110	327,921	10,135,844	11,149,429
2025	300,495	330,545	10,433,955	11,477,350
2026	302,899	333,189	10,734,450	11,807,895

WASTE ACCEPTANCE RATES (Continued)

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	(short tons/year)	(Mg)	(short tons)
2027	305,322	335,854	11,037,349	12,141,084
2028	307,765	338,541	11,342,671	12,476,938
2029	310,227	341,250	11,650,436	12,815,479
2030	312,709	343,980	11,960,663	13,156,729
2031	315,210	346,731	12,273,371	13,500,709
2032	317,732	349,505	12,588,582	13,847,440
2033	320,274	352,301	12,906,314	14,196,945
2034	322,836	355,120	13,226,588	14,549,247
2035	325,419	357,961	13,549,424	14,904,366
2036	328,022	360,824	13,874,843	15,262,327
2037	330,646	363,711	14,202,865	15,623,151
2038	333,292	366,621	14,533,511	15,986,862
2039	335,958	369,554	14,866,803	16,353,483
2040	338,646	372,510	15,202,761	16,723,037
2041	341,355	375,490	15,541,406	17,095,547
2042	344,086	378,494	15,882,761	17,471,037
2043	346,838	381,522	16,226,846	17,849,531
2044	349,613	384,574	16,573,685	18,231,053
2045	352,410	387,651	16,923,297	18,615,627
2046	355,229	390,752	17,275,707	19,003,278
2047	358,071	393,878	17,630,936	19,394,030
2048	360,935	397,029	17,989,007	19,787,908
2049	363,823	400,205	18,349,943	20,184,937
2050	366,734	403,407	18,713,766	20,585,142
2051	369,667	406,634	19,080,499	20,988,549
2052	370,276	407,303	19,450,167	21,395,183
2053	372,853	410,139	19,820,443	21,802,487
2054	375,431	412,974	20,193,296	22,212,625
2055	378,008	415,809	20,568,727	22,625,599
2056	380,586	418,644	20,946,735	23,041,408
2057	383,163	421,479	21,327,320	23,460,052
2058	385,740	424,314	21,710,483	23,881,531
2059	388,318	427,150	22,096,223	24,305,846
2060	390,895	429,985	22,484,541	24,732,995
2061	40,184	44,202	22,875,436	25,162,980
2062	0	0	22,915,620	25,207,182
2063	0	0	22,915,620	25,207,182
2064	0	0	22,915,620	25,207,182
2065	0	0	22,915,620	25,207,182
2066	0	0	22,915,620	25,207,182

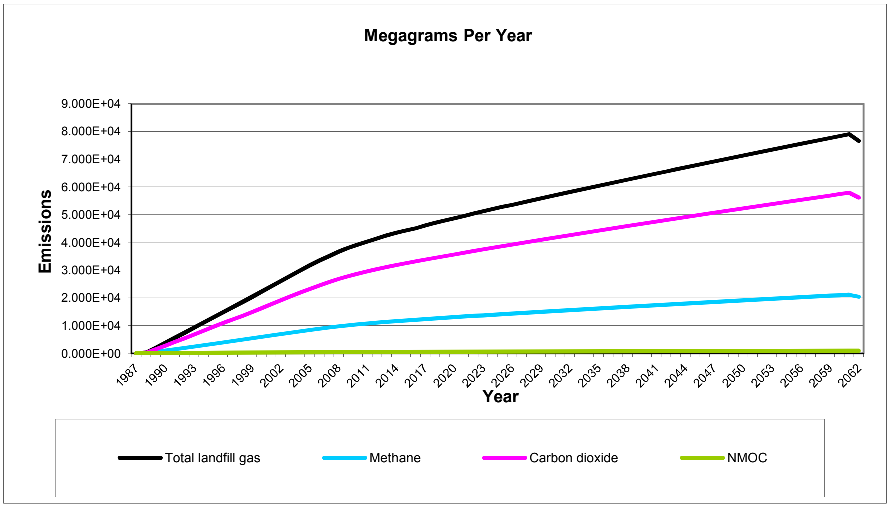
Pollutant Parameters

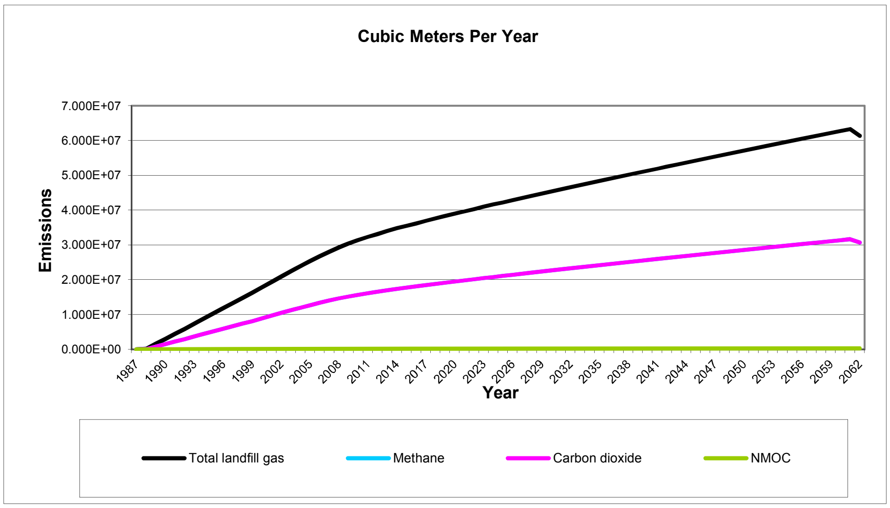
	Compound	Gas / Pollutant Default Parameters: Concentration (*ppmv*)	Molecular Weight	User-specified Pollutant Parameters: Concentration (*ppmv*)	Molecular Weight
Gases	Total landfill gas		0.00		
	Methane		16.04		
	Carbon dioxide		44.01		
	NMOC	4,000	86.18		
Pollutants	1,1,1-Trichloroethane (methyl chloroform) - HAP	0.48	133.41		
	1,1,2,2-Tetrachloroethane - HAP/VOC	1.1	167.85		
	1,1-Dichloroethane (ethylidene dichloride) - HAP/VOC	2.4	98.97		
	1,1-Dichloroethene (vinylidene chloride) - HAP/VOC	0.20	96.94		
	1,2-Dichloroethane (ethylene dichloride) - HAP/VOC	0.41	98.96		
	1,2-Dichloropropane (propylene dichloride) - HAP/VOC	0.18	112.99		
	2-Propanol (isopropyl alcohol) - VOC	50	60.11		
	Acetone	7.0	58.08		
	Acrylonitrile - HAP/VOC	6.3	53.06		
	Benzene - No or Unknown Co-disposal - HAP/VOC	1.9	78.11		
	Benzene - Co-disposal - HAP/VOC	11	78.11		
	Bromodichloromethane - VOC	3.1	163.83		
	Butane - VOC	5.0	58.12		
	Carbon disulfide - HAP/VOC	0.58	76.13		
	Carbon monoxide	140	28.01		
	Carbon tetrachloride - HAP/VOC	4.0E-03	153.84		
	Carbonyl sulfide - HAP/VOC	0.49	60.07		
	Chlorobenzene - HAP/VOC	0.25	112.56		
	Chlorodifluoromethane	1.3	86.47		
	Chloroethane (ethyl chloride) - HAP/VOC	1.3	64.52		
	Chloroform - HAP/VOC	0.03	119.39		
	Chloromethane - VOC	1.2	50.49		
	Dichlorobenzene - (HAP for para isomer/VOC)	0.21	147		
	Dichlorodifluoromethane	16	120.91		
	Dichlorofluoromethane - VOC	2.6	102.92		
	Dichloromethane (methylene chloride) - HAP	14	84.94		
	Dimethyl sulfide (methyl sulfide) - VOC	7.8	62.13		
	Ethane	890	30.07		
	Ethanol - VOC	27	46.08		

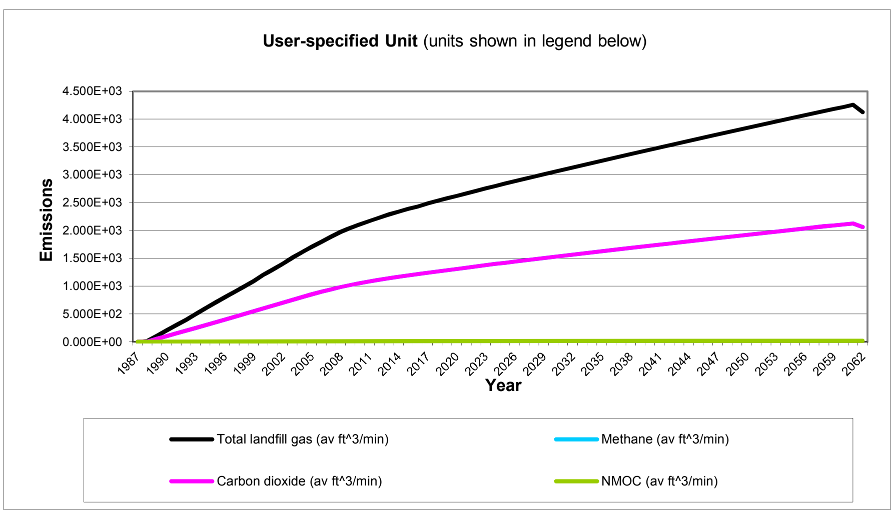
Pollutant Parameters (Continued)

	Compound	Gas / Pollutant Default Parameters: Concentration (*ppmv*)	Molecular Weight	User-specified Pollutant Parameters: Concentration (*ppmv*)	Molecular Weight
Pollutants	Ethyl mercaptan (ethanethiol) - VOC	2.3	62.13		
	Ethylbenzene - HAP/VOC	4.6	106.16		
	Ethylene dibromide - HAP/VOC	1.0E-03	187.88		
	Fluorotrichloromethane - VOC	0.76	137.38		
	Hexane - HAP/VOC	6.6	86.18		
	Hydrogen sulfide	36	34.08		
	Mercury (total) - HAP	2.9E-04	200.61		
	Methyl ethyl ketone - HAP/VOC	7.1	72.11		
	Methyl isobutyl ketone - HAP/VOC	1.9	100.16		
	Methyl mercaptan - VOC	2.5	48.11		
	Pentane - VOC	3.3	72.15		
	Perchloroethylene (tetrachloroethylene) - HAP	3.7	165.83		
	Propane - VOC	11	44.09		
	t-1,2-Dichloroethene - VOC	2.8	96.94		
	Toluene - No or Unknown Co-disposal - HAP/VOC	39	92.13		
	Toluene - Co-disposal - HAP/VOC	170	92.13		
	Trichloroethylene (trichloroethene) - HAP/VOC	2.8	131.40		
	Vinyl chloride - HAP/VOC	7.3	62.50		
	Xylenes - HAP/VOC	12	106.16		

Graphs


Megagrams Per Year
Emissions
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


Cubic Meters Per Year
Emissions
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


User-specified Unit (units shown in legend below)
Emissions
Year
Total landfill gas (av ft^3/min)
Methane (av ft^3/min)
Carbon dioxide (av ft^3/min)
NMOC (av ft^3/min)

Results

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
1987	0	0	0	0	0	0
1988	2.425E+02	1.942E+05	1.305E+01	6.478E+01	9.710E+04	6.524E+00
1989	2.021E+03	1.619E+06	1.088E+02	5.399E+02	8.093E+05	5.438E+01
1990	3.807E+03	3.049E+06	2.048E+02	1.017E+03	1.524E+06	1.024E+02
1991	5.636E+03	4.513E+06	3.033E+02	1.506E+03	2.257E+06	1.516E+02
1992	7.369E+03	5.901E+06	3.965E+02	1.968E+03	2.951E+06	1.982E+02
1993	9.293E+03	7.442E+06	5.000E+02	2.482E+03	3.721E+06	2.500E+02
1994	1.113E+04	8.915E+06	5.990E+02	2.974E+03	4.458E+06	2.995E+02
1995	1.301E+04	1.042E+07	7.000E+02	3.475E+03	5.209E+06	3.500E+02
1996	1.489E+04	1.192E+07	8.009E+02	3.976E+03	5.960E+06	4.004E+02
1997	1.663E+04	1.332E+07	8.950E+02	4.443E+03	6.660E+06	4.475E+02
1998	1.849E+04	1.481E+07	9.950E+02	4.940E+03	7.404E+06	4.975E+02
1999	2.027E+04	1.623E+07	1.091E+03	5.414E+03	8.115E+06	5.453E+02
2000	2.227E+04	1.784E+07	1.198E+03	5.950E+03	8.918E+06	5.992E+02
2001	2.421E+04	1.939E+07	1.303E+03	6.467E+03	9.694E+06	6.513E+02
2002	2.607E+04	2.087E+07	1.402E+03	6.963E+03	1.044E+07	7.012E+02
2003	2.810E+04	2.250E+07	1.512E+03	7.505E+03	1.125E+07	7.559E+02
2004	2.988E+04	2.393E+07	1.608E+03	7.981E+03	1.196E+07	8.038E+02
2005	3.169E+04	2.538E+07	1.705E+03	8.466E+03	1.269E+07	8.526E+02
2006	3.342E+04	2.676E+07	1.798E+03	8.926E+03	1.338E+07	8.989E+02
2007	3.506E+04	2.807E+07	1.886E+03	9.364E+03	1.404E+07	9.431E+02
2008	3.666E+04	2.936E+07	1.973E+03	9.794E+03	1.468E+07	9.863E+02
2009	3.804E+04	3.046E+07	2.047E+03	1.016E+04	1.523E+07	1.023E+03
2010	3.926E+04	3.144E+07	2.112E+03	1.049E+04	1.572E+07	1.056E+03
2011	4.039E+04	3.234E+07	2.173E+03	1.079E+04	1.617E+07	1.087E+03
2012	4.140E+04	3.315E+07	2.228E+03	1.106E+04	1.658E+07	1.114E+03
2013	4.253E+04	3.406E+07	2.288E+03	1.136E+04	1.703E+07	1.144E+03
2014	4.348E+04	3.482E+07	2.340E+03	1.162E+04	1.741E+07	1.170E+03
2015	4.436E+04	3.552E+07	2.386E+03	1.185E+04	1.776E+07	1.193E+03
2016	4.515E+04	3.616E+07	2.429E+03	1.206E+04	1.808E+07	1.215E+03
2017	4.616E+04	3.697E+07	2.484E+03	1.233E+04	1.848E+07	1.242E+03
2018	4.703E+04	3.766E+07	2.530E+03	1.256E+04	1.883E+07	1.265E+03
2019	4.788E+04	3.834E+07	2.576E+03	1.279E+04	1.917E+07	1.288E+03
2020	4.872E+04	3.901E+07	2.621E+03	1.301E+04	1.951E+07	1.311E+03
2021	4.955E+04	3.968E+07	2.666E+03	1.324E+04	1.984E+07	1.333E+03
2022	5.037E+04	4.034E+07	2.710E+03	1.346E+04	2.017E+07	1.355E+03
2023	5.119E+04	4.099E+07	2.754E+03	1.367E+04	2.049E+07	1.377E+03
2024	5.199E+04	4.164E+07	2.797E+03	1.389E+04	2.082E+07	1.399E+03
2025	5.279E+04	4.227E+07	2.840E+03	1.410E+04	2.114E+07	1.420E+03
2026	5.359E+04	4.291E+07	2.883E+03	1.431E+04	2.145E+07	1.442E+03
2027	5.437E+04	4.354E+07	2.925E+03	1.452E+04	2.177E+07	1.463E+03
2028	5.515E+04	4.416E+07	2.967E+03	1.473E+04	2.208E+07	1.484E+03
2029	5.592E+04	4.478E+07	3.009E+03	1.494E+04	2.239E+07	1.504E+03
2030	5.669E+04	4.539E+07	3.050E+03	1.514E+04	2.270E+07	1.525E+03
2031	5.745E+04	4.600E+07	3.091E+03	1.535E+04	2.300E+07	1.546E+03
2032	5.821E+04	4.661E+07	3.132E+03	1.555E+04	2.331E+07	1.566E+03
2033	5.896E+04	4.721E+07	3.172E+03	1.575E+04	2.361E+07	1.586E+03
2034	5.971E+04	4.781E+07	3.213E+03	1.595E+04	2.391E+07	1.606E+03
2035	6.046E+04	4.841E+07	3.253E+03	1.615E+04	2.421E+07	1.626E+03
2036	6.120E+04	4.900E+07	3.293E+03	1.635E+04	2.450E+07	1.646E+03

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
2037	6.194E+04	4.960E+07	3.332E+03	1.654E+04	2.480E+07	1.666E+03
2038	6.267E+04	5.018E+07	3.372E+03	1.674E+04	2.509E+07	1.686E+03
2039	6.340E+04	5.077E+07	3.411E+03	1.694E+04	2.539E+07	1.706E+03
2040	6.413E+04	5.136E+07	3.451E+03	1.713E+04	2.568E+07	1.725E+03
2041	6.486E+04	5.194E+07	3.490E+03	1.733E+04	2.597E+07	1.745E+03
2042	6.559E+04	5.252E+07	3.529E+03	1.752E+04	2.626E+07	1.764E+03
2043	6.631E+04	5.310E+07	3.568E+03	1.771E+04	2.655E+07	1.784E+03
2044	6.704E+04	5.368E+07	3.607E+03	1.791E+04	2.684E+07	1.803E+03
2045	6.776E+04	5.426E+07	3.646E+03	1.810E+04	2.713E+07	1.823E+03
2046	6.848E+04	5.484E+07	3.685E+03	1.829E+04	2.742E+07	1.842E+03
2047	6.920E+04	5.542E+07	3.723E+03	1.849E+04	2.771E+07	1.862E+03
2048	6.993E+04	5.599E+07	3.762E+03	1.868E+04	2.800E+07	1.881E+03
2049	7.065E+04	5.657E+07	3.801E+03	1.887E+04	2.829E+07	1.900E+03
2050	7.137E+04	5.715E+07	3.840E+03	1.906E+04	2.857E+07	1.920E+03
2051	7.209E+04	5.772E+07	3.879E+03	1.926E+04	2.886E+07	1.939E+03
2052	7.281E+04	5.830E+07	3.917E+03	1.945E+04	2.915E+07	1.959E+03
2053	7.351E+04	5.886E+07	3.955E+03	1.964E+04	2.943E+07	1.978E+03
2054	7.421E+04	5.942E+07	3.993E+03	1.982E+04	2.971E+07	1.996E+03
2055	7.491E+04	5.998E+07	4.030E+03	2.001E+04	2.999E+07	2.015E+03
2056	7.560E+04	6.054E+07	4.068E+03	2.019E+04	3.027E+07	2.034E+03
2057	7.630E+04	6.110E+07	4.105E+03	2.038E+04	3.055E+07	2.053E+03
2058	7.699E+04	6.165E+07	4.142E+03	2.056E+04	3.083E+07	2.071E+03
2059	7.768E+04	6.220E+07	4.179E+03	2.075E+04	3.110E+07	2.090E+03
2060	7.837E+04	6.275E+07	4.216E+03	2.093E+04	3.138E+07	2.108E+03
2061	7.906E+04	6.330E+07	4.253E+03	2.112E+04	3.165E+07	2.127E+03
2062	7.662E+04	6.135E+07	4.122E+03	2.047E+04	3.068E+07	2.061E+03
2063	7.391E+04	5.918E+07	3.976E+03	1.974E+04	2.959E+07	1.988E+03
2064	7.129E+04	5.709E+07	3.836E+03	1.904E+04	2.854E+07	1.918E+03
2065	6.877E+04	5.507E+07	3.700E+03	1.837E+04	2.754E+07	1.850E+03
2066	6.634E+04	5.312E+07	3.569E+03	1.772E+04	2.656E+07	1.785E+03
2067	6.400E+04	5.124E+07	3.443E+03	1.709E+04	2.562E+07	1.722E+03
2068	6.173E+04	4.943E+07	3.321E+03	1.649E+04	2.472E+07	1.661E+03
2069	5.955E+04	4.768E+07	3.204E+03	1.591E+04	2.384E+07	1.602E+03
2070	5.744E+04	4.600E+07	3.091E+03	1.534E+04	2.300E+07	1.545E+03
2071	5.541E+04	4.437E+07	2.981E+03	1.480E+04	2.219E+07	1.491E+03
2072	5.345E+04	4.280E+07	2.876E+03	1.428E+04	2.140E+07	1.438E+03
2073	5.156E+04	4.129E+07	2.774E+03	1.377E+04	2.064E+07	1.387E+03
2074	4.974E+04	3.983E+07	2.676E+03	1.329E+04	1.991E+07	1.338E+03
2075	4.798E+04	3.842E+07	2.582E+03	1.282E+04	1.921E+07	1.291E+03
2076	4.628E+04	3.706E+07	2.490E+03	1.236E+04	1.853E+07	1.245E+03
2077	4.465E+04	3.575E+07	2.402E+03	1.193E+04	1.788E+07	1.201E+03
2078	4.307E+04	3.449E+07	2.317E+03	1.150E+04	1.724E+07	1.159E+03
2079	4.155E+04	3.327E+07	2.235E+03	1.110E+04	1.663E+07	1.118E+03
2080	4.008E+04	3.209E+07	2.156E+03	1.071E+04	1.605E+07	1.078E+03
2081	3.866E+04	3.096E+07	2.080E+03	1.033E+04	1.548E+07	1.040E+03
2082	3.729E+04	2.986E+07	2.006E+03	9.961E+03	1.493E+07	1.003E+03
2083	3.597E+04	2.881E+07	1.936E+03	9.609E+03	1.440E+07	9.678E+02
2084	3.470E+04	2.779E+07	1.867E+03	9.269E+03	1.389E+07	9.335E+02
2085	3.348E+04	2.681E+07	1.801E+03	8.942E+03	1.340E+07	9.005E+02
2086	3.229E+04	2.586E+07	1.737E+03	8.626E+03	1.293E+07	8.687E+02
2087	3.115E+04	2.494E+07	1.676E+03	8.321E+03	1.247E+07	8.380E+02

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
2088	3.005E+04	2.406E+07	1.617E+03	8.026E+03	1.203E+07	8.083E+02
2089	2.899E+04	2.321E+07	1.560E+03	7.743E+03	1.161E+07	7.798E+02
2090	2.796E+04	2.239E+07	1.504E+03	7.469E+03	1.120E+07	7.522E+02
2091	2.697E+04	2.160E+07	1.451E+03	7.205E+03	1.080E+07	7.256E+02
2092	2.602E+04	2.083E+07	1.400E+03	6.950E+03	1.042E+07	6.999E+02
2093	2.510E+04	2.010E+07	1.350E+03	6.704E+03	1.005E+07	6.752E+02
2094	2.421E+04	1.939E+07	1.303E+03	6.467E+03	9.694E+06	6.513E+02
2095	2.336E+04	1.870E+07	1.257E+03	6.238E+03	9.351E+06	6.283E+02
2096	2.253E+04	1.804E+07	1.212E+03	6.018E+03	9.020E+06	6.061E+02
2097	2.173E+04	1.740E+07	1.169E+03	5.805E+03	8.701E+06	5.846E+02
2098	2.096E+04	1.679E+07	1.128E+03	5.600E+03	8.394E+06	5.640E+02
2099	2.022E+04	1.619E+07	1.088E+03	5.402E+03	8.097E+06	5.440E+02
2100	1.951E+04	1.562E+07	1.050E+03	5.211E+03	7.810E+06	5.248E+02
2101	1.882E+04	1.507E+07	1.012E+03	5.027E+03	7.534E+06	5.062E+02
2102	1.815E+04	1.454E+07	9.767E+02	4.849E+03	7.268E+06	4.883E+02
2103	1.751E+04	1.402E+07	9.421E+02	4.677E+03	7.011E+06	4.711E+02
2104	1.689E+04	1.353E+07	9.088E+02	4.512E+03	6.763E+06	4.544E+02
2105	1.629E+04	1.305E+07	8.767E+02	4.352E+03	6.524E+06	4.383E+02
2106	1.572E+04	1.259E+07	8.457E+02	4.198E+03	6.293E+06	4.228E+02
2107	1.516E+04	1.214E+07	8.158E+02	4.050E+03	6.071E+06	4.079E+02
2108	1.463E+04	1.171E+07	7.869E+02	3.907E+03	5.856E+06	3.935E+02
2109	1.411E+04	1.130E+07	7.591E+02	3.769E+03	5.649E+06	3.796E+02
2110	1.361E+04	1.090E+07	7.323E+02	3.635E+03	5.449E+06	3.661E+02
2111	1.313E+04	1.051E+07	7.064E+02	3.507E+03	5.257E+06	3.532E+02
2112	1.266E+04	1.014E+07	6.814E+02	3.383E+03	5.071E+06	3.407E+02
2113	1.222E+04	9.783E+06	6.573E+02	3.263E+03	4.891E+06	3.286E+02
2114	1.178E+04	9.437E+06	6.341E+02	3.148E+03	4.718E+06	3.170E+02
2115	1.137E+04	9.103E+06	6.116E+02	3.037E+03	4.552E+06	3.058E+02
2116	1.097E+04	8.781E+06	5.900E+02	2.929E+03	4.391E+06	2.950E+02
2117	1.058E+04	8.471E+06	5.691E+02	2.826E+03	4.235E+06	2.846E+02
2118	1.020E+04	8.171E+06	5.490E+02	2.726E+03	4.086E+06	2.745E+02
2119	9.844E+03	7.882E+06	5.296E+02	2.629E+03	3.941E+06	2.648E+02
2120	9.495E+03	7.604E+06	5.109E+02	2.536E+03	3.802E+06	2.554E+02
2121	9.160E+03	7.335E+06	4.928E+02	2.447E+03	3.667E+06	2.464E+02
2122	8.836E+03	7.075E+06	4.754E+02	2.360E+03	3.538E+06	2.377E+02
2123	8.523E+03	6.825E+06	4.586E+02	2.277E+03	3.413E+06	2.293E+02
2124	8.222E+03	6.584E+06	4.424E+02	2.196E+03	3.292E+06	2.212E+02
2125	7.931E+03	6.351E+06	4.267E+02	2.119E+03	3.176E+06	2.134E+02
2126	7.651E+03	6.126E+06	4.116E+02	2.044E+03	3.063E+06	2.058E+02
2127	7.380E+03	5.910E+06	3.971E+02	1.971E+03	2.955E+06	1.985E+02

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
1987	0	0	0	0	0	0
1988	1.777E+02	9.710E+04	6.524E+00	2.784E+00	7.768E+02	5.219E-02
1989	1.481E+03	8.093E+05	5.438E+01	2.321E+01	6.474E+03	4.350E-01
1990	2.790E+03	1.524E+06	1.024E+02	4.371E+01	1.219E+04	8.194E-01
1991	4.131E+03	2.257E+06	1.516E+02	6.471E+01	1.805E+04	1.213E+00
1992	5.401E+03	2.951E+06	1.982E+02	8.461E+01	2.360E+04	1.586E+00
1993	6.811E+03	3.721E+06	2.500E+02	1.067E+02	2.977E+04	2.000E+00
1994	8.160E+03	4.458E+06	2.995E+02	1.278E+02	3.566E+04	2.396E+00
1995	9.535E+03	5.209E+06	3.500E+02	1.494E+02	4.167E+04	2.800E+00
1996	1.091E+04	5.960E+06	4.004E+02	1.709E+02	4.768E+04	3.203E+00
1997	1.219E+04	6.660E+06	4.475E+02	1.910E+02	5.328E+04	3.580E+00
1998	1.355E+04	7.404E+06	4.975E+02	2.123E+02	5.924E+04	3.980E+00
1999	1.485E+04	8.115E+06	5.453E+02	2.327E+02	6.492E+04	4.362E+00
2000	1.633E+04	8.918E+06	5.992E+02	2.557E+02	7.135E+04	4.794E+00
2001	1.774E+04	9.694E+06	6.513E+02	2.780E+02	7.755E+04	5.211E+00
2002	1.910E+04	1.044E+07	7.012E+02	2.993E+02	8.349E+04	5.610E+00
2003	2.059E+04	1.125E+07	7.559E+02	3.226E+02	9.000E+04	6.047E+00
2004	2.190E+04	1.196E+07	8.038E+02	3.431E+02	9.571E+04	6.431E+00
2005	2.323E+04	1.269E+07	8.526E+02	3.639E+02	1.015E+05	6.821E+00
2006	2.449E+04	1.338E+07	8.989E+02	3.837E+02	1.070E+05	7.192E+00
2007	2.569E+04	1.404E+07	9.431E+02	4.025E+02	1.123E+05	7.545E+00
2008	2.687E+04	1.468E+07	9.863E+02	4.210E+02	1.174E+05	7.891E+00
2009	2.788E+04	1.523E+07	1.023E+03	4.368E+02	1.218E+05	8.187E+00
2010	2.877E+04	1.572E+07	1.056E+03	4.508E+02	1.258E+05	8.449E+00
2011	2.960E+04	1.617E+07	1.087E+03	4.637E+02	1.294E+05	8.692E+00
2012	3.034E+04	1.658E+07	1.114E+03	4.754E+02	1.326E+05	8.910E+00
2013	3.117E+04	1.703E+07	1.144E+03	4.883E+02	1.362E+05	9.154E+00
2014	3.187E+04	1.741E+07	1.170E+03	4.993E+02	1.393E+05	9.358E+00
2015	3.251E+04	1.776E+07	1.193E+03	5.092E+02	1.421E+05	9.546E+00
2016	3.309E+04	1.808E+07	1.215E+03	5.184E+02	1.446E+05	9.717E+00
2017	3.383E+04	1.848E+07	1.242E+03	5.300E+02	1.479E+05	9.935E+00
2018	3.446E+04	1.883E+07	1.265E+03	5.399E+02	1.506E+05	1.012E+01
2019	3.509E+04	1.917E+07	1.288E+03	5.497E+02	1.534E+05	1.030E+01
2020	3.571E+04	1.951E+07	1.311E+03	5.593E+02	1.560E+05	1.048E+01
2021	3.632E+04	1.984E+07	1.333E+03	5.689E+02	1.587E+05	1.066E+01
2022	3.692E+04	2.017E+07	1.355E+03	5.783E+02	1.613E+05	1.084E+01
2023	3.752E+04	2.049E+07	1.377E+03	5.877E+02	1.640E+05	1.102E+01
2024	3.811E+04	2.082E+07	1.399E+03	5.970E+02	1.665E+05	1.119E+01
2025	3.869E+04	2.114E+07	1.420E+03	6.061E+02	1.691E+05	1.136E+01
2026	3.927E+04	2.145E+07	1.442E+03	6.152E+02	1.716E+05	1.153E+01
2027	3.985E+04	2.177E+07	1.463E+03	6.242E+02	1.742E+05	1.170E+01
2028	4.042E+04	2.208E+07	1.484E+03	6.332E+02	1.766E+05	1.187E+01
2029	4.099E+04	2.239E+07	1.504E+03	6.421E+02	1.791E+05	1.204E+01
2030	4.155E+04	2.270E+07	1.525E+03	6.509E+02	1.816E+05	1.220E+01
2031	4.211E+04	2.300E+07	1.546E+03	6.596E+02	1.840E+05	1.236E+01
2032	4.266E+04	2.331E+07	1.566E+03	6.683E+02	1.864E+05	1.253E+01
2033	4.321E+04	2.361E+07	1.586E+03	6.770E+02	1.889E+05	1.269E+01
2034	4.376E+04	2.391E+07	1.606E+03	6.855E+02	1.913E+05	1.285E+01
2035	4.431E+04	2.421E+07	1.626E+03	6.941E+02	1.936E+05	1.301E+01
2036	4.485E+04	2.450E+07	1.646E+03	7.026E+02	1.960E+05	1.317E+01

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
2037	4.539E+04	2.480E+07	1.666E+03	7.111E+02	1.984E+05	1.333E+01
2038	4.593E+04	2.509E+07	1.686E+03	7.195E+02	2.007E+05	1.349E+01
2039	4.647E+04	2.539E+07	1.706E+03	7.279E+02	2.031E+05	1.365E+01
2040	4.700E+04	2.568E+07	1.725E+03	7.363E+02	2.054E+05	1.380E+01
2041	4.754E+04	2.597E+07	1.745E+03	7.447E+02	2.078E+05	1.396E+01
2042	4.807E+04	2.626E+07	1.764E+03	7.530E+02	2.101E+05	1.412E+01
2043	4.860E+04	2.655E+07	1.784E+03	7.614E+02	2.124E+05	1.427E+01
2044	4.913E+04	2.684E+07	1.803E+03	7.697E+02	2.147E+05	1.443E+01
2045	4.966E+04	2.713E+07	1.823E+03	7.780E+02	2.170E+05	1.458E+01
2046	5.019E+04	2.742E+07	1.842E+03	7.863E+02	2.194E+05	1.474E+01
2047	5.072E+04	2.771E+07	1.862E+03	7.945E+02	2.217E+05	1.489E+01
2048	5.125E+04	2.800E+07	1.881E+03	8.028E+02	2.240E+05	1.505E+01
2049	5.178E+04	2.829E+07	1.900E+03	8.111E+02	2.263E+05	1.520E+01
2050	5.230E+04	2.857E+07	1.920E+03	8.194E+02	2.286E+05	1.536E+01
2051	5.283E+04	2.886E+07	1.939E+03	8.277E+02	2.309E+05	1.551E+01
2052	5.336E+04	2.915E+07	1.959E+03	8.359E+02	2.332E+05	1.567E+01
2053	5.388E+04	2.943E+07	1.978E+03	8.440E+02	2.355E+05	1.582E+01
2054	5.439E+04	2.971E+07	1.996E+03	8.520E+02	2.377E+05	1.597E+01
2055	5.490E+04	2.999E+07	2.015E+03	8.600E+02	2.399E+05	1.612E+01
2056	5.541E+04	3.027E+07	2.034E+03	8.680E+02	2.422E+05	1.627E+01
2057	5.592E+04	3.055E+07	2.053E+03	8.760E+02	2.444E+05	1.642E+01
2058	5.643E+04	3.083E+07	2.071E+03	8.839E+02	2.466E+05	1.657E+01
2059	5.693E+04	3.110E+07	2.090E+03	8.919E+02	2.488E+05	1.672E+01
2060	5.744E+04	3.138E+07	2.108E+03	8.998E+02	2.510E+05	1.687E+01
2061	5.794E+04	3.165E+07	2.127E+03	9.077E+02	2.532E+05	1.701E+01
2062	5.615E+04	3.068E+07	2.061E+03	8.796E+02	2.454E+05	1.649E+01
2063	5.417E+04	2.959E+07	1.988E+03	8.485E+02	2.367E+05	1.591E+01
2064	5.225E+04	2.854E+07	1.918E+03	8.185E+02	2.284E+05	1.534E+01
2065	5.040E+04	2.754E+07	1.850E+03	7.896E+02	2.203E+05	1.480E+01
2066	4.862E+04	2.656E+07	1.785E+03	7.617E+02	2.125E+05	1.428E+01
2067	4.690E+04	2.562E+07	1.722E+03	7.347E+02	2.050E+05	1.377E+01
2068	4.524E+04	2.472E+07	1.661E+03	7.088E+02	1.977E+05	1.329E+01
2069	4.364E+04	2.384E+07	1.602E+03	6.837E+02	1.907E+05	1.282E+01
2070	4.210E+04	2.300E+07	1.545E+03	6.595E+02	1.840E+05	1.236E+01
2071	4.061E+04	2.219E+07	1.491E+03	6.362E+02	1.775E+05	1.193E+01
2072	3.918E+04	2.140E+07	1.438E+03	6.137E+02	1.712E+05	1.150E+01
2073	3.779E+04	2.064E+07	1.387E+03	5.920E+02	1.652E+05	1.110E+01
2074	3.645E+04	1.991E+07	1.338E+03	5.711E+02	1.593E+05	1.070E+01
2075	3.517E+04	1.921E+07	1.291E+03	5.509E+02	1.537E+05	1.033E+01
2076	3.392E+04	1.853E+07	1.245E+03	5.314E+02	1.483E+05	9.961E+00
2077	3.272E+04	1.788E+07	1.201E+03	5.126E+02	1.430E+05	9.609E+00
2078	3.157E+04	1.724E+07	1.159E+03	4.945E+02	1.380E+05	9.269E+00
2079	3.045E+04	1.663E+07	1.118E+03	4.770E+02	1.331E+05	8.941E+00
2080	2.937E+04	1.605E+07	1.078E+03	4.601E+02	1.284E+05	8.625E+00
2081	2.833E+04	1.548E+07	1.040E+03	4.439E+02	1.238E+05	8.320E+00
2082	2.733E+04	1.493E+07	1.003E+03	4.282E+02	1.195E+05	8.026E+00
2083	2.637E+04	1.440E+07	9.678E+02	4.130E+02	1.152E+05	7.742E+00
2084	2.543E+04	1.389E+07	9.335E+02	3.984E+02	1.112E+05	7.468E+00
2085	2.453E+04	1.340E+07	9.005E+02	3.843E+02	1.072E+05	7.204E+00
2086	2.367E+04	1.293E+07	8.687E+02	3.707E+02	1.034E+05	6.950E+00
2087	2.283E+04	1.247E+07	8.380E+02	3.576E+02	9.977E+04	6.704E+00

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
2088	2.202E+04	1.203E+07	8.083E+02	3.450E+02	9.625E+04	6.467E+00
2089	2.124E+04	1.161E+07	7.798E+02	3.328E+02	9.284E+04	6.238E+00
2090	2.049E+04	1.120E+07	7.522E+02	3.210E+02	8.956E+04	6.018E+00
2091	1.977E+04	1.080E+07	7.256E+02	3.097E+02	8.639E+04	5.805E+00
2092	1.907E+04	1.042E+07	6.999E+02	2.987E+02	8.334E+04	5.599E+00
2093	1.839E+04	1.005E+07	6.752E+02	2.882E+02	8.039E+04	5.402E+00
2094	1.774E+04	9.694E+06	6.513E+02	2.780E+02	7.755E+04	5.211E+00
2095	1.712E+04	9.351E+06	6.283E+02	2.681E+02	7.481E+04	5.026E+00
2096	1.651E+04	9.020E+06	6.061E+02	2.587E+02	7.216E+04	4.849E+00
2097	1.593E+04	8.701E+06	5.846E+02	2.495E+02	6.961E+04	4.677E+00
2098	1.536E+04	8.394E+06	5.640E+02	2.407E+02	6.715E+04	4.512E+00
2099	1.482E+04	8.097E+06	5.440E+02	2.322E+02	6.477E+04	4.352E+00
2100	1.430E+04	7.810E+06	5.248E+02	2.240E+02	6.248E+04	4.198E+00
2101	1.379E+04	7.534E+06	5.062E+02	2.161E+02	6.027E+04	4.050E+00
2102	1.330E+04	7.268E+06	4.883E+02	2.084E+02	5.814E+04	3.907E+00
2103	1.283E+04	7.011E+06	4.711E+02	2.010E+02	5.609E+04	3.769E+00
2104	1.238E+04	6.763E+06	4.544E+02	1.939E+02	5.410E+04	3.635E+00
2105	1.194E+04	6.524E+06	4.383E+02	1.871E+02	5.219E+04	3.507E+00
2106	1.152E+04	6.293E+06	4.228E+02	1.805E+02	5.035E+04	3.383E+00
2107	1.111E+04	6.071E+06	4.079E+02	1.741E+02	4.857E+04	3.263E+00
2108	1.072E+04	5.856E+06	3.935E+02	1.679E+02	4.685E+04	3.148E+00
2109	1.034E+04	5.649E+06	3.796E+02	1.620E+02	4.519E+04	3.036E+00
2110	9.975E+03	5.449E+06	3.661E+02	1.563E+02	4.359E+04	2.929E+00
2111	9.622E+03	5.257E+06	3.532E+02	1.507E+02	4.205E+04	2.825E+00
2112	9.282E+03	5.071E+06	3.407E+02	1.454E+02	4.057E+04	2.726E+00
2113	8.954E+03	4.891E+06	3.286E+02	1.403E+02	3.913E+04	2.629E+00
2114	8.637E+03	4.718E+06	3.170E+02	1.353E+02	3.775E+04	2.536E+00
2115	8.332E+03	4.552E+06	3.058E+02	1.305E+02	3.641E+04	2.447E+00
2116	8.037E+03	4.391E+06	2.950E+02	1.259E+02	3.512E+04	2.360E+00
2117	7.753E+03	4.235E+06	2.846E+02	1.215E+02	3.388E+04	2.277E+00
2118	7.479E+03	4.086E+06	2.745E+02	1.172E+02	3.268E+04	2.196E+00
2119	7.214E+03	3.941E+06	2.648E+02	1.130E+02	3.153E+04	2.118E+00
2120	6.959E+03	3.802E+06	2.554E+02	1.090E+02	3.041E+04	2.044E+00
2121	6.713E+03	3.667E+06	2.464E+02	1.052E+02	2.934E+04	1.971E+00
2122	6.476E+03	3.538E+06	2.377E+02	1.014E+02	2.830E+04	1.902E+00
2123	6.247E+03	3.413E+06	2.293E+02	9.786E+01	2.730E+04	1.834E+00
2124	6.026E+03	3.292E+06	2.212E+02	9.440E+01	2.634E+04	1.769E+00
2125	5.813E+03	3.176E+06	2.134E+02	9.106E+01	2.540E+04	1.707E+00
2126	5.607E+03	3.063E+06	2.058E+02	8.784E+01	2.451E+04	1.647E+00
2127	5.409E+03	2.955E+06	1.985E+02	8.473E+01	2.364E+04	1.588E+00

APPENDIX D

EXPANDED DIVERSION PROGRAMS OPTION ASSESSMENT AND RANKING

EXPANDED DIVERSION PROGRAMS OPTION ASSESSMENT AND RANKING

Option (Color Coding - Recycling, Yard and Garden, Mixed Organics, ICI Sector, Reuse, Bulky Items)	Criteria: High Diversion Potential	Reduces GHG Emissions	High Community Acceptance	Aligns with SWS Goals and Long-Term Plans	Positive Impact on SWS Finances	Reduces Cost to Waste Generator	Score (L=1; M=3; H=5)	Assessment Narrative
Reduction and Diversion Programs								
Material Disposal Surcharge to Support Recycling	H	H	H	H	L	L-M	23	Material disposal surcharges drive innovation to find better alternatives for use of materials. It is important that preferred alternatives for materials with surcharges are available and feasible for the community to use. This would result in a high score if preferred alternatives are in place and economically reasonable to use. Community acceptance and alignment of SWS goals should also be high if alternatives are available and economical. Since SWS owns and operates the ARL and revenues are primarily from tipping fee, impacts to SWS finances would be poor and score would be considered low due to diverted waste. As a cost to the generator, there will be an additional cost for programs which some residents might accept. From that perspective, the score is considered low to medium.
Mandatory Curbside Recycling for All Residences with Trash Collection (Non-SWS)	H	H	H	H	L	L-M	23	Assuming markets for recyclables are available, this will have a positive effect on diversion and GHG emission reduction. Residents will also likely support the greater level of convenience. This is in line with the SWS's goals and plans as they relate to the greater MOA. Much like above, the financial impacts on SWS will likely score a low and cost to generators will likely score a low to medium.
Mandatory Recycling – ICI Generators	H	H	M	H	L	L	20	This option will have similar scores for both environmental and social support as mandatory curbside recycling except for Community Acceptance as there would likely be resistance from ICI generators. Being one of the largest waste sectors, impacts on disposal volumes could be high which would suggest a low score for impacts to SWS finances. The cost to generators will also be in addition to their existing costs resulting in a low score.
Regionalized Mandatory Curbside Recycling for All Residences (including Non-SWS)	H	H	H	H	L	L	22	This is scored in a similar manner to Option 2 above. The cost to the generator might be viewed in a more negative light which would suggest a lower score for that criteria.

EXPANDED DIVERSION PROGRAMS OPTION ASSESSMENT AND RANKING

Option (Color Coding - Recycling, Yard and Garden, Mixed Organics, ICI Sector, Reuse, Bulky Items)	Criteria							Assessment Narrative
	High Diversion Potential	Reduces GHG Emissions	High Community Acceptance	Aligns with SWS Goals and Long-Term Plans	Positive Impact on SWS Finances	Reduces Cost to Waste Generator	Score (L=1; M=3; H=5)	
Expand Materials Collected through Existing Curbside Recycling	M	M	H	H	M	M	22	More materials will allow for more diversion and that will also lead to less GHG emissions. Community will likely support this initiative which will be in line with SWS goals and plans. It should not have a large impact on SWS finances since this only applies to existing curbside programs and there may be a cost to generator depending on the need for additional containers so is scored a medium for that criteria.
Expand/Improve Recycling Depots	M	M	H	M	M	M	20	Improving and expanding services at depots should have low to moderate improvements to diversion. Residents will appreciate the higher level of service and convenience of additional locations. Cost to undertake this is scored medium since it will be less costly than curbside collection.
Mandate Standardized Government Building Recycling Programs	M	M	H	H	H	H	26	Should score high for both public acceptance and alignment with SWS goals and plans. The score for environmental should be medium since it will not result in high diversion and GHG emission reduction as the recycling quantities are anticipated to be low. At the same time, cost to SWS and generator should be minimum and shows leadership by example for the public sector.
Partner with Private Sector to Stimulate and Support Recycling Markets	L	L	H	H	H	H	22	This option is not likely to result in any diversion or GHG emission reduction from the process itself but the partnerships could stimulate markets that would have future potential for diversion and GHG reduction. It will likely be widely publicly accepted, align with SWS goals and plans and have negligible impacts on finances to both SWS and generators. This can be viewed as a starting point to establishing markets so that materials can be diverted in the future.
Expand Yard and Garden Waste Drop-Off to CTS, Girdwood, ARL for beneficial use	M	M	H	H	M	M	22	This is in-line with expansion of services at depots for yard and garden waste. Having this available to customers will garner moderate diversion at the landfill and GHG emission reduction. This is scored high as it relates to public acceptance and aligning with SWS goals and plans. The financial impacts to SWS or generator should not be excessive and are, therefore, scored as medium.
Add Seasonal Yard Waste Drop-Off Depots	L-M	L-M	M	H	M	M	18	This is similar to the option above but only seasonal. Will result in less material being diverted with results in a slightly lower score from a diversion and GHG emission reduction perspective. Since there is less convenience for residents, public acceptance is considered moderate (resulting in a medium score). The financial implications are estimated to be similar to the option above.

EXPANDED DIVERSION PROGRAMS OPTION ASSESSMENT AND RANKING

Option (Color Coding - Recycling, Yard and Garden, Mixed Organics, ICI Sector, Reuse, Bulky Items)	Criteria: High Diversion Potential	Reduces GHG Emissions	High Community Acceptance	Aligns with SWS Goals and Long-Term Plans	Positive Impact on SWS Finances	Reduces Cost to Waste Generator	Score (L=1; M=3; H=5)	Assessment Narrative
Implement Curbside Yard and Garden Waste Collection Program (SWS)	H	H	H	H	L	L-M	23	This option should receive high scores for waste diversion, GHG emission reduction, public acceptance and aligning with SWS goals and plans. The high diversion potential will likely reduce revenue from landfill tipping fees for SWS. The cost for service will also be higher but may be acceptable to a certain level since residents might accept the benefits of the additional cost.
Partner with private sector to increase composting capacity for green/yard waste	M	M	H	H	M	M	22	Having more processing options for organics should result in more organic material being diverted from disposal and being utilized in a beneficial manner. This initiative should result in high social acceptability and is highly aligned with SWS goals and plans. With a moderate diversion potential, there might be a moderate impact on SWS finances and cost to the waste generator.
Foster Partnerships with Community Gardens for Yard Waste Drop-Off	L	L	M	H	H	H	20	This partnership initiative is highly aligned with SWS goals and plans, and should not have any financial implication to SWS or waste generators. Should also result in moderate public acceptance. The waste diversion and GHG emission reduction potential should be fairly low based on the assumption that the capture area for community gardens would be limited to their immediate neighbors. Materials that could be used and composted by the garden would be collected there. It is unlikely that community gardens would be an appropriate location collection location for large-scale drop-off.
Mixed Organics (food and yard) Curbside Collection Program	H	H	H	H	L	L-M	23	Food and yard waste collection are considered high scoring for environmental and social considerations. The impacts to SWS finances should be significant and result in a low score. The cost to the generator should be moderately more expensive especially if yard and garden waste is already collected. This option assumes that organic processing is available.
Food Waste Drop-off at CTS, Girdwood, and ARL	L-M	M	M	M	M	M	17	Food waste drop off is typically collected in toter type bins. Diversion potential is likely low but can be quite dense. Although organics diversion is low, GHG emissions reduction is considered moderate due to the high CO2 equivalent of organics in landfills. This program will likely have good community acceptance from early adopters of organic waste diversion (i.e. less than 30% community participation in previous program). Cost to the SWS or waste generators should be moderate.

EXPANDED DIVERSION PROGRAMS OPTION ASSESSMENT AND RANKING

Option (Color Coding - Recycling, Yard and Garden, Mixed Organics, ICI Sector, Reuse, Bulky Items)	Criteria							Assessment Narrative
	High Diversion Potential	Reduces GHG Emissions	High Community Acceptance	Aligns with SWS Goals and Long-Term Plans	Positive Impact on SWS Finances	Reduces Cost to Waste Generator	Score (L=1; M=3; H=5)	
Food Waste Drop-off Depots at other locations	L-M	M	M	M	L	M	15	Similar to food waste drop off at SWS facilities but at other locations. The cost of this program will likely need to be subsidized by SWS which results in a low score for impacts to SWS finances. This option would also likely result in more work for SWS to manage.
Implement Food and Food-Soiled Paper Curbside Collection	H	H	H	H	L	L-M	23	Successfully implemented in many jurisdictions. Coupled with every-other-week garbage collection, it can result in high waste diversion and significant reduction in GHG emissions. Most communities support organics diversion and this should align with SWSSWS goals/plans. Loss in tonnage to landfill will reduce revenues for SWS. Cost to waste generator is considered high but may garner some support due to environmental benefits.
Develop Food Waste Reduction and Prevention Programs – Residences	M	H	H	H	H	H	28	Food waste prevention will result in less organic waste being disposed (up to 10% for organic waste stream) and that means less infrastructure to manage organic waste and less GHG emissions. GHG reduction considered high due to conversion from CO_2 equivalents. Should fully align with SWS goals/plans and have high public acceptance. Cost to SWS or generator should also be low as compared to options to manage disposed food scraps (cost related to public education and outreach).
Partner with the Private Sector for Food Waste Reduction, Prevention, Rescue, and Recovery	M	H	H	H	H	H	28	Similar to option above but supported by organizations that will implement this initiative as part of its core business.
Promote and Subsidize Backyard Composting	L-M	M	M	H	M-H	H	22	Waste diversion potential is low to moderate due to anticipated lower volumes. However, this would result in lower collection infrastructure which will save money. Cost to SWS or waste generator should be minimal but some subsidy for backyard composters is typical for many communities. Community acceptance is moderate and usually applies to gardeners or residents who are early adopters for organics diversion. This initiative would align with SWS goals/plans.
Facilitate ICI Waste Diversion Working Group	L	L	M	H	H	H	20	This initiative would involve working with ICI waste generators to reduce waste and divert waste from disposal. Aligns with SWS goals and plans, and should have negligible impacts on SWS finances or cost to waste generator. Waste diversion potential considered low and should get moderate community (ICI sector) acceptance.

EXPANDED DIVERSION PROGRAMS OPTION ASSESSMENT AND RANKING

Option (Color Coding - Recycling, Yard and Garden, Mixed Organics, ICI Sector, Reuse, Bulky Items)	Criteria							Assessment Narrative
	High Diversion Potential	Reduces GHG Emissions	High Community Acceptance	Aligns with SWS Goals and Long-Term Plans	Positive Impact on SWS Finances	Reduces Cost to Waste Generator	Score (L=1; M=3; H=5)	
Develop ICI Waste Reduction Strategy and Toolkit	L	L-M	M-H	H	H	H	22	Similar to initiative above but should produce educational material that will help ICI sector to divert waste from disposal and should receive more acceptance. Likelihood that a little more organic material could be diverted and that would further reduce GHG emissions.
Roll-out ICI Waste Reduction Grant and Technical Assistance Program	M	M	M	M	L	H	18	Financial incentives to encourage the ICI sector to divert waste from disposal. Should result in some waste being diverted but at a higher cost to SWS to promote and implement. Social benefits are mixed since it will result in environmental benefits but at the cost of tax dollars.
Encourage the Development and Expansion of Thrift Store/Free Store/Reuse Center System	M	M	H	M	M	H	22	Reuse alternatives to divert waste from disposal or prolong life of materials before being disposed. Likely the receive high community support and should moderately align with SWS goals and plans. Cost to waste generators should be low and likely not going to affect SWS finances.
Develop a Resource Recovery Center for Upcycling	L	L	H	M	M	H	18	In the short-term, reuse and upcycling initiatives have little effect on disposal rate and/or reduce GHG emissions. However, in the long-term, these facilities act as education and behavior change tools which can have a significant impact over time. Should result in high community support and moderately aligns with SWS goals/plans. Although cost is not expected to be significant, SWS will likely need to financially support this initiative.
Develop Repair/Re-use Centers (e.g. Tool libraries)	L	L	H	M	M	H	18	Criteria implications likely to be similar to the Resource Recovery Center option.
Develop Waste Exchange Program (official website format of the repair/re-use centers)	L	L	H	M	M	H	18	Criteria implications likely to be similar to the Resource Recovery Center and Repair Center options.
Implement Bulky Item and Mattress Curbside Collection	L	L	H	L	L	L	10	Large item pick-up is a service that is typically well supported by the community but is costly and does not lead to more waste diversion or GHG emission reductions. Diversion potential from a weight perspective is likely low but will take up less air space in the landfill by diverting this material from disposal.

EXPANDED DIVERSION PROGRAMS OPTION ASSESSMENT AND RANKING

Option (Color Coding - Recycling, Yard and Garden, Mixed Organics, ICI Sector, Reuse, Bulky Items)	Criteria							Assessment Narrative
	High Diversion Potential	Reduces GHG Emissions	High Community Acceptance	Aligns with SWS Goals and Long-Term Plans	Positive Impact on SWS Finances	Reduces Cost to Waste Generator	Score (L=1; M=3; H=5)	
Implement drop off program for diversion of Bulky Items and Mattresses	L	L-M	H	H	M	L-M	18	Drop-off depots for bulky items and mattresses will likely cost less than a curbside collection service. Diversion potential from a weight perspective is likely low and less GHG emission from not collecting these materials. Likely to garner high community support and will allow private sector to collect and process these materials from one location.
Partner with the Private Sector to recycle/ process mattresses and bulky items	L	L-M	H	H	H	H	23	Diversion potential from a weight perspective is likely low but will take up less air space in the landfill. Likely to garner high community support because it can be bulky and difficult to discard. Eco fees can be applied at point of purchase by private sector to address waste management cost. Assumes mattress recycling alternative available. This should have no financial impacts to SWS or waste generators.
Construction and Demolition Waste								
Develop C&D Re-use Mandates and Policies in new buildings	M	M	L	H	H	M	20	Reuse policies and mandates for C&D materials for new construction. Aligns with SWS goals and plans, and should not affect SWS finances. Should have a moderate effect on waste disposal/diversion, and effect on GHG emissions should be less since less virgin materials being used. Not expecting much community support for this initiative, particularly generators.
Promote/Facilitate C&D Re-use programs (e.g. building material re-use centers)	M	M	H	H	H	H	26	Moderate level of waste diversion from reuse of C&D materials. Using less virgin materials should also reduce GHG emissions. Reuse centers generally have better community support and this should align with SWS goals and plans. Effects of finances should be minimal and should be cost effective for waste generators.
Develop Disaster Debris Response Plan	L	L	H	H	H	H	22	Until a disaster strikes, this will not result in more waste diversion or GHG emissions reduction. Due diligence aspect should align with SWS goals and planning. No financial impacts expected on SWS or waste generators.
Develop policies that support C&D recycling (e.g. minimum diversion for C&D projects)	M-H	M-H	M	M	H	M	22	Provided enforcement mechanisms are in place, should result in more materials being diverted from disposal. Social aspects should be moderate. Since C&D waste is not typically sent to ARL, the financial impact to SWS should be low. This may impact the waste generator if recycling options are not economical.

EXPANDED DIVERSION PROGRAMS OPTION ASSESSMENT AND RANKING

Option (Color Coding - Recycling, Yard and Garden, Mixed Organics, ICI Sector, Reuse, Bulky Items)	Criteria							Assessment Narrative
	High Diversion Potential	Reduces GHG Emissions	High Community Acceptance	Aligns with SWS Goals and Long-Term Plans	Positive Impact on SWS Finances	Reduces Cost to Waste Generator	Score (L=1; M=3; H=5)	
Partner with the Private Sector to stimulate and develop material markets	L	L	M	H	H	H	20	Diversion potential is likely low but working with the private sector will identify markets for the future. Partnerships are likely to garner some community support because of the potential to divert waste from disposal. This should have no financial impacts to SWS or waste generators as no subsidization or financial partnership is assumed but may be included in further analysis if warranted.
Create C&D Recycling Deposit Refund Program as part of building permits	M	M	M	M	H	L	18	Likely to lead to moderate levels of waste diversion and GHG reduction. Also, medium scores as it relates to community acceptance and alignment with community goals and plans. There should be no cost to SWS but it will like be more costly and time consuming for the waste generators.
Develop Deconstruction Strategies and Implement Policies the Prioritize Deconstruction over Demolition	M	M	L	M	H	M	18	Deconstruction should lead to less waste being disposed and less GHG being generated. Although it might meet SWS goals/plans, it is unlikely that the community would support this policy if it means a more cumbersome process to take down buildings. The cost to SWS should be minimal, however, the additional requirements might be viewed as an extra cost to waste generators.
Promotion and Education Programs								
Establish Community Based Social Marketing as framework for Promotion and Education	L	L	H	H	H	H	22	This is a public education and outreach approach that will eventually lead to more waste diversion and GHG reduction but not immediately. Environmental scores are low at this stage. The rest of the criteria is scored high since it aligns with SWS goals/plans and should be well supported by the public. Cost to SWS and waste generators should be minimal and score should be considered high.
Develop Community-Based Metrics and Waste Diversion Promotion and Recognition Program (i.e. track performance by	L	L	H	H	H	H	22	Will help with public education and outreach to support waste diversion. Standardizing programs and recognizing effort will make waste diversion easier and more effective. Will align with SWS goals/plans and should not be financially difficult to implement.

EXPANDED DIVERSION PROGRAMS OPTION ASSESSMENT AND RANKING

Option (Color Coding - Recycling, Yard and Garden, Mixed Organics, ICI Sector, Reuse, Bulky Items)	Criteria: High Diversion Potential	Reduces GHG Emissions	High Community Acceptance	Aligns with SWS Goals and Long-Term Plans	Positive Impact on SWS Finances	Reduces Cost to Waste Generator	Score (L=1; M=3; H=5)	Assessment Narrative
community and create a diversion competition)								
Develop Standardized Signage, Branding, and Color Coding for Region	L	L	H	H	H	H	22	Will help with public education and outreach to support waste diversion. Standardizing branding will make waste diversion easier and more effective. Will align with SWS goals/plans and should not be financially difficult to implement.
Promote "Waste as a Resource" through community engagement programs and events	L	L	H	H	H	H	22	This will not lead to large waste diversion changes but should be well supported by the pubic and will align with SWS goals/plans. Cost implications to SWS and waste generators should be negligible.
Policies and Measurement Tools								
Conduct Annual Solid Waste Master Plan Reporting	L-M	L-M	H	H	H	H	24	Reporting does not immediately result in waste diversion and GHG reduction, but will help assess the current status of the solid waste program and encourage better performance for the waste management system and programs. Annual reporting has the tendency to encourage better performance especially when below established goals. The environmental scores are listed to be between low and medium for this reason. This should receive high community acceptance and should align with SWS goals and plans. The cost to SWS and the waste generator should also low which would suggest a high score for financial considerations.
Develop Green Procurement Policy for MOA Government Contracts	L	L	H	H	H	H	22	Not likely to lead to high waste diversion or GHG reduction. Does demonstrate leadership by example to comply with SWS goals/plans and that should receive high community acceptance. Financial implications should not be significant and are, therefore, ranked a high score.

EXPANDED DIVERSION PROGRAMS OPTION ASSESSMENT AND RANKING

Option (Color Coding - Recycling, Yard and Garden, Mixed Organics, ICI Sector, Reuse, Bulky Items)	Criteria							Assessment Narrative
	High Diversion Potential	Reduces GHG Emissions	High Community Acceptance	Aligns with SWS Goals and Long-Term Plans	Positive Impact on SWS Finances	Reduces Cost to Waste Generator	Score (L=1; M=3; H=5)	
Perform Regular Waste Composition Audits (every 2-3 years)	L-M	L-M	H	H	H	H	24	Much like annual reporting, this will not result in high waste diversion but will provide information that will promote or further encourage diversion of waste which should lead to GHG emission reduction. Environmental scores are considered low to medium. Understanding the composition of discarded materials will help support waste diversion program development which should help with community acceptance and align with SWS goals/plans. The cost to SWS and waste generators should also be low which results in a high score for the two financial criteria.
Pilot Projects to Test New Initiatives	L	L	M	L	M	H	14	Does not lead to more waste diversion but will inform SWS of the pros and cons for certain new programs and whether these new programs would be supported by the community and should be implemented in the MOA. There will be cost to SWS and little to no cost for the waste generator. Does not directly align with SWS goals or plans but will help inform whether the public will support new programs.
Lobby State Government to Create Extended Producer Responsibility Programs (e.g. Bottle Deposits, Mattresses, HHW, Electronics, etc.)	M	M	H	H	H	M	24	Best suited for materials that are difficult and/or costly to manage. Some EPR programs help to address social issues such as litter and/or abandoned waste. ALPAR organization addresses some of these issues. Although it can be difficult to establish EPR programs, the end result is typically support by the community and it would support SWS goals and plans. Cost should not be borne by SWS; however, the waste generator might need to support these programs through eco fees passed on to customers.

APPENDIX E

CENTRAL TRANSFER STATION CONCEPTUAL PLANNING DESIGN BASIS REPORT

Central Transfer Station Conceptual Planning Design Basis Report

PREPARED FOR:

Municipality of Anchorage, Solid Waste Services

August 2018

SWS ISWMP
Design Basis Report

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1 PROJECT UNDERSTANDING

1.1 Central Transfer Station Background

The Central Transfer Station (CTS) and the Municipality of Anchorage (MOA) Department of Solid Waste Services (SWS) Administration/Maintenance Building are co-located in Midtown Anchorage at 1111 East 56th Avenue (see Figure 1). The facility occupies parcels 009-252-09-000, 009-252-22-000, and 009-252-23-000, with a combined area of 11.4 acres.

The CTS, operated by the SWS Solid Waste Disposal Utility (SWDU), currently provides commercial, small contractor, and residential waste and recycling drop-off services with an operating capacity of 1,600 tons per day. This location also hosts collection of residential bulky/white goods, used oil, batteries, and household hazardous waste. The CTS also operates a Reuse Center, where Anchorage residents can bring household items such as paints, cleaners, and solvents for pick up and reuse by other MOA residents.

In addition to waste and recycling services, the CTS property accommodates the SWS Administration/Maintenance Building, support for the SWS Refuse Collections Utility (RCU), a fueling island for SWS Operations Vehicles, container repair and equipment storage areas, outdoor and warm storage for SWS Operations Vehicles, and parking areas for employee vehicles.

The existing commercial entrance is located at 1111 East 56th Avenue and the residential/small contractor entrance is located at East 54th Avenue and Juneau Street. Ingra Street, between East 54th Avenue and East 56th Avenue, is utilized for excess residential queuing on known peak days when residential traffic (automobiles and pickup trucks) exceeds the available queuing area prior to the Cash Booth.

Hours for residential and small contractor operations are Monday through Saturday, 8:00 a.m. to 5:00 p.m. Commercial operating hours are Monday through Friday, 6:30 a.m. to 5:00 p.m. The facility is open to the public Saturday 8:00 a.m. to 5:00 p.m. and is closed on Sundays and on free dump days (usually at the end of April or beginning of May).

The SWDU operates a fleet of Transfer Trailers that transport solid waste from the CTS to the Anchorage Regional Landfill (ARL) for final disposal.

1.2 Current Challenges

This conceptual planning exercise has been driven by multiple factors, which can be generally traced to aging solid waste and recycling assets at the CTS, safety risks associated with intermingled customer/vehicle streams, and a desire to respond to SWS customer requests, concerns, and complaints. The most prominent customer feedback is related to the high volume and lengthy on-site dwell time of residential traffic, and the unavailability of solid waste and recycling (materials management) services and practices that have progressed since the facility’s original design.

The existing Transfer Station Building (TS Building) has been in operation for almost four (4) decades and is in need of comprehensive refurbishment activities and upgrades to enable continued efficient operations. As observed during Tetra Tech's site visit and through discussions with SWS staff, the components that are exhibiting excess wear include the reinforced concrete Tipping Floor, the pedestals supporting the two (2) Electric/Hydraulic Cranes used for Transfer Trailer loadout, interior roof drain conveyance piping, building columns, and the TS Building's original metal roofing. Additional supporting components and systems of the TS Building are also expected to require replacement due to the age and continuous operation of the facility, and a thorough structural, electrical, and mechanical assessment should be performed to detail the extent of needed work.

The need for upgrades extends to the supporting Household Hazardous Waste Facility/Reuse Center and the one (1) story Container repair/Storage Buildings in the northwest of the site. Currently, the Household Hazardous Waste Facility/Reuse Center are housed in aging, repurposed railcars, and the Container repair/Storage Buildings were adapted from a former self-storage facility. These facilities have experienced issues related to age, dimension, customer access/convenience, ventilation, and availability of sanitation facilities.

The increase in residential vehicles on Saturdays, with a peak of almost 640 inbound residential vehicles in one day in 2016, has created issues with on-site queuing and vehicle circulation under existing design conditions. To alleviate residential queuing on public roadways during known peak days, SWS has directed residential vehicles to queue on Ingra Street, between East 54th Avenue and East 56th Avenue. Although the use of Ingra Street has mitigated the occurrence of off-site queuing on public roadways, this interim solution does not alleviate the long on-site wait times for residential drop-off activities, space consumed by on-site residential queuing, or safety concerns that may be associated with comingled residential traffic queuing and SWS activities.

Additionally, MOA has experienced a need for increased maintenance, repair, and storage space to keep pace with SWS operations. This need is specific to the amount of warm (indoor) storage, outdoor storage space, and maintenance facilities (vehicles and equipment, as well as container repair).

The proposed conceptual designs must also accommodate future policy, asset, operational, and process/technology additions and/or advancements that are to be incorporated in the Integrated Solid Waste Management Plan (ISWMP), while reserving flexibility within the site for the next 30 years of SWS's operations. For example, SWS customers are interested in expanding materials recovery operations for cardboard, as this material is prevalent in the waste stream and is currently unfeasible to recover. At this time, it is anticipated that these future additions to SWS operations may include organics collection, grit management, and alternative waste conversion/diversion technologies (e.g. waste-to-energy, aerobic/anaerobic digestion, refuse derived fuel (RDF) production, etc.).

1.3 Proposed Conceptual Designs

The No Expansion Conceptual Plan (Conceptual Plan No. 0) is presented as the baseline, as upgrades and refurbishments are necessary for continued operation of the CTS. This alternative allows for only partial improvements to existing assets and does not address the main concerns associated with the existing CTS operations.

The next Conceptual Site Plan (Conceptual Plan No. 1) aims to support a short- to mid-term strategy that focuses on addressing immediate operational needs/challenges at the CTS, as well as refurbishment and/or relocation of existing physical assets. It is assumed that Conceptual Plan No. 1 will require minor additional property acquisition in the form of two properties now or formerly owned by Schwaiger and two additional properties (PAC and an isolated Wal-Mart property) (see Figure 2), located near the intersection of Old Seward Highway and East 56th Street (described in Section 5.2 – Proposed Property Needs).

Conceptual Plan No. 1 utilizes a strategy that provides physical separation of Indirect Operations (support assets/activities) from Direct Operations (material management activities). To further optimize traffic circulation and on-site dwell time, Conceptual Plan No. 1 then segregates the resultant traffic into five (5) distinct patterns that incorporate single direction traffic flows to the extent possible:

- SWS Employee Vehicles;
- SWS Operations Vehicles (Collection Vehicles {parking, warm storage, & maintenance}, Containers, Container movement, and Transfer Trailer movements);
- Residential;
- Small Contractor; and
- Commercial.

Although SWS treats Residential and Small Contractors collectively as Non-commercial (less than 1,000 pounds) for fee booth transactions, for planning purposes they are treated separately herein due to time and volume differences in unloading (trucks versus trailers).

As is typical of transfer stations in continuous operation for three plus (3+) decades, it is recommended that the existing TS Building undergo a comprehensive refurbishment. The refurbishment will focus on replacement of components subject to heavy wear (tipping floor, push walls, crane pedestals, etc.), as well as an assessment of materials and components that require routine repair and upgrades (including the mechanical, electrical, and lighting systems).

While Conceptual Plan No. 1 provides answers to the main concerns presented by current conditions, it does not address all of the challenges nor accommodate future resource management goals.

The second Conceptual Site Plan (Conceptual Plan No. 2A) substitutes the acquisition of the Schwaiger, PAC, and isolated Wal-Mart Properties for the larger Wal-Mart Properties (described in Section 6.2 – Proposed Property Needs) and applies a strategy similar to Conceptual Plan No. 1 for addressing short-term challenges while accommodating MOA's mid- and long-term goals through the sizable acquisition of real estate. Conceptual Plan No. 2A allows for the relocation and redesign of the TS Building, Administration & Employees Facilities Building, Maintenance Building, Warm Storage Building, and supporting assets to:

- Revamp site vehicle access/egress;

- Segregate and expand operations and services;
- Redesign and relocate a new Transfer Station Building;
- Redesign and relocate the Administration & Employees Facilities Building, Maintenance Building, Warm Storage Building; and,
- Accommodate future growth through flexible asset design and providing area(s) to incorporate advancements in policy and technology.

Conceptual Plan No. 2B will expand upon Conceptual Plan No. 2A to address the long-term goals of SWS, by utilizing the eastern Wal-Mart properties for future development of alternative waste conversion/diversion technologies.

Conceptual Plan No. 2A addresses MOA's current challenges and customer wishes, while providing the greatest flexibility for future growth and materials management opportunities. Further detail to support the evaluation of each development alternative is presented within Section 11 – Recommendations.

2 EXISTING SITE CONDITIONS

2.1 Site History

The CTS site is currently comprised of three (3) separate parcels that are owned by the MOA. The tax identification number, parcel size, and current use are noted below:

- 009-252-09-000; 7.12 acres. Parcel contains the administrative building, transfer station, scale facility, pay booth, and rail car hazmat storage. MOA acquired this parcel in approximately 1975.
- 009-252-22-000; 3.55 acres. Parcel contains the storage/container repair buildings. MOA acquired this parcel in 2007.
- 009-252-23-000; 0.76 acres. Parcel contains an access drive. MOA also acquired this parcel in 2007.

The data indicates that the existing transfer station was constructed in the mid-1970s and that the additions and modifications to place the site in its current configuration were completed in the early 1990s. Aerial photographs indicate that the 7.12 and 0.76-acre parcels remain relatively unchanged since 1994 aerial photographs.

It appears that the 3.55-acre parcel was used as a storage facility prior to purchase by the MOA. Aerial photographs indicate that approximately six (6) cargo containers and temporary multi-unit modular storage sheds, generally oriented in an east to west configuration, were located in the central part of the site. These buildings are no longer visible in 2010 aerial photographs, and only three (3) buildings along the site perimeter remain.

2.2 Site Description

The CTS site is in the central part of Anchorage Bowl approximately 4.5 miles east-southeast of the Anchorage airport. It is bounded by East 54th and 56th Avenues to the north and south, respectively;

Ingra Street to the west; and private industrial lands to the east. Homer Drive is located approximately 0.1 miles east of the site.

The earliest design drawings made available for this evaluation indicate that potions of the existing facility, including the transfer station, administrative building, scales and other related auxiliary structures were constructed in the mid to late-1970s. Site improvements were completed in the late 1980s and early 1990s and the site configuration has not changed significantly since that time.

The three (3) parcels that comprise the site are zoned I-1 District which is defined as light industrial. In addition, the site is located in an area that is designated as light industrial/commercial land use in the Anchorage 2040 Land Use Plan (September 2017).

The site is generally covered in structures and pavement, with limited areas of landscaping and other vegetation. Site drainage is somewhat radial from the center of the site, and surface water is directed to storm sewers around the perimeter of the site, and then generally towards the north and south and the existing municipal, closed storm water collection system.

2.3 Existing Buildings

2.3.1 Transfer Station Building

- Exterior Dimensions: The main part of the transfer station structure is 180-ft. by 156-ft. and there is a 59-ft. by 100-ft. addition at the west end of the original structure. This includes the original building that is 100-ft. by 180-ft. and the addition that was constructed on the south side of the building.
- Construction Type: The building is a steel framed structure with metal siding. Based on communications with SWS personnel, many of the columns have been damaged during transfer station operations and repaired.
- Sanitary Sewer Service: The sanitary sewer connection is provided near the southwest corner of the building. The line flows to the northwest and ties to the municipal sewer near the intersection of East 54^{th} Avenue and Juneau Street. Note that the drains in the tunnel are connected to the sanitary sewer system and are connected via a force main to the west side of the building.
- Water Service: Water Service is provided via a water main that enters the facility in the north of the site, near the intersection of East 54th Avenue and Juneau Street. The service is valved as it enters the CTS property, and then splits to provide service to the fire hydrant in the northwest corner of the site, the Cash Booth, the Administration Building, and the Transfer Station Building. The water main is reduced near the Transfer Station Building and services a fire hydrant, and then enters the Transfer Station Building at the southeast corner of the building. Within the Transfer Station Building, the water main services the sprinkler system, the boiler system, and restroom facilities.
- Electrical Service: Electrical service connects near the southwest corner of the building and connects to the electrical service panels located near the East 54^{th} Avenue access to the site. The CTS is located within the Chugach Electric Association, Inc. service area.

- Gas Service: Gas service is provided from the municipal system near the East 54th Avenue and Juneau Street intersection. The line crosses the site in a northwest to southeast direction, then follows the south building line, and enters the building at the southeast building corner. The gas service provides fuel for four (4) roof top furnaces and the ramp snow melt system.
- Overhead Doors: The north side of the building includes eight (8) overhead doors. The south side of the building was designed with three (3) 60-ft. by 24-ft. overhead folding fabric doors that are electrically operated. The west end of the building includes four (4) overhead doors.
- Building Interior Clearance: The original section of the transfer station provides 26.3-ft. of clearance along the eave line while the centerline provides approximately 30-ft. of clearance.
- Floor Slab: The floor slab in the original and two (2) addition sections of the transfer station are slab-on-grade and the thickness is 16-in. The reinforced concrete Tipping Floor is a two-layer system with a sacrificial concrete layer installed over the reinforced floor layers. Based on communications with SWS personnel, the sacrificial layer has been worn away up to 75% in some areas.
- Foundation: The original transfer station appears to be founded on shallow spread footings. The south and east additions are supported on 24-in. diameter, concrete-filled, steel pipe piles. The tunnel approach slabs include helical piles installed along the centerline of the travel lanes.
- Entrance Tunnel Pavement: The entrance and exit pavement for the transfer station pavement includes an 8-in. thick concrete pavement that overlies 3-ft. of classified backfill that is assumed to be non-frost susceptible material. The pavement includes helical hold-down anchors (single row or row of two anchors) for hold-down for hydrostatic uplift. The anchors are installed to a depth of 17-ft. below the bottom of the pavement slab, and include a 10-ft. extension and a 7-ft. long, 10-12-14 in. helical section. The pavement on the entrance ramps and within the Loadout Tunnel is equipped with a glycol circulation snow melt system.
- Roof: The roof over all sections are pre-formed metal over plywood sheathing. The north section of the building has an east-west oriented ridgeline near the center while the south side slopes toward the south side of the original transfer station. The southern section slope is 1.5V:12H while the northern portion slopes at 1V:12H up to the ridge line. The metal roofing panels remain from the original construction and have significant rust damage.

2.3.2 Administration and Maintenance Shop/Warm Storage Building

- Exterior Dimensions: Two-story building approximately 248-ft. by 80-ft. The original building was approximately 200-ft. by 80-ft., and an addition was constructed on the south end of the building.
- Construction Type: 8-in. Concrete Masonry Unit (CMU) with furring strips and insulation for exterior walls. Interior walls are mixed CMU and stud/drywall.
- Sanitary Sewer Service: Sanitary sewer exits the building at the northeast building corner, and flows northeast to a manhole located in the central portion of the site. The flow is then directed to the northwest where it connects to the municipal sanitary sewer near the intersection of East 54th Avenue and Juneau Street.
- Water Service: Water service is provided at the northeast corner of the building. The service starts at the municipal line near the intersection of East 54th Avenue and Juneau Street, where it then extends southeast towards the center of the site. It then branches to the southwest

towards the building, and there is a shutoff valve near the center of the site on the line extending southwest to the building.

- Electrical Service: Electrical service is provided through an underground line that starts on East 56th Avenue near the southwest corner of the parcel, and then extends to about the center of the south-side of the building.
- Gas Service: Gas service enters the building on the west side approximately 20-ft. south of the northwest building corner. The gas service line follows the west property line and then connects to a service line that angles to the northwest where it connects to the municipal line near the intersection of East 54th Avenue and Juneau Street.
- Overhead Doors: There are two overhead doors on the east side of the original building. The doors are both approximately 11-ft. wide by 16 and 8-ft. in height.
- Building Interior Clearance: Between floor spacing is 12-ft. and the floor to ceiling clearance is 8-½-ft.
- Floor Slab and Foundation: First floor is a cast-in-place slab-on-grade, and the columns and walls are supported on shallow, individual and strip foundations. For the addition, available information indicates that the footings are designed to bear at 2,500 pounds per square foot (psf) and at depths ranging from 4.5 to 5.5-ft. below ground surface. The footings and slab are to be underlain by 3-ft. and 1-ft., respectively, of non-frost susceptible material.
- Roof: The roof consists of plywood sheeting with an EPDM membrane and coated insulation board.

2.3.3 Cash Booth

- Exterior Dimensions: Approximately 10-ft. by 16-ft. encompassing approximately 160 sf.
- Construction Type: Wood frame, with wood floor over a crawl space. Exterior siding is wood T-111.
- Foundations: Shallow, perimeter strip footing that is 16-in. wide and bears 3.5-ft. below exterior grade. The crawl space walls are 8-in. CMU with waterproofing and 2-in. rigid insulation board on the exterior face.
- Building Interior Clearance: Single story building with approximately 8-ft. and 12-ft. of interior height at back and front of the building, respectively.
- Roof: Preformed metal roofing over plywood sheathing at a 3V:12H pitch from the front to back of the building.
- Utilities: Serviced by underground electric, water, and sanitary sewer. The water and sanitary sewer connects to the main on-site lines that extend southeast from the intersection of East 54th Avenue and Juneau Street. The electric connection is not known for certain, but it appears to connect to an electrical box at the Street intersection.

2.3.4 Scale House

- Exterior Dimensions: Approximately 14-ft. by 24-ft. encompassing approximately 336 sf.
- Construction Type: Wood frame, with 4-in. thick concrete slab-on-grade floor. Exterior siding is wood T-111.

- Foundations: Shallow, perimeter strip footing that is 16-in. wide and bears 3.5-ft. below grade. The foundation walls are 8-in. CMU with 2-in. rigid insulation board on the exterior face.
- Building Interior Clearance: Single story building with approximately 9-ft. of interior height at the building ends.
- Roof: Preformed metal roofing over plywood sheathing at a 3V:12H pitch from the front and back eves to nearly the mid-point of the building.
- Utilities: Serviced by underground electric, water, and sanitary sewer. The water and sanitary sewer connects to the municipal system located on East 56th Avenue. The electric and communication services are provided from the southeast corner of the Transfer Station.

2.3.5 Storage/Container Repair Buildings

- Exterior Dimensions: There are three (3) buildings in the northwest corner of the site that are used for container storage and repair. Two (2) buildings are aligned along East 54th Avenue and are approximately 100-ft. by 40-ft. The remaining building is oriented along the west property line and is approximately 130-ft. by 40-ft.
- Construction Type: The buildings appear to be former rental storage units and consist of CMU walls. They are wood frame construction, with steel pipe pile foundations and a structural wooden floor with crawl space.
- Roofs: The roofs of the two (2) building aligned along the street appear to be rolled or built up asphalt type roofing. The south portion of the other building is similar material, while the north approximately 40-ft. appears to be pre-formed metal roofing. The two (2) buildings aligned along East 54th Avenue are constructed with a flat roof slightly sloped to center interior drain. The building oriented along the west property line appears to have been constructed as a manager's apartment and has a pitched roof.
- Building Interior Clearance: These buildings were not accessed and plans are not available for review. However, based on feedback from SWS, the interior clearance is approximately 8-ft.

2.3.6 HHW/Reuse Railcars and Shed

- Exterior Dimensions: The recycling center includes two (2) former World War II vintage rail cars that were relocated to the site. It is believed that the boxcars are standard 50-ft. cars that would be approximately 50.5-ft. x 9-ft.
- Construction Type: Boxcar construction is somewhat variable depending on age and the rail carrier that used the car. It is anticipated that the boxcars were constructed in the early-1940s for use as troop carriers. As such the cars would have a steel frame with steel sides, ends, and roof.
- Building Interior Clearance: It is believed that the cars at the site are standard boxcars with an interior height of 10.5-ft.
- Doors: Standard 50-ft. boxcars were equipped with sliding doors, and the cars have a single sliding door with a width that may s range from 7 to 8-ft.
- Foundation: The cars are supported on 12-in. by 12-in. wood blocking. It is understood that the blocking is stacked on the ground surface.

- Utilities: The rail cars have electric service that is provided from the electrical box near the site entrance at East 54th Avenue.

2.4 Parking/Storage Areas

- Segregated Employee Parking: An approximately 240-ft. by 120-ft. parking area that contains space for approximately 50 cars is provided for employees. The area has a single entrance/exit location such that is only accessible from East 56th Avenue. The perimeter is landscaped with fencing and vegetation, and there are two (2) center islands that are vegetated. Pedestrian access is provided to the administration building west of the parking area. The asphalt surface includes a 2-in. thick asphalt concrete and a 2-in. leveling course placed over classified fill and backfill.
- Residential & Small Contractor Drop-Off Area: A paved area that is approximately 200-ft. by 80-ft. located on the north side of the transfer station building. The area provides approximately 20 parking spaces/unloading areas along the building face. The entrance to the area is from the west, and the exit driveway is at the northeast corner via a ramp that joins to the tunnel exit.
- Residential Traffic Queuing Areas: Residential traffic queuing utilizes the 0.76 acre parcel at the southwest corner of the site. The parcel is almost entirely covered with compacted gravel or reclaimed asphalt pavement (RAP) and is separated from Ingra Street by an approximate 20-ft. strip of grass/vegetation. Access to the area and parcel is from Ingra Street at a driveway at the southwest corner of the site, and from the northern portion of the site.
- SWS Vehicle Parking/Storage Area and Container/Equipment Storage Area: The vehicle and container/equipment parking and storage area encompasses the major portion of the 3.55 acre parcel located at the northwest corner of the site. The north part of this area along the East 54th Avenue property line is also used as the recyclables drop-off area. The central portion of the site is used as residential vehicle queuing.
- Bulky/White Goods Receiving and Storage Area: A paved area approximately 30-ft. by 65-ft. is provided immediately east of the hazmat rail car.
- HHW/Reuse Receiving and Storage Area: A paved area that is approximately 150-ft. by 65-ft. located near the residential site entrance near the intersection of East 54th Avenue and Juneau Street. The area is accessed from two (2) access driveways on the north side of the paved area. Landscaped or vegetated areas are located immediately north and south of the area.

2.5 Ancillary Features

2.5.1 Fueling Island

- Exterior Dimension: An approximate 10-ft. by 20-ft. covered fuel pump island is located near the northeast corner of the administration building.
- Capacity: The fuel island reportedly includes a 500-gallon aboveground storage tank for gasoline and a 5,000-gallon underground storage tank for diesel fuel, and the fuel pumps are located on a curbed island. A spill response kit is positioned immediately south of the fuel island.

2.5.2 Truck Scales

- Exterior Dimensions: The two (2) scales located near the southeast portion of the site are approximately 70-ft. by 10-ft.

- Construction Type: The pit consists of a 12-in. thick concrete slab and with eight (8) 3-ft. by 2-ft. concrete piers. The slab slopes at ¼-in per foot to a central sanitary sewer catch basin.
- Sanitary Sewer: The central catch basin includes a 2-ft. square sand trap covered with a cast iron pipe grate, and the drain pipe is heat taped on the vertical section to the sewer.

2.6 Existing Equipment

To support facility operations, SWS currently maintains the following mobile equipment, vehicles, and containers:

- Direct Operations Mobile Equipment:
  - Two (2) Wheel Loaders (Volvo L150);
  - One (1) Skid Steer;
  - One (1) Sweeper,
  - One (1) Water Truck (4000 gal),
  - One (1) End Dump Truck (8 CY),
  - One (1) Sander; and
  - Nine (9) Light Duty Vehicles.
- Collection Fleet:
  - Twenty-one (21) Front or Side Loader Trucks;
  - Two (2) Tom Cats;
  - One (1) Flatbed Truck;
  - One (1) Bulk Item Pickup; and
  - Four (4) Light Duty Vehicles.
- Fifteen (15) Transfer Trailers and Tractors:
  - Two (2) Spare Trailers.
- Roll-Off Containers:
  - Five (5) 10 CY Containers;
  - Twenty (20) 6 CY Containers;
  - Twenty (20) 4 CY Containers;
  - Twenty (20) 3 CY Containers; and
  - Twenty (20) 2 CY Containers.
- Residential Carts:
  - Approximately 2,800 Carts, including 48-, 64- and 96-gallon carts, yard waste carts, and bear resistant carts.

3 PROPOSED FACILITY OPERATIONS

3.1 Waste/Material Types and Capacity

At this time, it is anticipated that the material types and capacity will not be significantly altered for future operations.

3.2 Operating Hours

Unless future operating conditions require a modification to the operating hours to manage the proposed material streams and processes, Tetra Tech assumes that the operating hours will remain consistent with existing conditions. The specific operating scenarios to determine required hours would be part of detailed modeling during the design of a proposed facility, but our initial estimate based on current operations and site capacity assumes that operating hours will remain consistent.

As previously presented, hours for residential operations are Monday through Saturday, 8:00 a.m. to 5:00 p.m. Commercial operating hours are Monday through Friday, 6:30 a.m. to 5:00 p.m. The facility is open to the public Saturday 8:00 a.m. to 5:00 p.m. and is closed on Sunday and on free dump days (usually at the end of April or beginning of May).

3.3 Personnel

As indicated in a March 2018 Questionnaire response by SWS, the CTS currently accommodates the following personnel:

- Direct Operations (TS Building, Scale House, Cash Booth, Drivers, etc.): 40 operators
- Administration Building: 25 office staff
- Vehicle Maintenance/Warm Storage Building: 2 - 6 employees
- Container Maintenance: 2 - 4 employees

As Conceptual Plan Nos. 1 and 2A do not propose a significant change to facility operations, is it assumed that personnel needs will not change. However, Conceptual Plan No. 2B would likely require increased staffing or a different mix of staff for the potential addition of an Alternative Waste Conversion/Diversion Technology. Additional accommodations for these employees would be evaluated within the space reserved within the eastern Wal-Mart Properties during a future detailed design phase.

3.4 Mobile Equipment, Vehicles, and Containers

As the capacity and general function of the CTS are not being significantly changed, it is expected that mobile equipment and vehicle needs will remain consistent with existing conditions (see Section 2.6 – Existing Equipment).

Additional mobile equipment and vehicle needs related to the addition of site functions, as proposed in Conceptual Plan No. 2B, will depend on the selected technology and site plan as discussed below. Determination of these needs will be made during future design phases.

The storage and maintenance associated with containers at the CTS are generally related to refuse collection services, and would rely on the independent evaluation of future needs in this arena. These conceptual plans allow for typical growth, but do not anticipate a significant increase in function unless otherwise specified (e.g. expanded organics collection).

3.5 Parking Requirements

The proposed land use, Solid Waste and/or Recycling Transfer Facility, is considered a Waste and Salvage Industrial Use per Anchorage Municipal Code (AMC) Title 21.07.090E.3. This code states that this use does not have a specific parking requirement, therefore the requirements for off-street parking facilities shall be determined by the MOA director and the traffic engineer based upon the requirements for the use specified in Table 21.07-4 that is most nearly comparable to the unspecified use, traffic engineering principles, and/or parking studies. Comparability shall be determined by density, scale, bulk, area, type of activity, and location. Administrative offices that support SWS require one parking space per 350 square feet of gross floor area per Table 21.07-4, however may be determined by the MOA director and traffic engineer, as the site can be considered holistically.

The below Conceptual Plans indicate estimated parking layouts based on historic needs and Tetra Tech's experience with similar site layouts.

3.6 Potential Acquisition Properties

3.6.1 Schwaiger Properties

As shown on Figure 2, there are two (2) Schwaiger properties that are located on Old Seward Highway and East 56th Avenue, respectively (009-251-40-000 and 009-251-42-000). The property on Old Seward Avenue includes two, single-story buildings that are each approximately 6,900 sf. in size. The buildings were reportedly constructed in 1984 and consist of wood-frame buildings with stucco siding that houses multiple commercial uses and a church. Most of the remaining portion of the parcel is covered with asphalt that is used as parking for the businesses, and access to the site is along the apparent right-of-way of East 55th Avenue. The property located on East 56th Avenue is vacant and is covered with a non-paved parking surface. It appears the parcel may be used for seasonal vehicle storage based on readily available, published, aerial photographic information.

3.6.2 PAC Property

The PAC property (009-251-41-000) is adjacent to the Schwaiger properties and is located on Old Seward Highway with access to the site from a driveway off Old Seward Highway. The property contains one (1), two-story building approximately 6,200 sf. in footprint, with 12,400 sf of building area. The wood-frame structure was reportedly built in 1965 and includes 26 residential apartments, based on tax records. Most of the remaining portion of the parcel is covered with asphalt parking areas.

3.6.3 Wal-Mart Properties

There are seven (7) potential acquisition properties currently owned by Wal-Mart that are being considered for this evaluation. One (1) isolated parcel (009-251-33-000) would be associated with Conceptual Plan No. 1 that is located north of East 56th Avenue. The remaining six (6) parcels are associated with Conceptual Plan Nos. 2A/2B and are located south of East 56th Avenue. These parcels are all currently vacant and undeveloped.

3.7 Zoning Designation

The combined seven (7) parcels included in the current MOA and proposed Schwaiger, PAC, and isolated Wal-Mart Properties (see Section 5.2) considered under Conceptual Plan No. 1 are designated as Light Industrial/Commercial of the Anchorage Land Use Plan. These parcels are zoned Light Industrial (I-1) District as shown in Figure 3. The six (6) Wal-Mart parcels considered under Conceptual Plan Nos. 2A & 2B are also located in an area that is zoned Light Industrial, I-1. AMC 21.04.050B states that the intent of the I-1 District is:

> *The I-1 district is intended primarily for urban and suburban light manufacturing, processing, storage, wholesale and distribution operations, but also permits limited commercial uses. Regulations are intended to allow efficient use of the land while at the same time making the district attractive and compatible for a variety of uses.*

Within the I-1 District, the minimum lot area is 6,000 square feet (sf) with a minimum lot width of 50-ft. In areas where adjacent properties are non-residential, as the properties are, the front setback requirement is 10-ft. and the side and rear setbacks are 0-ft. The maximum building height is 50-ft., except that non-building industrial structures and appurtenances are exempt from this height requirement.

A Solid Waste and/or Recycling Transfer Facility is defined within AMC 21.05.060E. The intention of the I-1 District is for public and private light and general manufacturing, processing, service, storage, wholesale, and distribution operations along with other uses that support and are compatible with industrial uses (AMC 21.04.050B). Specific requirements for this use include:

- Facility cannot be located within 500-ft. of any academic school, hospital, or residential zoning district.
- Minimum lot size is 2-acres with 150-ft. lot width.
- Outdoor storage height cannot exceed 35-ft. and storage cannot be within the front or side setbacks set forth in AMC 21.06.
- In addition to landscaping, a Solid Waste and/or Recycling Transfer Facility is to be surrounded by an 8-ft. high fence, except that public drop-off areas do not need fencing unless located adjacent to a residential area.

The definition of incinerator per AMC 21.05.060E.3 is:

Incinerator. An establishment that uses thermal combustion processes to destroy or alter the character or composition of medical waste, hazardous waste, sludge, soil, or municipal solid waste (not including animal or human remains). This definition does not include "rag burners" or oil heaters.

Therefore, the proposed/potential Alternative Waste Conversion/Diversion Technologies contemplated for development under Concept Plan No. 2B on the eastern Wal-Mart parcels may require consideration as an Incinerator under the code.

A Solid Waste and/or Recycling Transfer Facility is a conditional use within the I-1 District and could be permitted following approval of a Conditional Use Permit (CUP) which requires review and approval in accordance with the procedures of Section 21.03.080, Conditional Uses. A CUP is intended for situations where a use may or may not be appropriate in a district, depending on the specific location, the use characteristics, and potential adverse impacts of the use on surrounding properties and community. Visual Enhancement Screening landscaping is also required along classified streets. The CUP approval process provides public review and evaluation of uses operating characteristics and site development through a public hearing process. Prior to submittal of a CUP application, a community meeting is required. The Planning and Zoning Commission will make a recommendation to the Anchorage Assembly, who will make the final decision based on the approval criteria. There may be use specific standards that apply. The need for a Site Selection Study per AMC 21.03.140 requiring the MOA to review and decide on selection of sites before certain public facilities may be authorized, was determined not to be needed due to the exclusion of sites being subject to approval of a CUP. It should also be noted that, without a variance, the 500-ft. separation to lands zoned Residential would preclude use of the eastern Wal-Mart parcels for Solid Waste and/or Recycling Transfer Facility as lands east of Seward Highway are less than 500-ft. from these parcels and are zoned Residential District.

Use as an Incinerator is not an approved or conditional use within the I-1 District. Therefore, this use would appear to be precluded without a zoning map amendment change to I-2 Heavy Industrial where such use is allowed as a conditional use or without approval of a design variance to allow construction of an Incinerator within the I-1 District. Note that there are additional restrictions, including a required separation of 1,315-ft. from lands zones residential. As noted, there is an insufficient separation to Residential lands located immediately east of Seward Highway to meet the current land use requirements without a design variance per AMC 21.03.240B.3b.

Design variances are reviewed and decided upon by the Urban Design Commission (UDC). The variance process is intended to provide limited relief from requirements in AMC Title 21 where strict application of a requirement will create a practical difficulty or an unnecessary hardship prohibiting the reasonable use of land in a manner otherwise allowed. Prior to submittal of a design variance application and a public hearing before the UDC, a pre-application meeting may be requested, if desired. The design variance application must state the relief sought and must specify facts or circumstances to show that the application substantially meets the following standards:

- The proposed alternative achieves the intent of the subject design standard to the same or better degree than the subject standard;
- The proposed alternative achieves the goals and policies of the comprehensive plan to the same or better degree than the subject standard;
- The proposed alternative results in benefits to the community that are equivalent to or better than compliance with the subject standard;
- The variance, if granted, will not adversely affect the use of adjacent property as permitted under this code;
- The variance, if granted, does not change the character of the zoning district where the property is located, is in keeping with the intent of the code, and does not permit a use not otherwise permitted in the district in which the property lies;
- Persons with disabilities are provided with access as required by the Americans with Disabilities Act (ADA) and reasonable accommodation; and
- The variance, if granted, does not adversely affect the health, safety, and welfare of the people of the municipality.

4 CONCEPTUAL PLAN NO. 0 – NO EXPANSION ALTERNATIVE

4.1 Conceptual Site Plan

The No Expansion Conceptual Plan provides SWS with the option of developing minor upgrades to select services (including HHW, White Goods, E-Waste & Waste Tire Collection, Reuse facilities, Container Repair, and Roll-Cart/Roll-Off Storage) and refurbishing the existing Transfer Station Building to meet short-term goals and maintain existing operations.

1. The TS Building would require a comprehensive refurbishment and upgrades for continued use by Residential, Commercial, and Small Contractor traffic.
2. A permanent, purpose-built structure would be erected for a HHW, White Goods, E-Waste, and Waste Tire Collection Building (depending on SWS needs and processing area requirements), serving Residential and Small Contractor traffic.
3. The Container Repair facilities, currently housed within former rental storage units, would be upgraded to include complete employee facilities (including an office, lockers, restroom/showers, breakroom), five (5) maintenance bays, and adjacent outdoor storage areas for containers and carts.

Development of the components of this alternative would occur concurrently, to minimize downtime and the duration of construction activities. However, as further discussed in Section 5.5 – Transfer Station Building, this Conceptual Plan is anticipated to require an interruption of Transfer Station operations during implementation which may approach a period of two (2) to three (3) years.

4.2 Proposed Property Needs

This Conceptual Plan assumes that no additional real estate will be purchased to support CTS operations, leaving only the open space on the western portion of the existing property for redevelopment activities.

4.3 Proposed Site Construction

Information relating to the Subsurface Conditions, Foundation Considerations, and on-site Utilities can be found under Section 5.4 – Proposed Site Construction for Conceptual Plan No. 1.

4.3.1 Site Access

Conceptual Plan No. 0 will utilize the existing curb cuts on the CTS property, as well as additional entry/exit locations to service the proposed HHW, White Goods, E-Waste, and Waste Tire Collection Building. Traffic patterns are designated with color-coded arrows depicted on Drawing No. 0 – Conceptual Site Plan No. 0 No Expansion Alternative.

Residential and Small Contractor traffic accessing the Waste Drop-Off Area at the TS Building will enter the site via an improved Ingra Street, at the intersection with East 54th Avenue. This lane can be designed to provide the equivalent of three (3) traffic lanes, in order to provide queuing space and segregated bypass lanes. This traffic will continue on a new access road across the site and utilize the existing Cash Booth.

The HHW, White Goods, E-Waste, and Waste Tire Collection Building will have two (2) segregated entrances. The eastern entrance will be for Small Contractors, which can then continue to the Waste Drop-Off Area at the TS Building or exit the site.

The western entrance to the HHW, White Goods, E-Waste, and Waste Tire Collection Building will be dedicated to Residential traffic. Residential traffic only accessing the HHW, White Goods, E-Waste, and Waste Tire Collection Building can then continue south on Ingra Street to the exit onto East 56th Avenue. Ingra Street would consist of one-way traffic flow to facilitate safe and convenient use by Residential and Small Contractor vehicles. Residential vehicles also carrying waste can also continue to the Waste Drop-Off Area at the TS Building, utilizing the existing Cash Booth.

The existing site entrance/exit near the intersection of East 54th Avenue and Juneau Street would be dedicated as an exit for Small Contractor, Residential, and Transfer Trailer traffic utilizing the TS Building. This Conceptual Plan provides the option to improve the maneuvering pattern beyond the Small Contractor & Residential Waste Drop-Off Area by installing a retaining wall to widen turn geometry and widen the exit road.

To provide additional queuing area during high volume periods, Residential and Small Contractor traffic may utilize the access route off Ingra Street and through the southerly proposed Roll-Off Container, Dumpster, & Roll-Cart Storage Yard. This optional heavy volume queuing area would serve to mitigate queuing on off-site roadways.

Traffic controls including signage and striping, if needed, would be specified during future detailed design.

Dependent on the final site layout, the design may require approval from the Municipal Traffic Engineer in areas where site space restrictions prohibit conformance with the requirements of the MOA Design Criteria Manual (e.g. municipal driveway spacing).

4.3.2 Parking

- Employee and Visitor Parking: Parking for employees and visitors would remain unchanged in the area east of the Administration & Employee Facilities Building.
- SWS Collection Vehicle Parking: This alternative does not provide additional segregated parking for SWS Collection Vehicles. SWS Collection Vehicles can utilize space within the Transfer Trailer and Tractor Storage/Parking Area as well as the Roll-Off Container, Dumpster, & Roll-Cart Storage Yards, if available.
- Residential Parking: Approximately 20 spaces located north of the HHW, White Goods, E-Waste, and Waste Tire Collection Building would be available for residents accessing this building. Employees working within the HHW, White Goods, E-Waste, and Waste Tire Collection Building would also utilize these parking facilities.
- Transfer Trailer Parking: The area north of the proposed Refueling Area and west of the TS Building provides space for limited Transfer Trailer and Tractor Storage/Parking.

4.4 Transfer Station Building

The Transfer Station Building would require a comprehensive refurbishment and reconstruction, consistent with the proposal outlined within Conceptual Plan No. 1. See Section 5.5 – Transfer Station Building under Conceptual Plan No. 1 for detail.

4.5 HHW, White Goods, E-Waste, and Waste Tire Building

The HHW, White Goods, E-Waste, and Waste Tire Building would be constructed on the existing CTS site, consistent with the proposal outlined within Conceptual Plan No. 1. See Section 5.8 – HHW, White Goods, E-Waste, and Waste Tire Building under Conceptual Plan No. 1 for detail.

4.6 Container Repair Building/Storage

The Container Repair Building would be constructed on the existing CTS site, consistent with the proposal outlined within Conceptual Plan No. 1. See Section 5.11 – Container Repair Building/Storage under Conceptual Plan No. 1 for detail.

4.7 Truck Scale

As the configuration of the Commercial and Transfer Trailer traffic patterns is not significantly altered as part of this Conceptual Plan, no modification to the existing Truck Scales and Scale Booth is contemplated at this time.

4.8 Refueling Areas

The existing Refueling Area would be relocated to streamline access by SWS vehicles (Direct and Indirect), in the location northwest of the existing Maintenance Shop/Warm Storage Building as depicted on Drawing 0.

5 CONCEPTUAL PLAN NO. 1 – FACILITY UPGRADES

5.1 Conceptual Site Plan

Conceptual Plan No. 1 focuses on SWS' short- to mid-term goals to improve existing CTS operations with some small property acquisitions and relocation of select assets to segregate Direct and Indirect Operations. The proposed layout of facility operations is depicted on Drawing No. 1 – Conceptual Site Plan No. 1 Facility Upgrades.

1. Indirect Operations (support assets/activities) would be relocated to the Schwaiger, PAC, and isolated Wal-Mart Properties (see Section 5.2), including:
    - Administration & Employee Facilities Building;
    - Maintenance Building;
    - Warm Storage Building;
    - Employee Parking; and
    - SWS Collection Vehicle Parking.
2. The Residential Drop-Off would be improved and expanded, utilizing the area vacated by the relocated Administration & Employee Facilities Building. An elevated, one-way drive-through design would promote segregated, safe, and streamlined residential operations.
3. A permanent, purpose-built structure would be erected for a HHW, White Goods, E-Waste, and Waste Tire Collection Building (depending on SWS needs and processing area requirements), serving Residential and Small Contractor traffic.
4. The Container Repair facilities, currently housed within former rental storage units, would be upgraded to include complete employee facilities (including an office, lockers, restroom/showers, breakroom), five (5) maintenance bays, and adjacent outdoor storage areas for containers and carts.
5. Within the existing CTS property, the TS Building would require a comprehensive refurbishment and upgrades for continued use by Commercial and Small Contractor traffic.

The sequence of construction would roughly follow the above noted order of development, with simultaneous construction planned whenever possible. However, as further discussed in Section 5.5 – Transfer Station Building, this Conceptual Plan is anticipated to require an interruption of Transfer Station operations during implementation which may approach a period of two (2) to three (3) years.

This concept is independent of Conceptual Plan Nos. 2A and 2B, as SWS has communicated during a May 2, 2018 conference call that the property acquisition will be limited to either the Schwaiger, PAC, and isolated Wal-Mart Properties north of East 56th Avenue or the six (6) Wal-Mart Properties south of East 56th Avenue (see Figure 2).

5.2 Proposed Property Needs

Conceptual Plan No. 1 assumes the availability of Parcel 009-251-40-000 (N/F Schwaiger Hans), Parcel 009-251-42-000 (N/F Schwaiger Hans & Judy), Parcel 009-251-33-000 (N/F Wal-Mart Stores), and Parcel 009-251-41-000 (N/F PAC Property), with a total additional area of 3.79 acres (Schwaiger, PAC, and isolated Wal-Mart Properties). As per feedback from MOA provided within the March 2018 Questionnaire, purchase of all four (4) lots would be necessary to provide a meaningful property area.

5.3 Siting Considerations

5.3.1 Wetlands

As shown in Figure 4, no portion of the proposed Schwaiger, PAC, and isolated Wal-Mart Properties (north of East 56th Avenue) or the current MOA properties have been designated as wetlands, as confirmed by the wetlands mapping performed by the U.S. Army Corps of Engineers and the U. S. Fish and Wildlife Services National Wetlands Inventory.

5.3.2 Flood Hazard Areas

As confirmed by the Federal Emergency Management Agency (FEMA)'s Flood Insurance Rate Map (FIRM), none of the subject properties are within either the 1% annual chance or the 0.2% annual chance Flood Hazard Areas (Map Number 0200050761D, revised September 25, 2009).

5.3.3 Seismic

The Conceptual Plan No. 1 site is in a moderate seismic hazard zone (Zone 3). The Geotechnical Advisory Commission (GAC) acts in an advisory capacity on issues relating to natural hazards risk mitigation, including in areas designated with high or very high (Zones 4 or 5) susceptibility to seismically induced ground failure per AMC 21.02.080. It is unlikely that expansion of the CTS in Conceptual Plan No. 1 will require a review by the GAC.

5.3.4 Avalanche Hazards

There is no data of historic avalanche zones in the lands included in Conceptual Plan No. 1. The GAC acts in an advisory capacity regarding proposed development located in high or moderate snow avalanche hazard zones per AMC 21.02.080. It is unlikely that development of Conceptual Plan No. 1 will require a review by the GAC.

5.4 Proposed Site Construction

5.4.1 Subsurface Conditions

Drawing No. C-8 – "Boring Logs" of the January 1987 drawing set prepared by Arctic Engineers Inc. for the CTS, includes a location plan and boring logs for explorations completed as part of the transfer station modifications. This information indicates that twelve (12) test borings (TH-1 through TH-12) were drilled on the parcels owned by the MOA. The explorations were made along the transfer station tunnel, the new scale and scale house, employee parking area, and the administration building expansion.

Subsurface explorations are not available for the Schwaiger Property parcels. However, it is anticipated that the subsurface conditions for these properties are consistent with those subject to the prior exploration for the CTS as GIS information available from the MOA indicates that the surficial soils at all five (5) parcels would be sand associated with the low-lying belt around Connors Lake. Portions of the Schwaiger parcels reportedly contain overburden material that was placed on the property in the 1960s and 1970s when the Seward Highway (now Old Seward Highway) was widened. As such, an elevation change is evident between this property and the existing CTS property.

While the drawing information available for review was from scans that omitted information near the edges of the plan sheet, the explorations appear to have been advanced to depths ranging from approximately 11-ft. to 50-ft. below ground surface (bgs). It is understood that the soil classifications on the test borings logs are based on visual classifications.

The upper soil deposit is generally described as Sandy Gravel, trace to some silt and the deposit thickness appears to range from approximately 4 to 7-ft. Standard Penetration Test (SPT) N-values are variable and appear to range from approximately 5 to 20. The surficial soil is generally underlain by a deposit that is visually described as SILT, with trace Sand and Gravel. This deposit also appears to include SILTY Clay to the CLAYEY lenses and layers. N-Values appear to range from approximately 5 to 20. This deposit, where fully penetrated, appears to be underlain at a depth of approximately 20-ft. bgs by a deposit that is described as Sandy GRAVEL to SAND and GRAVEL. N-Values appear to range from approximately 20 to 90. Two explorations, TH-11 and TH-12, were advanced to refusal which was encountered at a depth of approximately 45 to 50-ft. bgs.

The exploration logs indicate that seasonal frost depths, based on visual observation, range from approximately 4 to 6-ft. bgs. Observations of subsurface water levels indicate some perched water on the silt and clay layers at approximately 3-ft. bgs, and saturated soils were noted at variable depth ranging from approximately 10 to 20-ft. bgs. It does not appear that groundwater level monitoring wells were installed as part of this exploration program.

5.4.2 Foundation Considerations

Design and construction drawings for the original transfer station (shredding & baling operations), administration building, and other associated structures (circa 1970s) were not provided for review. However, design and construction drawings for the transfer station and administration building additions, the cash booth, and the scale house (circa 1987) were made available for our review.

These design drawings indicate that the cash booth, scale house, and administration building addition are supported on individual and strip, shallow foundations. The available information indicates that the footings are designed to bear at 2,500 pounds per square foot (psf) and at depths ranging from 4.5 to 5.5-ft. bgs. The footings and slab are to be underlain by 3-ft. and 1-ft., respectively, of non-frost susceptible material. The first floor is a cast-in-place slab-on-grade.

The original transfer station appears to be founded on shallow spread footings. The south and east additions are supported on 24-in. diameter, concrete-filled, steel pipe piles. It is probable that the additions were constructed using deep foundation elements to address potential loading of adjacent structures and to expedite construction. The floor slab in the original and two (2) addition sections of the transfer station are slab-on-grade with a design thickness of 16-in. In addition, the entrance and exit pavement for the transfer station tunnel includes an 8-in. thick concrete pavement that overlies 3-ft. of classified backfill that is assumed to be non-frost susceptible material. The pavement includes helical hold-down anchors (single row or row of two anchors) for hold-down for hydrostatic uplift. These anchors are installed to a depth of 17-ft. below the bottom of the pavement slab, and include a 10-ft. extension and a 7-ft. long, 10-12-14 in. helical section.

Based on the available subsurface and existing building design data, it appears that shallow, individual spread and strip foundations may be suitable for use for proposed buildings and structures on the seven (7) parcels. It would appear feasible to construct the first/ground floors as cast-in-place, concrete, slab-on-grade. Provisions should be made to provide non-frost susceptible soils beneath the foundation elements and floor slabs, and it appears that this material will need to be imported to the site. Note that a geotechnical investigation should be conducted at the site during design to provide site specific information for design of the foundations.

5.4.3 Site Access

Conceptual Plan No. 1 will utilize the existing curb cuts on the CTS property, as well as additional entry/exit locations to facilitate segregation of traffic patterns. Traffic patterns are designated with color-coded arrows depicted on Drawing No. 1 – Conceptual Site Plan No. 1 Facility Upgrades.

The existing site entrance near the intersection of East 54th Avenue and Juneau Street (formerly Residential and Small Contractor) would be dedicated as an entrance and exit for Small Contractor traffic utilizing the Small Contractor Waste Drop-Off Area at the TS Building only. This traffic will continue to utilize the existing Cash Booth. This Conceptual Plan aims to improve the Small Contractor maneuvering pattern beyond the Small Contractor Waste Drop-Off Area by installing a retaining wall to widen turn geometry and widen the exit road.

The HHW, White Goods, E-Waste, and Waste Tire Collection Building will have two (2) segregated entrances. The eastern entrance will be for Small Contractors, which can then continue to the Small Contractor Waste Drop-Off Area at the TS Building or exit the site.

The western entrance to the HHW, White Goods, E-Waste, and Waste Tire Collection Building will be dedicated to Residential traffic. This lane can be designed to provide the equivalent of three (3) traffic lanes, in order to provide queuing space and segregated bypass lanes. Residential traffic only accessing the HHW, White Goods, E-Waste, and Waste Tire Collection Building can then continue south on an improved Ingra Street to the exit onto East 56th Avenue. Ingra Street would consist of one-way traffic flow to facilitate safe and convenient use by Residential vehicles. Residential traffic will also be able to proceed directly to the elevated Residential Drop-Off. The segregated exit from the Residential Drop-Off will be directed onto East 56th Avenue.

To provide additional queuing area during high volume periods, Residential traffic may utilize the access route off Ingra Street and through the proposed Optional Roll-Off Container, Dumpster, & Roll-Cart Storage Yard. Although it is anticipated that expedited Residential operations will reduce the on-site dwell time currently experienced during peak traffic times, this optional heavy volume Residential vehicle queuing area would serve to mitigate queuing on off-site roadways.

Commercial traffic and Transfer Trailers will continue to enter the site from the existing entrance from East 56th Avenue, utilizing the existing Scale House and Truck Scales. After exiting the TS Building, Commercial vehicles will continue to utilize the Outbound Truck Scale and exit onto East 56th Avenue. Transfer Trailers will continue to exit near the intersection of East 54th Avenue and Juneau Street.

Employee and visitor traffic, including bus traffic, will utilize a segregated entrance/exit off of East 56th Avenue directly into the Employee and Visitor Parking Area.

Main access to the Maintenance Building, Warm Storage Building, and SWS Collection Vehicle Parking will be available via a new, dedicated curb cut from Old Seward Highway.

Traffic controls including signage and striping, if needed, would be specified during future detailed design.

Dependent on the final site layout, the design may require approval from the Municipal Traffic Engineer in areas where site space restrictions prohibit conformance with the requirements of the MOA Design Criteria Manual (e.g. municipal driveway spacing).

5.4.4 Parking

- Employee and Visitor Parking: A minimum of 80 spaces would be constructed on the Schwaiger Property, adjacent to the Administration & Employee Facilities Building. These spaces provide adequate parking for anticipated staffing (see Section 3.3), as well as visitor parking.
- SWS Collection Vehicle Parking: Approximately 30 oversized spaces would be constructed on the Schwaiger Properties to provide parking for the SWS Collection Vehicle fleet. This parking area would be located on the interior of the site, adjacent to Ingra Street, for security purposes.
- Residential Parking: Approximately 20 spaces located north of the HHW, White Goods, E-Waste, and Waste Tire Collection Building would be available for residents accessing this building. Employees working within the HHW, White Goods, E-Waste, and Waste Tire Collection Building would also utilize these parking facilities.
- Transfer Trailer Parking: At least 17 spaces are planned for the area west of the Truck Scales, for use by SWS' fleet of Tractors and Trailers.

5.4.5 Utilities

Existing on-site and proximate utilities are depicted on Figure 5 – Existing Utility Map, which was created using .PDF files of prior construction documents and GIS information obtained from the MOA Data Downloads website.

- Water Service: Water service to the CTS will continue to be provided through the Anchorage Water & Wastewater Utility's (AWWU) public water supply. As indicated on Figure 5, with information obtained from the MOA GIS Data Downloads website, water mains are available around the perimeter of the Schwaiger Properties, in addition to a private service line already installed in Parcel 009-251-40-000. Connection to the public water main and assessment of the private service line would need to be coordinated with AWWU.
- Electric Service: Electric service needs for proposed structures and lighting would be obtained from the nearest right-of-way, as determined in coordination with the electric service provider (expected to be Chugach Electric Association, Inc.).
- Gas Service: Gas service needs would be provided via extension of the existing on-site municipal gas service and/or connection to existing off-site service, as determined in coordination with the natural gas service provider (expected to be ENSTAR Natural Gas Company).
- Sanitary Sewer Service: Sanitary sewer service to the CTS would continue to be provided through AWWU's municipal sanitary sewer. As indicated on Figure 5, existing sanitary sewer pipes are present north and south of the Schwaiger Properties, as well as a line that crosses the Schwaiger Properties and follows Ingra Street. Connection to the sanitary sewer would need to be coordinated with AWWU.
- Stormwater Control: Site drainage would connect to the municipal storm drain system, which is accessible at the perimeter of the Schwaiger, PAC, and isolated Wal-Mart Properties. Stormwater management features and practices for proposed development would be designed in accordance with the municipal stormwater policies and stormwater management requirements for "large projects" within the December 2017 Anchorage Stormwater Manual.

5.5 Transfer Station Building

Subject to a more thorough structural, mechanical, and electrical assessment, the TS Building requires the following existing elements to be addressed as part of a comprehensive refurbishment and reconstruction:

- Replacement of reinforced concrete Tipping Floor and Loadout Tunnel, considering the use of a proprietary concrete mix specifically designed for wear surfaces.
- Refinement and/or replacement of embedded steel "wear rails." One consideration is replaceable "bristle brush" seal between the bottom of the existing loading slot and top of Transfer Trailers in the loading position.
- As there have been concerns with the structural integrity of the (2) Electric/Hydraulic Crane Pedestals, a proposed design could consider a hydraulic or mechanical "cushion" to alleviate Builtrite Crane turntable weakness and force transfer of stress to the reinforced pedestals.
- Address the existing roof drain system within the original building and addition, including adjustment of the height of interior roof drain conveyance piping proximate to the commercial tipping bays and connection of downspouts to the CTS' subsurface stormwater management system.
- Consider replacement and/or addition of overhead doors (Commercial tipping area, Small Contractor tipping area, and Operations Equipment Enclosure) with clear panels (high speed fabric or conventional) as practical. This option could reduce the open area required for regular operation and limit exposure to weather, if needed.

  - The three (3) Commercial tipping area door openings are currently each approximately 60-ft. wide. To enable more refined enclosure of the TS Building, an option would be to install 30-ft. wide overhead doors within each door opening, for a total of six (6) overhead doors on the southern face of the TS Building to manage exposure and improve housekeeping operations without adding significant obstructions to vehicle access. It is anticipated that these overhead doors would remain open during times of heavy commercial traffic, but installation would allow for flexibility to protect interior operations from the weather and improve the efficiency of heaters when necessary.
  - If functional doors are added to the TS Building, MOA should consider installation of an improved, roof mounted ventilation system.
- Replacement of sheeting (roof and siding), supporting purlins and girts, and doors. Replacement of sheeting should incorporate use of as many translucent panels as possible, to take advantage of available natural lighting. As some of the TS Building's columns appear damaged, the superstructure will require assessment and potential repair/replacement of components.
- Assessment of mechanical, electrical, and lighting systems to determine lifecycle stage and realization of increased efficiencies via current technologies. Based on input from SWS personnel, these systems are largely unchanged from the original construction. Therefore, it is anticipated that comprehensive upgrades will be required.
- Additional systems within the existing TS Building and Loadout Tunnel remain from the original construction, including the snow melt system and leachate collection piping, and may require replacement in order to support continued operations.

To improve existing Transfer Station operations, an optional single-story Operations Equipment Enclosure (±5,440 S.F.) is proposed for consideration on the western side of the TS Building. This heated Operations Equipment Enclosure could be utilized as needed to support SWS operations including, for example, to provide heated parking and storage space for approximately seven (7) Direct Operations vehicles. Addition of this Operations Equipment Enclosure would necessitate the relocation of the existing Used Oil Receiving and Storage Area to the grassed island north of the Enclosure.

The current site grading is relatively flat, which can contribute to ponding and insufficient drainage. MOA could consider grading and pavement improvements to incorporate smaller drainage areas with ties to an expanded site subsurface stormwater management system.

As requested by SWS personnel, a Wheel Wash could be installed prior to the Outbound Truck Scale. Based on initial design collaborations with wheel wash vendors having experience with cold weather and solid waste facility operations, we suggest a two (2) tire revolution system, with a 10,000-gallon recycling tank, and installation of cold weather management components that provide submerged heaters for water tanks and heat tracing for plumbing components.

The above described refurbishment activities are anticipated to result in intrusive construction that would likely require cessation of Transfer Station operations for two (2) to three (3) years. A more accurate construction schedule would be determined following a detailed evaluation of the existing building and direction from SWS regarding desired modifications.

5.6 Residential Drop-Off

The dedicated Residential Drop-Off area is designed to segregate residential waste drop-off activities and reduce the on-site dwell time currently experienced during peak traffic times.

The proposed Residential Drop-Off will be elevated above surrounding grade to allow residents to deposit bagged waste, waste oil, organics, and select recyclables into a combination of 40 CY roll-off containers and Transfer Trailers for collection. The elevated platform includes purpose built proprietary railings, gates, hinged aprons (to aid in depositing items into large roll-off containers), and roll-off container guide plates to promote safe, secure, and streamlined operations (see Attachment 1). The platform would be designed at a height of approximately 9 to 10-ft. above grade depending on the ability to grade the surrounding surface to accommodate both roll-off containers (approximately 8-ft. high) and Transfer Trailers (approximately 13.5-ft. high). The Transfer Trailers would be used to receive residential bagged waste which can be lifted above the height of the railings, and roll-off containers would be placed to reach the elevation of the platform allow receipt of all other materials collected at this location. The Entry and Exit Ramps could be equipped with electric snow melt systems to alleviate concerns about vehicles stopping and restarting on the inclined ramps during winter months.

The elevated platform will also house an Attendant Booth to monitor residential activities, as well as supplemental HHW and E-waste Booths. With a Residential Drop-Off of this size, it may be beneficial to have attendants present on both ends of the elevated platform to allow unencumbered visual access. Therefore, the design accommodates an area at the top of the Entry Ramp for a second optional Attendant Booth. These structures could be constructed of converted ISO containers, modified to accommodate occupancy and special requirements for receipt and management of materials. Examples of converted ISO containers are included in Attachment 2.

To minimize queuing on the inclined Entry and Exit Ramps, a separate Transaction Booth could be located prior to the Entry Ramp to initiate payment prior to drop-off activities. Alternatively, the employee within the Attendant Booth at the top of the Entry Ramp could operate a boom-type gate at the bottom of the ramp to control access and alleviate the potential for vehicles to temporary stop on the inclined Entry Ramp.

Full roll-off containers and Transfer Trailers can be conveniently pulled from the “z wall” slots by SWS staff, for transport to the TS Building or direct haul to the end disposal/market location.

5.7 Administration & Employee Facilities Building

To segregate Direct and Indirect Operations, this Conceptual Plan relocates the Administration and Employee Facilities Building onto the Schwaiger, PAC, and isolated Wal-Mart Properties.

The Administration and Employee Facilities Building has been designed as a three (3) story building with an area of approximately 7,000 S.F. per floor. The functions of this building are described below:

- First (1st) floor – Public and administration entryway, employee entryway, and employee facilities (breakroom, locker room, & restrooms with showers to accommodate at least 40 operations staff);
- Second (2nd) floor – Administration Offices, with office space for more than 25 office staff; and,
- Third (3rd) floor – Media/Conference Rooms & Learning/Education Center. The Education Center would be equipped with observation windows to provide a general visualization of the CTS layout from the third (3rd) floor vantage point.

As described above, more than 80 parking spaces are available for employees and visitors, and the lot is designed to accommodate bus travel movements.

5.8 HHW, White Goods, E-Waste, and Waste Tire Building

To replace the current, temporary structures used for HHW, white goods, e-waste, and waste tire collection, this Conceptual Plan provides for a permanent HHW, White Goods, E-Waste, and Waste Tire Collection Building.

The HHW, White Goods, E-Waste, and Waste Tire Collection Building is designed with two (2) entrances, with segregated Residential and Small Contractor traffic. Each traffic pattern is provided with a drive-up canopy to protect Residential and Small Contractor traffic from the elements. Access for drop-off activities on both sides of the building could include small (motorized & insulated) overhead doors and double man doors to access small foyers that act as “airlocks” for climate control efficiency within the building.

The HHW, White Goods, E-Waste, and Waste Tire Collection Building will be fully climate controlled, with restrooms for SWS personnel.

Direct Operations within this building provide for the following functions:

- HHW Storage Area, with separate ventilation and accommodations for spill control and clean-up;
- Operational area for White Goods refrigerant extraction and dismantling activities;
- Area for consolidating and palletizing E-Waste; and
- Loading docks for:
  - Forklift load of palletized E-waste;
  - Direct load of Waste Tires to enclosed Trailer.

With the size of the proposed building, this concept provides for a Reuse Center to be located within the HHW, White Goods, E-Waste, and Waste Tire Collection Building. Resident parking to access the Reuse Center is provided north of the building.

The Received Material Management & Loading Area south of the building could accommodate roll-off containers or Trailers for material loading (such as waste tires), which would minimize the frequency of SWS handling to manage the material.

5.9 Maintenance Shop

The single-story Maintenance Building would be relocated to the Schwaiger, PAC, and isolated Wal-Mart Properties, adjacent to the Administration and Employee Facilities Building.

The Maintenance Building would accommodate five (5) bays (work bays for repair and fabrication, as well as a wash/cleaning/prep/refinishing bay), each with a minimum size 60’ L x 25’ W, as well as storage space for parts. The bays would be sized to easily accommodate the full length of SWS vehicles that would typically back in to the Maintenance Building bays.

The Maintenance Building would be designed for at least six (6) employees, including offices and restroom facilities. Maintenance employees would utilize the lockers, showers, and break room facilities within the adjoining Administration and Employee Facilities Building.

5.10 Warm Storage Building

The Warm Storage Building will also be segregated from Direct Operations and relocated to the Schwaiger Properties. The Warm Storage Building has been preliminarily sized to accommodate 24 bays for vehicle storage (40’ L x 15’ W).

Outdoor parking (unheated) is provided for SWS Collection Vehicles, adjacent to the Warm Storage Building.

5.11 Container Repair Building/Storage

The Container Repair facilities, currently housed within former rental storage units, would be upgraded to a complete, purpose-built permanent structure. This permanent structure will include complete employee facilities (including an office, lockers, restroom/showers, breakroom), five (5) maintenance bays for tools/fabrication equipment, fabrication, washing/cleaning/prep, and painting/refinishing.

As shown on the Conceptual Site Plan, outdoor storage area for roll-off containers, dumpsters, and carts is designated adjacent to the Container Repair Building, as well as in the area south of the HHW, White Goods, E-Waste, and Waste Tire Collection Building.

SWS has expressed the need to provide covered Pavilions for roll-carts to prevent impacts from precipitation and freezing weather. As depicted on the Conceptual Site Plan, a Roll-Cart/Roll-Off Container Storage Pavilion could be constructed adjacent to the Container Repair Building and/or in the area south of the HHW, White Goods, E-Waste, and Waste Tire Collection Building. These Pavilions would be designed to allow for future installation of siding to enclose the structure, if necessary.

5.12 Truck Scale

As the configuration of the Commercial and Transfer Trailer traffic patterns is not significantly altered as part of this Conceptual Plan, no modification to the existing Truck Scales and Scale Booth is contemplated at this time.

5.13 Refueling Areas

Locations for two (2) Refueling Areas are identified within this Conceptual Plan to support SWS collection, maintenance, and transfer station operations, in the locations as follows:

- Within the SWS Collection Vehicle Parking area near the Warm Storage Building; and
- Near the Transfer Trailer and Tractor Storage/Parking area in the south of the existing site (relocated from existing fueling island).

5.14 Organic Material Segregation Area

For the purposes of this Conceptual Plan, an area has been reserved for organics material segregation west of the existing TS Building. Further development of this concept will be dependent on direction from MOA with respect to desired function.

6 CONCEPTUAL PLAN NO. 2A – FACILITY EXPANSION

6.1 Conceptual Site Plan

Conceptual Plan No. 2A (Drawing No. 2A – Conceptual Site Plan No. 2A Facility Expansion) applies the same strategy as the previous plan to address the operational challenges currently experienced at the CTS, by segregating Indirect Operations (support assets/activities) from Direct Operations (materials management activities) and then further separating the resultant traffic into the below five (5) discreet patterns, to the extent possible:

- SWS Employee Vehicles;
- SWS Operations Vehicles (*Collection Vehicles {parking, warm storage, & maintenance}, Containers, Container Movements*);
- Residential;
- Small Contractor; and
- Commercial.

This plan carries over the design of assets from Conceptual Plan No. 1 that are proposed on current MOA property, including the HHW, White Goods, E-Waste, and Waste Tires Collection Building, Residential Drop-Off, Organic Material Segregation Area, and Container Repair Building, for use by both Residential, SWS Operations, and Small Contractor traffic.

Select Direct Operations would be relocated to the Wal-Mart Properties south of East 56th Avenue, including:

- New Transfer Station Building;
- Employee/visitor entrance and exit;
- Small Contractor Waste Drop-Off Area entrance and exit;
- Administration & Employee Facilities Building;
- Maintenance Building;
- Warm Storage Building;
- Employee Parking; and,
- SWS Collection Vehicle Parking.

The development of Conceptual Plan No. 2A will occur in stages to ensure a construction timeline that enables CTS operations to remain continuous.

Proposed timeline for development:

1. Construct new Transfer Station Building, Operations Equipment Enclosure, Scale House, Trucks Scales, Small Contractor Pay Booth, and Appurtenances;
2. Construct HHW, White Goods, E-Waste, and Waste Tire Collection Building, Container Repair Building, Residential Drop-Off, and Roll-Cart/Roll-Off Container Storage Pavilions;
3. Construct new Administration & Employee Facilities Building, Maintenance Building, and Employee Parking;
4. Construct Warm Storage Building and SWS Collection Vehicle Parking;
5. Demolition and/or repurposing of the assets serving the above functions on the existing MOA properties can occur upon construction of the new facilities. In some cases where the proposed facility remains on the same location as the existing asset, such as the Container Repair Building, select operation may have to be temporarily relocated during construction.

Again, this concept is independent of Conceptual Plan No. 1, as acquisition of the Wal-Mart Properties south of East 56th Avenue would replace utilization of the Schwaiger, PAC, and isolated Wal-Mart Properties north of East 56th Avenue.

6.2 Proposed Property Needs

Conceptual Plan No. 2A assumes the availability of Parcels 009-284-01-000, 009-284-02-000, 009-284-09-000, and 009-284-10-000 (N/F Wal-Mart Stores Inc.), with a total additional area of 16.46 acres.

Conceptual Plan No. 2A avoids infringement on the Latouche Street ROW and the eastern Wal-Mart Properties (Parcels 009-281-70-000 and 009-281-71-000), based on future land development planned in these areas as well as potential wetlands concerns. However, from communications with SWS, it is understood that the six (6) Wal-Mart parcels south of East 56th Avenue must be purchased as a block.

6.3 Siting Considerations

6.3.1 Wetlands

As shown in Figure 4, Parcels 009-284-01-000 and 009-284-02-000 contain designated wetlands, as indicated by the wetlands mapping performed by the U.S. Army Corps of Engineers. A significant portion of Parcel 009-284-01-000 contains wetlands that are designated as "A" wetlands (high valuation), and the portion of wetlands on Parcel 009-284-02-000 is considered "C" wetlands (low valuation). Both wetlands areas are identified within Site #46 on Anchorage Wetlands Atlas Map #44, at the Northwest Intersection of East Dowling Road and Seward Highway.

"A" and "C" wetlands are defined within the July 2014 Anchorage Wetlands Management Plan, as follows:

> *"A" wetlands have the highest wetland resource values. They perform at least two, but typically more, significant wetland functions. "A" wetlands are considered most valuable in an undisturbed state, as most uses or activities, especially those requiring fill, negatively impact known wetland functions. "A" wetlands are not to be altered or otherwise disturbed in any manner, except as outlined in the following discussion and in the enforceable policies.*
>
> *"C" wetlands are the lowest value wetlands within the Municipality. Some "C" sites may have moderate values for one or more wetland function, but they generally have reduced or minimal functions and/or ecological values. Such sites are suitable for development and are to be generally managed to support community expansion and infilling. "C" sites are intended to be permitted under General Permit authorization from the Corps of Engineers, administered by the Municipality of Anchorage's Community Development Department. The development of "C" wetlands in accordance with Table 4 and Enforceable Policies is considered to have a minimal cumulative impact on overall functions and values of Anchorage wetlands.*

For Conceptual Plan No. 2A, we have assumed that no development will be allowed in the "A" wetlands as these wetlands have been preserved through permit POA-2005-510-4. Development on "A" wetlands would require a Section 10-404 Individual Permit from the U.S. Army Corps of Engineers. Although there is potential for development in the "C" wetlands given a successful General/Nationwide Permit or Individual Permit application process, we have used a conservative approach within Conceptual Plan No. 2A which minimizes encroachment on wetlands having either designation. It is likely that the minor "C" wetlands disturbance associated with Conceptual Plan No. 2A would qualify for the Nationwide Permit and/or MOA Watershed Management Services General Permit and may require mitigation depending on the area of disturbance.

As discussed within Section 7 below, Conceptual Plan No. 2B relies on development within the eastern Wal-Mart Properties (Parcels 009-281-70-000 and 009-281-71-000), both of which have significant delineations of "C" wetlands. Future development and/or placement of fill on these parcels would require MOA to obtain coverage under either the MOA General Permit authorization (if less than one acre of wetlands), or under a Section 404 Individual Permit from the U.S. Army Corps of Engineers if the disturbance area exceeds one acre which has the potential to require compensatory mitigation. The “C” wetlands areas on the eastern Wal-Mart Properties are also identified within Site #46 on Anchorage Wetlands Atlas Map #44.

The wetlands mapped by the U. S. Fish and Wildlife Services National Wetlands Inventory were also considered as part of this evaluation. However, it is estimated, based on recent development activities on Parcel 009-284-02-000 and the date of the wetlands surveys, that the wetlands mapped by the National Wetlands Inventory within the Municipality of Anchorage has been superseded by more detailed mapping accepted by the U.S. Army Corps of Engineers and included in the July 2014 Anchorage Wetlands Management Plan.

For projects that result in a loss of less than 0.1 acres of wetlands and require a pre-construction notification, the district engineer may determine if compensatory mitigation is needed on a case-by-case basis. For projects impacting greater than 0.1 acres of wetlands compensatory mitigation is required. When mitigation is required, the applicant selects a mitigation method (listed in order of U.S. Army Corps of Engineers preference):

1. Mitigation Bank,
2. In-Lieu Fee Sponsor, or
3. Permittee Responsible.

When mitigation is required, the Anchorage Debit-Credit Methodology is used to determine the compensatory mitigation needed to replace the loss of wetland function.

For small wetland impacts (less than 1.0 acres covered under a Nationwide Permit or the MOA Wetland General Permit), the use of Mitigation Banks and In-Lieu Fee Sponsors is preferred as mitigation is provided as a large wetland complex instead of small isolated wetlands. Permittee responsible mitigation would be practical for larger projects where it is easier to construct, enhance, or preserve wetland functions. Development on the eastern Wal-Mart Properties for Conceptual Plan No. 2B could incorporate permittee responsible mitigation into the design.

6.3.1.1 Wetlands Buffer

In accordance with Chapter 4, Section II.C. of the July 2014 Anchorage Wetlands Management Plan, development adjacent to an “A” wetland may require a 25’ setback for placement of fill. This Conceptual Plan assumes the 25’ buffer between the “A” wetland on Parcel 009-284-01-000 and planned development.

6.3.2 Flood Hazard Areas

As confirmed by the Federal Emergency Management Agency (FEMA)’s Flood Insurance Rate Map (FIRM), none of the subject properties are within either the 1% annual chance or the 0.2% annual chance Flood Hazard Areas (Map Number 0200050761D, revised September 25, 2009).

6.3.3 Wind

As indicated on Illustration 1, the prevailing wind direction in Anchorage is South-Southeast in the summer months (April – September) and North in the winter months (October – March).

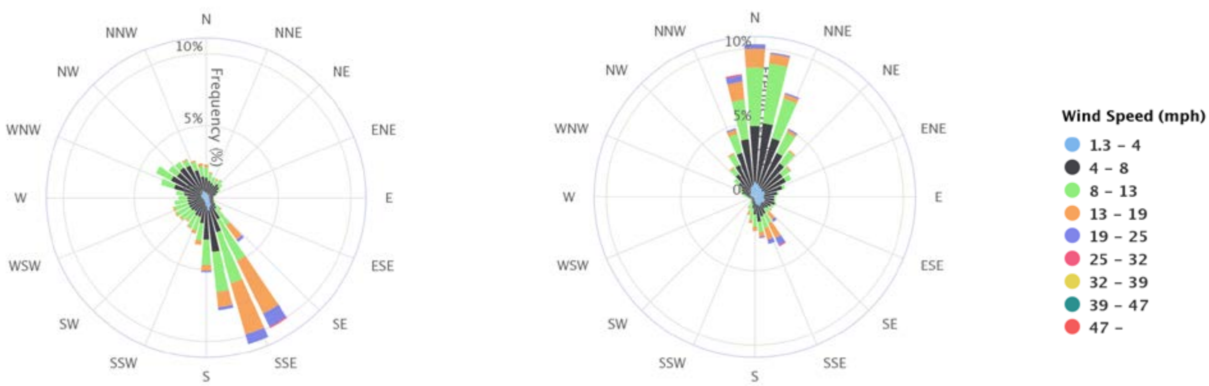

Illustration 1: Wind Rose, Anchorage International Airport (1998 – 2018)
(Midwestern Regional Climate Center cli-MATE, 2018)

Observing that the Commercial/Small Contractor bay doors are currently exposed to the prevailing wind, the proposed Conceptual Plan would rotate the tipping bay doors and loadout tunnel orientation in order to minimize wind speed through these openings. This design mitigates the potential negative impacts associated with litter, particulate, and odor within the Transfer Station Building.

6.3.4 Seismic

The Conceptual Plan Nos. 2A and 2B site is in a moderate seismic hazard zone (Zone 3). The GAC acts in an advisory capacity on issues relating to natural hazards risk mitigation, including in areas designated with high or very high (Zones 4 or 5) susceptibility to seismically induced ground failure per AMC 21.02.080. It is unlikely that expansion of the CTS in Conceptual Plan Nos. 2A and 2B will require a review by the GAC.

6.3.5 Avalanche Hazards

There is no data of historic avalanche zones in the lands included in Conceptual Plan Nos. 2A and 2B. The GAC acts in an advisory capacity regarding proposed development located in high or moderate snow avalanche hazard zones per AMC 21.02.080. It is unlikely that development of Conceptual Plan Nos. 2A and 2B will require a review by the GAC.

6.4 Proposed Site Construction

6.4.1 Subsurface Conditions

Conceptual Plan Nos. 2A and 2B would utilize some portion of the three (3) parcels currently owned by the Municipality and add the six (6) parcels presently owned by Wal-Mart Stores, Inc. (009-2894-

01-000, 009-284-02-000, 009-284-09-000, 009-284-10-000, 009281-70-00, & 009-281-71-000). It is expected that Wal-Mart completed a geotechnical investigation on these parcels, however, the data from the explorations was not available for our review.

The MOA GIS information indicates that the surface soils at the Wal-Mart parcels would be the Sands of the low-lying belt around Connor Lake. Historic topographic maps and wetland maps reveal that the parcels contain wetlands, and thus the subsurface soil conditions are expected to be less favorable. It is anticipated that due to the presence of wetlands, organic soils, peat, or additional clay soils may be encountered at this location. Absent subsurface exploration data, it is not possible to predict the nature and characteristic of the soils.

6.4.2 Foundation Considerations

Oral information provided to the Tetra Tech team and observed satellite imagery indicates that a surcharge load of undetermined magnitude was applied in the central portion of parcel 009-284-02-000. Pre-loading a site with a surcharge load is generally done to induce settlement and consolidation of underlying soft, compressible soils such that shallow foundations may be used for building and structure support. While it is not known how long the surcharge load was in place or the magnitude of any resulting consolidation, it is our opinion that the pre-load was intended to reduce the resulting settlement of foundation elements such that they were within generally accepted tolerable levels.

Based on the limited information available to date, it appears that shallow, individual spread and strip foundations may be feasible in the area that was pre-loaded. However, this is predicated on receipt and review of the previous geotechnical investigations and surcharge load monitoring results. A cast-in-place concrete slab-on-grade may also be suitable in this area. In other areas of the site, a deep foundation consisting of piles or caissons may be needed for support. Note that a geotechnical investigation should be conducted at the site during design to provide site specific information to allow design of the foundations.

6.4.3 Site Access

Conceptual Plan No. 2A will utilize the existing curb cuts on the CTS property, as well as additional entry/exit locations to facilitate segregation of traffic patterns. Traffic patterns are designated with color-coded arrows depicted on Drawing No. 2A – Conceptual Site Plan No. 2A Facility Expansion.

In the short term during construction of the new Transfer Station Building, the existing site entrance near the intersection of East 54th Avenue and Juneau Street (formerly Residential and Small Contractor) would be dedicated as an entrance and exit for Small Contractor traffic utilizing the Small Contractor Waste Drop-Off Area at the existing TS Building only. This traffic will continue to utilize the existing Cash Booth. This Conceptual Plan also allows for the option to improve the Small Contractor maneuvering pattern following the Small Contractor Waste Drop-Off Area by installing a retaining wall to widen turn geometry and widen the exit road, as these minor improvements aim to significantly improve the traffic patterns to support short term operations. In the short term, Transfer Trailers will continue to utilize the existing traffic patterns.

Following the construction of Conceptual Plan No. 2A on the Wal-Mart Properties, Small Contractor traffic accessing the TS Building will utilize a new entrance/exit off the south side of East 56th Avenue.

Under Conceptual Plan No. 2A Facility Expansion, empty Transfer Trailers will enter the site from a new entrance off of East Dowling Road. Transfer Trailers, once loaded, will exit north via a new curb cut on East 56th Avenue.

The HHW, White Goods, E-Waste, and Waste Tire Collection Building will have two (2) segregated entrances. The eastern entrance will be for Small Contractors. Following activities at the HHW, White Goods, E-Waste, and Waste Tire Collection Building, Small Contractors may either exit to East 54th Avenue and leave the CTS, or exit to East 56th Avenue and continue to the new Transfer Station Building via the Small Contactor access from this street.

The western entrance to the HHW, White Goods, E-Waste, and Waste Tire Collection Building will be dedicated to Residential traffic. This lane can be designed to provide the equivalent of three (3) traffic lanes, in order to provide queuing space and segregated bypass lanes. Residential traffic only accessing the HHW, White Goods, E-Waste, and Waste Tire Collection Building can then continue south on an improved Ingra Street to the exit onto East 56th Avenue. Ingra Street would consist of one-way traffic flow to facilitate safe and convenient use by Residential vehicles. Residential traffic will also be able to proceed directly to the elevated Residential Drop-Off. The segregated exit from the Residential Drop-Off will be directed onto East 54th Avenue.

To provide additional queuing area during high volume periods, Residential traffic may utilize the access route off Ingra Street and through the proposed Optional Roll-Off Container, Dumpster, & Roll-Cart Storage Yard. Although it is anticipated that expedited Residential operations will reduce the on-site dwell time currently experienced during peak traffic times, this optional heavy volume Residential vehicle queuing area would serve to mitigate queuing on off-site roadways.

Commercial traffic and SWS Collection Vehicles (loaded and empty) will enter the site from a new entrance off of East 56th Avenue and utilize the proposed Scale House and Truck Scales or bypass lane. Conceptual Site Plan 2A has been designed to provide supplementary queuing space for Commercial vehicles prior to the Inbound Truck Scale. Loaded Commercial vehicles will proceed to the new TS Building, and empty SWS Collection Vehicles can access the parking areas or proceed to the Maintenance Building. After exiting the TS Building, Commercial vehicles will return to the Scale House and Truck Scales for exit back onto East 56th Avenue. Commercial vehicles that have been previously weighed to obtain a vehicle tare weight could be given the option to use the Sliding Gate for tared Commercial vehicles and discharge via a one-way curb cut to East Dowling Road.

Employee and visitor traffic, including bus traffic, will utilize the new entrance/exit off the south side of East 56th Avenue that would be shared with Small Contractor traffic, and then will turn to access the Employee and Visitor Parking Area.

Traffic controls including signage and striping, if needed, would be specified during future detailed design.

Dependent on the final site layout, the design may require approval from the Municipal Traffic Engineer in areas where site space restrictions prohibit conformance with the requirements of the MOA Design Criteria Manual (e.g. municipal driveway spacing).

6.4.4 Parking

- Employee and Visitor Parking: Over 90 spaces would be constructed on the Wal-Mart Property, adjacent to the proposed Administration & Employee Facilities Building. These spaces provide adequate parking for anticipated staffing (Section 3.3), as well as visitor parking.
- SWS Collection Vehicle Parking: Approximately 40 oversized spaces would be constructed on the Wal-Mart Property that would provide parking for the SWS Collection Vehicle fleet.
- Residential Parking: Approximately 20 spaces located north of the HHW, White Goods, E-Waste, and Waste Tire Collection Building would be available for residents accessing this building and the Reuse Center. Employees working within the HHW, White Goods, E-Waste, and Waste Tire Collection Building would also utilize these parking facilities.
- Transfer Trailer Parking: Well over the requested 17 spaces are provided within the area south east of the Residential Drop-Off for use by SWS' fleet of Tractors and Trailers.

6.4.5 Utilities

Existing on-site and proximate utilities are depicted on Figure 5 – Existing Utility Map, which was created using .PDF files of prior construction documents and GIS information obtained from the MOA Data Downloads website.

- Water Service: Water service to the CTS will continue to be provided through the Anchorage Water & Wastewater Utility's public water supply. As indicated on Figure 5, water mains are available within the roadways north and south of the Wal-Mart Properties. Connection to the public water main and assessment of the private service line would need to be coordinated with AWWU.
- Electric Service: Electric service needs for proposed structures and lighting would be obtained from the nearest right-of-way, as determined in coordination with the electric service provider (assumed to be Chugach Electric Association, Inc.).
- Gas Service: Gas service needs would be provided via extension of the existing on-site municipal gas service and connection to existing off-site service, as determined in coordination with the natural gas service provider (assumed to be ENSTAR Natural Gas Company).
- Sanitary Sewer Service: Sanitary sewer service to the CTS would continue to be provided through AWWU's municipal sanitary sewer. As indicated on Figure 5, existing sanitary sewer pipes are present within the roadways north and south of the Wal-Mart Properties. Connection to the sanitary sewer would need to be coordinated with AWWU.
- Stormwater Control: Site drainage would connect to the municipal storm drain system, which is accessible north and south of the Wal-Mart Properties. Stormwater management features and practices for proposed development would be designed in accordance with the municipal stormwater policies and stormwater management requirements for "large projects" within the December 2017 Anchorage Stormwater Manual.

6.5 Transfer Station Building

As discussed above, the existing TS Building has been in continuous operation for three plus (3+) decades and requires significant refurbishment and/or upgrades. Conceptual Plan No. 2A proposes the complete relocation and redesign of the TS Building and select appurtenances on the Wal-Mart Properties, rather than a comprehensive refurbishment of the existing facility.

The proposed TS Building would maintain similar design capacity (1,600 TPD) and building area to the existing facility that includes a reinforced Tipping Floor (±35,000 S.F.), Loadout Slot & Utility Areas (±6,600 S.F.), and a full depth Loadout Tunnel underneath the loadout slots.

To address prevailing winds, the proposed TS Building would be rotated approximately 90° from the current configuration and allow:

- Small Contractor Waste Drop-Off Area on the east side;
- Commercial tipping area on the west side; and,
- Transfer Trailer Loadout Tunnel on the south side, with west to east Transfer Trailer traffic movements though the tunnel.

To eliminate the maintenance issues resultant from continuous stress placed on the reinforced concrete crane pedestals experienced at the existing TS Building, MOA may consider replacing the rigid mounted Electric/Hydraulic Cranes with Electric/Hydraulic Excavators similar to those manufactured for the solid waste industry by Sennebogen (see Illustration 2). These Electric/Hydraulic Excavators can be supported by tracked, wheeled, or stationary undercarriages, rather than rigidly mounted to the building foundation, which will minimize the transfer of force and subsequent damage experienced at the existing TS Building.

Illustration 2: Sennebogen Electric Excavator (“Sennebogen Maschinenfabrik GmbH, 2018)

The Tipping Floor would be constructed considering the use of a proprietary concrete mix specifically designed for wear surfaces, which would be comparable to that successfully demonstrated at numerous transfer stations. The construction of push walls within the TS Building would incorporate metal armor similar to the existing CTS design but with an extension below the tipping floor slab surface to provide additional reinforcement.

Sheeting (roof and siding) would incorporate use of as many translucent panels as possible, to take advantage of available natural lighting.

To provide more enclosure within the TS Building (protection from the elements and containment of particulate and/or odors), the proposed design could consider the use of overhead doors (roll-up or folding fabric) at all door openings. Use of clear panels within these overhead doors would provide additional natural lighting even when the doors are in the closed position. Typically, Commercial access doors will be a minimum of 18' wide, and Small Contractor/Operations access doors would be a minimum of 15' wide.

If functional doors are included within the design of the TS Building, the proposal would incorporate installation of a roof mounted ventilation system.

Similar to the optional addition to the existing TS Building proposed within Conceptual Plan No. 1, the proposed site plan also includes an optional enclosed area on the north side of the new TS Building. This heated Operations Equipment Enclosure could be utilized as needed to support SWS operations including, for example, to provide heated parking and storage space for approximately seven (7) Direct Operations vehicles.

The Small Contractor Waste Drop-Off Area is proposed on the east side of the TS Building, and will incorporate a raised area (±4' above the Tipping Floor) under a cantilever canopy for Small Contractor waste unloading activities. In addition, a Waste Oil Tank would be located in the vicinity of the Small Contractor Waste Drop-Off Area.

The site design also can accommodate a Wheel Wash prior to the Outbound Truck Scale as described within Section 5.5 – Transfer Station Building and shown on Drawing No. 2A – Conceptual Site Plan No. 2A Facility Expansion.

6.6 Residential Drop-Off

The Residential Drop-Off would be constructed on the existing CTS site, consistent with the proposal outlined within Conceptual Plan No. 1. See Section 5.6 – Residential Drop-Off under Conceptual Plan No. 1 for detail. Under Concept Plan No. 2A, the Residential Drop-Off can be located in a way that displaces current access roads but does not require demolition of the existing Administration & Maintenance Shop/Warm Storage Building. Following relocation of these assets to the Wal-Mart Properties, the existing structure could be repurposed.

6.7 Administration & Employee Facilities Building

The Administration & Employee Facilities Building would be relocated to the Wal-Mart Properties, and would adhere to an approach consistent with the proposal outlined within Conceptual Plan No. 1. See Section 5.7 – Administration & Employee Facilities Building under Conceptual Plan No. 1 for detail, and Drawing No. 2A – Conceptual Site Plan No. 2A Facility Expansion for the conceptual layout.

6.8 HHW, White Goods, E-Waste, and Waste Tire Building

The HHW, White Goods, E-Waste, and Waste Tire Building would be constructed on the existing CTS site, consistent with the proposal outlined within Conceptual Plan No. 1. See Section 5.8 – HHW, White Goods, E-Waste, and Waste Tire Building under Conceptual Plan No. 1 for detail.

6.9 Maintenance Shop

The Maintenance Shop would be relocated to the Wal-Mart Properties, and would adhere to an approach consistent with the proposal outlined within Conceptual Plan No. 1. See Section 5.9 – Maintenance Shop under Conceptual Plan No. 1 for detail, and Drawing No. 2A – Conceptual Site Plan No. 2A Facility Expansion for the conceptual layout.

6.10 Warm Storage Building

The Warm Storage Building would be relocated to the Wal-Mart Properties, and would adhere to an approach consistent with the proposal outlined within Conceptual Plan No. 1. See Section 5.10 – Warm Storage Building under Conceptual Plan No. 1 for detail, and Drawing No. 2A – Conceptual Site Plan No. 2A Facility Expansion for the conceptual layout. Under the Conceptual Plan No. 2A design, the Warm Storage Building could be equipped with doors on both the east and west side of the building to allow access from the SWS Collection Vehicle Parking area as well as the Maintenance Building.

6.11 Container Repair Building/Storage

The Container Repair Building would be constructed on the existing CTS site, consistent with the proposal outlined within Conceptual Plan No. 1. See Section 5.11 – Container Repair Building/Storage under Conceptual Plan No. 1 for detail.

6.12 Truck Scale

Consistent with the design of the existing Truck Scale facilities, the proposed Truck Scales would be configured with two (2) 70-ft. x 11-ft. scales (separate inbound and outbound), with 10-ft. level pads on each approach to accommodate certification by the Alaska Department of Transportation and Public Facilities, Division of Measurement Standards & Commercial Vehicle Enforcement.

The designs incorporate a centrally located Scale Booth, accessible by drivers of both inbound and outbound Collection Vehicles from within vehicle cabs.

6.13 Refueling Areas

Two (2) Refueling Areas are proposed within this Conceptual Plan to support SWS collection, maintenance, and transfer station operations, in the following locations:

- Within the SWS Collection Vehicle Parking area; and,
- Near the Transfer Trailer and Tractor Storage/Parking area in the south of the existing site (relocated from existing fueling island).

6.14 Organic Material Segregation Area

For the purposes of this Conceptual Plan, an area has been reserved for organic material segregation in the southwest corner of the existing property. Space could also be designated for organic material management west of the existing TS Building, following relocation of Transfer Station activities. Further development of this concept will be dependent on direction from MOA with respect to desired function.

7 CONCEPTUAL PLAN NO. 2B – FACILITY EXPANSION WITH ALTERNATIVE WASTE CONVERSION/DIVERSION TECHNOLOGY

Conceptual Plan No. 2B would be a continuation of the development proposed in Conceptual Plan No. 2A, accounting for the potential siting of an Alternative Waste Conversion/Diversion Technologies facility on the eastern Wal-Mart Properties. The eastern Wal-Mart Properties are comprised of Parcels 009-281-70-000 and 009-281-71-000 (N/F Wal-Mart Stores Inc.), with a total additional area of 11.18 acres.

At this stage of conceptual planning, these parcels have just been reserved for potential use in support of an Alternative Waste Conversion/Diversion Technology. It is our understanding that this future development would be part of SWS's long-term strategy (10+ years), and a proposal would be subject to a future feasibility study and input from SWS.

Siting and planning restrictions on this site are discussed within Section 3.7 – Zoning Designation and Section 6.3.1 – Wetlands.

Note that the initial intent of Conceptual Plan Nos. 2A and 2B included the relocation of all Direct and Indirect Operations to the Wal-Mart Properties from the existing CTS site, as previously discussed with SWS staff. However, the presence of undevelopable "A" wetlands on Parcel 009-284-01-000 has decreased the available area by almost three (3) acres. Therefore, select Direct Operations involving Residential and limited Small Contractor traffic, Indirect Operations for container repair and storage, and the parking of SWS Transfer Trailers remain on the western portion of the existing CTS property.

8 CONCEPTUAL COST ESTIMATES

Conceptual cost estimates for Conceptual Plan No. 1 and Conceptual Plan No. 2A are presented and explained within Attachment 3.

9 FUTURE ADDITIONAL SWS DEVELOPMENT AT CTS

As noted by SWS in the March 2018 Questionnaire, SWS is considering the implementation of a Grit Management Facility in the near future. While progress of this alternative may be dependent on a forthcoming pilot study, the above Conceptual Plans do not address placement of this facility at the CTS site. Within Conceptual Plan No. 1, space for a Grit Management Facility would likely be obtained through purchase of additional property, to avoid infringing on planned parking or storage space. Within Conceptual Plan Nos. 2A and 2B, the location of a Grit Management Facility could be accommodated on the site of the existing TS Building, following its relocation to the Wal-Mart Properties.

Within Conceptual Plan Nos. 2A and 2B, the existing Administration & Maintenance Shop/Warm Storage Building structure could be repurposed by MOA following relocation of these assets to the Wal-Mart Properties.

10 PROJECT SCHEDULE

The development of each Conceptual Site Plan will be dictated by MOA's/SWS's ability to secure the required real property assets, as well as the capital to begin construction.

Based on the desired timeframes expressed by SWS, the refurbishment or relocation of the TS Building, construction of the Residential Drop-Off, and construction of the permanent HHW, White Goods, E-Waste, and Waste Tire Collection Building are high-priority, short-term goals. Priority development of these components are incorporated into the above Conceptual Plans, where practical.

11 RECOMMENDATIONS

The No Expansion Conceptual Plan (Conceptual Plan No. 0) is presented as the baseline, as upgrades and refurbishments are necessary for continued operation of the CTS. This option allows for only partial improvements to existing assets, without addressing the main operational issues (safety, customer feedback, resource management options) while providing little to no strategic advantage that accommodates growth.

While Conceptual Plan No. 1 provides answers to the main concerns presented by current conditions, it does not address all of the challenges nor accommodate future resource management goals. The extent of reconstruction needed to perform the refurbishment of the existing TS Building would be significant for both Conceptual Plan No. 0 and Conceptual Plan No. 1, requiring a suspension of transfer operations at the CTS during the multiple year construction, with a cost estimated to approach that of a new, larger, and more advanced replacement facility. In addition, the future operations would continue to be subject to the existing Transfer Station framework which has demonstrated issues relating to vehicle dwell time, access/egress, and safety. Further financial impacts would include the unnecessary expense for demolition of the existing Administration and Maintenance Shop/Warm Storage Buildings which could otherwise be repurposed and additional costs to procure land and construct a regional grit management facility. Conceptual Plan No. 1 also does not serve MOA's longer-term goals that includes expansion or addition of services, materials management, and extending the life of the ARL.

Conceptual Plan No. 2A addresses MOA's current challenges (safety, customer feedback, resource management options), while providing the greatest flexibility for future growth and materials management opportunities. Further benefits include additional space for expanded organics management capacity, the opportunity to use the existing TS Building as a regional grit management facility and avoid the associated costs with new construction of this facility, and the ability to re-purpose the existing Administration and Maintenance Shop/Warm Storage Buildings for other MOA uses. Also, the construction of a new TS Building would alleviate the difficulties associated with the cessation of operations at the CTS during refurbishment activities. The acquisition of the larger Wal-Mart properties also gives MOA the opportunity to further the zero-waste initiative in the future by establishing an Alternative Waste Conversion/Diversion Technology (e.g. waste-to-energy, aerobic/anaerobic digestion, refuse derived fuel (RDF) production, etc.).

The opportunities available to the MOA upon the acquisition of the Wal-Mart properties and subsequent development of Conceptual Plan No. 2A provide SWS with an inimitable opportunity to resolve decades old operational challenges and address short- and long-term needs and priorities of their customers through the realization of progressive solutions for waste and resource management strategies.

12 DOCUMENT NEEDS

Further progress with the design of the CTS upgrades and/or expansion would be aided by access to additional documentation regarding the following features, if available:

- Original Baler & Shredder facility, including as-built or construction drawings;
- Documentation relating to the Schwaiger, PAC, and isolated Wal-Mart Properties, including existing use and subsurface conditions;
- Details relating to the apparent former self-storage facility (current Container Storage & Repair Building), to inform potential demolition activities; and,
- Geotechnical data and information associated with the Wal-Mart parcels.

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FIGURES

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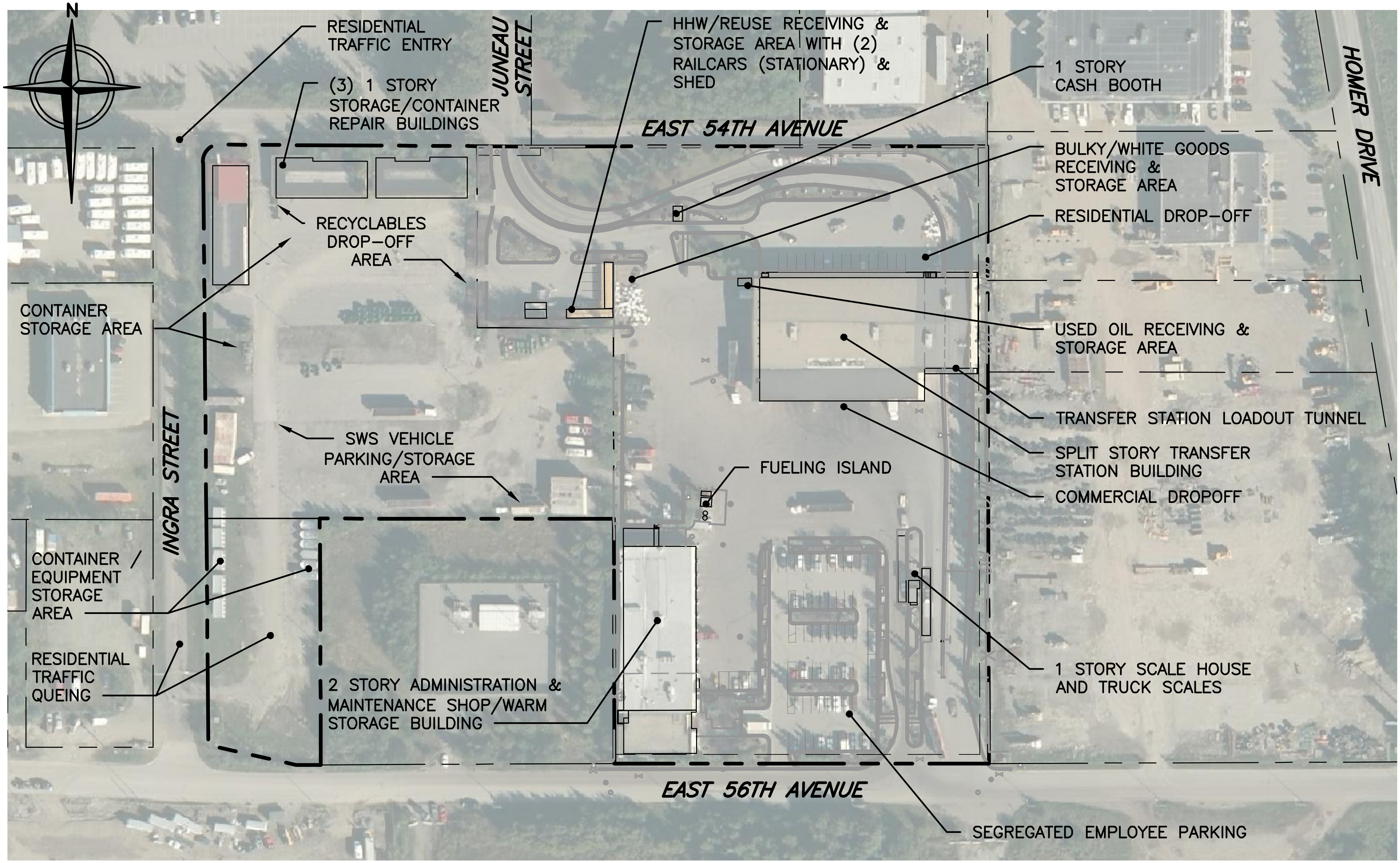

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MUNICIPALITY OF ANCHORAGE
SOLID WASTE SERVICES
CENTRAL TRANSFER STATION

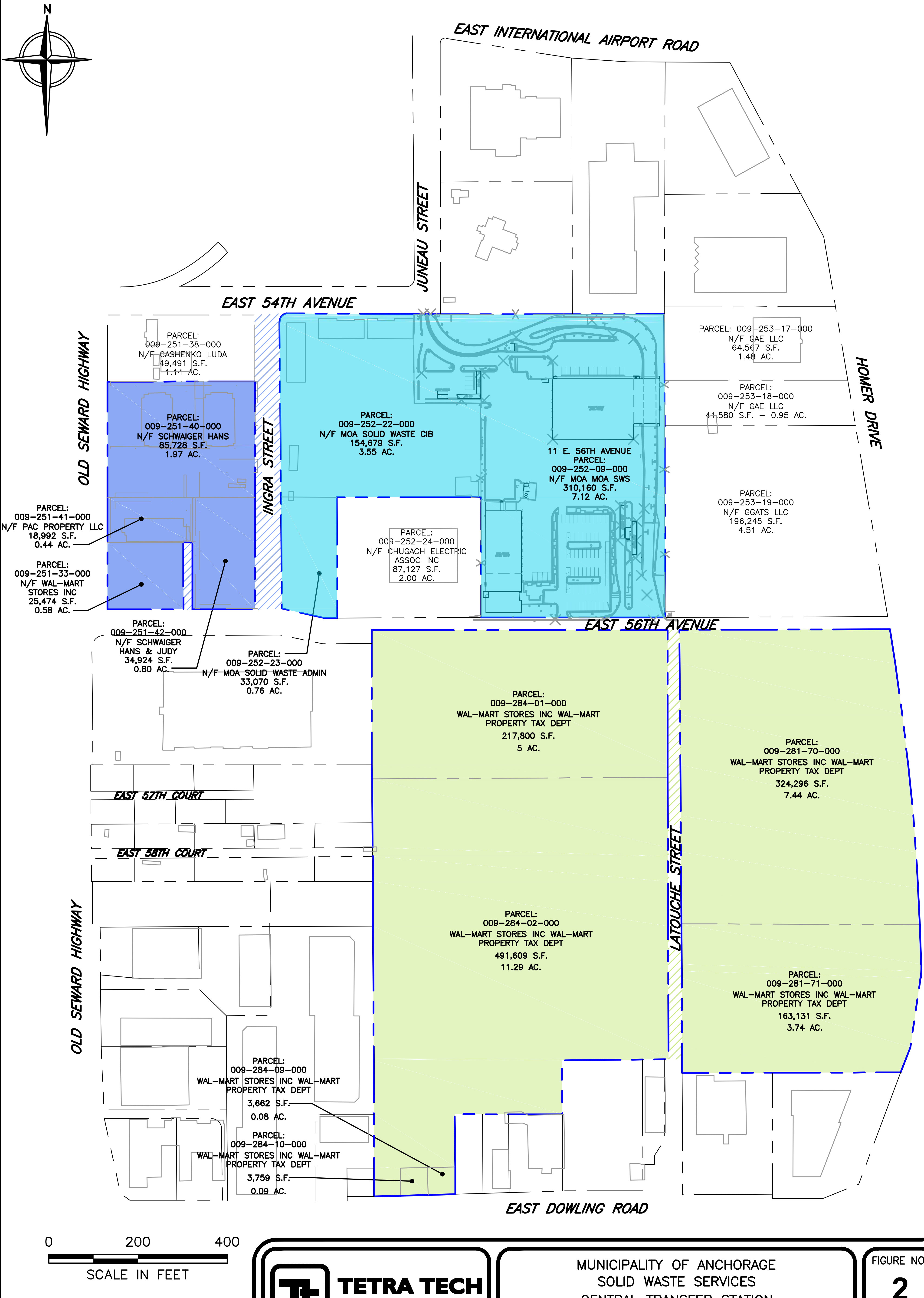
EXISTING CTS SITE PLAN

FIGURE NO.
1

PROJECT NO.
170672

LEGEND:

- EXISTING CTS PROPERTY – CONCEPTUAL PLANS NO. 1 & 2
- POTENTIAL PROPERTY ACQUISITION AND ROW ABANDONMENT (SCHWAIGER, PAC, AND WAL–MART PROPERTIES) – CONCEPTUAL PLAN NO. 1
- POTENTIAL PROPERTY ACQUISITION AND ROW ABANDONMENT (WAL–MART PROPERTIES) – CONCEPTUAL PLAN NOS. 2A & 2B



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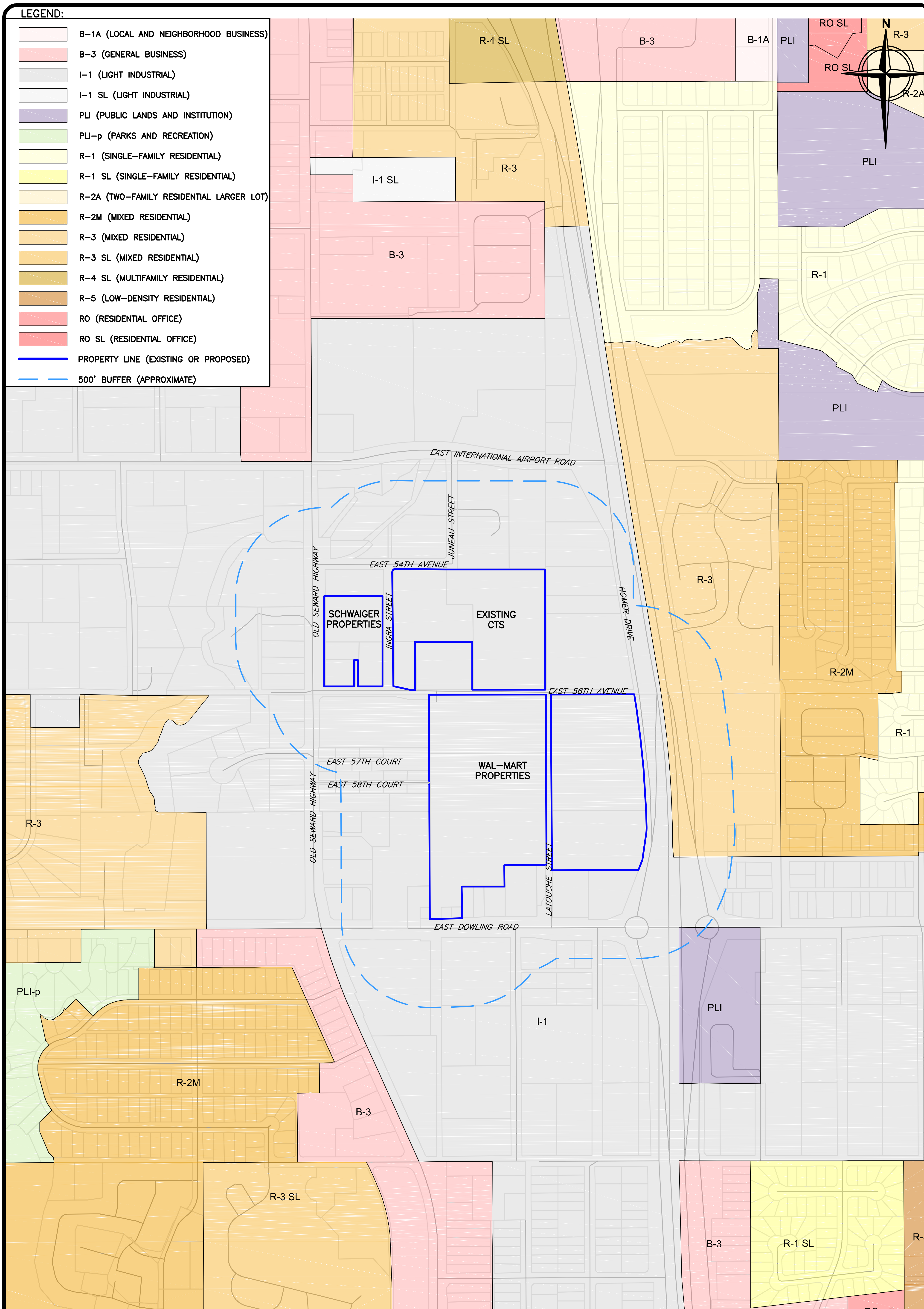
SOLID WASTE SERVICES
CENTRAL TRANSFER STATION

REAL ESTATE MAP

FIGURE NO. 2

PROJECT NO. 170672



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SOLID WASTE SERVICES
CENTRAL TRANSFER STATION

ZONING MAP

FIGURE NO.
3

PROJECT NO.
170672

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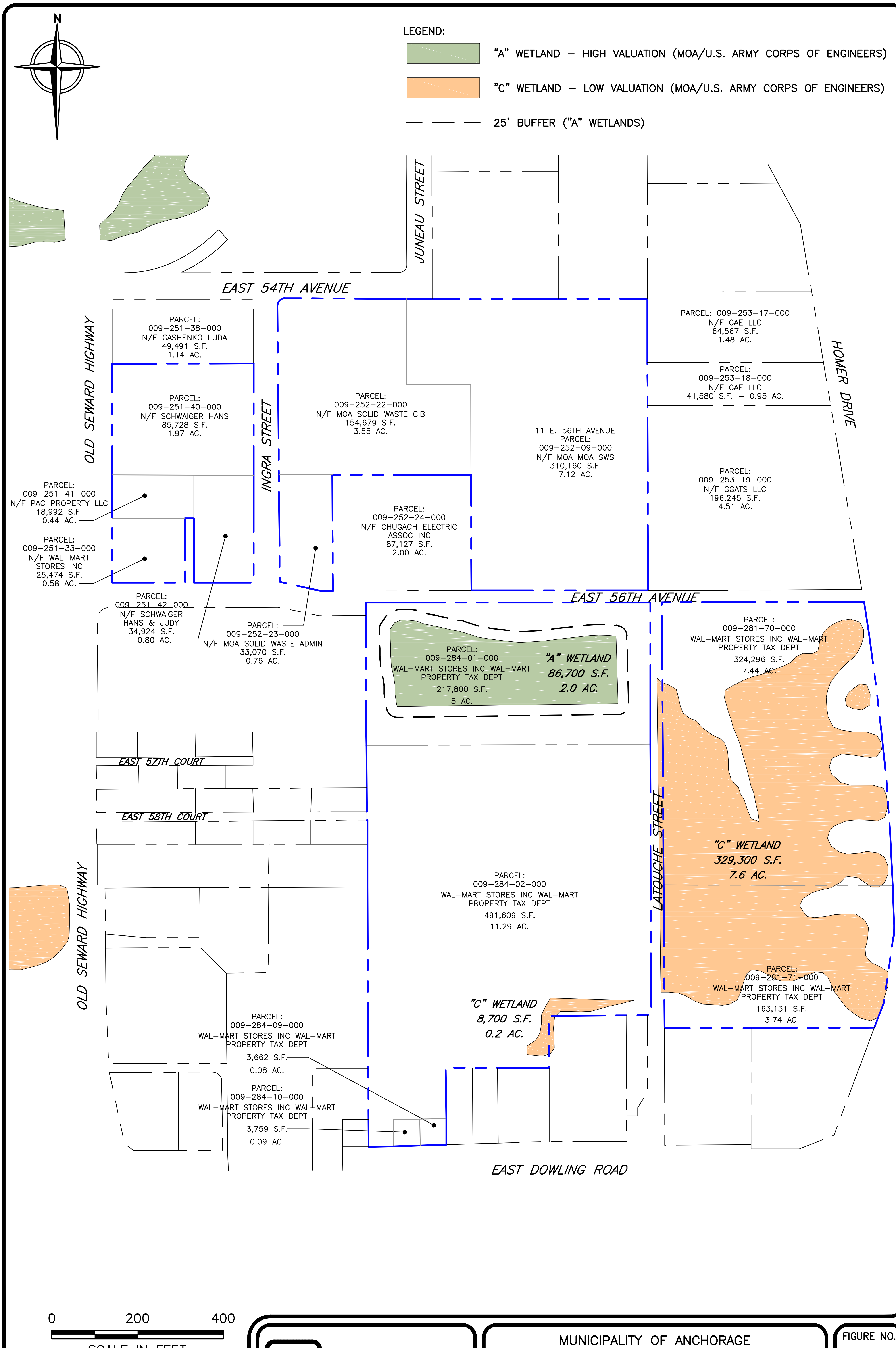

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SOLID WASTE SERVICES
CENTRAL TRANSFER STATION

WETLANDS MAP

FIGURE NO. 4

PROJECT NO. 170672

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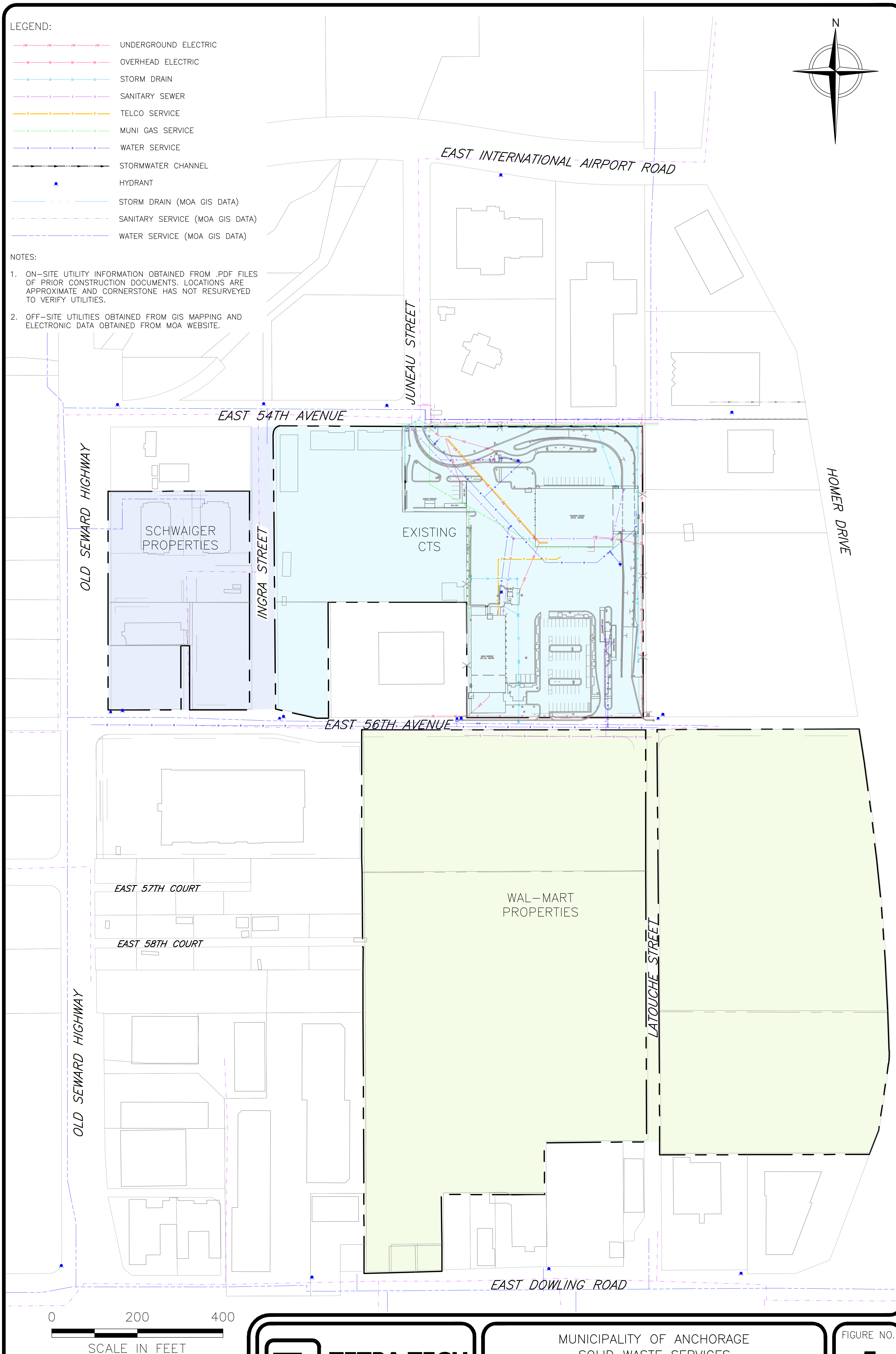

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SOLID WASTE SERVICES
CENTRAL TRANSFER STATION

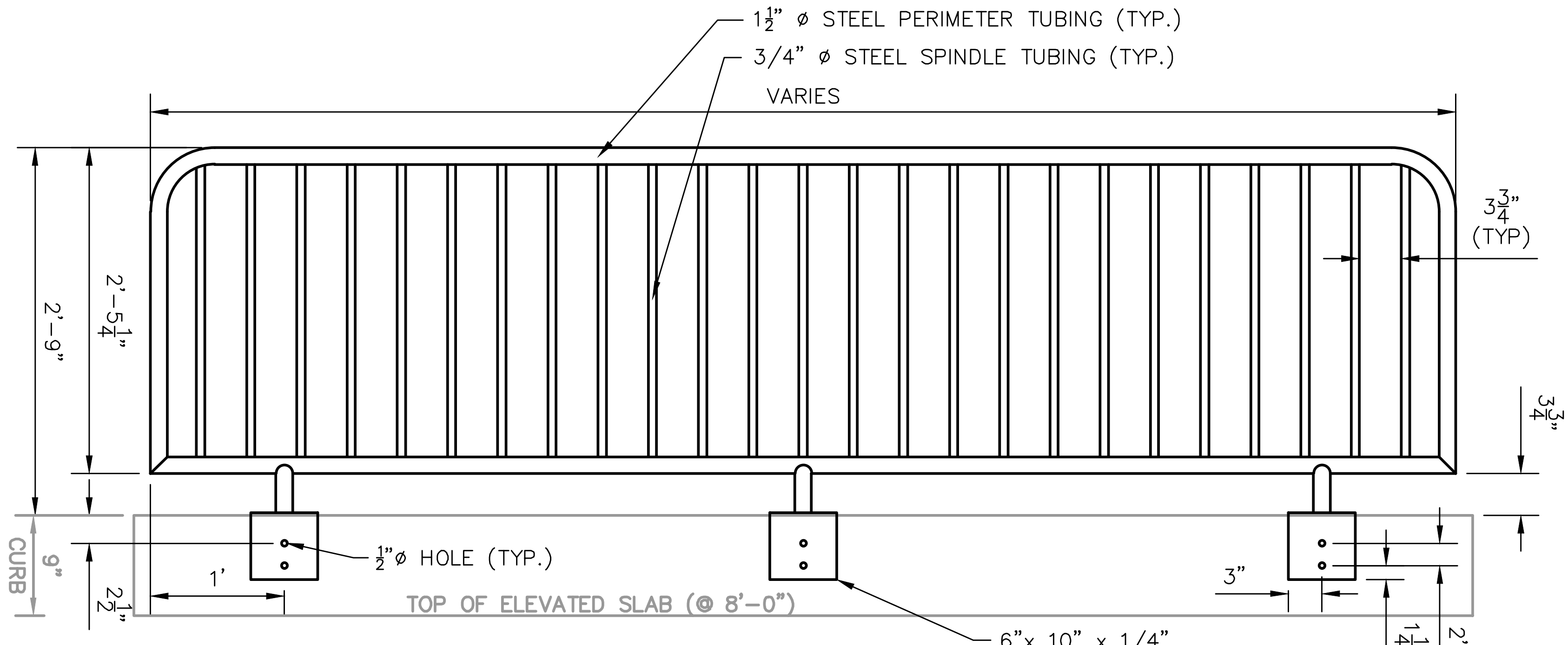
EXISTING UTILITY MAP

FIGURE NO.
5

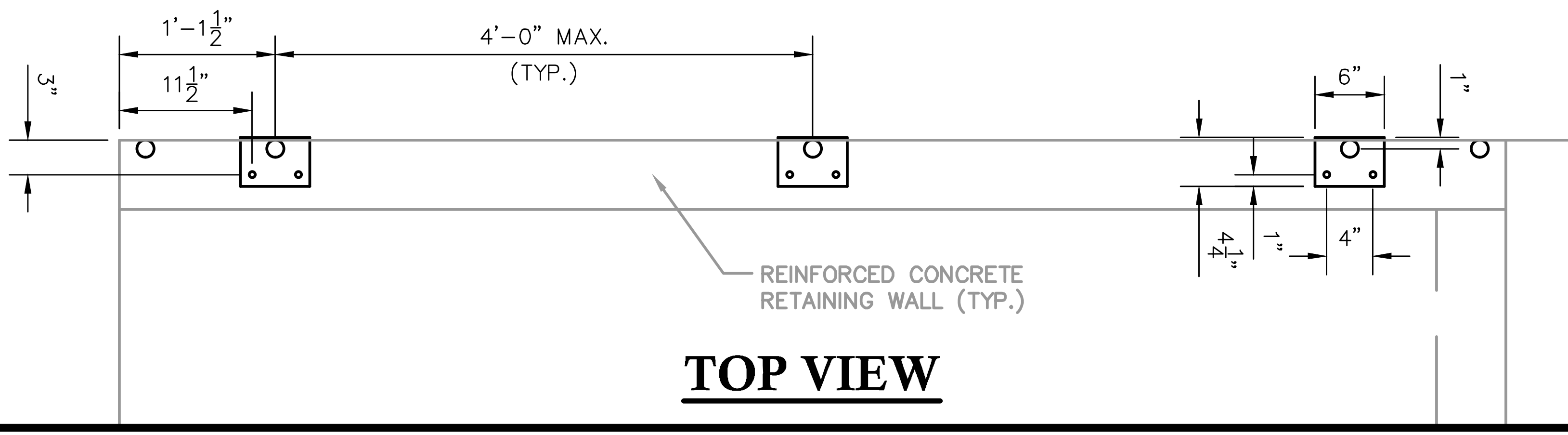
PROJECT NO.
170672

ATTACHMENTS

Attachment 1 – Residential Drop-Off Miscellaneous Metals Details



FRONT VIEW



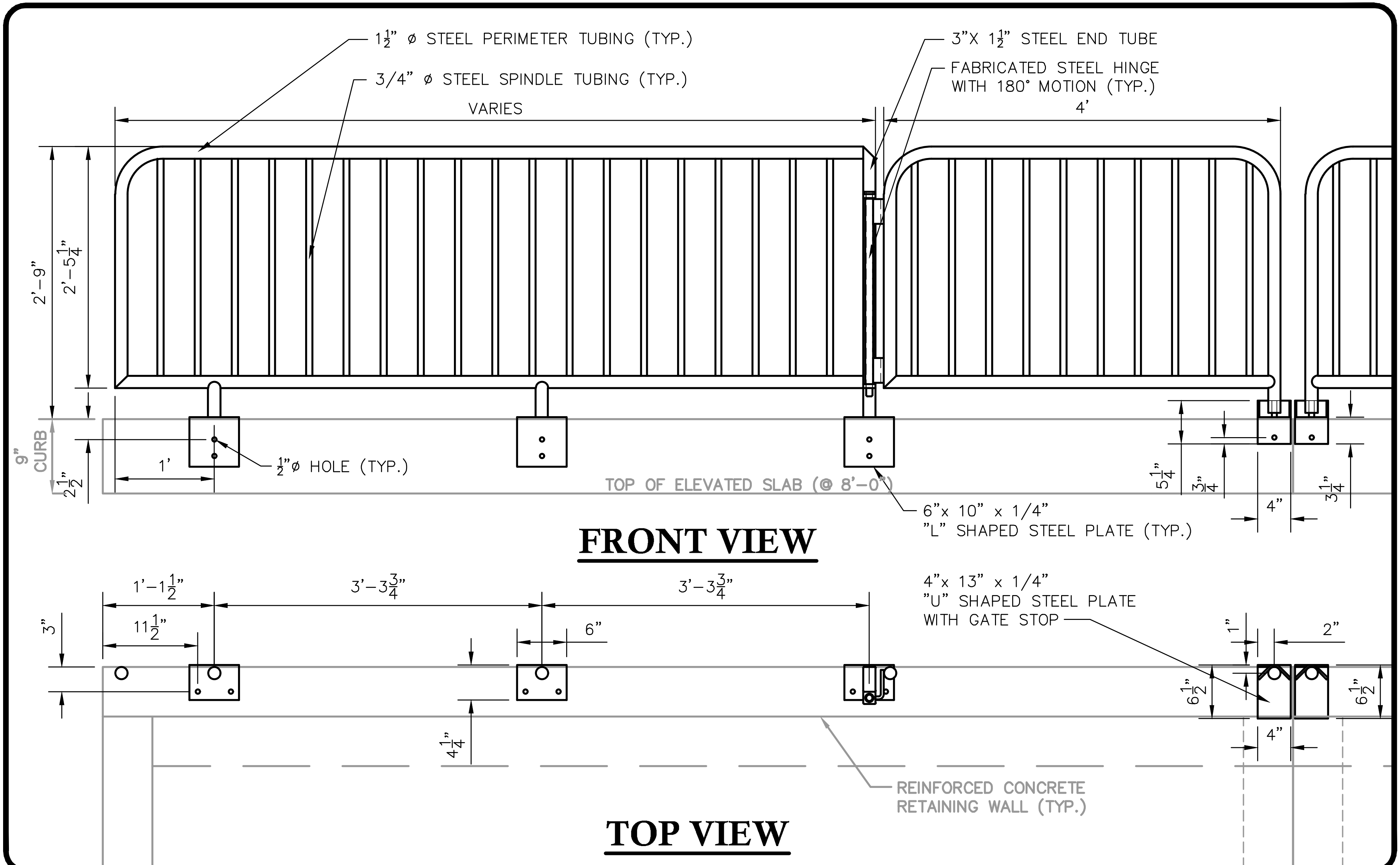
TOP VIEW

TETRA TECH

MUNICIPALITY OF ANCHORAGE
SOLID WASTE SERVICES
CENTRAL TRANSFER STATION
RESIDENTIAL DROP-OFF
TYPICAL RAILING

FIGURE NO.
1

PROJECT NO.
170672



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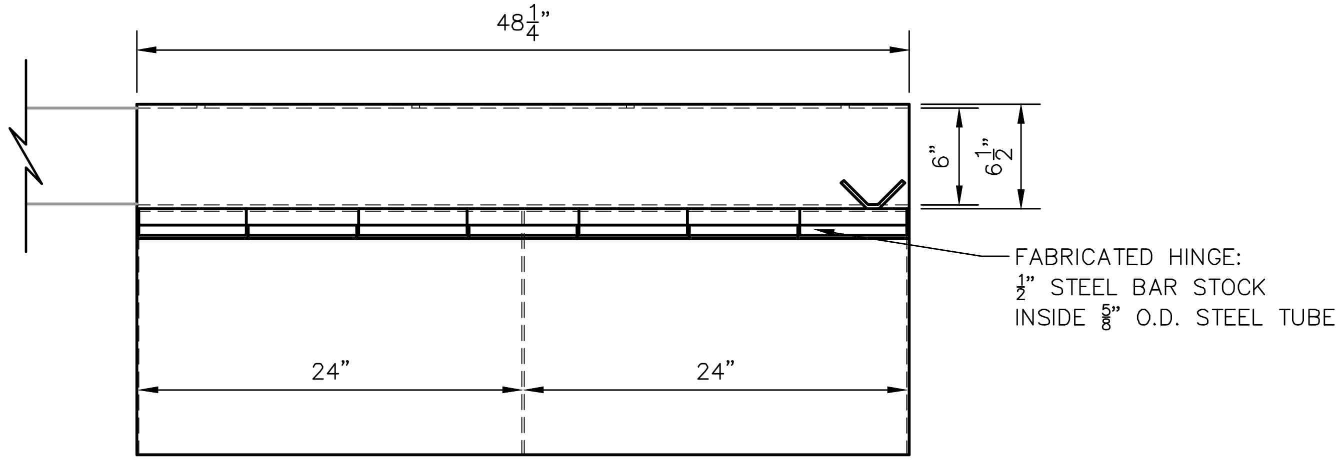
MUNICIPALITY OF ANCHORAGE
SOLID WASTE SERVICES
CENTRAL TRANSFER STATION

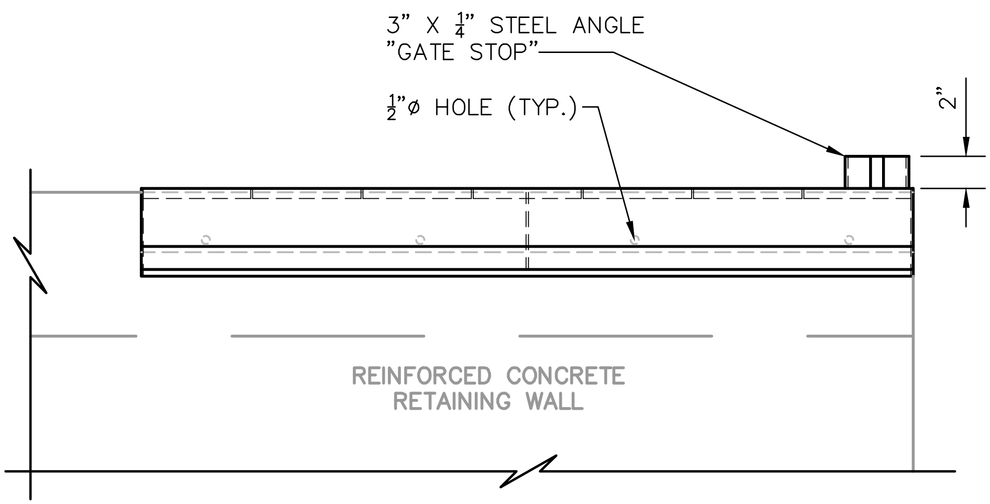
RESIDENTIAL DROP-OFF RAILING WITH SWING GATE

FIGURE NO. 2

PROJECT NO. 170672



TOP VIEW



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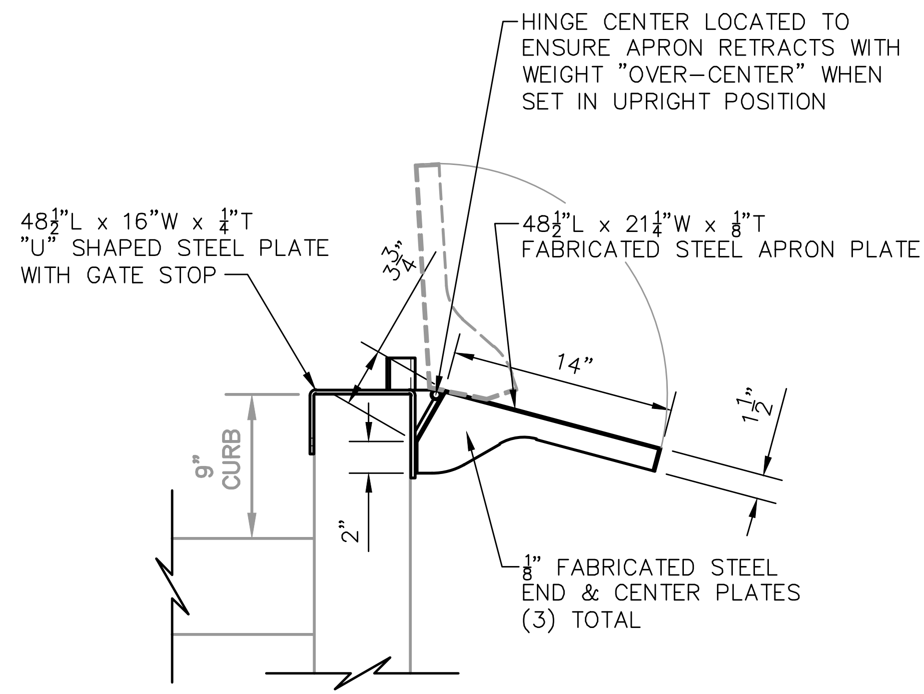

SIDE VIEW

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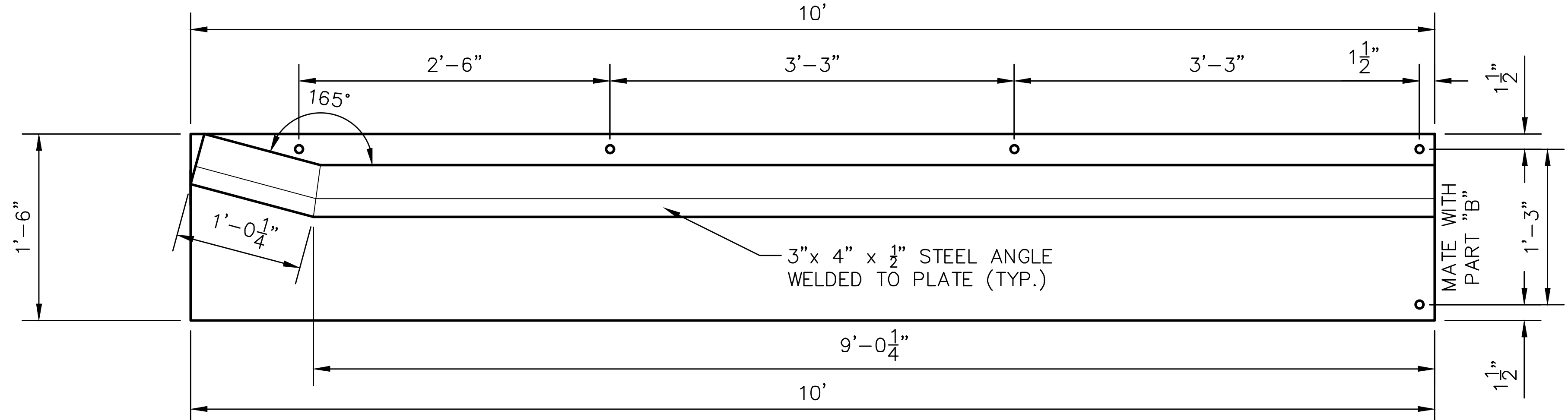
MUNICIPALITY OF ANCHORAGE
SOLID WASTE SERVICES
CENTRAL TRANSFER STATION

RESIDENTIAL DROP-OFF
HINGED APRON FOR SWING GATE

FIGURE NO.
3

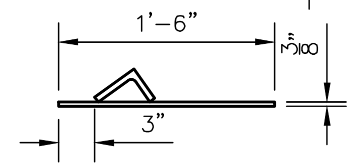
PROJECT NO.
170672



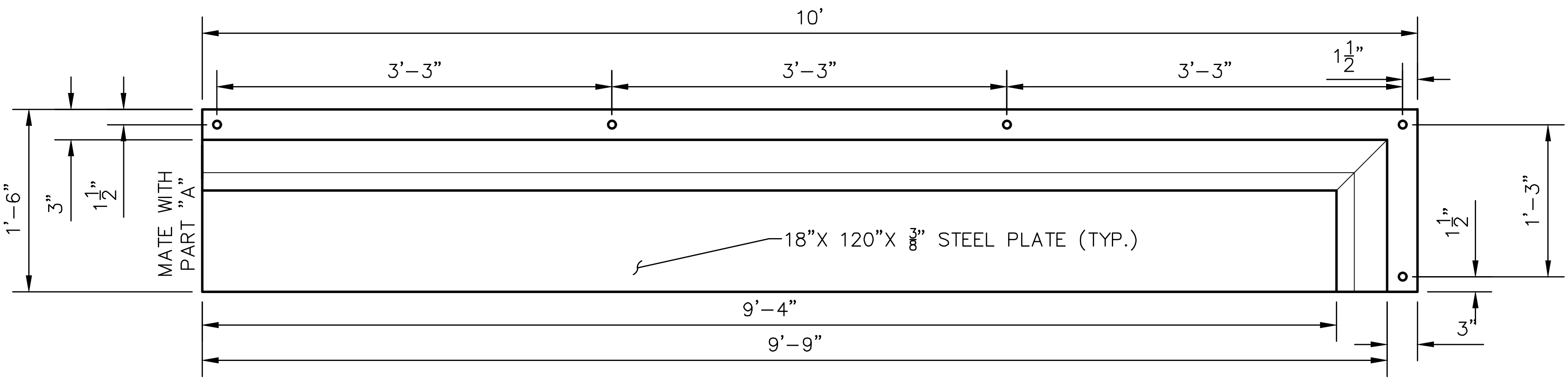
TOP VIEW - PART "A"

NOTE:

DEPICTED PARTS "A" & "B" ARE TYPICAL OF A "RIGHT SIDE" ROLL-OFF GUIDE. INSTALLATION ALSO INCLUDES A "LEFT SIDE" ROLL-OFF GUIDE WHICH IS A MIRROR IMAGE OF THE "RIGHT SIDE" ROLL-OFF GUIDE.



SECTION VIEW



TOP VIEW - PART "B"

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SOLID WASTE SERVICES
CENTRAL TRANSFER STATION

RESIDENTIAL DROP-OFF
ROLL-OFF CONTAINER GUIDE PLATES

FIGURE NO. 4

PROJECT NO. 170672

Attachment 2 – Residential Drop-Off Custom ISO Container Options

CUSTOM ISO CONTAINER OPTIONS

July 2018

Client: MOA Solid Waste Services
Site Name: Central Transfer Station
Project Name: Task 4.1 Conceptual Planning – Central Transfer Station

Example **Transaction Booth ISO Container** **Exterior view with climate controls, windows and access**	
Example **Transaction Booth ISO Container** **Exterior view with climate controls, windows and access**	

20FT OPEN OFFICE PREMIUM

FS-P-20FO-PR

TURN-KEY WORKSPACE WITH HALF BATH

FEATURES AND BENEFITS

- Maximize productivity in tough environments or quickly expand existing facilities
- Convenient half-bath restroom with easily connected plumbing portal
- Support for two workstations in comfortable work environment with climate control and office-grade finish out
- Durable, heavy-duty industrial construction for long useful life
- Quick setup and relocation with easy electrical and plumbing connection and no need for steps, ramps, tie downs, skirting or foundation
- Includes steel personnel door, two windows, plywood walls, insulation, HVAC unit, sink & toilet, overhead lighting, outlets, & 125 ft^2 of workspace

ABOUT FALCON STRUCTURES

Founded in 2003, Falcon Structures creates safe places by re-purposing shipping containers. We provide living, working, and storage solutions for a wide variety of industries including energy, construction, general industry, and the military.

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20' OPEN OFFICE PREMIUM

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FALCON STRUCTURES
V.04122016

SPECIFICATIONS

Exterior

- Cargo doors: inoperable
- (1) 3'W x 6'8" personnel door with lever and deadbolt
- (2) 3'x3' double-pane windows with burglar bars + mini blinds
- Paint: ☐ Tan ☐ Grey ☐ None

Interior

- Office Floor - original marine-grade wood container floor
- Restroom Floor - vinyl flooring and rubber base with 8" raised platform
- Walls - $\frac{1}{4}$" panel over wood stud walls - R-13 Batt. Insul
- Ceiling - $\frac{1}{4}$" panel over wood joists - R19 Batt. Insul
- Interior walls + ceiling painted Dover White
- (1) partition wall with 2'-6" x 6'-8" interior door w/privacy lock

MEP

- (1) 15K PTAC w/ 3kw heat
- (5) 110V duplex outlets
- (1) 110V duplex GFI outlet in restroom
- Recessed electrical
- (2) 4' Fluorescent lights
- (1) 2' Fluorescent lights
- (1) Ext. security light at door
- (1) panel with service disconnect
- Data pass-thru LB connector
- (1) Bathroom exhaust fan
- (1) Sink/vanity w/mirror
- (1) Toilet
- 2.4kW demand water heater

NOTE: UNLESS OTHERWISE NOTED, MOUNTING HEIGHTS OF FIXTURES AND EQUIPMENT WILL BE AT THE DISCRETION OF FALCON STRUCTURES.

Customer Contact:

Customer Approval: Date:

Desired Delivery Date: Falcon Box #:

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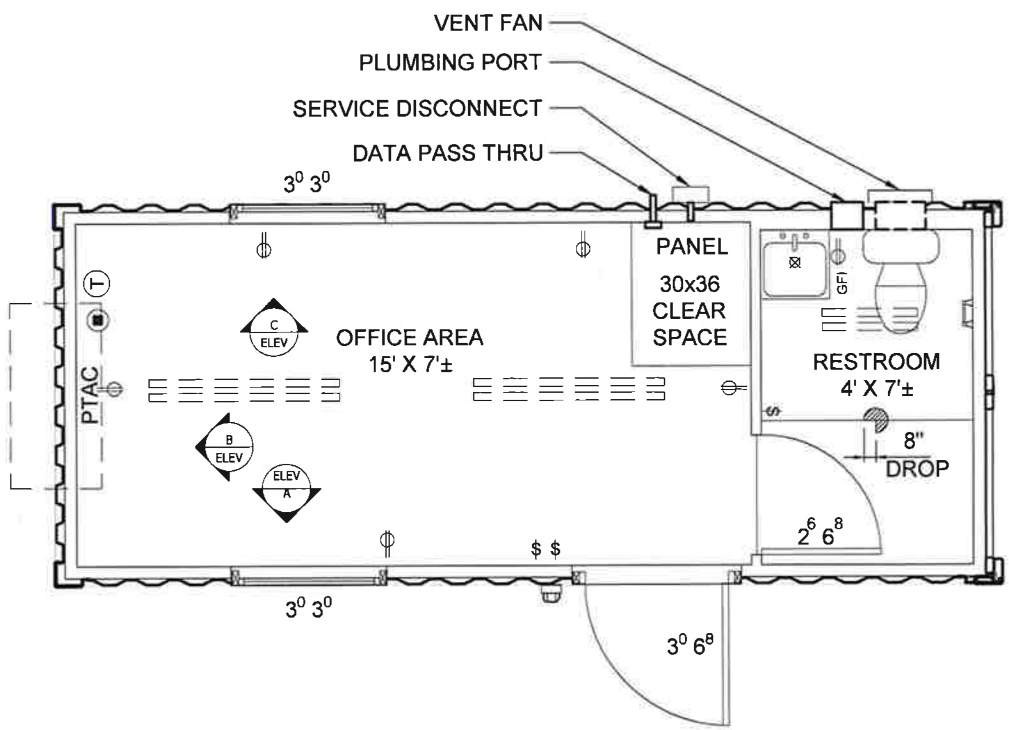

FLOOR PLAN

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Customer Approval:

Date:

20' OPEN OFFICE PREMIUM

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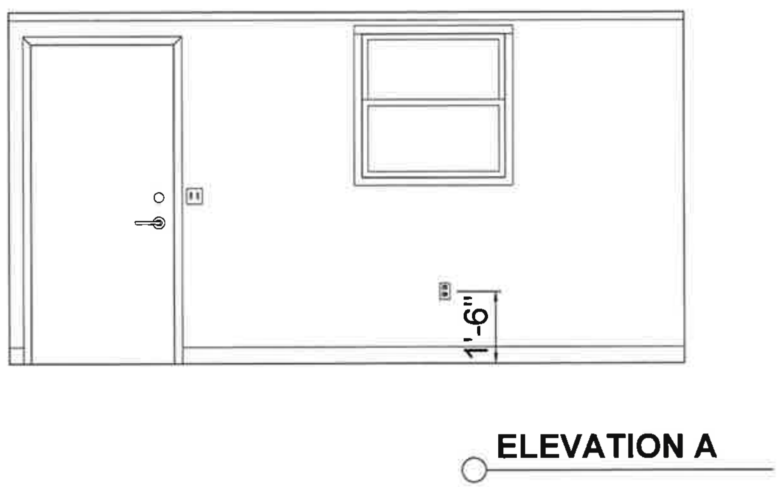

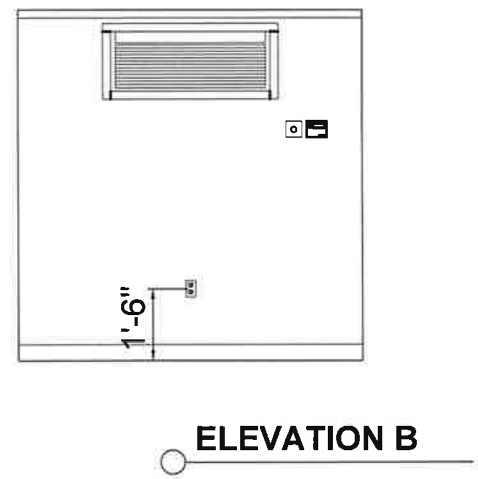

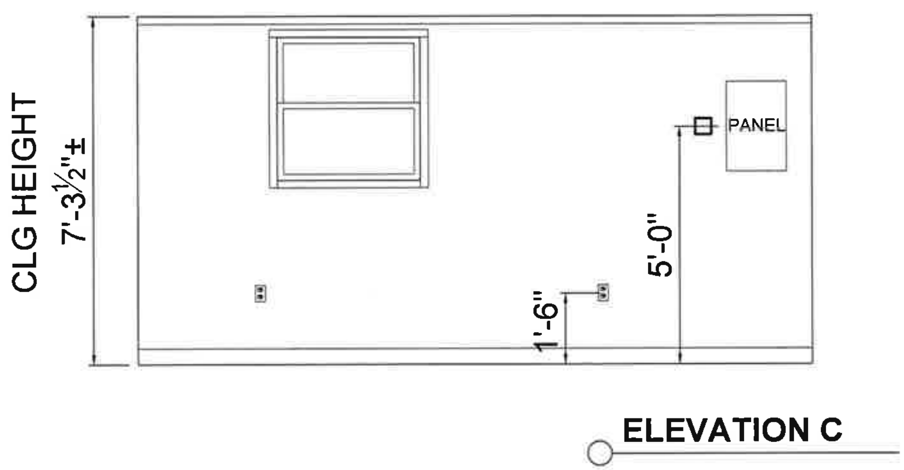

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Customer Approval: Date:

CUSTOM ISO CONTAINER OPTIONS

July 2018

Client: MOA Solid Waste Services
Site Name: Central Transfer Station
Project Name: Task 4.1 Conceptual Planning – Central Transfer Station

Example **Attendant Booth ISO Container** **Exterior view with optional front and side windows**	
Example **Attendant Booth ISO Container** **Interior view of Attendant Booth section**	

CUSTOM ISO CONTAINER OPTIONS

July 2018

Client: MOA Solid Waste Services
Site Name: Central Transfer Station
Project Name: Task 4.1 Conceptual Planning – Central Transfer Station

Example **HHW ISO Container** **Access to HHW storage with raised, grated floor and spill containment tub**	
Example **HHW ISO Container** **Interior view of HHW storage section with raised, grated floor, spill containment tub, and ventilation louver**	

20FT STORE AND WORK BOX

FS-P-20SW-ST

COMBINED WORK & UTILITY SPACE

FEATURES AND BENEFITS

- Consolidate workspace and storage utility space into one container footprint for efficient site utilization
- Comfortable work environment with climate control and office-grade finish out
- Connecting secure, weather-proof storage utility space
- Durable, heavy-duty industrial construction for long useful life
- Quick setup and relocation with easy electrical connection and no need for steps, ramps, tie downs, skirting or foundation
- Includes steel personnel door, two windows, plywood walls, insulation, HVAC unit, overhead lighting, outlets, & 80 ft^2 of workspace

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20' STORE AND WORK

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SPECIFICATIONS

Exterior

- Cargo doors: operable
- (1) 3'W x 6'8" personnel door with lever and deadbolt
- (2) 3'x3' double-pane windows with burglar bars + mini blinds
- Paint: ☐ Tan ☐ Grey ☐ None

Interior

- Floor - original marine-grade wood container floor throughout
- Office walls - $\frac{1}{4}$" panel over wood stud walls - R-13 Batt. Insul
- Office ceiling - $\frac{1}{4}$" panel over wood joists - R19 Batt. Insul
- Interior walls + ceiling painted Dover White in office area
-

MEP

- (1) 15k PTAC w/3kW heat
- (3) 110V duplex outlets
- (1) 110V duplex GFI outlet in storage area
- Recessed electrical
- (1) 4' Fluorescent light
- (1) Ext. security light at door
- (1) panel with service disconnect
- Data pass-thru LB connector

NOTE: UNLESS OTHERWISE NOTED, MOUNTING HEIGHTS OF FIXTURES AND EQUIPMENT WILL BE AT THE DISCRETION OF FALCON STRUCTURES.

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Customer Approval: Date:

Desired Delivery Date: Falcon Box #:

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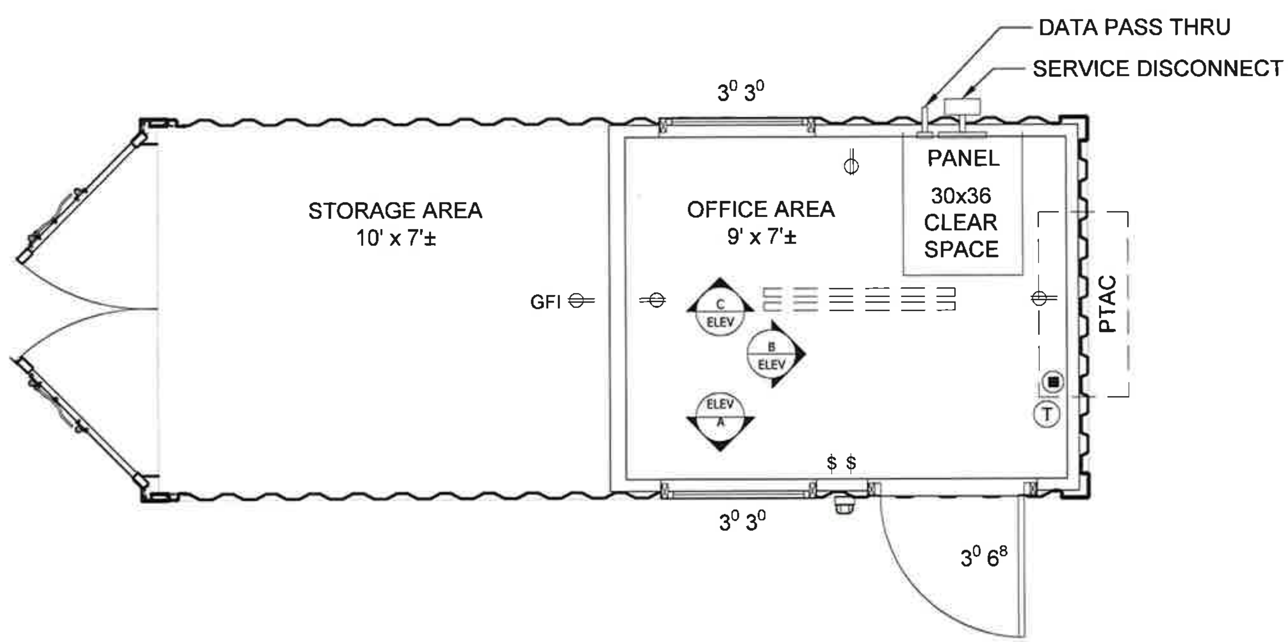

FLOOR PLAN

W I - 2

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Customer Approval:

Date:

20' STORE AND WORK

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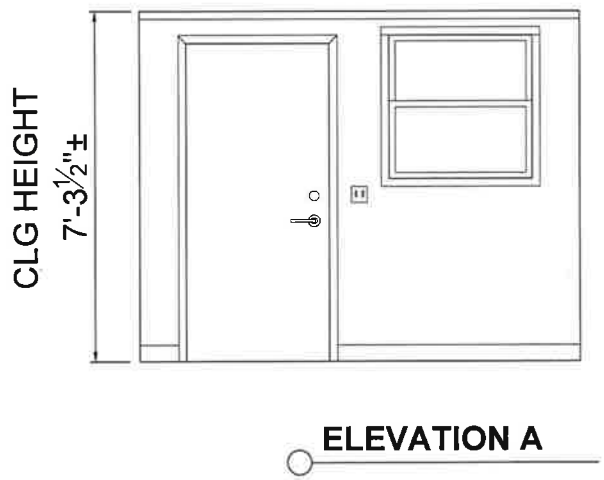

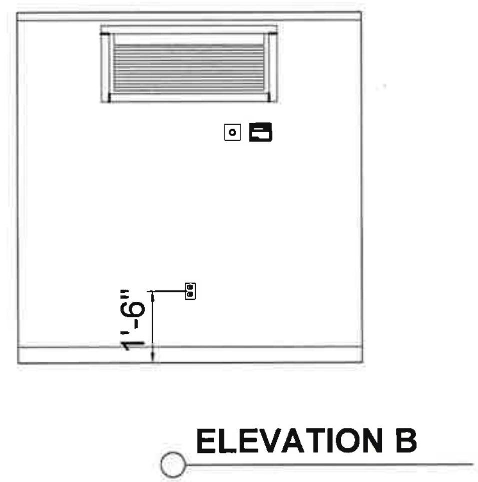

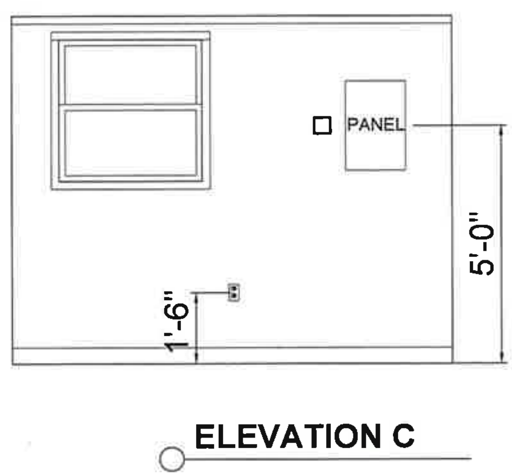

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SHT 3 0F 3

Customer Approval: Date:

CUSTOM ISO CONTAINER OPTIONS

July 2018

Client: MOA Solid Waste Services
Site Name: Central Transfer Station
Project Name: Task 4.1 Conceptual Planning – Central Transfer Station

Example **E-Waste ISO Container** **Interior view**	
Example **E-Waste ISO Container** **Exterior view with optional roll-up and side access door**	

20FT OVERHEAD DOOR BOX

FS-P-20OH-ST

SECURE EASY ACCESS STORAGE

FEATURES AND BENEFITS

- Easy, convenient access to your storage space with 6’ (W) roll-up, overhead doors
- 160 ft^2 of flexible and affordable storage space
- Secure, weather-proof, and rodent-proof storage
- Durable, heavy-duty industrial construction for long useful life
- Quick setup and relocation with no need for foundation

ABOUT FALCON STRUCTURES

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Attachment 3 – Conceptual Cost Estimates

TETRA TECH

Date: August 15, 2018

To: Solid Waste Services (SWS), SWS ISWMP Team

From: Tetra Tech Team

Subject: Task 4.1 Conceptual Planning – Central Transfer Station
Attachment 3 – Conceptual Cost Estimates

Project Understanding

The *Task 4.1 Conceptual Planning, Design Basis Memorandum* for the Central Transfer Station (CTS), prepared for the Municipality of Anchorage (MOA) Department of Solid Waste Services (SWS), describes three (3) Conceptual Site Plans for upgrades to the CTS facilities, as follows:

- Conceptual Pan No. 0 (No Expansion Alternative) – Facilities upgrades on existing CTS properties only.
- Conceptual Plan No. 1 – Facilities upgrades on existing CTS properties, with minor property expansion to the Schwaiger, PAC, and isolated Wal-Mart property.
- Conceptual Plan No. 2 – Facilities upgrades on existing CTS properties and expansion to the larger Wal-Mart properties, proposed in two (2) stages as follows:
    - 2A – Relocation and redesign of the Transfer Station, Administration/Employee Facilities Building, Maintenance Building, Warm Storage Building and supporting assets.
    - 2B – Expansion of Conceptual Plan No. 2A to address long-term goals of SWS for future development of alternative waste conversion/diversion technologies.

Based on discussions and comments from MOA SWS personnel, the above site plans and concepts were refined to address some or all future needs of SWS operations, depending on available real estate, as presented in the Design Basis Memorandum. Based on this conceptual design process, conceptual-level cost estimates have been prepared for Conceptual Plan Nos. 0, 1, and 2A. These conceptual-level cost estimates are provided to MOA SWS to help facilitate financial planning around the future facilities upgrades.

The sections that follow provide an explanation of the basis for these conceptual-level cost estimates and the cost estimates presented by major asset and construction elements.

1 COST ESTIMATE BASIS

The Design Basis Memorandum presents the above conceptual plans at a conceptual level commensurate with limited, available site information and the preliminary nature of the planning-level work performed. The cost estimates, therefore, have been developed to a corresponding conceptual level. More particularly, the costs were estimated using the following resources and premises:

- Costs are estimated separately for each major asset so that MOA SWS can assess costs over time depending on its anticipated implementation schedule for various facilities.
- Costs for property acquisition are excluded from the estimates. However, demolition costs for existing structures on property that may be acquired are included in the estimates based on RSMeans CostWorks software (2017 version). Demolition costs include estimates for removal or abandonment of existing structures, pavement, utilities, vegetation, and topsoil, and provide an allowance for typical environmental abatement during the demolition of existing structures (e.g., asbestos removal).
- Building foundation costs are based RSMeans CostWorks software for major foundation assemblies, and the following assumptions:
    - For Conceptual Plan No. 0 & 1, spread/strip footings similar to existing construction, with an assumed bearing capacity of 2,500 pounds per square foot.
    - For Conceptual Plan No. 2A, while spread/strip footings may be possible, the presence of surcharge fill on a portion of the larger Wal-Mart property indicates the potential for underlying compressible soils, and so, pile foundations have been assumed to a depth no greater than 50 feet.
- Building superstructure costs (not including solid waste specialty assets, see below) were estimated using RSMeans CostWorks software square foot costs representing complete building assemblies, for the closest type of building to the facilities included in the Conceptual Site Plans. Site development of parking lots were also estimated using the RSMeans CostWorks software for parking lot assemblies on a per spot basis.
- For solid waste specialty assets, including existing transfer station improvements, a new transfer station, wheel wash, residential drop off, and roll-cart storage pavilion, for which there are not comparable facilities in the RSMeans CostWorks software, costs were estimated based on Tetra Tech's experience with similar facilities, and prior project bid costs from similar projects.
- Appurtenant building development costs including utilities, stormwater controls, exterior lighting, and landscaping were estimated from RSMeans CostWorks software. This software provides typical costs based on building types and sizes comparable to the conceptual plans. Where appropriate, costs were prorated on a per square foot basis. These costs were also prorated for development of utilities, pavement, stormwater, exterior lighting, and landscaping associated with general site work outside of the building assembly areas.
- Miscellaneous construction costs such as mobilization/demobilization, general conditions, security, bonds, temporary facilities, and the like, were taken as 15 percent of the subtotal of base construction costs.

- For buildings with unique features (e.g., multiple, electric overhead doors) or substantial stationary equipment (e.g., maintenance facility lifts, spray booth, lube, etc.), estimates were included based on costs available from comparable items in RSMeans CostWorks software.
- Fees were included for architectural, engineering, and construction management services based on typical percentages in the RSMeans CostWorks software, and varied from 5 to 10 percent. These are fees associated with the construction of the facilities, and do not include other soft costs which may be incurred, such as permitting or legal.
- RSMeans CostWorks software provides national average costs, and location factors. RSMeans CostWorks identifies a composite (i.e., for various construction trades) location factor for Anchorage of 1.176, and this factor was applied to the national average costs.
- As an additional point of comparison, General Unit Costs (presented in costs per square meter) available from the Naval Facilities Engineering Command (NAVFAC) for various building types were applied to the various building sizes. However, these estimates were used as an order of magnitude check, as there were fewer directly comparable NAVFAC building types given the military nature of the buildings. Of note, also, the Department of Defense identifies a location factor of 2 applied to its national average costs for estimates of construction in Anchorage.
- Site development costs unassociated with a particular building (e.g., utilities, parking lots, fencing, stormwater, non-frost-susceptible fill, overall site grading, landscaping) were estimated as follows:
  - In accordance with the Anchorage Building Code and the Highway Design Manual, the cost estimates include excavation of existing soils under roadways and buildings, then furnishing, placement, and compaction of non-frost-susceptible fill within these areas. Considerations for non-frost-susceptible fill were not included for development on the original CTS property (Parcel 009-252-09-000), as it is assumed that this property is previously developed with adequate soil conditions.
  - Construction costs for rough and fine grading were developed from the RSMeans Site Work and Landscape Costs book (2018).
  - An allowance was made for fencing and gates, based on cost data for perimeter fencing and internal/external gates estimated from the RSMeans Site Work and Landscape Costs book.
- After developing base costs for each individual, major asset, a range was developed using factors typical for assessing a range of costs for conceptual or feasibility study level of development (e.g., AACE International). The range was set by using the base cost as the minimum, applying a 20% contingency factor to the base cost for mid-range, and applying a 40% contingency factor to the base cost for the high-range.

2 COST ESTIMATES

Using the premises and resources described above, the conceptual-level cost estimates are shown in the tables that follow.

Conceptual Plan No. 0

Asset	Conceptual Level Cost Estimate		
	Low	Mid	High
Demolition (CTS Properties)	$640,000	$768,000	$896,000
Site Work (CTS Properties)	$4,110,000	$4,932,000	$5,754,000
HHW, White Goods, E-Waste, and Waste Tire Building	$2,783,000	$3,339,000	$3,896,000
Container Repair Building/Storage	$1,394,000	$1,673,000	$1,951,000
Roll-Cart/Roll-Off Container Storage Pavilions	$1,507,000	$1,808,000	$2,110,000
Transfer Station Refurbishment	$10,848,000	$13,017,000	$15,187,000
Wheel Wash	$413,000	$496,000	$579,000
Refueling Area	$206,000	$248,000	$289,000
TOTALS	$21,901,000	$26,281,000	$30,662,000

Conceptual Plan No. 1

Asset	Conceptual Level Cost Estimate		
	Low	Mid	High
Demolition (Schwaiger Properties)	$554,000	$665,000	$776,000
Site Work (Schwaiger Properties)	$3,468,000	$4,162,000	$4,856,000
Administration & Employee Facilities Building	$6,020,000	$7,224,000	$8,428,000
Maintenance Shop	$3,727,000	$4,473,000	$5,218,000
Warm Storage Building	$4,171,000	$5,005,000	$5,840,000
Refueling Area	$206,000	$248,000	$289,000
Demolition (CTS Properties)	$998,000	$1,198,000	$1,397,000
Site Work (CTS Properties)	$3,859,000	$4,631,000	$5,402,000
Residential Drop-Off	$3,809,000	$4,571,000	$5,333,000
HHW, White Goods, E-Waste, and Waste Tire Building	$2,783,000	$3,339,000	$3,896,000
Container Repair Building/Storage	$1,394,000	$1,673,000	$1,951,000
Roll-Cart/Roll-Off Container Storage Pavilions	$1,507,000	$1,808,000	$2,110,000
Transfer Station Refurbishment	$10,848,000	$13,017,000	$15,187,000
Wheel Wash	$413,000	$496,000	$579,000
Refueling Area	$206,000	$248,000	$289,000
Operations Equipment Enclosure	$1,438,000	$1,725,000	$2,013,000
TOTALS	$45,401,000	$54,483,000	$63,564,000

Conceptual Plan No. 2A

Asset	Conceptual Level Cost Estimate		
	Low	Mid	High
Demolition (Initial Wal-Mart Properties)	$221,000	$266,000	$310,000
Site Work (Initial Wal-Mart Properties)	$4,413,000	$5,296,000	$6,179,000
Transfer Station Building	$18,836,000	$22,604,000	$26,371,000
Scale Booth and Truck Scales	$661,000	$793,000	$926,000
Small Contractor Cash Booth	$139,000	$167,000	$195,000
Wheel Wash	$413,000	$496,000	$579,000
Operations Equipment Enclosure	$1,634,000	$1,960,000	$2,287,000
Demolition (CTS Properties)	$627,000	$752,000	$877,000
Site Work (CTS Properties)	$5,991,000	$7,189,000	$8,387,000
Residential Drop-Off	$3,991,000	$4,789,000	$5,587,000
HHW, White Goods, E-Waste, and Waste Tire Building	$2,783,000	$3,339,000	$3,896,000
Container Repair Building/Storage	$1,394,000	$1,673,000	$1,951,000
Roll-Cart/Roll-Off Container Storage Pavilions	$1,507,000	$1,808,000	$2,110,000
Refueling Area	$206,000	$248,000	$289,000
Site Work (Wal-Mart Properties)	$4,660,000	$5,592,000	$6,524,000
Administration & Employee Facilities Building	$6,346,000	$7,615,000	$8,885,000
Maintenance Shop	$4,176,000	$5,012,000	$5,847,000
Warm Storage Building	$4,749,000	$5,699,000	$6,648,000
Refueling Area	$279,000	$335,000	$391,000
TOTALS	$63,026,000	$75,633,000	$88,239,000

DRAWINGS

REV	DATE	DESCRIPTION	DWN BY	DES BY	CHK BY	APP BY

DATE OF ISSUE AUGUST 2018
DRAWN BY ____ CHECKED BY ____
DESIGNED BY ____ APPROVED BY ____

TETRA TECH

ALL PROFESSIONAL ENGINEERING WORK IS PERFORMED BY DULY LICENSED PROFESSIONAL ENGINEERS UNDER THE APPROPRIATE STATE REGISTERED PROFESSIONAL ENTITY.

MUNICIPALITY OF ANCHORAGE
SOLID WASTE SERVICES
CENTRAL TRANSFER STATION

CONCEPTUAL SITE PLAN NO. 0
NO EXPANSION ALTERNATIVE

SHEET NO. 0

PROJECT NO. 170672

REV	DATE	DESCRIPTION	DWN BY	DES BY	CHK BY	APP BY

DATE OF ISSUE AUGUST 2018
DRAWN BY ____ DESIGNED BY ____
CHECKED BY ____ APPROVED BY ____

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MUNICIPALITY OF ANCHORAGE
SOLID WASTE SERVICES
CENTRAL TRANSFER STATION

CONCEPTUAL SITE PLAN NO. 1
FACILITY UPGRADES

SHEET NO. 1

PROJECT NO. 170672

REV	DATE	DESCRIPTION	DWN BY	DES BY	CHK BY	APP BY

DATE OF ISSUE AUGUST 2018
DRAWN BY
DESIGNED BY
CHECKED BY
APPROVED BY

TETRA TECH

MUNICIPALITY OF ANCHORAGE
SOLID WASTE SERVICES
CENTRAL TRANSFER STATION

CONCEPTUAL SITE PLAN NO. 2A
FACILITY EXPANSION

SHEET NO. **2A**

PROJECT NO. 170672

APPENDIX F

ALTERNATIVE TECHNOLOGIES ASSESSMENT

Alternative Technologies Assessment

PREPARED FOR:

Municipality of Anchorage Solid Waste Services

SEPTEMBER 2018

FINAL

Tetra Tech

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TABLE OF CONTENTS

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ACRONYMS & ABBREVIATIONS

Acronyms/Abbreviations	Definition
AAC	Alaska Administrative Code
AD	Anaerobic Digestion
ADEC	Alaska Department of Environmental Conservation
AMC	Anchorage Municipal Code
APDES	Alaska Pollutant Discharge Elimination System
ARL	Anchorage Regional Landfill
Btu/scf	British Thermal Units/Standard Cubic Foot
CAA	Clean Air Act
CFR	Code of Federal Regulations
CH_4	Methane
C:N	Carbon to Nitrogen Ratio
CO_2	Carbon Dioxide
CTS	Central Transfer Station
CUP	Conditional Use Permit
CWA	Clean Water Act
EPA	Environmental Protection Agency
F	Fahrenheit
GHG	Greenhouse Gas
HHV	High Heat Value
HAP	Hazardous Air Pollutants
Mg/dscm	Milligrams per Dry Standard Cubic Meter
MOA	Municipality of Anchorage
MSW	Municipal Solid Waste
N_2	Nitrogen
NESHAP	National Emission Standard for Hazardous Air Pollutants
Ng/dscm	Nanograms per Dry Standard Cubic Meter
NSPS	New Source Performance Standards
Ppmv	Parts per Million Volume
RNG	Renewable Natural Gas
SSO	Source Separated Organics
USEPA	United States Environmental Protection Agency
TDU	Thermal Desorption Unit

TPD	Tons per Day
TPY	Tons per Year
WTE	Waste-to-Energy

1.0 INTRODUCTION

Tetra Tech was retained by the Municipality of Anchorage (MOA) Solid Waste Services Department to provide information on alternative technologies that could be used to process the MOA's municipal solid waste (MSW). Alternative technologies for managing MSW are those technologies that are technically more advanced, produce beneficial end products and/or are more protective of the environment than traditional landfill disposal practices. In the case of the MOA, these facilities could use different technologies for processing MSW that would divert materials from the Anchorage Regional Landfill (ARL) thereby extending the life of the landfill which is a valuable resource for the community.

The objective of this study is to provide an overview of the various landfill disposal alternative technologies and the permitting and financial considerations associated with implementing these technologies to divert materials from the landfill. The study also involves examining the feedstock, the amount of MSW and the types of available materials that could be processed. Two types of alternative technologies – thermal treatment and biological processing technologies – will be evaluated. Both types of technologies would process MSW and convert the materials into usable end-products, such as energy and soil amendments. A high-level financial analysis was performed for selected scenarios based on waste composition data and analysis of waste flows from various generators in the Anchorage area.

2.0 THERMAL TREATMENT TECHNOLOGIES

2.1 Technology Types

This section explores several types of thermochemical conversion technology systems that are capable of processing MOA's combustible feedstock. Thermochemical conversion technologies primarily use heat and oxygen (or air) to breakdown material via thermal chemical reactions. The higher the operating temperature (large amounts of heat), the faster the thermal reaction. Similarly, more oxygen (or air, that consists of 21% oxygen) usage correlates to faster reaction rates up to a certain level.

2.1.1 Mass Burn

Combustion, also referred to as mass burn or incineration, is defined as the burning of fuel to produce heat and subsequently power. Combustion occurs with oxygen in slight stoichiometric excess to rapidly complete a thermal oxidation reaction. The products of combustion are heat, an ash residue, and an off gas made up of predominantly nitrogen (N_2), carbon dioxide (CO_2), and water vapor. The off gas must be treated to meet regulatory emission requirements for chemical pollutants and particulates. Combustion is an exothermic (net heat output) process; therefore, the technology lends itself to heat recovery in many applications. Heat generation can be used in boilers or converted to power via turbines. The combustion process is highly developed commercially and is available in numerous vendor specific designs.

The most common direct combustion technology for biomass is stoker boiler technology. Various forms of stoker boilers have been employed since the 1920s. Stoker boilers employ direct fire combustion of solid fuels with excess air, producing hot flue gases, which then heats water to produce steam in the heat exchange section of the boiler. The steam is used directly for heating purposes or passed through a steam turbine generator to produce electricity. The energy recovery capabilities of the boiler system can be further enhanced when excess heat is used in a district heating/energy infrastructure. While this technology is conventional and well proven, it is not as environmentally friendly as other alternative technologies. This type of technology typically produces more fly ash and air emissions than other technologies, which usually requires close monitoring and management. Combustion technologies can process most types of MSW, but operate more efficiently with dry feedstock materials that have medium to high calorific value. Figure 2-1 illustrates the process flow of municipal solid waste through the Metro Vancouver mass burn waste to energy facility.

Mass burn technologies have the ability to process biosolids from wastewater treatment plants. Depending on the moisture content of the biosolid, a mass burn facility can process biosolids up to 20% of the plant's design capacity. Generally, mass burn facilities are able to process more biosolids the lower the moisture content.

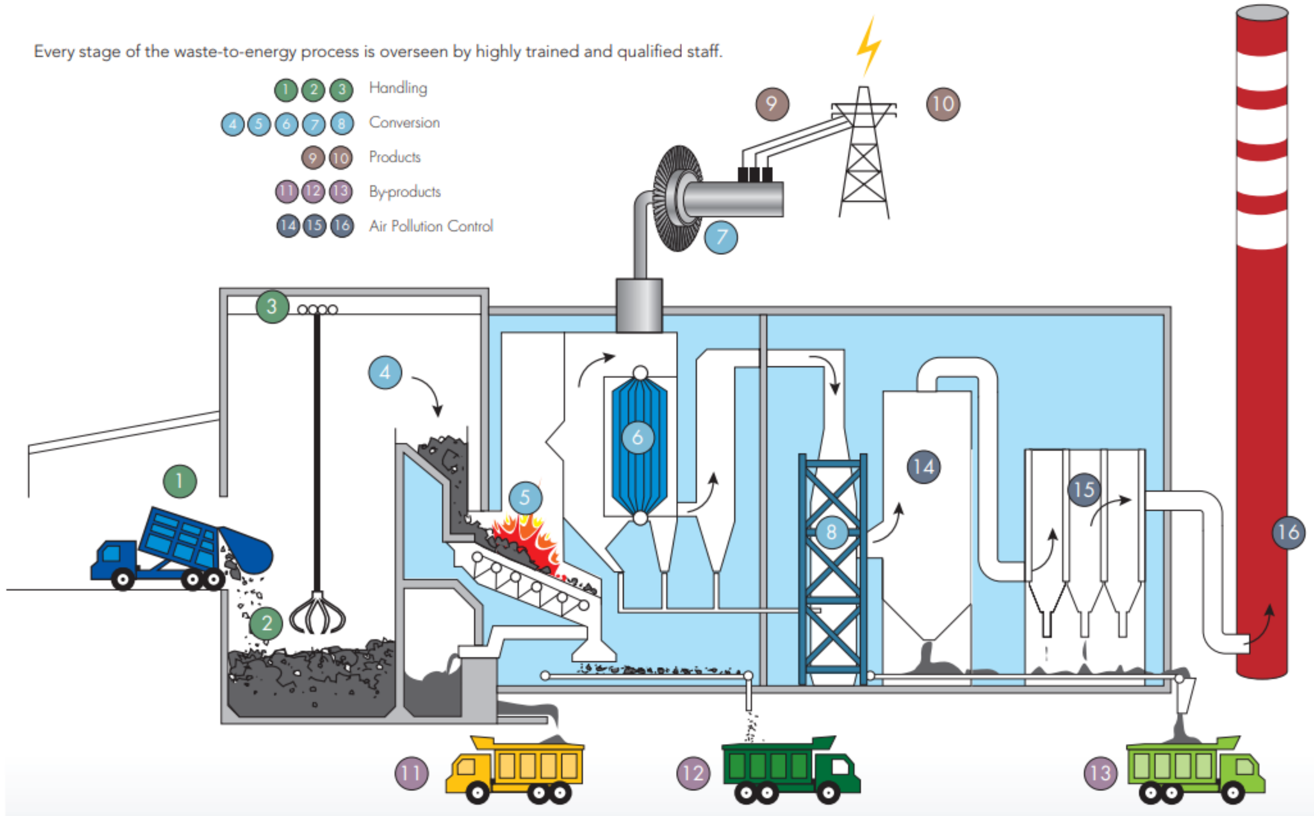


Figure 2-1: Mass Burn Waste to Energy (WTE) Facility Diagram - Metro Vancouver WTE (285,000 tons per year (tpy), 21 MW)

2.1.2 Controlled Air or Hybrid Gasification

In controlled air systems or hybrid gasification systems, a synthetic gas or 'syngas', is created from the conversion of combustibles in an oxygen starved pre-burn chamber. This syngas is then directed and burned in a second combustion chamber. The syngas generated is more combustible than the solid carbon material (such as wood), thus improving overall combustion efficiency and generating a cleaner burn. Advanced combustion systems have high heat value (HHV) basis boiler efficiencies that approach 78% for green biomass. Despite their increased efficiency, these systems are not always financially comparable to stoker boiler systems due to the increased complexity and maintenance needs to operate these systems and higher residuals volumes that need to be disposed in a landfill.

Advanced combustion is an emerging hybrid combustion/gasification methodology that results in higher combustion efficiency and less emissions as compared to traditional combustion and is a lower cost option than full gasification technologies. This technology is also best suited to process MSW and dry material.

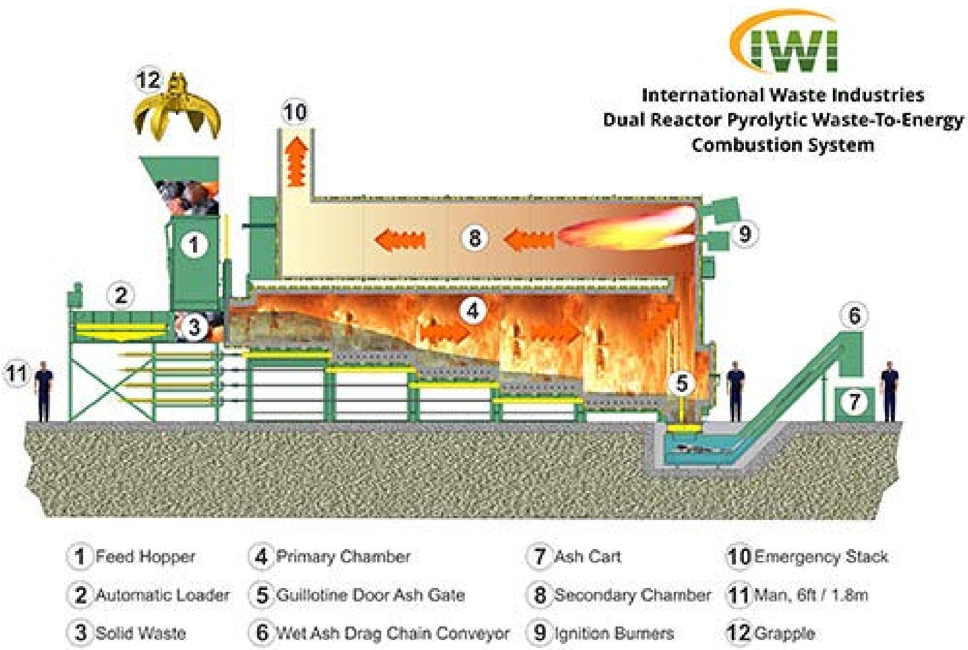


Figure 2-2 shows the schematic of a hybrid gasification or controlled air combustion process.

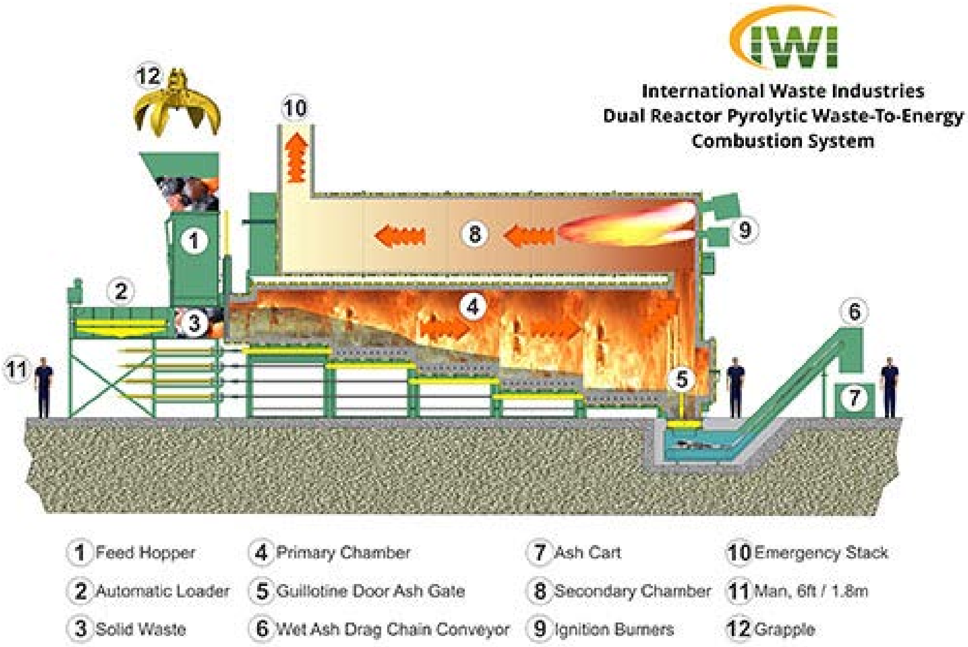


Figure 2-2: Hybrid Gasification System Diagram

2.1.3 Gasification

Gasification is a partial combustion process in an oxygen-deficient atmosphere (i.e., the oxygen level is limited to convert the solid material). The resulting products are a carbon-rich ash and a syngas stream. The syngas is composed of various gases – hydrogen, carbon dioxide, and other trace gas. Gasification processes that use pure oxygen are able to obtain higher syngas energy content (300 to 380 British thermal units/standard cubic foot (Btu/scf)) as a result of the elimination of the nitrogen present in atmospheric air. While gasification is a more complex technology, it allows for the recovery of value products (i.e., syngas) which can be used to generate chemicals (fuels, alcohols, etc.). Catalytic conversion via the Fischer-Tropsch process and other methods can also be used to generate "drop-in" biofuels such as synthetic gasoline, renewable natural gas (RNG) and diesel. The syngas can also be used to drive gas engines and turbines to generate electricity that could be used internally or exported to a local electricity grid.

The benefits of gasification are considered to be increased efficiency, greater variety of end products, and fewer back-end pollution control requirements. Commercially, gasification technologies have not proven to be economically and operationally comparable to traditional combustion processes such as mass burn because of its high complexity and high capital costs.

This technology is best suited to processing homogeneous materials that are pre-shredded and have a medium to high energy content such as biomass, plastics and shredded tires. However, there are still challenges that affect continuous and reliable operation of the facility.

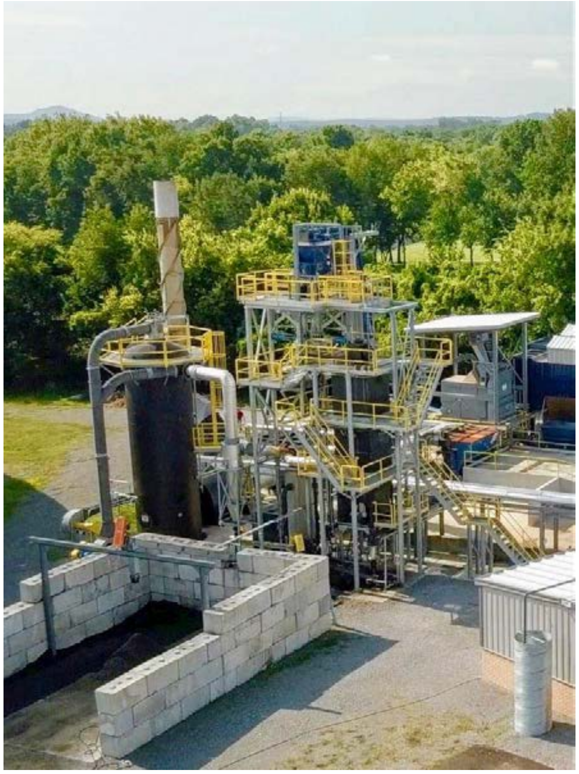


Figure 2-3: Gasification Plant in Lebanon, Tennessee (64 tpd, 1.8M kWh)

This technology is more complex and more expensive than other thermo-chemical technologies, and has limited proven commercial viability and success. Figure 2-3 shows the external view of a gasification plant operating in Lebanon, Tennessee. There is also another facility that is not fully operational in Edmonton, Alberta that is designed to process 100,000 tpy of MSW.

The ash produced is considered carbon rich and potentially has market value. Using MSW as a feedstock results in an ash material that likely contains inert materials that would affect the marketability of the end product. It remains to be seen whether a market for the ash end product exists. The lack of commercially proven facilities and markets using this type of material makes it difficult to identify suitable markets for the end products.

2.1.4 Other Technologies

Pyrolysis

Pyrolysis is similar to gasification except for the source of heat. A pyrolysis system uses an external source of heat to drive the process whereas gasification uses the heat from the waste generated inside the reaction chamber. Generally, gasification is configured to maximize the production of gaseous fuel, while pyrolysis is optimized to produce liquid fuel.

Pyrolysis technologies are best suited for pre-dried fuels, as heat is generated from external fuel sources. These technologies are considered unsuitable for the MOA, as they have some capacity limitations and are typically less efficient compared to other technologies.

Plasma Arc Gasification

Plasma arc gasification uses extremely high temperatures in low oxygen to gasify waste into hydrogen, methane, and other potential fuels. High temperatures are created by running an electric current through a low pressure gas stream, producing a plasma stream at 9,000 °F – 27,000 °F. The products of this process are a recyclable slag and combustible gases. The slag produced by this process is inert and will not leach metals or other contaminants into the environment.

While this technology is commonly used in other industries, applications in solid waste management are limited to hazardous wastes and other materials such as medical waste that justify the high capital and operating costs. Costs are high due to the specialized materials, energy and maintenance required to produce and maintain the high temperatures.

2.2 Thermal Treatment Summary

Table 2-1 summarizes the system capacity, input, and output considerations related to thermal technologies discussed, while Table 2-2 provides cost comparisons for the systems. As noted in Table 2-1, the gasification technology has limitations because only a few full-scale operational facilities exist and the high capital and operating costs that impact economic feasibility. Mass burn is considered the more commercially proven thermal treatment technology and most suitable for the MOA.

Table 2-1: Comparison of Technology Capacity, Feedstocks, and Suitability

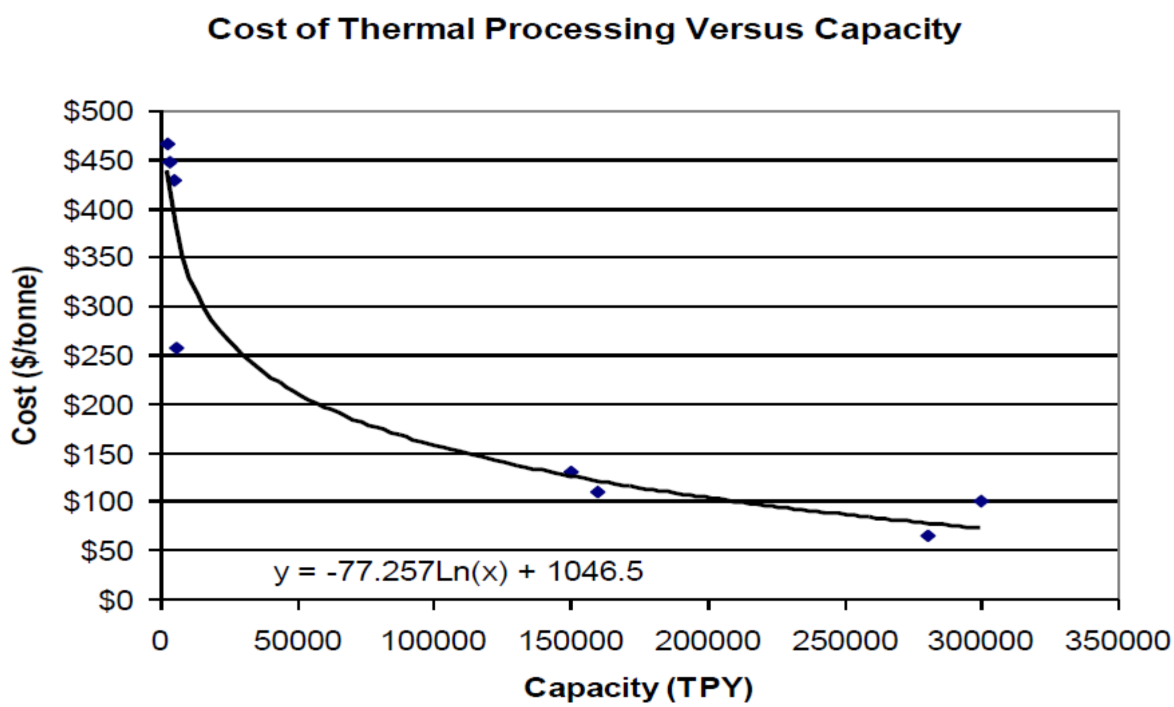
Technology Type	Scalability	Suitability for MOA	Typical Feedstock	Beneficial Outputs
Mass Burn	25,000 to 350,000 tons per year	Established technology and works well with existing MOA waste stream	Municipal solid waste, ▪ No pre-processing required Biosolids with calorific value	▪ Heat (steam boiler) ▪ Electricity ▪ Combined heat and power ▪ Recyclable metals ▪ Commercially proven
Gasification	25,000 to 300,000 tons per year	Few full-scale operational facilities (8,000 to 100,000 tpy)	Municipal solid waste, high energy waste, biomass ▪ Pre-processing required	▪ Heat ▪ Electricity ▪ Hydrogen gas ▪ Renewable natural gas ▪ Methanol ▪ Ethanol
Controlled Air Combustion/ Hybrid Gasification	1,000 to 300,000 tons per year	Few large full-scale operational facilities. Most facilities are of a smaller scale (1,000 to 100,000 tpy)	Municipal solid waste ▪ No pre-processing required	▪ Similar aspects to gasification with improved combustion in the secondary chamber

Table 2-2: Comparison of System Costs for Technologies

	Capital Cost ($/ton)	Operating Cost ($/ton)
Mass Burn	$800 to $1,200 per annual design ton	$80 to $130 per ton
Gasification	$900 to $1,800 per annual design ton	$80 to $150 per ton
Controlled Air Combustion/ Hybrid Gasification	$900 to $1,500 per annual design ton	$80 to $150 per ton
Pyrolysis	$900 to $1,500 per annual design ton	$50 to $110 per ton

As shown in Table 2-2, capital and operating cost have a relatively large range as this relates to economies of scale. Economies of scale play are key factor in the cost for large industrial facilities and is a primary consideration when a facility is designed and built. Incrementally, a larger facility will have a higher total cost but the cost per unit input decreases with increasing amount of waste. For example, as shown in Figure 2-4, a facility with a capacity of 100,000 tpy would have a higher unit processing cost per ton (approximately $150) than a larger facility with a capacity of 300,000 tpy (listed at approximately $75 per ton). While the processing capacity has tripled, the unit cost per ton has decreased by almost half. Figure 2-4 is presented to illustrate how relative unit processing costs for thermal processing facilities can vary with the processing capacity.

Figure 2-4: Example of Economies of Scale for Waste-to-Energy Facilities



2.3 Environmental Considerations

Thermal treatment results in a net greenhouse gas (GHG) reduction when compared to landfill disposal. The reduction is primarily from the avoided methane gas emissions from the decomposition of organic materials in the landfills. Landfills without a comprehensive landfill gas collection system can significantly contribute to GHG emissions. When trash is disposed in landfills, the organic fraction biodegrades and is converted into methane gas. Thermal treatment technologies, on the other hand, typically converts all the organic material into carbon dioxide and water. Methane has a global warming potential 25 times that of carbon dioxide, which means 1 ton of methane has the same atmospheric effect as 25 tons of carbon dioxide.

Table 2-3 summarizes typical environmental impacts from various thermochemical conversion technologies. Typically, 25% (by weight) of the solid waste that is thermally processed remains as ash residuals. Ash residuals are by-products from the combustion of waste, and their type and properties depend on the MSW combusted, emission controls, and technology employed. The ash residuals are typically disposed by landfilling. The two common types of ash residuals include bottom ash and fly ash. Bottom ash is the remaining residual after the combustion process and consists of unburned waste, inert residues, glass, and metallic objects, and 2 to 10 percent carbon[1]. Fly ash, on the other hand, are compounds and fine contaminants that are carried by the combustion gases through the furnace, boiler, and scrubber, and ultimately captured in the pollution control devices[2].

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[1] Tchobanoglous and Kreith. 2002. Handbook of Solid Waste Management, 2nd edition. McGraw-Hill. New York, US.
[2] ibid.

Table 2-3. Environmental Impacts of Thermal Conversion Technologies

Technology	Environmental Impacts
Mass Burn	• High emission outputs can be mitigated with a properly designed air pollution control system. • 20-30% by weight bottom ash (depending on burnout of carbon) and 2-6% fly ash, and air pollutant if untreated.
Gasification	• 20 -25% by weight bottom ash requiring landfill disposal • 1-5% fly ash, an air pollutant if untreated.
Advanced Combustion/ Hybrid Gasification	• 25 -35% by weight bottom ash requiring landfill disposal • 1-5% fly ash, an air pollutant if untreated.
Pyrolysis	• 25 - 30% by weight bottom ash requiring landfill disposal • 1-5% fly ash, an air pollutant if untreated.

2.4 Permitting Considerations

This section provides an overview of the environmental and land use regulations and permitting pathways related to development of a thermochemical conversion technology system in the MOA. This review provides a roadmap that can be applied to development scenarios being considered and to specific projects after the actual sites and technologies are selected.

2.4.1 Federal Regulations

Federal New Source Performance Standards

Under the federal Clean Air Act (CAA), the Environmental Protection Agency (EPA) establishes health-based air quality standards that all states must achieve.

Title 40, Part 60 of the Code of Federal Regulations (CFR) contains "new source performance standards" (NSPS) for many types of emission sources. An NSPS that could potentially apply to renewable technology systems includes pyrolysis of MSW: Standards of Performance for Small Municipal Waste Combustion Units (40 CFR 60, Subpart AAAA). It is possible that other NSPS could apply depending on the specific alternative technology being proposed.

In the regulation, the term "municipal waste combustion unit" means "any setting or equipment that combusts solid, liquid, or gasified MSW including … pyrolysis/combustion units." This apparently applies to conversion technologies that create syngas through pyrolysis and then combust it, as in thermal oxidizers or boilers. The NSPS applies to new facilities that "combust" 35 to 250 tons per day (TPD) of municipal solid waste.

MSW combustion units are divided into two classes, according to their processing capacity. Class I units have a plant-wide combustion capacity exceeding 250 TPD, while Class II units have a plant-wide combustion capacity less than or equal to 250 TPD. The two classes have the only following differences in requirements:

- Class I units have emission limits, continuous emissions monitoring, recordkeeping, and reporting requirements for NOx.
- Class II units do not have NOx monitoring, testing, recordkeeping, or reporting requirements.

The following information is a brief summary of the provisions of the NSPS that apply to Class I and Class II units:

- The facility must prepare and hold a public meeting on a “materials separation plan,” which consists of a goal and an approach for separating certain components from MSW prior to combustion, making them available for recycling.
- The facility must prepare and hold a public meeting on a “siting analysis,” which estimates how the new MSW combustion unit affects ambient air quality, visibility, soils, and vegetation. Alternative air pollution control measures must also be discussed.
- Plant operators must receive formal training through a U.S. EPA- or State-approved course.
- The emission limits in Table 2-4 must be met.
- Annual reports on operating parameters and emissions must be submitted. If the facility is out of compliance with any part of the NSPS, then information on the out-of-compliance pollutants must be submitted semi annually.

Table 2-4. Emission Limits Under 40 CFR Part 60 Subpart AAAA[1]

Parameter	Limit
Mass Burn	13 ng/dscm
Dioxins/Furans	0.020 mg/dscm
Cadmium	0.20 mg/dscm
Lead	0.080 mg/dscm or 85 percent reduction of potential mercury emissions
Mercury	10 percent
Opacity	24 mg/dscm
Particulate Matter	25 ppmv dry or 95 percent reduction of potential hydrogen chloride emissions
Hydrogen Chloride	150 (180 for 1st year of operations) ppmv dry
Nitrogen Oxides (Class I Units)	500 ppmv dry
Nitrogen Oxides (Class II Units)	30 ppmv dry or 80 percent reduction of potential sulfur dioxide emissions
Sulfur Dioxide	Visible emissions for no more than 5 percent of hourly observational period
Fugitive Ash	13 ng/dscm

1. All emission limits (except opacity) are referenced to 7 percent oxygen. Averaging times for emissions measurement vary by pollutant.

Title V

The “Title V” program, named after the portion of the federal CAA of 1990 that created it, is a national operating permit program for facilities that qualify as “major” sources of criteria pollutants and/or hazardous air pollutants (HAPs). It is a national program in the sense that it must, at the state and local level, follow guidelines set by the EPA, and in that Title V permit provisions are federally enforceable. Every eligible facility must obtain a Title V operating permit, which is valid for five years and is renewable. The permit does not create or modify any emission limitations, but it does add record-keeping, monitoring, and public review provisions to those already in conventional permits to operate. The Title V Permitting Program provides for the following items:

- EPA veto authority over permit issuance;
- Greater opportunity for federal and citizen enforcement;
- Enhanced public participation during the permit issuance process;
- Clearer determination of applicable requirements; and
- Improved enforceability of applicable requirements.

The first decision is whether a facility is eligible for Title V. The following are three conditions under which a renewable technology facility could be determined to be eligible:

- It is a major stationary source (defined below);
- It is subject to a federal NSPS that specifically requires obtaining a Title V permit; or
- It is subject to a National Emission Standard for Hazardous Air Pollutants (NESHAP) that specifically requires obtaining a Title V permit.

A facility is a major stationary source if its emissions of certain pollutants exceed thresholds that vary by geographical area.

2.4.2 State Regulations

A conversion technology facility would be regulated under Title 18 of the Alaska Administrative Code (18 AAC), in particular under the Air Quality Control Regulations in 18 AAC 50. Such facility would be defined as an "incinerator" under 18 ACC 50.990.(48), which means "a device used for the thermal oxidation of garbage or other wastes, other than a wood-fired heating device, including an air curtain incinerator burning waste other than clean lumber, wood wastes, or yard waste;". Any proposed facility would be presented to the Alaska Department of Environmental Conservation (ADEC) in a draft permit application and a meeting would be scheduled with the local ADEC office to discuss the project and any specific requirements that the ADEC may have based on the nature and extent of the proposed facility. As required by 18 AAC 50.050.(b), Particulate matter emissions from an incinerator may not exceed the particulate matter standard listed for that incinerator in Table 2-5.

Table 2-5. Particulate Matter Standards for Incinerators

Incinerator	Particulate Matter Standard
Rated capacity less than 1,000 pounds per hour	No Limit
Rated Capacity greater than or equal to 1,000 but less than 2,000 pounds per hour	0.15 grains per cubic foot of exhaust gas corrected to 12 percent carbon dioxide and standard conditions, averaged over three hours
Rated capacity greater than or equal to 2,000 pounds per hour	0.08 grains per cubic foot of exhaust gas corrected to 12 percent carbon dioxide and standard conditions, averaged over three hours
An incinerator that burns waste containing more than 10 percent wastewater treatment plant sludge by dry weight from a municipal wastewater treatment plant that serves 10,000 or more persons	0.65 grams per kilogram of dry sludge input

Alaska Pollutant Discharge Elimination System (APDES)

A conversion technology facility to be developed in the MOA, whether to be located at operating or closed solid waste landfill facilities or elsewhere, will be regulated under the Clean Water Act (CWA). The Alaska Pollutant Discharge Elimination System (APDES), Alaska Statute (AS) 46.03; Title 18, Chapter 83 (18 AAC 83) is a NPDES permit that regulates select industrial activities subject to the CWA. The ADEC adopted the latest version of the APDES in November 2017.

2.4.3 Municipality of Anchorage

The Anchorage Municipal Code (AMC) provides for regulations pertaining to solid waste incinerators or thermal desorption facilities in Title 21 Use Regulations, Chapter 21.05.060. Industrial Uses: Definitions and Use-Specific Standards. Table 21.05-1: Table of Allowable Uses designates an incinerator or thermal desorption facilities as a "conditional use" in the Heavy Industrial (I-2) District. An incinerator or thermal desorption facility is not an identified use in the Light Industrial (I-1) District and would require a zoning map amendment from I-1 to I-2 to permit. **A re-zoning would require approval of the Planning and Zoning Commission.**

Title 21, Chapter 21.05.060(E), Subsections (3.) Incinerator or Thermal Desorption Unit (TDU) include use-specific standards for incinerators and TDU's including:

- *Separation of **not less than 1,315 feet from Residential Zoning Districts and Academic Schools**.*
  - *If separation requirements cannot be met, the project proponent would be required to go to the **Urban Design Commission for a variance**.*
- *Hazardous Waste Prohibited.*
- *Separation Distances between Incinerator Facilities.*
- *Analysis of Health Risk.*
- *Standards for facilities not meeting Separation Requirements.*
- *Additional submittal requirements for a Conditional Use Permit (CUP).*
- *Additional Conditions of Approval.*

Conditional Use Permit - A conversion technology facility sited in an I-2 District **will require a Conditional Use Permit (CUP)** in accordance with AMC 21.03.080. A CUP is intended for situations where a use may or may not be appropriate in a district, depending on the specific location, the use characteristics, and potential adverse impacts of the use on surrounding properties and community. The procedure provides public review and evaluation of a use's operating characteristics and site development through a public hearing process. Prior to submittal of a CUP application, a community meeting is required. The Planning and Zoning Commission will make a recommendation to the Anchorage Assembly, who will make the final decision based on the approval criteria. There may be use-specific standards that apply. For example, the MOA has issued a CUP to SWS to allow operation of the Central Transfer Station (CTS).

3.0 ORGANIC PROCESSING TECHNOLOGIES

There are two general types of organic processing technologies –composting and anaerobic digestion. Both types utilize microbial degradation where microorganisms break down the organic fraction of MSW into valuable products (e.g. energy and soil amendment/compost). The following is a general description of a few common types of organic processing technologies.

3.1 Composting

Composting is a biological decomposition process that reduces organic material (in the presence of oxygen) to produce a peat-like humus. Composting processes can range from very simple pile systems, generally only suitable for composting yard and garden waste, to more complex self-contained systems that are capable of processing mixed organics.

Composting is utilized in many jurisdictions for processing food scraps, food soiled paper, yard and garden waste, animal by-products, manure, and biosolids. Composting generates heat which is used to destroy pathogens within the compost pile (i.e. heat is generated and used to reduce pathogen levels in the compost) provided a certain duration and temperature is maintained. Composting is also often used after anaerobic digestion to produce a more stable and marketable organic rich compost.

3.1.1 Composting Process Overview

Although different technologies may utilize different configurations, there are three basic phases to a composting process.

1. **Pre-processing** of the organic waste is usually implemented prior to the composting stage. Pre-processing may include particle size reduction, screening, and the addition of amendments. The goal of pre-processing is to create a more homogeneous input into the system, to extract contaminants (such as metals, plastics and glass) and to create a feedstock that has the necessary ratio of carbon to nitrogen. The addition of amendments is especially important, because there is little opportunity to alter the mix once the material has been incorporated into piles, laid in beds, or sealed in the compost vessel. Feedstock 'recipes' must therefore, be fairly consistent to allow for proper operation. Required equipment includes a grinder and/or shredder, screens (such as trommels), and mixing equipment (this may be combined with the grinder if the feedstock is soft enough).

2. The **primary composting phase** involves the actual breakdown of the material. Once the pre-processing is complete, the organic waste is loaded into the compost system (piles, vessels or beds). In the case of in-vessel systems, the sealed composting unit is then connected to the aeration and monitoring equipment. In covered aerated static pile systems, the piles are built over the aeration system, which may be a series of in-ground vents, or a network of air distribution piping. During this phase, the temperature, oxygen and moisture levels in the vessel are monitored and adjusted as needed to maintain the optimum operating conditions. Air and water may be introduced into the vessel via piping systems if the system requires additional air or moisture. Excess moisture may be drained off the compost and stored for later use in adding moisture to dry feedstock. Exhaust air is typically run through a biofilter and/or wet scrubber in order to minimize odors.

3. Once the material has finished in the primary composting phase, the material is stabilized and cured in windrows or static piles. During the **stabilization phase**, continued aeration is necessary to complete the composting process. Aeration may be achieved either by using a forced aeration system such as the system used in covered aerated static pile systems, or by turning the piles on a regular basis. During the curing phase, aeration is not required. Stabilization typically lasts 4-6 weeks and is a minimum requirement; curing can last an additional 4-6 weeks, or as long as is available. Many facilities store curing compost for 12 – 18 months after completion of the primary composting phase.

Photo 3.1: Finished Compost

3.1.2 Windrow Composting

Photo 3.2: Windrow Composting

Windrow composting consists of placing the mixture of organic materials into long narrow piles, or windrows, which are agitated or turned on a regular basis. Typically, these windrows are three feet high for dense or tightly packed materials such as manures, and 10 to 15 feet high for porous or less dense materials such as yard waste (leaves and branches). In colder climates, windrows tend to be taller and wider to reduce heat loss. The equipment used for turning these windrows determines the size, shape, and spacing of the windrows. Front-end bucket loaders or telescopic handlers with a long reach can build higher windrows, while turning machines tend to produce low and wide windrows.

Windrows aerate primarily by natural or passive air movement (convection and gaseous diffusion). The rate of air exchange depends on the porosity of the windrow. Turning the rows mixes the materials, rebuilds the porosity of the windrow, and releases trapped heat, water vapor and gases. This type of compost technology is best suited to composting yard and garden waste. Composting times are typically over six months.

Table 3-1. Windrow Composting Advantages and Disadvantages[1]

Advantages	Disadvantages
▪ Can handle feedstocks with lower Carbon to Nitrogen (C:N) ratios ▪ Relatively-low capital costs and low technology requirements (windrow turners, front-end loaders, or farm equipment will suffice) ▪ Relatively low operating costs ▪ No electric power needed ▪ Large amount of industry practical experience	▪ Large land area required ▪ More labor intensive that aerated static pile, particularly for feedstock with low C:N ratio or porosity ▪ No odor control, which may require larger buffer area between operation and neighbors ▪ More challenges to overcome if food waste or biosolids are included due to increased odors and reduced markets ▪ Exposure to rain, wind, and cold can be problematic

[1] Sourced from http://aep.alberta.ca/waste/reports-data/documents/LeafYardWasteDiversionStrategy-Aug2010.pdf

3.1.3 Aerated Static Pile

Photo 3.2: Aerated Static Pile

This composting approach should have the composting area built on an impermeable surface such as a concrete or asphalt pad with a 2% grade to allow for leachate collection. Each pile can be equipped with a trench style concrete aeration floor or perforated pipe that is placed on the ground and compost piles are built on top. The aeration pipes are connected to a blower equipped with a control system to moderate temperature and oxygen content in the pile. The control system tracks operating conditions to determine aeration rates. Condensate and leachate are collected in the trench. Odor is managed by maintaining aerobic conditions in the pile (for positive air systems) or with a simple biofilter made with a wood chip based medium (for negative air systems). The composting time for this type of system ranges from three to six months.

Table 3-2. Aerated Static Pile Composting Advantages and Disadvantages[1]

Advantages	Disadvantages
▪ Forced aeration reduces land requirements and mixing ▪ Use of negative aeration can help control odors ▪ Smaller surface area relative to windrows ▪ Lower operating costs from shorter processing times and less mixing/turning ▪ Material handling requirements are less than windrow system (less turning required)	▪ Slightly higher capital cost for forced-aeration equipment ▪ Over-aeration can remove moisture ▪ Feedstock pre-processing requires a higher degree of care; feedstocks must be well mixed and properly sized and moistened ▪ More operator skill required to manage aeration systems ▪ Aeration systems generally require more complex (three phase) electrical supply

[1] Sourced from http://aep.alberta.ca/waste/reports-data/documents/LeafYardWasteDiversionStrategy-Aug2010.pdf

3.1.4 Membrane Covered Aerated Static Pile

Photo 3.3: Membrane Covered Aerated Static Pile

The covered aerated static pile composting area is typically constructed on an impermeable surface such as concrete or asphalt with a 2% grade to allow for leachate collection. The aeration system design uses a trench built into the impermeable surface to allow for leachate collection and aeration of the pile. The system being shown, GORE Cover System, operates using positive aeration. The cover is made of a Goretex material that covers the pile and is secured to the ground or support walls on the side of the pile. As air is injected into the pile, the breathable membrane expands like a balloon to create an in-vessel like environment. The sealed edges creates a fully-enclosed system. This membrane allows for the management and retention of moisture, temperature, and odor. The control system measures oxygen and temperature which helps dictate the aeration rate. The composting process consists of the main active phase (4 weeks under GORE cover), second active phase (2 weeks under GORE cover) and curing phase (2 weeks without GORE cover). The residence time for this type of system is approximately 56 days.

Table 3-3. Membrane Covered Aerated Static Pile Composting Advantages and Disadvantages[1]

Advantages	Disadvantages
▪ Newer facilities use coverall (low cost) buildings, for better odor control ▪ Lower space requirements than windrow systems ▪ Contained system reduces potential for odor emissions and contaminated storm water	▪ Potential steam or dust issues inside the enclosure ▪ Indoor air must be managed in odor control system prior to release ▪ Operating and maintenance expertise required ▪ Moderate to high capital and operating costs

[1] Sourced from http://aep.alberta.ca/waste/reports-data/documents/LeafYardWasteDiversionStrategy-Aug2010.pdf

3.1.5 In-Vessel Composting

Photo 3.4: In-Vessel Composting Bunker

The in-vessel composting process is similar to covered aerated static pile composting in that the piles are aerated continuously (with a combination of positive and negative air flow) and contained in a vessel. The difference is that the piles are contained in a rigid structure. The vessels are made of concrete, with gasketed and insulated stainless steel doors. The residence time for this type of system is in the order of 28 days with several additional weeks for curing. The vessel is equipped with an aeration floor and condensate/leachate collection system. The control system tracks operating conditions to optimize aeration rates. Exhaust gases are treated with wet scrubbers and biofilters to control odours.

Table 3-4. In-Vessel Composting Advantages and Disadvantages[1]

Advantages	Disadvantages
▪ High degree of odor control except for receiving area and when doors are opened ▪ Lower space requirements	▪ Operating and maintenance expertise required ▪ Higher capital and operating costs. ▪ Some vendors claim shorter residence time (1 to 4 weeks) and used in combination with another composting method/technology.

[1] Sourced from http://aep.alberta.ca/waste/reports-data/documents/LeafYardWasteDiversionStrategy-Aug2010.pdf

3.1.6 Composting Technology Summary

Table 3-5 provides a comparison of operational and cost considerations for the various composting approaches discussed above.

Table 3-5. Comparison of Composting Approaches[1]

Composting Approach	Odor & Nuisance Control Requirements	Maintenance Requirements	Staffing Needs	Capital Cost	Operating Cost	Space Requirements	Typical Processing Time
Windrow	Low – Moderate	Low	Low – Moderate	Low – Moderate	Low – Moderate	Large	4 to 12 months
Aerated Static Pile	Low – High	Low	Low – Moderate	Low – Moderate	Low – Moderate	Low – Moderate	3 to 6 months
Covered Aerated Static Pile	High	Low	Low – Moderate	Moderate – High	Low – Moderate	Low – Moderate	2 to 4 months
In-Vessel Composting	High	Moderate – High	Low – Moderate	High	High	Low – Moderate	1 to 4 months

[1] Sourced from http://aep.alberta.ca/waste/reports-data/documents/LeafYardWasteDiversionStrategy-Aug2010.pdf

3.1.7 End Products - Compost

End products of composting is a peat-like humus material that is suitable as a soil amendment. End markets for processed organics from municipal solid waste sources typically include soil amendments used for landscaping purposes, soil erosion control, and horticultural/agricultural applications. Some rural solid waste authorities stockpile processed organics at their landfills for future use as final topsoil cover to promote vegetative growth once the landfill is closed.

Most States have compost quality standards that dictate acceptable uses and distribution of compost from municipal solid waste sources. Pathogen levels are typically regulated to protect public health. Having markets for the compost material is critical to the success of any organic processing operation. Producing high quality compost usually results in more available markets and higher revenues for the end products.

3.2 Anaerobic Digestion

Anaerobic digestion (AD) is the biological decomposition of organic materials in the absence of oxygen. The process is carried out by anaerobic micro-organisms that convert carbon-containing compounds to biogas, which consists primarily of methane (CH_4) and carbon dioxide (CO_2), with trace amounts of other gases. For the process to take place efficiently, six key process parameters must be carefully controlled. These are pH, temperature, carbon to nitrogen ratio (C:N), organic loading ratio, retention time and reaction mixing.

For MSW applications, AD focuses on the organic or compostable portions of the waste stream. Communities that produce large quantities of organic waste (such as food processing plants) can benefit from AD.

A wide variety of microorganisms are involved in all stages of the AD process. AD can be performed either under mesophilic conditions or thermophilic conditions. Mesophilic bacteria operate at an optimum temperature range of 95-104°F, while thermophilic bacteria prefer warmer conditions, in the range of 122-131°F. While retention times will depend on process design specifics and feedstock characteristics, typical retention times range between 12-30 days. Physical mixing of the feedstock is important as it provides improved contact between the organic material and bacteria and prevents the formation of dead zones and scum layers and promotes effective heat transfer.

Since AD works only on the organic fraction of the waste stream, pre-treatment processes are undertaken to separate the organic fraction from the inorganic and other materials that are not suitable for treatment in the AD process. Pre-treatment is also required to achieve:

- Removal of non-digestible materials which take up unnecessary space in the digester;
- Provision of a uniform small particle size in the feedstock to promote efficient digestion;
- Protection of the plant and equipment from waste components that may cause physical damage; and
- Removal of materials which may adversely affect the quality of the digestate.

Mechanical pre-treatment can involve the following processes:

- Trommels/screens for the removal of the oversized fraction;
- Hammer mill (or similar) for size reduction of the feedstock; and
- Shredding/mixing of the feedstock (or use of a Hydro-pulper as a wet pre-treatment process to break down the organics and separate out the heavy and light non-organic fractions)

Following pre-treatment, the organic fraction is loaded into the reactor where digestion takes place. In the first stage of digestion, organic material is broken down by microbes called acid formers, to produce fatty acids. In the second stage of the digestion process, generally referred to as methanogenesis, another group of microbes called methane producers convert the fatty acids into biogas, which generally contains about 55% methane and 45% carbon dioxide, along with other trace gases. The material remaining is a partially stabilized organic material that can be used as a soil amendment or separated into solid and liquid fractions. The liquid fraction can be disposed in a wastewater plant or used as liquid fertilizer if there are agricultural users nearby. The solid digestate can be dewatered and composted for full stabilization. The insoluble solids in the digestate are comprised of non-digestible inert material, non-digestible organic materials and microbial biomass.

3.2.1 Dry AD Systems

Dry AD technologies (“dry AD”) or high solids AD is commonly used for source separated organics (SSO) that contain woody materials such as yard and garden waste. Dry AD has a similar biological process to wet AD, however, for wet AD the substrate is a slurry (<15% total solids by mass) and for dry AD the substrate is 40% to 50% total solids. This falls well within the range of available high “solid” or “stackable” substrates such as MSW, food waste, yard waste, and other organic substrates. The higher solids content equates to higher transport efficiencies in comparison to wet systems where 90% or more of the feedstock transported is simply water. Numerous proprietary technologies have been developed to commercially execute dry AD. Most notable amongst these technologies are “garage style” digesters and assisted plug flow digesters.

In “garage” style dry digesters, biomass is placed inside a sealed garage-like container with or without the use of material separation. Once the container is full, the environment is sealed, oxygen is removed, the temperature is increased to approximately 98˚F, and the substrate is “irrigated” with microbially enhanced liquids for a period of 25 to 30 days (which varies based upon substrate and technology purveyor). Liquid percolate (leachate) infiltrates the biomass and is collected through floor drains.

The methane rich biogas is continuously collected from the container. The biogas can be used to generate heat, electricity or both as in a traditional wet AD system. After the reaction period, the remaining waste is removed (either to landfilling or composting), and a new batch is inserted. This method has few mechanical parts and thus offers the advantage of needing limited material separation prior to digestion. This process has feedstock flexibility that comes at the cost of gas production efficiency.

The lack of stirring during the process means that not all materials are exposed to the methanogenic microbes vital to AD reactions, and the gas production suffers as a result. Depending on the preprocessing, dry AD can achieve a portion of the efficiencies (as low as 50% to 60%) in comparison to production rates achieved by wet AD technologies. Specifically, garage style digesters convert available total solids to biogas with roughly half the efficiency of wet AD systems. However, there is more flexibility as wet and dry materials that can be processed.

An advantage of dry AD systems is that they can handle larger amounts of contaminants (i.e., metal, glass, plastics, woody material, etc). This is also a disadvantage at the back end of the process as the end product needs additional handling and processing and the contaminants affect the marketability of the end product.

Figure 3-1: Example of Garage Style Dry Anaerobic Digestion

Source: *BioFerm Energy Systems* http://biofermenergy.com/

3.2.2 Assisted Plug Flow High Solids AD Systems

Assisted plug flow high solids AD systems is a technology that falls between wet and dry AD systems and addresses the issue of material conversion efficiencies. This is accomplished by moving the substrate along the length of a sealed container using "paddle arms". The "paddle arms" serve two purposes. First, they move the substrate along the length of the reactor at a pre-determined rate allowing the substrate a digester retention time of 25 to 30 days. Second, they mix the substrate somewhat as it is moved such that the material is exposed to the bacteria (e.g., methanogenic bacteria) that generate biogas. This method results in a volatile solids destruction of 90% according to Eisenmann[3]. If this efficiency is reached, it would be comparable to wet AD systems for conversion efficiency. However, the "paddle arms" require that material entering the digester be separated and preprocessed sufficiently prior to digestion in order to limit damage that non-digestible materials might cause to the digester. This preprocessing equipment can raise capital costs, and greatly increase operational and maintenance costs as the mechanical and operation costs are higher.

[3] Eisenmman provides systems for surface finishing, air pollution control, anaerobic digestion and process & high-termperature technologies.

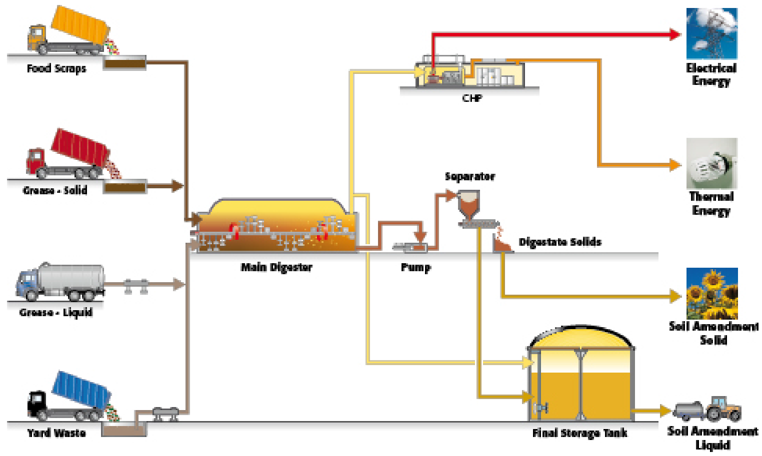

Figure 3-2: Example of Assisted Plug Flow Dry AD

Source: Eisenmann Corporation. http://www.eisenmann.us.com/

3.2.3 Wet AD Systems (including Co-digestion Systems)

Wet AD systems basically follow the processes listed above in Section 3.2 but have a feedstock input that is less than 15% total solids. Figure 3-3 is a flow diagram that illustrates the various stages in a wet AD process.

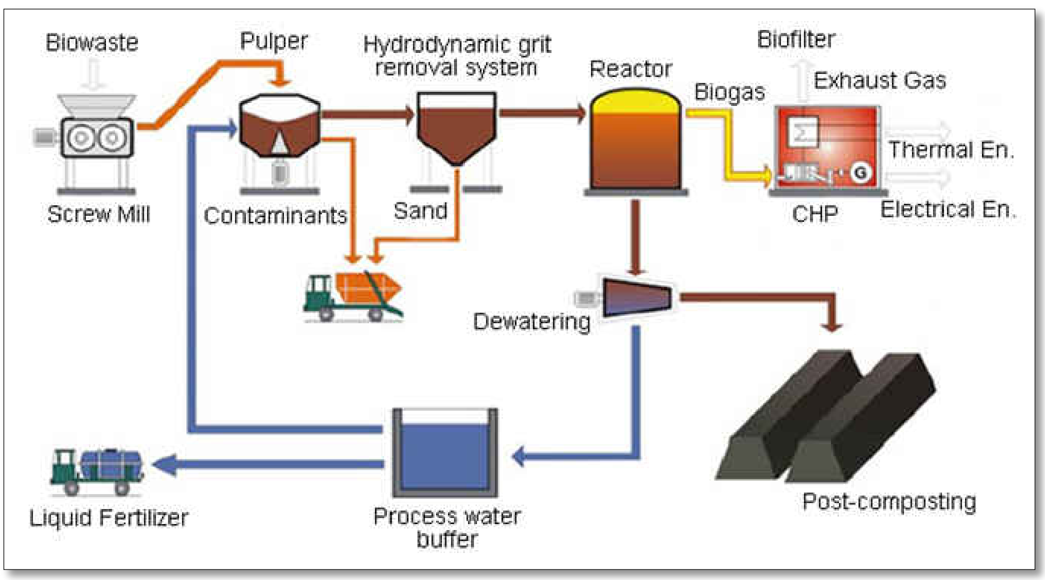

Figure 3-3. Flow Diagram of a Typical Single Stage Wet AD Process

Co-digesting waste water treatment residuals (biosolids) with source separated organics (SSO) from a MSW stream is being tested and considered in many waste water treatment plants. Sanitary waste water treatment plants that have anaerobic digesters have similar back-end processes for managing solids from the waste water treatment plant. Co-digestion would require source separated organics to be processed into a slurry before it is fed into an anaerobic digestion unit. The source separated organic and biosolids would then be blended and mixed and fed into the co-digestion unit (i.e. anaerobic digestion reactor).

The digesters are typically pancake style digesters with fixed covers and insulation to conserve heat and minimize energy consumption for maintaining process temperatures. As with other anaerobic digestion alternatives, a hot water boiler and heat exchangers would be used to heat the feedstock and maintain process temperatures within the digesters. Mixing would be provided by submersible mixing equipment configured with tank roof access for maintenance and repairs while the tank remains in service.

As with the other technologies, biogas generated with co-digestion is recovered, cleaned, compressed, stored and used to produce electrical power or upgraded for injection into a natural gas distribution system. Heat recovered would supplement natural gas consumed in maintaining digestion process temperatures. Benefits to co-digestion compared to other AD approaches for the organic fraction of MSW are as follows:

- Utilize available digester capacity at waste water treatment plants;
- Increase biogas quality and quantity that could be sold and/or used to supplement energy use at the plant; and
- Increase reaction time in the reactor.

3.3 Summary of Organic Processing Technologies

Table 3-6 summarizes the scalability, suitability for MOA, feedstock preference, and output considerations for the various organic processing technologies discussed. Figure 3-4 illustrates the range of organic processing cost estimates (from a previous Tetra Tech study) that takes into consideration technology and design capacity.

Table 3-6. Organic Processing Comparison

Technology Type	Scalability	Suitability for MOA	Typical Feedstock	Outputs
Composting (Varied Approaches)	Can be scaled up or down as many technologies are modular	Suitable for SSO from various sectors, cannot process all MSW	SSO and yard waste	▪ Compost
Dry Anaerobic Digestion (Garage Style)	Can be scaled up by adding more modular units	Suitable for SSO and organics collected with yard waste, cannot process all MSW	SSO and yard waste	▪ Biogas ▪ Compost of soil amendment
Assisted Plug Flow High Solids AD	Can be scaled up by adding more lines	Most suitable for SSO and biosolids, cannot process all MSW	SSO and biosolids	▪ Biogas ▪ Compost or soil amendment
Wet AD Systems (Co-digestion with biosolids)	Can be scaled up by adding more digesters. Some cities are using available capacity at treatment plants to process organics.	Most suitable for SSO and biosolids, cannot process all MSW	SSO and biosolids	▪ Biogas ▪ Compost or soil amendment

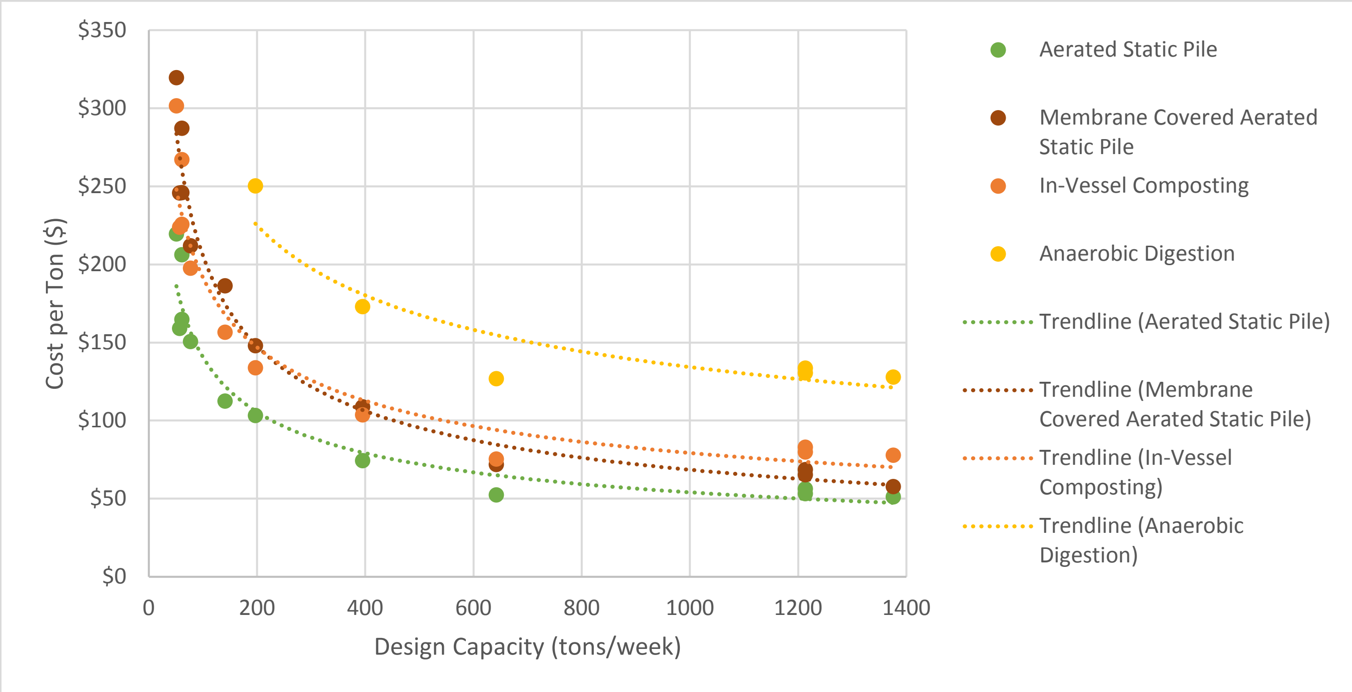

Figure 3-4. Organic Processing Cost Estimate by Technology and Design Capacity (RDOS Study$_{2014}$)

3.4 Environmental Considerations

Similar to thermal treatment technologies, organic treatment technologies would result in net GHG reductions. The GHG reduction would primarily be due to diverting the organic fraction of MSW from landfill disposal.

The environmental impacts from organic treatment technologies are commonly lower than impacts from thermal conversion technologies. Unlike thermal conversion technologies, organic treatment technologies do not create by-products such as ash residuals, but instead produce usable marketable products such as soil amendments or compost. The type of end-market products depend on the treatment technology used. An important consideration for the MOA is to assess the marketability of end products from organics processing to ensure there locations where this material could be used and/or provide value.

However, the most common environmental issue associated with organic treatment technology is odor. Odor is a result of the biodegradation of organic materials where odorous gases such as methane and ammonia are created. These gases should be managed through prevention and/or gas capture systems to ensure neighboring properties are not affected. Odors may be mitigated and prevented through a good technology design and feedstock control as well as reduced through implementing additional treatment works such as biofilters and/or wet scrubber.

3.5 Permitting Considerations

This section provides an overview of the environmental and land use regulations and permitting pathways related to development of a composting or anaerobic digestion facility in the MOA. This analysis provides a summary that can be applied to development scenarios being considered and to specific projects after the actual sites and technologies are selected.

3.5.1 Federal Regulations

There are no federal regulations that require a permit or identify requirements for proposed improvements, expansion, or new composting and anaerobic digestion facilities at this time.

3.5.2 State Regulations

Facilities used to store materials for transfer, reuse, recycling, or resource recovery are not required to obtain a facility permit under 18 AAC, in particular under the Solid Waste Regulations in 18 AAC 60, unless such facility is causing or contributing to a nuisance or poses a risk to public health and the environment. If this occurs, the facility operator would be required to submit a facility design and operations plan.

Proposed improvements, expansion, or new pre-processing and recycling facilities including transfer stations, materials recovery facilities (MRFs), construction and demolition recycling, and composting facilities (including in-vessel digestion) which are not located or occurring in a permitted facility such as the ARL would not be required to obtain a solid waste facility permit under 18 AAC 60.

3.5.3 Municipality of Anchorage

The AMC provides for regulations pertaining to composting facilities in Title 21 Land Use Regulations, Chapter 21.05.060 Industrial Uses: Definitions and Use-Specific Standards. Table 21.05-1: Table of Allowable Uses designates a composting facility as a "permitted use" in the Heavy Industrial (I-2) District. Title 21, Chapter 21.05.060E.1. (E. Waste and Salvage; 1. Composting Facility) defines a composting facility as *a facility where organic matter, including leaves, grass, manures, and non-meat, non-biosolids waste, amassed primarily from off site, is processed by* ***composting and/or processing*** *for commercial purposes.* Based on this composting facility land use definition, an anaerobic digestion facility (**processing**) **could be deemed a permitted use** in a Heavy Industrial District, similar to a composting facility. A composting facility is not an identified use in the Light Industrial (I-1) District, and would require a zoning map amendment from I-1 to I-2 to permit. A re-zoning would require approval of the Planning and Zoning Commission.

Title 21, Chapter 21.05.060(E), Subsections (1.) Composting Facility include use-specific standards for composting facilities including:

- *Any composting storage area of a composting facility shall be set back at least* ***200 feet from any lot line abutting a residential district*** *or use.*
- *Composting facilities shall* ***contain and treat on-site, all water run-off*** *that comes into contact with the feedstocks or compost, in such manner that the run-off will not contaminate surface or ground water.*
- *Composting facilities shall* ***not be located in any floodway****.*
- *No composting facility shall commence operation until a* ***nuisance condition control plan****, specifying all measures to be taken to control nuisance conditions (such as odor, noise, scattered solid waste, dust) has been approved by the director.*

Conditional Use Permit - A composting facility will not require a Conditional Use Permit (CUP) if it is sited in a Heavy Industrial (I-2) designated parcel. However, a composting facility could be sited in a Public Lands and Institutions (PLI) District which would require a CUP. Composting (and likely anaerobic digestion uses) are prohibited in all other zoning designations.

4.0 COST SCENARIOS

This section summarizes of financial considerations for four selected waste management scenarios using some of the alternative technologies discussed above. Evaluation of these scenarios should provide the SWS department with an overview and understanding of which waste stream might be the most cost effective to process and how those yield benefits to reducing waste disposal in the landfill.

The financial analysis calculated the net annual cost that includes capital and operating costs as well as potential revenue. The selected scenarios were based on waste generation data and waste flow analysis from various generator sources and the potential for waste diversion using different types of technology. Four scenarios were evaluated and compared to the current system (Scenario 0 – Status Quo) as follows:

- **Scenario 0. Status Quo** (landfill) – The current practice of sending MSW to a landfill.
- **Scenario 1. Waste-to-Energy** – A waste-to-energy facility (mass burn technology) would process most of the MOA's MSW, and some of the residual from the WTE facility would be sent to a landfill.
- **Scenario 2. Organics Diversion, Composting** – A composting facility (windrow with a membrane system cover) would process SSO from the residential and commercial sectors, while the remaining MSW continues to be landfilled.
- **Scenario 3. Organics Diversion, Anaerobic Digestion** – An advanced organics processing facility (dry AD system with digestate composted under a membrane cover) would process SSO from residential and commercial sectors, while the remaining MSW continues to be landfilled.
- **Scenario 4. Comprehensive Diversion** (organics processing facility, recycling diversion, and waste-to-energy facility) – Three streams (SSO, recyclables, and trash) are processed to maximize diversion resulting in less waste being sent to landfill. This scenario includes a dry anaerobic digestion facility for the SSO (with a membrane cover composting system), a MRF for source separated recyclables, and a waste-to-energy facility (mass burn technology) to process the remaining MSW.

4.1 Solid Waste Feedstock

The feedstock for the alternative technologies assessment would primarily be MSW and possibly biosolids from a waste water treatment facility.

In 2016, the MOA disposed of 330,805 tons of MSW, an average of approximately 26,000 tons per month. For simplicity purposes, the annual baseline disposal rate of 330,000 tons per year was used for the scenario comparison analysis.

The average monthly disposal tonnages from 1990 to 2017 are shown in Figure **4**-1 (for several representative years), while Table 4-1 summarizes the average monthly tonnages, standard deviation, and range (low and high). As shown in Figure 4-1, there is a significant monthly fluctuation in MSW disposed in the municipality. The monthly amount is as low as 19,000 tons per month in the winter (January and February), and as high as 35,000 tons per month in the summer (July and August). Further analysis would be needed to understand the variability in the quantity and composition of the waste stream to obtain a more accurate average and baseline of MSW generated in the area prior to any facility design and construction.

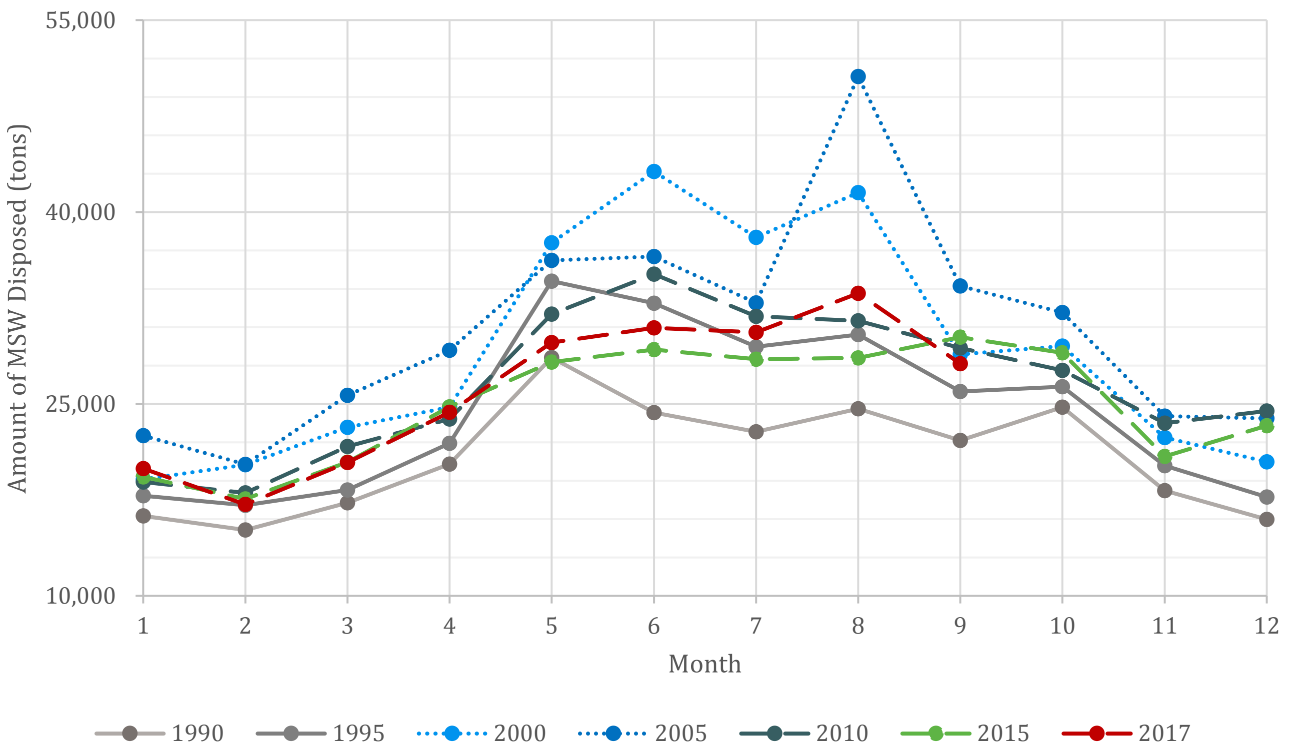

Figure 4-1: Monthly MSW Disposal for the MOA

Table 4-1: Monthly Tonnage Estimates – Average, Standard Derivation, Low and High Values.

Tonnage	January	February	March	April	May	June	July	August	September	October	November	December
Average	21,761	19,275	22,464	25,784	33,909	33,368	32,870	34,616	31,665	31,804	22,591	23,439
Standard Deviation	2,003	1,250	2,150	2,130	3,139	2,742	3,084	5,671	2,762	4,181	1,975	4,232
Low	19,758	18,025	20,315	23,655	30,770	30,626	29,786	28,945	28,903	27,623	20,615	19,208
High	23,764	20,524	24,614	27,914	37,048	36,109	35,954	40,287	34,427	35,984	24,566	27,671

4.1.1 Organic Fraction in MSW

Based on waste composition data from comparable northern communities, approximately 55% of the MSW stream is estimated to be comprised of food waste, yard waste, and food soiled paper. These organic materials may readily decompose and could be diverted through an organic processing facility such as a composting and/or anaerobic digestion facility.

Developing an organics diversion program would provide numerous benefits, such as reducing the amount of materials entering the landfill site and subsequently reducing landfill gas (primarily methane gas) emitted into the atmosphere. An estimated 175,000 tons of organic materials is available in the MOA's waste stream. Table 4-2 summarizes the breakdown of available organics in the MSW by sector.

Table 4-2: Organics Disposed by Sector

Sector	Material Stream Characteristics	Estimated Available Organics in the Waste Stream
Single Family Residential	▪ Yard/garden waste ▪ Food waste and soiled paper	60,650 tons per year
Multi-Family Residential	▪ Food waste and soiled paper ▪ Yard/ garden waste likely less than SF residential	
Institutional, Commercial and Industrial	▪ Mostly food waste and soiled paper	86,625 tons per year
Construction & Demolition Self-Haul	▪ Typically stumps, branches and shrubs ▪ C&D wood waste	26,000 tons per year

When collecting organics through a dedicated organics diversion program, not all of the organics would be captured and diverted. Table 4-3 summarizes the potential capture rates based on the collection approach for the respective sector.

Table 4-3: Organics Diversion Potential by Program

Approach	Typical Organics Capture Rates	Types of Feedstock	Estimated Organics to be Diverted (tons per year)
Drop-off depots	10 to 25%	Food and yard waste	6,000 – 15,500
Curbside collection	50 to 75%	Food waste and yard waste	25,000 – 30,000
Commercial collection	25 to 50%	Food waste and soiled paper	21,600 – 43,300
		TOTAL	52,600 – 88,800

4.1.2 Recycling Programs

The implementation of recycling programs as described in the Diversion Program Options component of the ISWMP Task 4 Memorandum would divert material from the current waste stream to commodity markets. Consequently, this would affect the composition and quantity of feedstock available for a waste to energy facility. Typically, 30% of the MSW stream consists of recyclables. Increasing recycling capture would predominantly divert paper, rigid plastic, and metal products. The estimated potential capture rates of proposed recycling approaches are shown in Table 4-4, which reflects the potential capture from expanding current recycling collection programs. The quantity presented are a relatively small amount of the overall waste stream and thus wouldn't significantly affect the required capacity of a potential waste-to-energy facility, However, the specific diversion of paper and rigid plastics from the waste stream may affect the composition and energy content of potential feedstocks.

Table 4-4: Recyclable Diversion Potential

Approach	Types of Materials Collected	Additional Recyclables Diverted (tons per year)
Drop Off Depots	Paper, Rigid Plastics, Metals	~3,500
Residential Curbside Collection		8,000 – 10,000
Commercial Collection		5,000 – 7,000
	TOTAL	16,500 – 20,500

4.1.3 Biosolids from Wastewater Treatment Facility

Biosolids are another potential feedstock source for alternative technologies. Biosolids are produced as byproducts from wastewater treatment facilities that are anaerobically digested and thickened into a sludge. In the case of MOA, biosolids are currently generated at the Asplund Wastewater Treatment Facility (AWWTF). The Anchorage Water and Wastewater Utility (AWWU) recently commissioned a study of alternative management options for biosolids, as their current dewatering and incineration technologies are 30 years old and require refurbishment or replacement. The AWWTF generates an average of 17 dry tons per day of biosolids with an average solids content of 27-30%. This equate to approximately 20,600 tons per year of wet biosolids as a potential feedstock for an alternative technology.

Photo 4.1: Asplund Waste Water Treatment Plan

4.1.4 Feedstock Summary

Table 4-5 summarizes the feedstock (inputs) and assumptions for the scenarios described above.

Table 4-5: Feedstock Summary by Scenario

	Process Type	Processing capacity (tpy)	Assumptions/Descriptions
Scenario 0. Status Quo (landfill)	Landfill	330,000	▪ Continue to landfill.
Scenario 1. Waste-to-Energy	WTE – Mass Burn	330,000	▪ All MSW that would be landfilled except bulky items
Scenario 2. Organics Diversion (Composting)	Organics Diversion	77,000	▪ SSO from Residential and commercial sectors (85% of total MSW) ▪ 55% of MSW is SSO including food soiled paper ▪ Assume 50% capture rate ▪ Round to 75,000 tpy (from 73,600 tpy).
	Landfill	253,000	▪ All remaining MSW would be landfilled.
Scenario 3. Organics Diversion (Anaerobic Digestion)	Organics Diversion	77,000	▪ Same amount as Scenario 2 Organics Diversion that would be directed to an AD facility
	Landfill	253,000	▪ All remaining MSW would be landfilled.
Scenario 4. Comprehensive Diversion	Organics Diversion	77,000	▪ Same amount as Scenario 2 Organics Diversion that would be directed to an AD facility
	Recycling	42,000	▪ Assumed 30% recyclables in MSW from Residential and Commercial sectors ▪ Assume 50% capture rate ▪ Round to 42,000 tpy
	WTE – Mass Burn	211,000	▪ All remaining MSW material

4.2 Cost Estimates

To ensure proper comparison between each scenario, a baseline disposal rate of 330,000 tons per year of MSW was selected. For simplicity and purpose of this analysis, the design basis does not account for population growth, changes in diversion behavior, and other factors that would increase or decrease the total MSW produced.

Table 4-6 summarizes each scenario's cost estimates and how it compares to the status quo scenario.

Table 4-6 Estimated Cost for Each Scenario

Factor	Scenario 0. Status Quo (landfill)	Scenario 1. Waste-to-Energy	Scenario 2. Organics Diversion, Composting	Scenario 3. Organics Diversion, Anaerobic Digestion	Scenario 4. Comprehensive Diversion
System and Processing Capacity	▪ Landfill: 330,000 tpy	▪ WTE (Mass Burn): 330,000 tpy	▪ Composting: 77,000 ▪ Landfill: 253,000 tpy	▪ AD & composting: 77,000 tpy ▪ Landfill disposal: 253,000 tpy	▪ AD & composting: 77,000 tpy ▪ MRF: 42,000 tpy ▪ WTE (Mass Burn): 211,000 tpy
Total Capital Cost for New Infrastructure	$0	$342,000,000	$17,700,000	$58,000,000	$320,000,000
Annual Total Cost (capital and operating[1])	$19,000,000	$60,000,000	$20,500,000	$25,000,000	$62,000,000
Annual Total Revenue	$0	$9,000,000	$110,000	$500,000	$7,000,000
Net Annual Cost	$19,000,000	$51,000,000	$20,000,000	$24,500,000	$55,000,000
Net Cost per ton	$57.58	$154.55	$63.64	$74.42	$166.67
% Diversion from Landfills	0%	80%	23%	23%	85%
Products	▪ None	▪ Electricity ▪ Metals	▪ Compost	▪ Electricity ▪ Compost	▪ Electricity ▪ Compost ▪ Recyclables ▪ Metals
Comparison to Status Quo					
Net Cost per ton (compared to status quo)	n/a	+ $96.97	+ $6.06	+ $16.67	+ $109.09
% Relative to Status Quo	n/a	2.68x status quo	1.11x status quo	1.29x status quo	2.89x status quo

[1] Operating costs do not include the cost to collect materials.

4.3 Co-Digestion Cost Estimate

The cost estimate for co-digestion was calculated using capital and operation cost factors from a business case evaluation prepared for AWWU for biosolids from the AWWTF. As noted above, the AWWTF produces 20,600 tpy of biosolids. Organics that would be best suited for co-digestion is SSO from the commercial sector which is estimated to be 43,300 tpy (50% capture rate). The total processing capacity is estimated to be 63,900 tpy. Details of the financial analysis for Co-Digestion for the MOA is summarized in Table 4-7 below.

Table 4-7: Co-Digestion Financial Analysis

Description	Cost	Comments
Total Capital Cost	$184,000,000	Based on cost factors from AWWU business case for a 63,900 tpy facility
Annualized Capital and Operating Cost	$21,400,000	Amortization at 6% for 20 years
Annual Revenue for Energy Sales	$1,700,000	Sale of electricity at 80% of market rates.
Net Annual Cost	$19,700,000	
Unit Processing Cost ($/t)	$309	

Assuming a cost sharing arrangement of 50/50, the cost per ton would be $154.50 for the MSW organic portion.

4.3.1 Waste to Energy Processing of Biosolids

A MSW waste to energy facility can be designed to process and destroy biosolids. Biosolids have heating value that can be combusted to create heat and thereby electricity. Moisture in the biosolids affects the energy value in the feedstock. Drying the biosolids creates a feedstock with a higher energy content that can be used as a fuel. Utilizing biosolids as a fuel or as a feedstock for a waste to energy facility is an option that many jurisdictions have implemented.

Considering that the AWWTF generates 20,600 tpy of biosolids, either of the scenarios with a WTE facility could be used to process biosolids.

4.4 Discussion and Findings

The following were determined in this financial analysis:

- The net annual cost for all the scenarios ranged from $18 million (or $57.14 per ton processed) to $52 million (or $165.08 per ton processed)
  - While the lowest cost per ton is the status quo scenario, this scenario provides 0% diversion as MSW continues to be sent to landfill sites.
  - The comprehensive diversion scenario (scenario 4) provides the highest diversion (85%) and produces the most end-value products, this scenario has the highest net annual cost.

- If all the MSW was sent to a WTE facility (scenario 1) instead of a landfill (status quo), the net annual cost of the WTE would be $48 million (or $152.38 per ton processed). This would increase the current disposal cost by 2.67 times more. However, the WTE facility would result in 80% diversion from landfill by weight.
- Organics diversion scenarios (scenario 2 and 3) were determined to have lower cost compared to the other scenario options. Both organics diversion scenarios would provide a diversion of 24%.
  - Implementing a composting facility (scenario 2) has a net annual cost of $20 million ($63.49 per ton processed), which is 1.11 times more than the status quo practice.
  - Implementing an anaerobic digestion facility (scenario 3) has a net annual cost of $23.5 million ($74.60 per ton processed), which is1.31 times more than the status quo practice.
  - Organics process options should assess the potential markets for the end products. It is recommended that SWS conduct an organics market analysis to ensure there are markets for the processed organics. Otherwise the processed organics would be disposed in the landfill. If this were the case, there would be a net benefits from GHG reduction of organics materials decomposing in the landfill.
- Economy of scales impacts the net annual cost as more materials being processed can greatly decrease the net unit cost per ton. For example, in this analysis, a WTE facility processing 330,000 tpy has a cost per ton of $154, while the same WTE facility processing 200,000 tpy has a cost per ton of $194, a difference of about 25%.

4.5 Assumptions and Limitations of Cost Estimates

The following are assumptions made in the cost estimates:

- This analysis was a high level (Class 5) conceptual cost estimate over a 20-year period and assumes feedstock characteristics remain the same
- Land cost and site works were assumed to be 10% and 5% of building cost, respectively. Cost of the land and siting/permitting were excluded.
- Capital cost and operating cost were estimated based on processing capacity and availability of information for other similar facilities across North America. These costs may differ in Anchorage due to the geographical and climatic differences, such as availability and transportation of labor and materials.
- Annual capital costs were determined with a 6% interest and annual payments over 20 years.
- The cost of electricity was assumed to be half of the residential rate and sold at 80%, which equates to about $54 per MWh. It was assumed that WTE and AD facilities had 85% availability.
- Current market prices were used that may not represent conditions over 20 years. A sensitivity analysis and further investigation is needed to understand market trends and impacts on cost. For example, current market prices for recycled commodities have been in a state of flux recently due to the impacts of China's "National Sword" policy. This policy has significantly restricted most sales of recyclable materials in the country.

5.0 CLOSURE

In summary, the two different types of alternative technologies presented herein are designed to handle very different types of feedstocks and waste types. In general, thermal treatment technologies process most all MSW materials, while biological processing technologies target the organic fraction of MSW (such as food waste, yard, and paper towels).

Both types of technologies require some pre-processing and pre-sorting of material to enhance the technology conversion. These pre-processing and pre-sorting operations may be accomplished by mechanical means (e.g. trommel screening and separation) or at the source generators (e.g. source separation programs). Furthermore, the two types of technologies vary in the end-product such as in the form of energy (electricity, heat, power, liquid fuel) and products (e.g. compost). A key consideration in selecting a technology is identifying the customer or end-user (i.e. markets) for the products created.

This evaluation and findings were developed for SWS to include in their Integrated Solid Waste Master Plan for potential alternative technologies to be considered in the mid-term and long-term planning horizon. Numerous factors were presented herein that must be considered in determining the feasibility and applicability of alternative technologies such as collection and pre-processing of feedstock, economics, environmental impacts and benefits, permitting and available end markets/users.

For the mid-term planning horizon (5 to 10 years), existing composting facility capacity can be expanded, or a new facility can be established and operated by the private sector like many facilities in North America. It is indicative that the compost operator would be supported by initiatives for diverting organics in the SWS and greater MOA service areas.

In the long-term, an Anaerobic Digestion facility or Waste-to-Energy facility could be considered, particularly if a landfill expansion is deemed infeasible. As mentioned above, another option for an alternative technology is a co-digestion facility to meet the needs of AWWU and SWS, or a waste to energy facility that could process MSW and biosolids.

A detailed feasibility study should be undertaken to further explore the potential for alternative technologies that could service the MOA including availability of markets for the end products and permitting challenges (with public acceptance and significant rate increases). A detailed economic analysis should also be included in the feasibility study based on a site specific conceptual design and local costs.

APPENDIX G

MRF FEASIBILITY STUDY

TETRA TECH

OQM CERTIFIED

Material Recovery Facility Feasibility Study

PRESENTED TO

Municipality of Anchorage

NOVEMBER 2019
ISSUED FOR USE
FILE: 704-SWM.PLAN03118-01
REVISION 1

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EXECUTIVE SUMMARY

Tetra Tech Canada Inc. (Tetra Tech) was retained by the Municipality of Anchorage (MoA) to assess the feasibility of establishing a material recovery facility (MRF) at a site close to the proposed new transfer station to manage current and future diversion of recyclable materials. The purpose of this document is to accomplish the following objectives:

- Characterize the current recycling situation in the MoA and develop future recycling collection and processing scenarios;
- Provide context to outline the trade-offs of potential collection program changes, including source separated glass collection and curbside collection expansion;
- Determine prospective site footprint for the MRF, facility layout, equipment requirements, estimated capital and operating costs, and operational flexibility for future recycling scenarios and community growth;
- Assess potential revenues from sale of commodities and other socio-environmental benefits; and
- Develop a framework for evaluating the feasibility of constructing and operating a MRF in the MoA.

A MRF is defined by the Solid Waste Association of North America as a facility "where comingled recyclables are separated and processed (including sorting, baling, and crushing) or where source separated recyclables are processed for sale to various markets". The primary function of a MRF is to extract or separate out recyclable commodities in order to obtain the highest quality of recovered materials to be sold into markets for the highest financial value. A MRF should be designed to promote an efficient and effective operation for incoming feedstocks, while maintaining the safety of site users and workers.

Collection methods and the type of materials collected will usually influence the type of equipment and manpower required to produce a quality and marketable product. There is also a growing trend to collect glass as a separate stream because glass typically has low commodity value (when it is curbside collected) and glass shards can affect the quality and value of commodities such as paper products. Collection approaches that are typically employed include the following: (1) source separated, (2) dual stream (paper and other recyclables), and (3) single stream, which is also called comingled recycling. In the MoA, the most likely collection approach that would be single stream curbside collection with a separate glass collection option.

The potential feedstock for a prospective MRF in the MoA was estimated based on historical municipal solid waste (MSW) disposal rates and waste composition data obtained through relevant waste composition studies. The estimated feedstock, commodity, and residual characteristics were assessed to form a variety of potential recycling scenarios. Design capacities were based on 2040 Anchorage population growth projections to ensure adequate future MRF processing capacity. Three design feedstock scenarios were calculated for the future MRF capacity, based on varying levels of recycling participation as noted below.

- **Scenario 1** is designed based on status quo collection levels, with improved recapture from City Municipal – CM (75%), City Private – CP (50%), and Drop-Off – DO (20%) sectors, but with no improved recycling recapture from the commercial sector.
- **Scenario 2** is designed for improved moderate recycling recapture, where the commercial sector achieves a recapture rate of 40% in addition to the increases in participation described in Scenario 1.
- **Scenario 3** is designed for optimistic increases in recycling participation from CM (75%), CP (75%), DO (75%), and ICI (50%).

The estimated feedstock quantities and outgoing commodities quantities are described in Table A below.

Table A: Annual Feedstock and Commodity Tonnage

Scenario	Yearly Recycling Tonnage	Weekly Recycling Tonnage	Annual Commodity Tonnage
Existing Commercial Source Separated Recycling			
WestRock	**20,000**	363	19,800
Residential and Commercial Recycling Capture Scenarios			
Scenario 1	**22,500**	433	20,025
Scenario 2	**33,000**	633	29,370
Scenario 3	**50,000**	962	44,500
Total MRF Processing			
Scenario 1	**42,500**	817	37,825
Scenario 2	**53,000**	1,019	49,170
Scenario 3	**70,000**	1,346	64,300

Two MRF equipment vendors were contacted to provide quotes and equipment information that would suit the MoA's needs. The processing capacity was based on the above noted capture rates and operation of the facility was based on one shift per day, and five days per week. Important space considerations for the MRF (including the processing equipment, feedstock receiving and storage area, and recyclable commodities storage) and operating requirements were discussed and provided.

Capital cost was estimated based on the processing equipment and the building to house that equipment. Processing equipment was quoted to cost between $6M and $8M for a turn key system which includes delivery and commissioning. Building costs were based on a new pre-engineered metal building that was estimated to be 63,000 square feet. Building costs according to the Central Transfer Station (CTS) study are expected to range between $240 to $250 per square foot. This suggests that the building cost would range between $15.3M and $15.9M. A summary of the capital costs is shown in Table B below.

Table B: Summary of Capital Costs

Item	Scenarios 1 - 3	
	Vendor 1	**Vendor 2**
Building Size (sq. ft.)	63,600	
Site Development Costs	$800,000	
Building Cost	$15.9M	
Stationary and Mobile Equipment	$8M	$6M
Engineering Design (10%)	$1.6M	
Administration & Contingency (20%)	$3.2M	
Total Capital Cost	**$29.5M**	**$27.5M**
Annual Amortized Capital Cost (20 years at 5% interest)	**$2.33M**	**$2.19M**

Operating costs were calculated based on labour requirements for the MRF (which ranges based on the throughput), electricity and maintenance costs and disposal costs for the residuals from the MRF process. Table C lists the annual operating costs which includes the amortization costs for the building and processing equipment.

Table C: Annual MRF Processing Cost

Item	Scenario 1		Scenario 2		Scenario 3	
	Vendor 1	**Vendor 2**	**Vendor 1**	**Vendor 2**	**Vendor 1**	**Vendor 2**
Annual Tonnage	20,000 (SSR) 22,500 (Comingled)		20,000 (SSR) 33,000 (Comingled)		20,000 (SSR) 50,000 (Comingled)	
Residuals Disposal Fees (Tip Fee = $80/t)	$270,000		$396,000		$600,000	
Labour and Administrative	$980,000	$1,520,000	$1,330,000	$1,960,000	$1,900,000	$2,790,000
Electricity/Fuel/Maintenance	$960,000	$1,040,000	$1,240,000	$1,370,000	$1,640,000	$1,800,000
Total Operating Costs	$2,210,000	$2,830,000	$2,970,000	$3,720,000	$4,140,000	$5,190,000
Annual Amortized Capital Costs	$2,330,000	$2,190,000	$2,330,000	$2,190,000	$2,330,000	$2,190,000
Total Annual Cost	**$4,540,000**	**$5,020,000**	**$5,300,000**	**$5,910,000**	**$6,470,000**	**$7,370,000**
Cost per ton (w/o Commodities Revenue)	**$106.74**	**$118.12**	**$100.00**	**$111.51**	**$92.43**	**$105.29**

The value of commodities from the MRF should offset the processing costs of the collected recyclables. Commodity prices were investigated relative to historical lows, highs and current market rates. Table D shows how net MRF processing costs can fluctuate and be influenced by recycling material commodity prices.

Table D: Net MRF Unit Processing Cost with Variable Commodity Pricing

Item	Scenario 1	Scenario 2	Scenario 3
Annual Tonnage	42,500	53,000	70,000
Total Annual Cost (w/o Commodities Revenues)	**$4,540,000 – $5,090,000**	**$5,340,000 – $6,050,000**	**$6,760,000 – $7,780,000**
Historical Low			
Commodities Revenues	$1,800,000	$2,460,000	$3,550,000
Net Total Annual Cost	**$2,740,000 – $3,290,000**	**$2,880,000 – $3,590,000**	**$3,210,000 – $4,230,000**
Cost per ton (w/ Revenues)	**$64.40 – $77.34**	**$54.32 – $67.66**	**$45.89 – $60.49**
Historical High			
Commodities Revenues	$7,820,000	$10,400,000	$14,650,000
Net Total Annual Cost	**($2,730,000 – $3,280,000)**	**($4,350,000 – $5,060,000)**	**($6,870,000 – $7,890,000)**
Cost per ton (w/ Revenues)	**($64.31 – $77.25)**	**($82.15 – $95.49)**	**($98.09 – $112.69)**
Current Market			
Commodities Revenues	$3,000,000	$4,220,000	$6,220,000
Net Total Annual Cost	**$1,540,000 – $2,090,000**	**$1,120,000 – $1,830,000**	**$540,000 – $1,570,000**
Cost per ton (w/ Revenues)	**$36.16 – $49.11**	**$21.11 – $34.45**	**$7.74 – $22.34**

Table D shows that revenue can be made based on the state of the recycling commodity markets. Although the current markets are a little higher than historical lows, the end result is there will be a cost to processing and selling recyclables. The recycling commodities industry is expected to rebound in the future and this feasibility assessment shows that there are scenarios with positive cash flow to establishing and expanding the recycling programs in Anchorage.

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APPENDICES

ACRONYMS & ABBREVIATIONS

Acronyms/Abbreviations	Definition
ARL	Anchorage Regional Landfill
CTS	Central Transfer Station
ICI	Industrial Commercial and Institutional
ISWMP	Integrated Solid Waste Management Plan
MRF	Material Recovery Facility
MoA	Municipality of Anchorage
PRRD	Peace River Regional District
SWS	Solid Waste Services

LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of Municipality of Anchorage and their agents. Tetra Tech Canada Inc. (Tetra Tech) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than Municipality of Anchorage, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this document is subject to the Limitations on the Use of this Document attached in the Appendix or Contractual Terms and Conditions executed by both parties.

1.0 INTRODUCTION

Tetra Tech Canada Inc. (Tetra Tech) was retained by the Municipality of Anchorage (MoA) to develop its Solid Waste Master Plan in 2017. This Master Plan provides direction, a framework, and a strategy for managing solid waste in the MoA for the next 20 years. Moving forward from the Master Plan, the MoA acquired some property to site a new transfer station that will increase the capacity and improve operations currently occurring at the Central Transfer Station (CTS) to accommodate regional growth and program changes. The design of a new transfer station was contracted to Tetra Tech and will be led out of the Seattle office.

As part of the transfer station design, Tetra Tech was requested to consider the feasibility of co-locating a material recovery facility (MRF) at the same site to manage current and future diversion of recyclable materials. This report discusses typical MRF components, recycling collection system considerations, and available recyclable material feedstock in the Anchorage area. The report also discusses different recycling capture scenarios, corresponding to required infrastructure, capital and operating costs, and the benefits of developing a proposed MRF facility. Collectively, this document aims to accomplish the following objectives:

- Characterize the current recycling situation in the MoA and develop future recycling collection and processing scenarios;
- Provide context to outline the trade-offs of potential collection program changes, including source separated glass collection and curbside collection expansion;
- Determine prospective MRF footprint, layout, equipment requirements, estimated capital and operating costs, and operational flexibility for future recycling scenarios and community growth;
- Assess potential revenues from sale of commodities and other socio-environmental benefits; and
- Develop a framework for evaluating the feasibility of constructing and operating a MRF in the MoA.

2.0 BACKGROUND

As a municipality of almost 300,000 people, Anchorage generates approximately 330,000 tons of waste each year. The MoA's Solid Waste Services (SWS) provides refuse collection services for the original City of Anchorage, which is approximately 20% of the population of the MoA, and the remainder is serviced by private sector waste haulers. SWS is also responsible for solid waste disposal which includes the Anchorage Regional Landfill (ARL), three transfer stations, collection of household hazardous waste, recycling drop-off depots (at the ARL and transfer stations) and seasonal food scraps and yard waste collection programs.

The ARL is the only operating landfill within the MoA. The SWS also has three transfer stations located at Girdwood, midtown Anchorage (CTS) and at the ARL. The purpose of these transfer stations is to reduce traffic and control access to the working face of the ARL. Waste from the transfer stations make up approximately 80% of the total waste disposed at the ARL and the majority comes from the CTS.

The SWS disposal utility's budget includes a recycling fund which supports various community recycling and outreach programs. The fund also supports several grants with ALPAR (Alaskans for Litter Prevention and Recycling) that includes glass recycling, wharf-age costs for shipping recyclable materials to market, youth litter patrol, and Christmas tree recycling.

2.1 Solid Waste Master Plan

The SWS authorized development of an integrated solid waste management plan (ISWMP) to optimize its system and assets through improved operational efficiencies, capital improvements and new practices and programs that are aimed to increase landfill life, improve safety and customer service, protect the environment, increase waste reduction, and improve reuse and recycling of materials that are currently disposed. The ISWMP includes the following:

- Strategies for solid waste management in the short, medium and long term;
- Optimize the operation and capacity of the ARL:
  - Optimizing airspace utilization
  - Evaluating expansion alternatives
  - Considering alternative technologies
- Optimization of CTS operations; and
- Assessment of diversion opportunities.

Through the development of the ISWMP, a set of recommendations were developed for short, medium and long-term strategies to optimize capacity through landfill operational improvements and diversion programs and to optimize CTS operations with new and expanded facilities and services. Improving CTS operations includes constructing a new transfer station, administration, maintenance and warm storage building, and public drop-off facilities to replace assets that are 30+ years old. The goals are to improve safety, customer service, efficiency, and materials management that increases the life of the ARL through improved community diversion opportunities. Moving to a new property would prevent a 2- to 3- year shutdown of the existing facility for improvements and allow for future uses by other MoA departments (i.e., grit management facility at existing transfer station, additional warm storage and administrative space). It also controls adjacent uses that may impact future CTS operations.

Co-locating a MRF with the new transfer station targets medium to long-term goals of expanding diversion programs in the region and extending the lifespan of the ARL. A MRF could enable further collection of comingled recycling from commercial and residential sectors, by upgrading the mixed residential commodity to higher value source separated materials. Moreover, improving the quality of material commodities (including contamination removal) is integral to securing buyers given current trends in international recycling markets.

3.0 MATERIAL RECOVERY FACILITY BASICS

A MRF is defined by the Solid Waste Association of North America as a facility “where comingled recyclables are separated and processed (including sorting, baling, and crushing) or where source separated recyclables are processed for sale to various markets”. The primary function of a MRF is to extract or separate out recyclable commodities in order to obtain the highest quality of recovered materials to be sold into markets for the highest financial value. A MRF should be designed to promote an efficient and effective operation for incoming feedstocks, while maintaining the safety of site users and workers.

A MRF that is designed for mixed waste or trash is known as a “dirty MRF”, where more sorting and processing is required to extract marketable end-products and a majority of the mixed waste feedstock ends up being disposed. A MRF designed for recyclable materials (i.e., single stream and source separated recycling) is known as a “clean MRF” and requires a similar level of processing in order to create marketable end-products, but ends up with a cleaner and higher valued commodity and has less residuals that would require disposal.

Small MRFs can vary in size, but typically receive less than 20 tons per day of recyclable materials. They usually involve limited automation and use minimal manual labour for sorting. Processing equipment mainly consists of a vertical or horizontal baler and a forklift, thus building floor space is often less than 15,000 square feet. Facilities of this type also typically serve as public drop-off facilities.

Large scale MRF’s are typically equipped with automated equipment and supported with varying levels of manual and automated sorting. Building floor space is variable depending on feedstock volumes received, processing equipment, and storage space requirements for marketable materials and incoming feedstocks.

3.1 Process Flow

A MRF receiving recyclable materials requires a variety of mechanical and manual sorting methods. The type of equipment employed will depend on the materials collected for processing and how contaminated the feedstocks are. The broader the material mix, the more comprehensive a system is required.

Materials are typically unloaded to a tip floor and fed into a MRF system that separates desirable materials from undesirable materials. Materials such as mixed paper or plastic are subsequently baled to reduce volume, and glass is crushed and, in some instances, used as an aggregate. Residuals removed during the separation process generally require further disposal, whereas desirable materials such as paper, metals and certain plastics can be sold to end markets where it can be processed and repurposed. Figure 3-1 below depicts the material separation process of a typical MRF system.

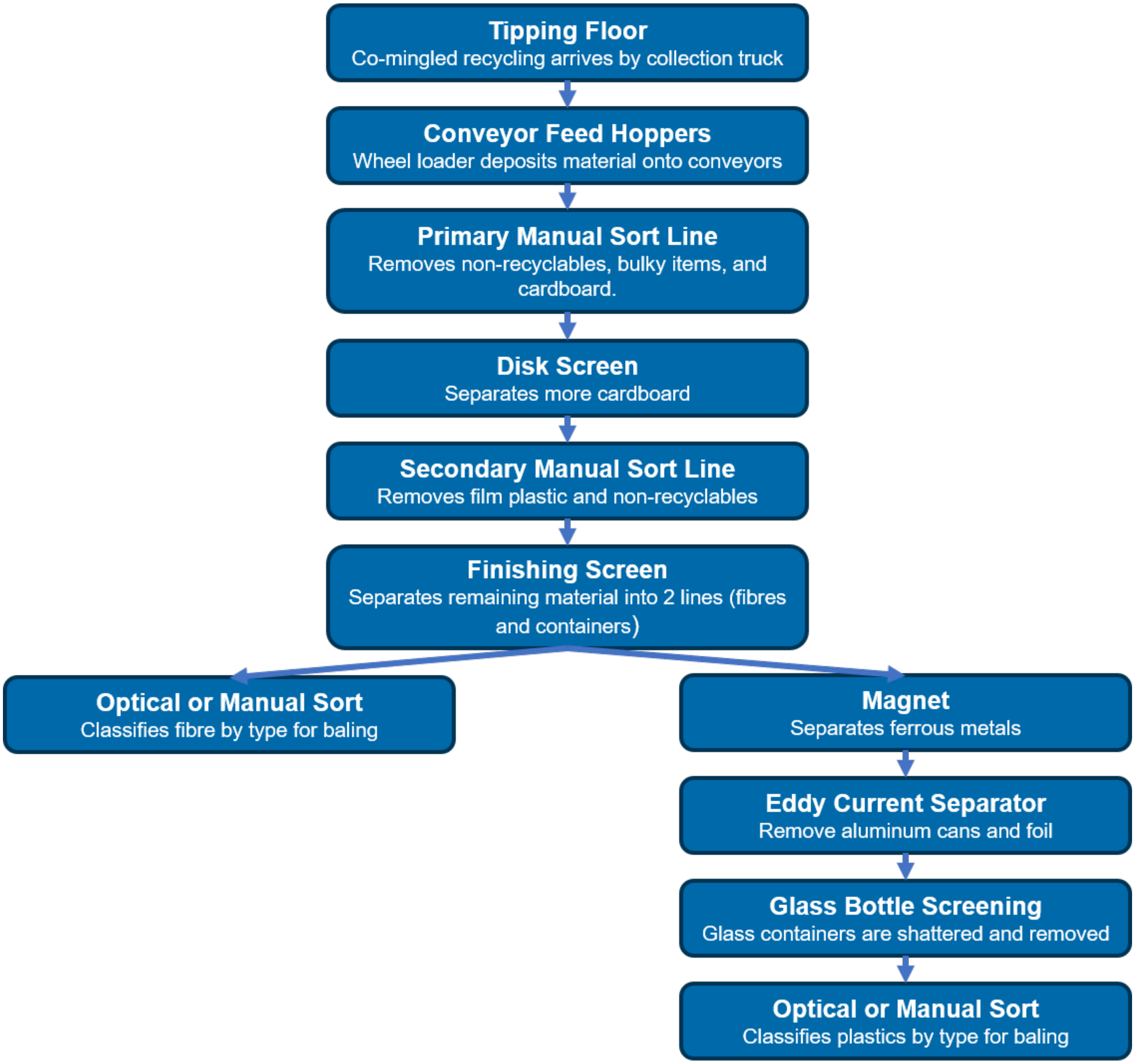

Figure 3-1: MRF Sorting Process

3.2 Material Recyclability

A 2006 assessment of a MRF located in King County, Washington identified the categories of materials based on their potential for recycling. Table 3-1 is derived from the findings at King County and is tailored to current and future residential recycling collection programs at the MoA. Limited access to markets in Anchorage and recent tightening of overseas market quality requirements may affect this list.

Table 3-1: Material Categories (Example)

Collection Status	Recyclable	Marginally Recyclable	Contaminants (non-recyclable)
Existing Residential Collection	▪ Cardboard ▪ Newspaper ▪ Mixed Paper ▪ Aluminum Cans ▪ Ferrous Cans ▪ Ferrous Metals ▪ HDPE Bottles (#1) ▪ PETE Bottles/Jars (#2)	▪ Printed Wrapping Paper ▪ Shredded Paper ▪ Other Aluminum and Mixed Metals ▪ Other PETE Containers ▪ Other HDPE Containers and Buckets ▪ #3, 4, 5, 7 Bottles and Containers	▪ Cartons ▪ Photographic Paper ▪ Hard Cover Books ▪ Foil Lined Paper ▪ Paper Composites ▪ Other Glass and Pyrex ▪ Expanded and Ridged Polystyrene ▪ Mixed Packaging ▪ Trash Bags ▪ Mixed Plastics ▪ Compostable Plastics ▪ Organics ▪ Household Hazardous Waste ▪ Compressed Gas Cylinders ▪ Non-Descriptive Fines
Potential Residential Collection	▪ Glass Containers ▪ Glass Cullet	▪ Glass Shards ▪ Plastic Film and Bags	

Residual rates for comingled recyclables vary widely depending on contamination levels in the collection streams, effectiveness of processing equipment and/or changing market conditions. Residual rates are known to range from as low as 3% to over 30% of the total feedstock. A typical residual/contamination rate for comingled recycling across North America is around 15%. The contamination rate currently found in MoA recyclables is reported to be about 11%.

4.0 COLLECTION PROGRAM CONSIDERATIONS

Collection methods and the type of materials collected will usually influence the type of equipment and manpower required to produce a quality and marketable product. There is also a growing trend to collect glass as a separate stream because glass typically has low commodity value (when it is curbside collected) and glass shards can affect the quality and value of commodities such as paper products.

Collection program options typically include, (1) source separated, (2) dual stream (paper and other recyclables), and (3) single stream, which is also called comingled recycling. As noted above, the collection options could also be conducted with or without glass, or have glass collected as a separate stream.

For discussion purposes, we have assumed that the collection approach would be based on the current approach of single stream collection with glass being collected as a separate stream.

4.1 Curbside Collection Versus Depot Drop-Off

4.1.1 Single Stream Curbside Collection

Curbside collection of materials for recycling typically is mandated or coordinated by municipalities. Often, municipalities will provide residences with a storage vessel to store their recycling in, but in some municipalities, residents are expected to provide their own storage vessels (e.g., clear blue bags). In 2019, most municipalities that launch a curbside recycling collections program often introduce rolling carts with lids and automated collection capabilities. Automated collection reduces labour requirements, improves working conditions, and lessens risk of injury through strain and exposure. Containment of waste inside a cart also deters pests, reduces moisture from precipitation, reduces litter, and provides opportunities to implement volume limits and user fees. These benefits can improve service and reduce costs. As a result, automated collection is becoming an industry norm with broad uptake across North America. The disadvantage of automated collections is that in northern communities like Anchorage, where the community can receive plenty of snow and below freezing temperatures, it can obstruct the collection vehicles and hinder the efficiency of automated collection.

Curbside recycling is typically single stream where all recyclable materials are commingled into a container upon collection and sorted at a MRF. This makes it more convenient for the residents to use, and often the municipality will see high participation rates once implemented. Another benefit to curbside recycling collection is the increase in employment, particularly if manual collection is used rather than automated.

Curbside recycling results in potentially a higher contamination rate that requires more processing at the MRF, thereby increasing processing costs. Higher rates of contamination in the recycling stream is a growing issue in light of the current recycling markets that require less than 0.5% (by weight) contaminants in the commodities. Contamination can be attributed to misunderstanding of what is or is not recyclable.

To minimize contamination levels at the curb, a comprehensive education program is necessary. Residents will need to be continually reminded about what is acceptable and not acceptable in curbside recycling carts. Periodic audits of cart contents will help provide the municipality with data on contaminant levels to develop targeted information or messaging for residents.

4.1.2 Depot Drop-off

A typical recycling depot consists of an area with several bins for collecting recyclable materials such as paper, cardboard, plastics, glass, and metals. Each bin is dedicated to specific materials, thus reducing processing requirements in the MRF. The recycling depot may also accept household hazardous waste (HHW), with specific containment measures for paint, used oil, electronics, and tires. If the municipality chooses, they can have a warehouse sized facility to house a baler, making the collected recyclable material more compact for storage and transportation. The warehouse also can double as storage for bales and a customer interface for collecting materials. Bales can also be stored in a shipping container outdoors, preventing bales, such as cardboard, from getting wet and losing value.

With a depot system, residents have their own storage containers for recyclable materials and self-haul that material to the depot. The biggest advantage to having a staffed depot drop-off is that the recyclable material is centralized; thus, a higher level of sorting occurs at the source and the contamination rate is usually lower. It allows the option to have operations staff supervise the site and ensure that customers are dropping off materials in the correct bins. There is a lower capital investment as it relates to trucks and carts for curbside collection and a reduced operating cost associated with curbside collection activity.

Disadvantages include a lower participation rate than with curbside collection. Depots can be problematic for those with limited mobility that cannot access the recycling depot. A recycling depot can also result in concentrated traffic issues. Where job creation is part of the decision process, recycling depots create fewer employment opportunities than curbside collection programs. The level of diversion from a depot drop-off system ranges from 15% to 25%.

Recycling depots can still be used with a curbside collection program to serve those who do not receive curbside service, such as multi-family dwellings, and those who have large quantities of recyclables and want to get rid of their materials in a convenient manner.

4.2 Separated Glass Collection

Communities are moving away from collecting glass in their single stream recycling collection programs because it degrades the quality and value of commodities collected and increases the wear and tear on processing equipment from breakage of glass during collection. Broken glass shards can contaminate other materials and reduce market potential and value. Glass can continue to be collected at a recycling depot or through curbside collection as long as a separate box or bin is provided to residents and it is placed in a separate compartment on the truck. A separate curbside glass collection stream will add costs to the overall collection system.

The City of Lethbridge, Alberta, for example, collects glass separately at depots located at various locations in the city. In a recent glass composition study, Tetra Tech identified the composition of recycled glass in Lethbridge to be comprised of glass bottles and glass jars with plastic and/or paper labels (2019). Typical contaminants include pane glass, heat-treated glass, ceramics, window frames, picture frames, plastics, metals, and organics. Since there is no bottle deposit system in Alaska, there is significantly more glass collected in the existing recycling depots than in jurisdictions with bottle bills.

Glass collected in Anchorage is processed by the main private construction and demolition contractor using their concrete crushing system. The municipality provided a grant for the company to purchase an air density separator to control contamination. The Solid Waste and Water and Wastewater Utilities partnered to use glass cullet as pipe bedding. Glass cullet is less expensive for contractors to use than virgin aggregate and have been used this manner since 2012.

5.0 FEEDSTOCK CHARACTERISTICS

The potential feedstock for a prospective MRF in the MoA was estimated based on historical municipal solid waste (MSW) disposal rates and waste composition data obtained through relevant waste composition studies. The estimated feedstock, commodity, and residual characteristics were assessed to form a variety of potential recycling scenarios.

5.1 Historical Tonnages

Table 5-1 summarizes the amount of MSW hauled to the ARL and CTS in 2016 and 2017. The waste that was received at these two facilities were further broken down by source which includes city residential collection, private residential collection, drop-off at the facilities, and commercial sector. These details are depicted in Table 5-1 below.

Table 5-1: MSW Historical Tonnages

Scenario	2016	2017	Average
Anchorage Regional Landfill			
City Residential	800	100	400
Private Residential	17,000	11,700	14,400
Drop-off	14,600	10,800	12,700
Commercial	55,500	36,100	45,800
Total	**88,000**	**59,000**	**74,000**
Central Transfer Station			
City Residential	35,600	27,100	31,400
Private Residential	69,300	51,600	60,500
Drop-off	23,300	18,000	20,600
Commercial	89,900	69,400	79,600
Total	**218,000**	**166,000**	**192,000**
Total Municipal Solid Waste			
City Residential	36,400	27,200	31,800
Private Residential	86,300	63,300	74,800
Drop-off	37,900	28,800	33,300
Commercial	145,400	105,400	125,400
Total	**306,000**	**225,000**	**265,500**

The majority of Anchorage's MSW is hauled to the CTS (approximately 72%). It appears that the total MSW tonnage decreased slightly in Anchorage from 2016 to 2017. An average of the waste disposed from these two years was utilized in the feedstock calculations.

5.1.1 Anchorage Regional Landfill

The average tonnage of city residential, private residential, drop-off, and commercial collection streams for each material category hauled to ARL in 2016 and 2017 are graphically depicted on Figure 5-1 below. For each collection stream, compostable materials and garbage made up the largest portion of all waste hauled to the ARL.

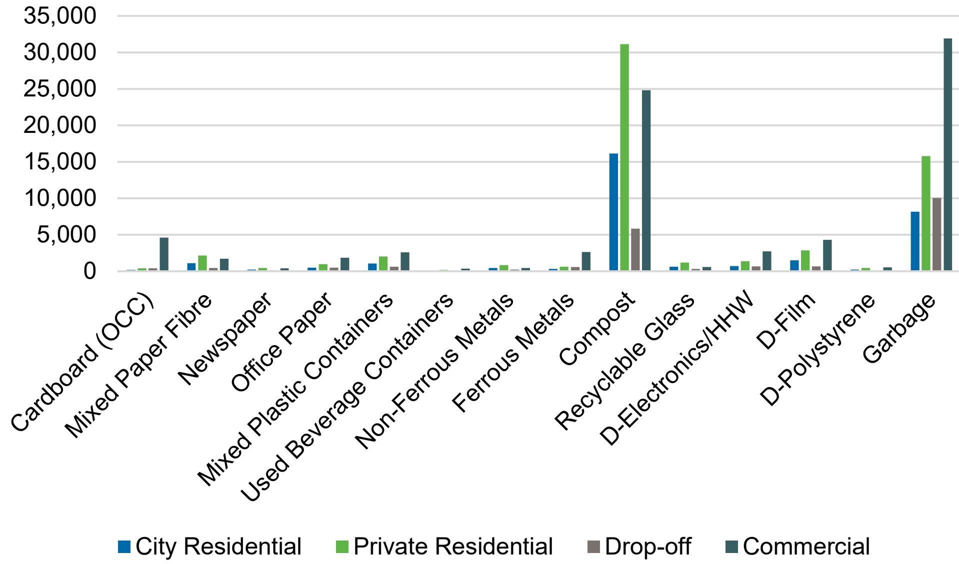

Figure 5-1: Average Tonnage Received at Anchorage Regional Landfill in 2016 and 2017

5.1.2 Central Transfer Station

The tonnages of each material category for city residential, private residential, drop-off, and commercial collection streams hauled to CTS in 2016 and 2017 are graphically depicted on Figure 5-2 below. For each collection stream, compostable materials and garbage made up the bulk of all waste hauled to CTS.

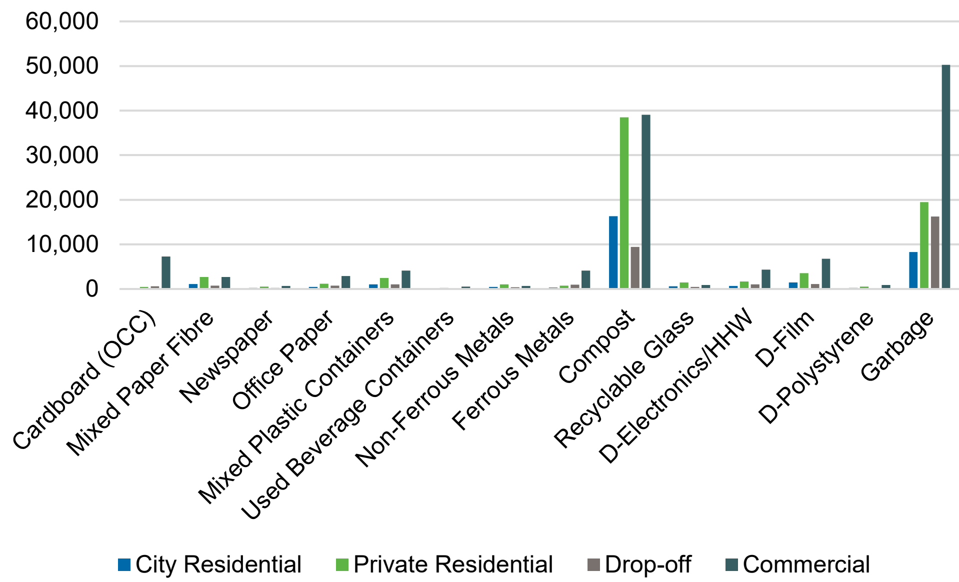

Figure 5-2: Average Tonnage Received at Central Transfer Station in 2016 and 2017

5.1.3 Total Anchorage Tonnages

The total tonnages of each material category for city residential, private residential, drop-off, and commercial collection streams at both facilities in 2016 and 2017 are graphically depicted on Figure 5-3 below. Across each collection stream, compostable materials and garbage made up the bulk of total MSW collected in Anchorage.

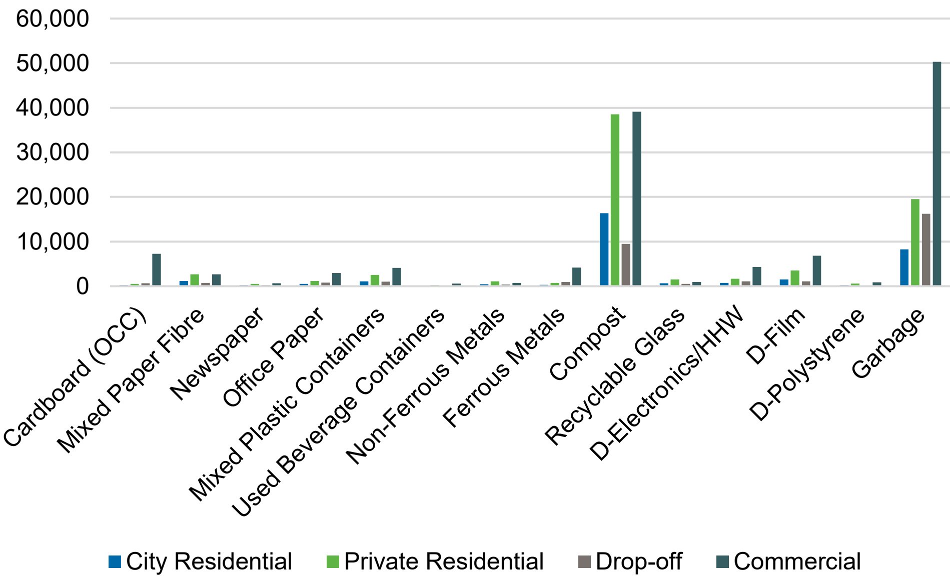

Figure 5-3: Average Tonnage Received in Municipality of Anchorage in 2016 and 2017

5.2 Waste Composition

The United States Environmental Protection Agency (EPA) maintains a list of state and local waste characterization studies. The EPA does not have a record of waste composition studies undertaken in Alaska. The most recent waste composition study in Anchorage was conducted in 2017. To gain an understating of the composition, Tetra Tech utilized data from a comparable northern jurisdiction (Peace River Regional District) to estimate the 2040 potential recapture percentages for Anchorage.

5.2.1 Anchorage Waste Composition

A waste composition study conducted at ARL in 2017 sampled roughly 2,000 pounds of randomly selected MSW from the active face. However, no waste collection streams were considered. Figure 5-4 below, depicts waste composition results from ARL in 2017.

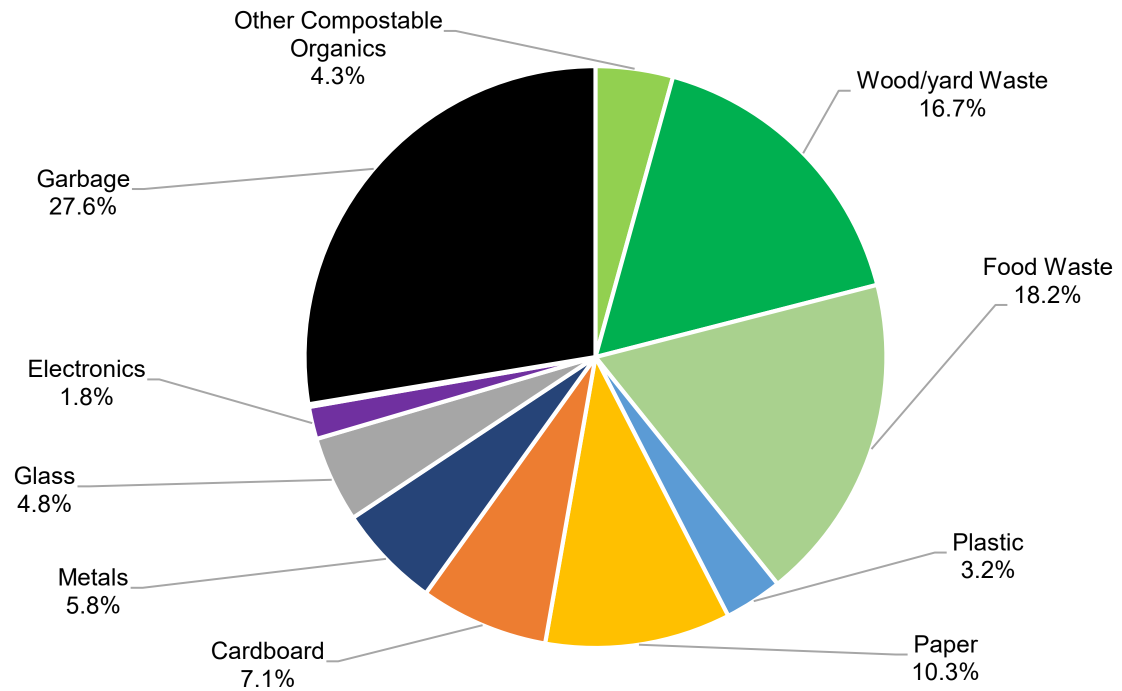

Figure 5-4: Total Anchorage Waste Composition

Food waste made up the largest proportion of waste sampled at ARL (18.2%), followed by wood/yard waste (16.7%) and inert material (15.6%).

5.2.2 Comparable Municipality Waste Composition

The waste composition study from the Peace River Regional District (PRRD) was selected as a comparable jurisdiction to Anchorage due to its existing service levels, and close geographical location. The PRRD waste composition study included 146 samples from Single Family (SF), Drop-Off (DO), and Industrial Commercial and Institutional (ICI) sources, and over 30,000 pounds of waste was sampled. Moreover, the PRRD study was conducted over multiple seasons (Spring, Summer, Fall, Winter) to account for seasonal variability.

Figure 5-5 below illustrates the waste composition from PRRD landfills in 2016 and 2017.

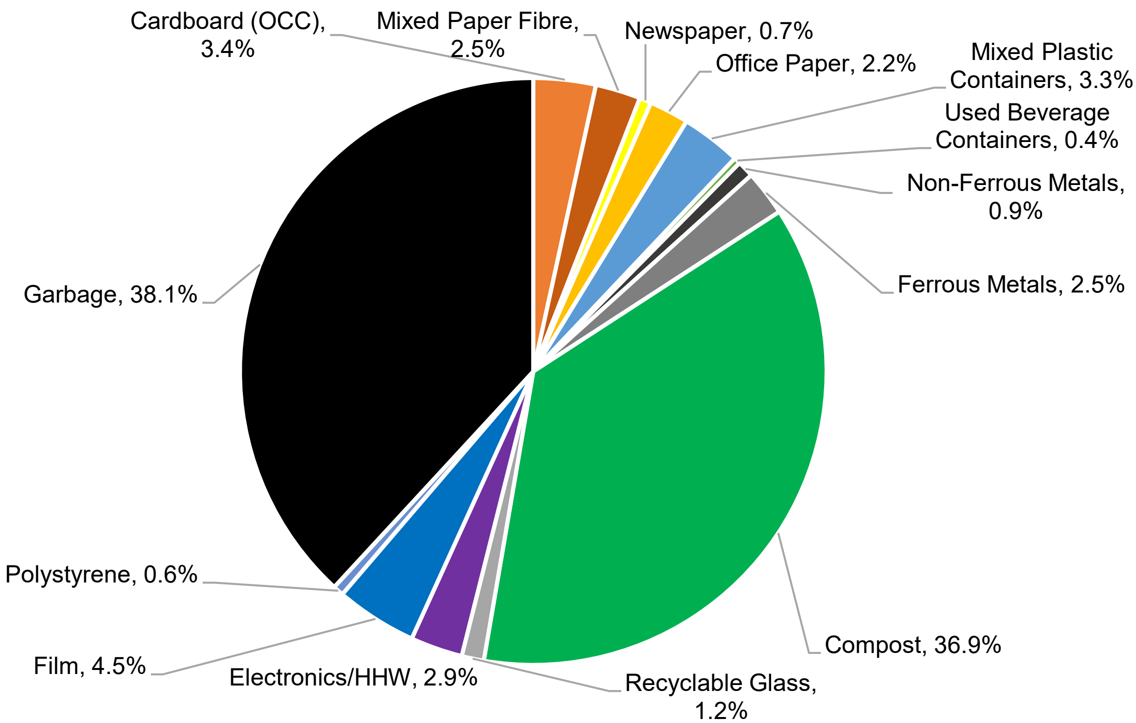

Figure 5-5: Total Peace River Waste Composition

The largest proportion of waste sampled in PRRD was garbage (38.1%), followed by compostable materials (36.9%) and plastic films (4.5%). Compostable materials in the PRRD study would include food waste and wood/yard waste from the Anchorage waste composition study. In Anchorage, the compostable materials would represent 34.9%.

5.3 Feedstock Design Projections

For the MRF feedstock projections, the waste composition of PRRD was utilized instead of the Anchorage waste composition results. These numbers were used because substantially more samples were taken, as well as data specific to each collection stream was included. Moreover, the composition of the PRRD's waste was found to be relatively similar to the waste composition noted at ARL.

Design capacities were designed for 2040 Anchorage population growth projections to ensure adequate future MRF processing capacity. Three design feedstock scenarios were calculated for the future MRF capacity, based on varying levels of recycling participation.

Scenario 1 is designed based on status quo collection levels, with improved recapture from City Municipal – CM (75%), City Private – CP (50%), and Drop-Off – DO (20%) sectors, but with no improved recycling recapture from the commercial sector.

Scenario 2 is designed for improved moderate recycling recapture, where the commercial sector achieves a recapture rate of 40% in addition to the increases in participation described in Scenario 1.

Scenario 3 is designed for optimistic increases in recycling participation from CM (75%), CP (75%), DO (75%), and ICI (50%).

The incoming feedstock quantities and outgoing commodities quantities are described in Table 5-2 and Table 5-3 below.

Table 5-2: Annual Feedstock and Commodity Tonnage

Scenario	Yearly Recycling Tonnage	Weekly Recycling Tonnage	Annual Commodity Tonnage
Commercial Source Separated Recycling			
WestRock	**20,000**	363	19,800
Residential and Commercial Comingled Recycling			
Scenario 1	**22,500**	433	20,025
Scenario 2	**33,000**	633	29,370
Scenario 3	**50,000**	962	44,500
Total MRF Processing			
Scenario 1	**42,500**	817	37,825
Scenario 2	**53,000**	1,019	49,170
Scenario 3	**70,000**	1,346	64,300

Table 5-3: Daily Feedstock and Commodity Tonnage

Scenario	Daily Recycling Tonnage	Tons processed per hour	Daily Commodity Tonnage
Commercial Source Separated Recycling			
WestRock	**52**	7	51.5
Residential and Commercial Comingled Recycling			
Scenario 1	**62**	8	55
Scenario 2	**90**	11	80
Scenario 3	**137**	17	122

5.3.1 Quantity of Residuals

Residual rates experienced currently at the WestRock Anchorage Recycling Centre are relatively low, with RESMIX, or comingled recyclables, feedstocks having a residual rate of approximately 11%. WestRock reports that the source separated recyclable materials that they currently receive at their facility have negligible contamination rates (<1%). Residuals from MRF processes consist of non-recyclable or non-marketable materials and are typically disposed at a landfill.

The annual residual quantities from a potential Anchorage MRF in each scenario are described in Table 5-4 below using a conservative expected contamination rate for comingled recyclables at 15%. Disposal fees were calculated at the current rate of $60 per ton and an estimated future rate of $80 per ton.

Table 5-4: Residual Tonnage and Costs

Scenario	Annual Tonnage	Current Annual Disposal Costs	Future Annual Disposal Costs
Scenario 1	3,375 tons	$202,500	$270,000
Scenario 2	4,950 tons	$397,000	$396,000
Scenario 3	7,500 tons	$450,000	$600,000

6.0 MATERIAL RECOVERY FACILITY CAPACITY AND LAYOUT

Two MRF equipment vendors were contacted to provide quotes and equipment information that would suit the MoA's needs. The following summarizes the MRF design capacity, operational features, facility layout and cost considerations. The operation of the facility is based on one shift per day, and five days per week.

6.1 Material Recovery Facility Design Capacity

The MRF design capacities were estimated based on feedstock forecasts for the three scenarios mentioned above. The MRF would process two types of incoming recycling streams that consist of: (1) source separated materials from commercial sources that required limited processing (i.e., sorting) but would need to be baled for shipping, and (2) comingled recyclables from residential and commercial sources that would need to be sorted and then baled.

6.1.1 Processing Equipment

The processing parameters described earlier were presented to the MRF equipment vendors to assist with selection of the processing equipment and estimate space requirements for the MRF building. As noted in Section 5.3, the sorting portion of the MRF would need a processing capacity that ranged from 8 tons to 17 tons per hour. The low end of the processing capacity would be for Scenario 1 whereas the high end of the processing capacity would be for Scenario 3. Processing requirements for source separated commercial recyclables is assumed to be minimal.

The baler should be large enough to accommodate the two recycling streams. This would mean the baler should have the capacity to process 24 tons per hour of materials.

6.1.2 Recyclables Storage

The MRF design should incorporate storage areas for incoming recyclables. Most MRFs have inbound storage for three days in the event the facility is shut down for maintenance. That would represent approximately 600 tons of material. Assuming the infeed storage area could accommodate an average height of three yards of materials and an average density of comingled recyclables is 250 pounds per cubic yard, area of the inbound feedstock area should be at least 14,400 square feet.

6.1.3 Commodities Storage

Storage space is also required for the sorted commodities. WestRock ships out commodities on a daily basis and has indicated that the facility should have a minimum of two days of commodity space for storage. Two days of commodities storage represents approximately 370 tons of recyclable materials. Assuming baled materials can be stored three yards high and the density of compacted paper products has a density that is approximately 0.19 tons per cubic yard, the area required to store commodities should be a minimum of 6,000 square feet.

In the event the storage area for commodities is insufficient, the commodities could also be loaded into shipping containers and stored outside on the MRF site or off-site such as the wharf before being loaded onto the barges. Each shipping container could hold approximately 20 tons to 25 tons of commodities.

6.2 Material Recovery Facility Operational Features

The sorting system would start with an infeed conveyor. The process would start with a horizontal pit conveyor that feeds an incline conveyor with a photocell at the transition between the two conveyors that starts and stops the horizontal conveyor depending on whether material is blocking the photocell or not. This helps meter the material evenly as it moves up the incline conveyor. The facility would require a knowledgeable loader operator who can continuously feed the horizontal pit conveyor when the pit starts becoming empty.

The incline conveyor would lead to a pre-sort conveyor line to remove film, bulky rigids and other objectionable and unacceptable items.

The remaining material would be sent to an OCC (Old Corrugated Cardboard) screens to remove the bigger OCC and OBB (Old Box Board).

The rest of the material would then go to a series of ballistic separators that would work to separate the 2D (flexible) from the 3D (rigid) material. At that stage, a fiber sort line would target all the 2D/flexible material and a container sort line for all the 3D/rigid material.

The fiber sort line should be staffed to remove additional contamination to try and make the fiber as valuable as possible. The remaining material is usually a lower grade fiber that can be acceptable with minimal sorting to remove rejects (e.g., film) and be baled and shipped out.

A container line would include both a ferrous magnet to remove tin cans and an eddy current to remove aluminum. A few sorters could remove contamination. The rest of the plastics would fall off the end of the line as a negative sort to be baled and shipped out.

The plastics would use optical sorters to high grade the plastics or be baled together to produce mixed plastics. Figure 6-1 illustrates the sorting process for the comingled recyclable materials.

As for the source separated commercial materials, those materials would be loaded in an area that has direct access to the baler where it would simply be loaded directly onto the baler feed conveyor and baled.

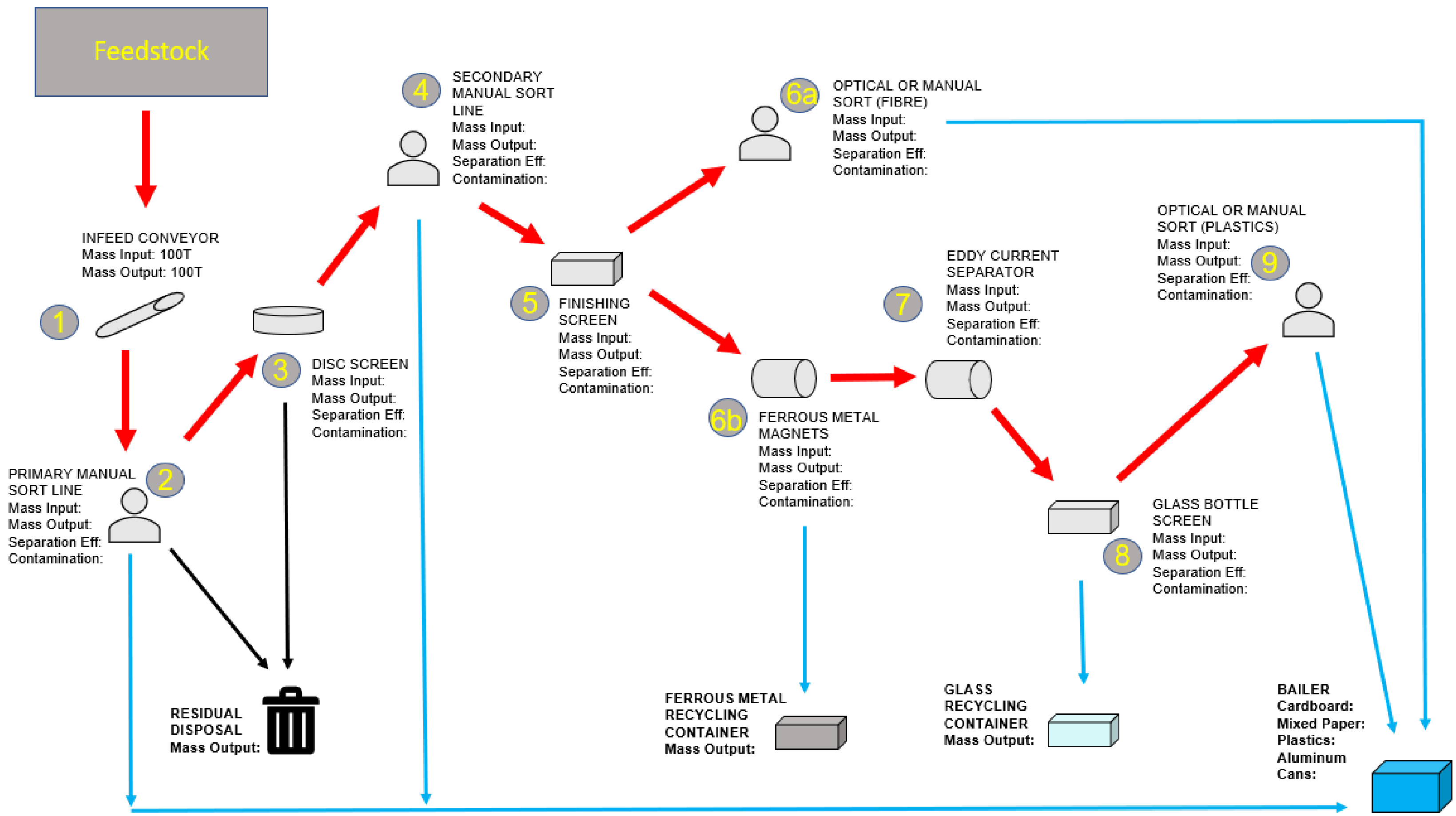

Figure 6-1: MRF Operational Features

6.2.1 Operating Requirements

The MRF requires labour and utilities to receive, sort and bale the commodities. The configuration proposed above by the vendors has the capacity to process the daily inbound stream from the low end of 15 tons per hour (32,000 tons/year – one 8-hour shift) to as high as 25 tons per hour (62,400 tons/year – one 8-hour shift). Higher annual processing rates can be achieved by adding an additional shift or a partial shift (e.g., half shift equating to 4 extra hours of processing). As the quantities increase or decrease, the MRF operator can add more shifts (or partial shifts) or reduce shifts to address the processing demand of the inbound materials.

The following table (Table 6-1) lists the types of personnel and energy requirements to operate the proposed MRF (Scenario 1). The labour requirements should range between 18 and 24 fulltime equivalents (FTE) for the three scenarios. The labour rates were obtained from the Bureau of Labour Statistics for the industrial sector in Anchorage. It is assumed that the electricity schedule is Schedule 23 (General Service: Large at Primary Voltage). The estimated unit operating cost for the MRF is calculated at the bottom of the table.

Table 6-1: Summary of Operating Costs for Scenario 1

Cost Items	Quantity	Unit	Unit Rate	Unit	Hours (See Hours Calculation table)	Annual Cost	
						Vendor 1	Vendor 2[1]
Plant Manager	1	staff	$50.10	$/hour	2000-3000	$100,200	$100,200
Plant Administration	1	staff	$24.46	$/hour	2000-3000	$48,900	$48,900
Operations Supervisors	1 or 2	staff	$41.58	$/hour	2000-3000	$83,200	$249,500
Equipment Maintenance Personnel	1	staff	$27.45	$/hour	2000-3000	$54,900	$82,400
Equipment Operators	2	staff	$21.20	$/hour	2000-3000	$127,200	$190,800
Sort Staff	18	staff	$15.66	$/hour	2000-3000	$563,800	$845,600
					Total Staffing Costs	**$978,200**	**$1,517,400**
Basic monthly charge for electricity	12	months	$619.42	$/mo	N/A	$7,400	$7,400
Energy charge for electricity	1,500	kW/h	$0.04	$/kWh	2600-3900	$163,800	$245,700
Demand charge for electricity	18000	kW/yr	$43.10	$/kW	N/A	$64,700	$64,700
Bale Cost	42,500	tons	$9.00	$/ton	N/A	$382,500	$382,500
Maintenance Cost	42,500	tons	$6.00	$/ton	N/A	$340,000	$340,000
Residuals Disposal Fees ($80/t)	3,300	tons	$80.00	$/ton	N/A	$270,000	$270,000
					Total Other Operating Costs	***$1,228,400***	***$1,310,300***
					Total Average Annual Operating Cost	**$2,206,600**	**$2,827,700**
					Operating Cost per ton	**$51.92**	**$66.53**

[1] Vendor 2 requires 50% more hours of operation, hence increased energy and labour costs

For the Scenario 2 where more material is processes and more resources would be utilized, the estimated unit processing costs increased by approximately $4.85 per ton and $4.56 per ton. For Scenario 3, the estimated unit processing costs increased by $11.39 per ton and $11.70 per ton compared to Scenario 1.

6.3 Material Recovery Facility Layout

The layout for a MRF is typically governed by the property configuration and the traffic flow in and out of the property. Figure 6-2 is an example of a 3-D illustration of a MRF layout. The diagram illustrates (from the top left-hand corner to the bottom right-hand corner) where inbound recyclables are unloaded into the facility, how comingled recyclables are pushed or moved into the pit conveyor, how recyclable materials move through the material recovery process, where commodities are picked out of the recycling stream, where non-recyclable residuals (i.e., contamination) are removed and placed into transfer trailers for disposal, where commodities are baled, where commodities are stored and how commodities are loaded into truck to ship to market.

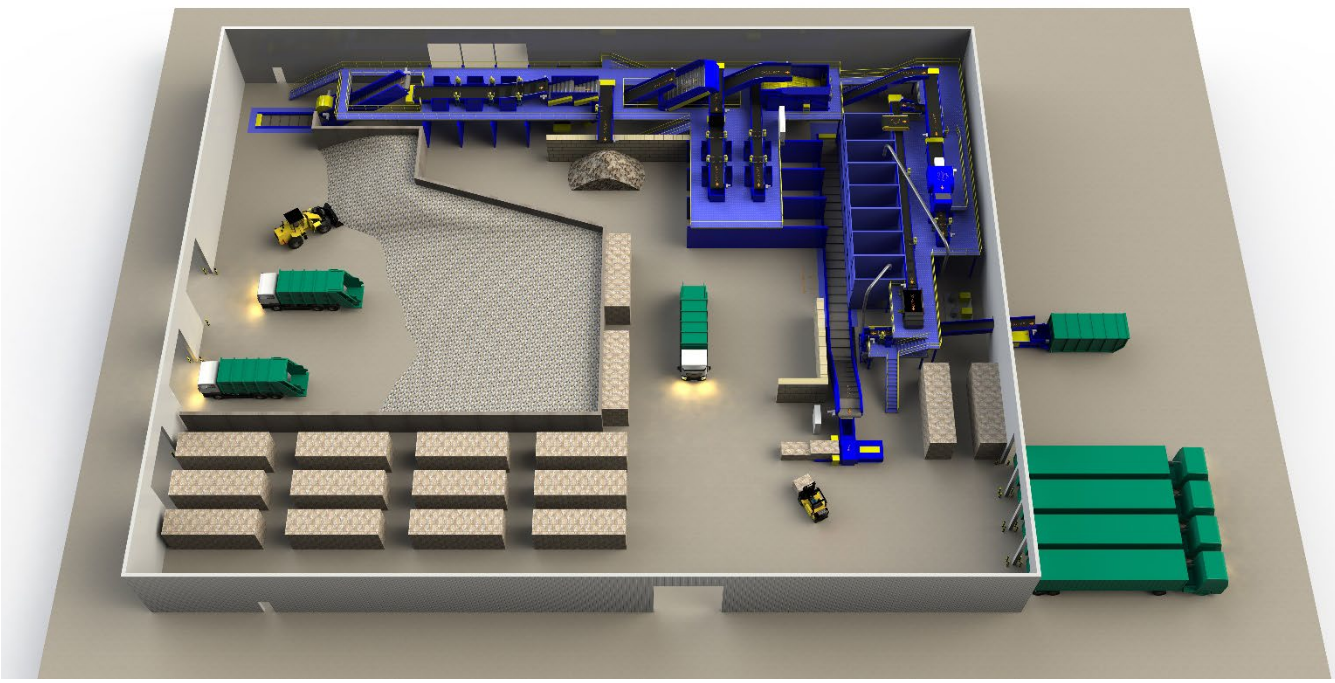

Figure 6-2: Example MRF Conceptual Layout

The proposed Anchorage MRF building is estimated to be approximately 63,600 square feet. The dimensions from a comparable facility is 265 feet by 240 feet. MRF buildings are typically engineered metal free spanning buildings. Cost estimates from the CTS study estimates capital costs to range from $240 to $250 per spare foot. That would equate to a building that cost between $15.3M and $15.9M.

Most MRF facilities also have additional properties outside the MRF enclosure for staff parking, truck movement (entering and exiting the property), and for storage of shipping containers (empty and loaded containers). The additional space can be as much as 60,000 square feet of outdoor property.

6.4 Financial Considerations

The feasibility study will examine the capital and operating cost of the MRF and the off-set revenues from the sale of recovered commodities. The capital costs will be financed over 20 years to calculate the annualized capital costs. The annualized capital cost and annual operating cost will be added together to obtain the annual cost for the MRF. Potential revenues from the sale of commodities will be calculated based on market rates found during research. This should result in the net annual cost which is then divided by the amount of material received at the MRF to calculate the unit processing cost for the proposed MRF at the proposed scenarios.

Turn key costs for the MRF processing equipment are estimated to range between $6M and $8M. For the feasibility study, a MRF processing cost of $8M was used to provide a conservative estimate.

7.0 FINANCIAL SCENARIO DEVELOPMENT

This section outlines three different processing scenarios for managing recyclables in the MoA. The following assumptions were used in the development and financial analysis of these options:

- Design capacity for each of the scenarios is as shown in Section 5.3:
  - It is estimated that the MRF would process approximately 20,000 tons of source separated recyclables in each scenario from established commercial sector customers;
  - **Scenario 1** represents current recycling with modest increased participation across residential sectors and growth, and projects receiving approximately 22,500 tons of comingled recycling per year;
  - **Scenario 2** outlines moderate increases in participation of the commercial sector and residential recycling programs and estimates receiving 33,000 tons of comingled recycling per year;
  - **Scenario 3** frames high recycling increases across both commercial and residential sectors as a maximum capture situation with approximately 50,000 tons of comingled recycling received per year; and
  - As outlined in Section 5.3.1, contamination of incoming comingled recycling is estimated at 11%, and residuals separated via the MRF processes will be disposed in the ARL. For the analysis, a contamination rate of 15% was used to provide a conservative analysis of this potential initiative.
- Capital costs include site preparation and pre-construction, construction of facility(ies), procurement of required equipment, and engineering design and contingency factors;
- Capital costs include a 10% engineering design and 20% contingency factor costs;
- Capital costs are annualized at a borrowing interest rate of 5% over a 20-year period; and
- Operating costs for the MRF include utility costs (e.g., diesel, electricity, water), labour, equipment maintenance, and a contingency factor of 20%.

7.1 Capital Costs

Table 7-1 below depicts the estimated capital costs of a potential MRF in the MoA, based on information provided by vendors and Tetra Tech calculations.

Table 7-1: Capital Costs

Item	Scenario 1		Scenario 2		Scenario 3	
	Vendor 1	Vendor 2	Vendor 1	Vendor 2	Vendor 1	Vendor 2
Building Size (Sq. Ft)	63,600		63,600		63,600	
Site Development Costs	$800,000		$800,000		$800,000	
Building Cost	$15.9M		$15.9M		$15.9M	
Stationary and Mobile Equipment	$8M	$6M	$8M	$6M	$8M	$6M
Engineering Design	$1.6M		$1.6M		$1.6M	
Administration & Contingency	$3.2M		$3.2M		$3.2M	
Total Capital Cost	**$29.5M**	**$27.5M**	**$29.5M**	**$27.5M**	**$29.5M**	**$27.5M**
Annual Amortized Capital Cost	**$2.33M**	**$2.19M**	**$2.33M**	**$2.19M**	**$2.33M**	**$2.19M**

7.2 Operating Costs

Table 7-2 below depicts the estimated operating costs of a potential MRF in the MoA. Costs affiliated with implementing a curbside recycling program are not included.

Table 7-2: Annual Operating Costs (including amortized capital costs)

Item	Scenario 1		Scenario 2		Scenario 3	
	Vendor 1	Vendor 2	Vendor 1	Vendor 2	Vendor 1	Vendor 2
Annual Tonnage	20,000 (SSR) 22,500 (Comingled)		20,000 (SSR) 33,000 (Comingled)		20,000 (SSR) 50,000 (Comingled)	
Residuals Disposal Fees (Tip Fee = $80/t)	$270,000		$396,000		$600,000	
Labour and Administrative	$980,000	$1,520,000	$1,330,000	$1,960,000	$1,900,000	$2,790,000
Electricity/Fuel/Maintenance	$960,000	$1,040,000	$1,240,000	$1,370,000	$1,640,000	$1,800,000
Total Operating Costs	$2,210,000	$2,830,000	$2,970,000	$3,720,000	$4,140,000	$5,190,000
Annual Amortized Capital Costs	$2,330,000	$2,190,000	$2,330,000	$2,190,000	$2,330,000	$2,190,000
Total Annual Cost	**$4,540,000**	**$5,020,000**	**$5,300,000**	**$5,910,000**	**$6,470,000**	**$7,370,000**
Cost per Ton (w/o Commodities Revenue)	**$106.74**	**$118.12**	**$100.00**	**$111.51**	**$92.43**	**$105.29**

7.3 End-Markets and Shipping

An important part of developing comingled recycling processing capacity is developing reliable end markets for the baled and unbaled commodities. End markets will ensure that the processed commodities do not continuously stockpile onsite and may enable revenue generation.

Currently, WestRock Anchorage Recycling Centre ships the bulk of its processed materials to markets in Washington State or Oregon, dependent on the quantity of contamination removed during processing. This requires shipment via ocean freighter. Commodities are shipped out on a daily basis from the facility.

Commodity sales prices were compared with historical (since 1988) and October 2019 prices provided by Sound Resource Management. As shown in Appendix B, the average market prices for 2012-2017 were relatively stable and almost all historical lows have occurred in the past 2 years. Potential reasons for these decreases are discussed in Section 8.1. Relevant prices are depicted in Table 7-3 below.

Table 7-3: Commodity Prices in USD per Ton

Material	Historical Low[1]	Historical High[1]	Current Market[1]
Mixed Paper	($10)	$130	$10
Office Paper	80	$200	$100
Magazines	($10)	$130	$10
Newspaper	($10)	$160	$0
Cardboard	$45	$225	$45
Plastics	$50	$250	$150
Tin cans	$50	$200	$80
Aluminum cans	$600	$1,600	$950
Metals (Ferrous)	$50	$200	$80

[1] Current market rates, historical low, and historical high were estimated from online research focused on Washington and Oregon, as Anchorage currently exports much of its material to these states. These rates are only indicators, as actual sale prices can vary significantly. Historical highs and lows were estimated from 5-years of commodity price data where available.

Scenario 1 revenues from each commodity are included in Table 7-4 below. Status quo revenues are based off potential material sale prices and include the cost of freight. The separated cost of freight was unavailable, so historical low, historical high, and current market revenues are estimations of potential sales, but would need to include ALPAR shipping rates to for a detailed cost analysis.

Table 7-4: Commodity Revenues for Scenario 1

Material	Historical Low	Historical High	Current Market
Mixed Paper	$(60,000)	$760,000	$60,000
Office Paper	$390,000	$980,000	$490,000
Magazines	$(10,000)	$90,000	$10,000
Newspaper	$(10,000)	$160,000	$10,000
Cardboard	$530,000	$2,640,000	$530,000
Plastics	$200,000	$980,000	$590,000
Tin cans	$30,000	$130,000	$80,000
Aluminum cans	$600,000	$1,610,000	$960,000
Metals (Ferrous)	$120,000	$490,000	$290,000
Total	**$1,800,000**	**$7,820,000**	**$3,000,000**

Scenario 2 revenues from each commodity are included in Table 7-5 below. The separated cost of freight was unavailable so historical low, historical high, and current market revenues are estimations of potential sales, but would need to include ALPAR shipping rates to for a detailed cost analysis.

Table 7-5: Commodity Revenues for Scenario 2

Material	Historical Low	Historical High	Current
Mixed Paper	$(70,000)	$940,000	$70,000
Office Paper	$490,000	$1,230,000	$610,000
Magazines	$(10,000)	$110,000	$10,000
Newspaper	$(10,000)	$230,000	$10,000
Cardboard	$610,000	$3,040,000	$610,000
Plastics	$280,000	$1,410,000	$850,000
Tin cans	$50,000	$190,000	$110,000
Aluminum cans	$940,000	$2,490,000	$1,480,000
Metals (Ferrous)	$190,000	$760,000	$460,000
Total	**$2,460,000**	**$10,400,000**	**$4,220,000**

Scenario 3 revenues from each commodity are included in Table 7-6 below. All revenues are based off potential material sale prices and include the cost of freight.

Table 7-6: Commodity Revenues for Scenario 3

Material	Historical Low	Historical High	Current
Mixed Paper	$(100,000)	$1,240,000	$100,000
Office Paper	$660,000	$1,640,000	$820,000
Magazines	$(10,000)	$140,000	$10,000
Newspaper	$(20,000)	$340,000	$20,000
Cardboard	$740,000	$3,700,000	$740,000
Plastics	$430,000	$2,130,000	$1,280,000
Tin cans	$70,000	$290,000	$180,000
Aluminum cans	$1,480,000	$3,950,000	$2,350,000
Metals (Ferrous)	$310,000	$1,220,000	$730,000
Total	**$3,550,000**	**$14,650,000**	**$6,220,000**

In the case that the MoA implements a source separated glass collection program, local end markets would be required, as long-distance shipping of glass lacks cost feasibility.

7.4 Financial Feasibility for Recycling

Table 7-7 shows how the capital and operating costs would be offset by revenues from above noted commodities. The net annual costs and the unit processing costs for recyclables processed at the potential MRF as summarized based on the state of commodity markets.

Table 7-7: Net MRF Unit Processing Cost with Variable Commodity Pricing

Item	Scenario 1	Scenario 2	Scenario 3
Annual Tonnage	42,500	53,000	70,000
Total Annual Cost (w/o Commodities Revenues)	**$4,540,000 – $5,020,000**	**$5,300,000 – $5,910,000**	**$6,470,000 – $7,370,000**
Historical Low			
Commodities Revenues	$1,800,000	$2,460,000	$3,550,000
Net Total Annual Cost	**$2,740,000 – $3,220,000**	**$2,840,000 – $3,450,000**	**$2,920,000 – $3,820,000**
Cost per ton (w/ Revenues)	**$64.47 – $75.76**	**$53.58 – $65.09**	**$41.71 – $54.57**
Historical High			
Commodities Revenues	$7,820,000	$10,400,000	$14,650,000
Net Total Annual Cost	**($2,800,000 – $3,280,000)**	**($4,490,000 – $5,100,000)**	**($7,280,000 – $8,180,000)**
Cost per ton (w/ Revenues)	**($65.89 – $77.18)**	**($84.72 – $96.23)**	**($104.00 – $116.86)**
Current Market			
Commodities Revenues	$3,000,000	$4,220,000	$6,220,000
Net Total Annual Cost	**$1,540,000 – $2,020,000**	**$1,080,000 – $1,690,000**	**$250,000 – $1,150,000**
Cost per ton (w/ Revenues)	**$36.26 – $47.53**	**$20.38 – $31.89**	**$3.57 – $16.43**

Table 7-7 shows that revenue can be made based on the state of the recycling commodity markets. Although the current markets are a little higher than historical lows, the end result is there will be a cost to processing and selling recyclables. The recycling commodities industry is expected to rebound in the future and this feasibility assessment shows that there are scenarios with positive cash flow to establishing and expanding the recycling programs in Anchorage.

8.0 SYSTEMS ANALYSIS CONSIDERATIONS

This section discusses the recycling industry trends and the sustainability considerations that may influence establishing a new MRF in the MOA.

8.1 Recycling Industry Trends

This section discusses some of the trends in the recycling industry.

8.1.1 National Sword

The “National Sword” is a policy from China that banned the importation of certain solid waste materials into the country and set strict limits on contamination rates in recyclable materials. The policy was announced in July 2017 and implemented starting in 2018 (January 1, 2018). China also reduced the number of import licenses which meant that fewer businesses would be able to import recyclable materials into the country. As a result, he National Sword greatly impacted the global waste recycling industry.

Being the largest importer of recyclable materials for decades, the entire world was affected by the new policy either by the amount of materials that would be recycled or by the revenues that would be received. Materials that did not meet the new contamination rate standards (i.e. 0.5% by weight) were rejected and/or brokers would need to find other markets in countries that typically paid less for their commodities. Most MRFs in the United States produced a recycling stream that did not meet the new standards. Although the effects of the National Sword were well known and foreseen, the recycling industry was slow to respond until loads started being rejected. This resulted in recycling materials piling up, dropping the price for traditional recycling commodities and affecting the bottom line of many MRFs around the world. Many MRFs that did not have the resources to improve their operations were forced to close their doors.

8.1.2 MRFs in North America

The new standards have forced communities and MRFs around North America to improve their processing systems and their education/enforcement programs. Many MRFs are slowing down their processing lines with a goal to remove more contamination or are upgrading their facilities to improve commodity quality and reduce contamination in their commodities that are processed. Slowing the processing line adds more operating cost to the MRFs. Based on discussions with MRF equipment vendors, the new standards have increased orders for new equipment and/or construction of newer MRFs with higher performance standards.

Although there are many reports of MRFs shutting down, there are also many reports of MRFs being upgraded or being built to higher performance standards. For example, the City of Calgary is spending $4M upgrading their MRF and the City of Lethbridge opened their new MRF in Spring 2019. The City of Edmonton has also been investigating options to expand their MRF’s processing capacity and performance. In the Pacific Northwest (Washington and British Columbia) there are several facilities that were upgraded before the National Sword policy was implemented and contamination limits were not a concern in finding markets for their processed commodities.

Closure of MRFs is certain parts of the United States were seen as opportunities for certain investment firms. These closed facilities were purchased a low prices and investments were made to improve the quality of the end-product. These new investors also worked with their respective communities to improve education programs and show their residents how to improve use of their recycling programs. Although markets are currently below market norms, many industry experts predict that the commodities market will rebound in the next two to three years.

8.2 Socio-Environmental Considerations

The ranking proposed for each of the recycling recapture scenarios presented is based on a qualitative ranking of low, medium and high of the evaluation criteria. Table 8-1 describes the criteria used to select the preferred options and the preliminary relative weighting with regards to environmental and social considerations. The evaluation of the scenarios is based on preliminary weighting determined from previous meetings with MoA staff, shifting the weighting of criteria, or including new criteria that may change the results.

Table 8-1: Socio-Environmental Criteria Descriptions

Criteria	Description
Environmental	
GHG Emissions	While all design options involve diverting recyclables from being landfilled, an increase in commodities results in more freight required. Design options rated highly will involve the least amount of GHG emissions from transportation.
Reduced Landfilling	An enhanced recycling program results in less MSW being landfilled. Options rated highly will involve the least amount of MSW requiring landfilling.
Local System Resiliency	Resiliency is important for Anchorage as international commodity markets continue to shift. Options rated highly will improve the ability for Anchorage to control the quality of material for export.
Social	
Public Acceptance	The implementation of a curbside recycling program in the MoA would require effort from the public. Especially if recycling bylaws are enforced. Options rated highly will involve the least amount of public effort.
Commercial Sector Acceptance	If recycling regulations are implemented, commercial sectors will need to modify their operations to accommodate. Options rated highly will involve the least amount of commercial sector modification.
Job Creation	Job creation can be a vital component of building public support for new MRF infrastructure and initiatives. Options rated highly will involve the most job creation in the MoA.

Table 8-2 provides an initial multi-criteria analysis ranking of the priority of the recycling recapture scenarios with regards to social and environmental considerations using the nominal value comparison introduced in Table 8-1.

Table 8-2: Socio-environmental Scenario Comparison

Scenario	Environmental Considerations			Social Considerations			Score (/18)
Criteria	GHG Emissions (3 – Low GHGs, 1 – High GHGs)	Reduced Landfilling (3 – Low Landfilling, 1 – High Landfilling)	Local System Resiliency	Public Acceptance (3 - High Public Acceptance, 1 – Low Public Acceptance)	Commercial Sector Acceptance (3 – High Commercial Acceptance, 1 – Low Commercial Acceptance)	Job Creation (3 – High Job Creation, 1 – Low Job Creation)	
Scenario 1	3	1	2	2	3	2	**13**
Scenario 2	2	2	3	1	2	2	**12**
Scenario 3	1	3	3	1	1	3	**12**

Using the nominal weighting system, recycling recapture Scenario 1 yielded the highest point total (13). Followed by Scenario 2, Scenario 3, with 12 points.

8.3 Financial Considerations

The ranking proposed for each of the recycling recapture scenarios presented is based on a qualitative ranking of low, medium and high of the evaluation criteria. Table 8-3 describes the criteria used to select the preferred options and the preliminary relative weighting with regards to financial considerations. The evaluation of the scenarios is based on preliminary weighting determined from previous meetings with MoA staff, shifting the weighting of criteria, or including new criteria that may change the results.

Table 8-3: Financial Scenario Criteria Descriptions

Criteria	Description
Capital Investments	Capital cost refers to the upfront expenditures for infrastructure and equipment for a dirty MRF. Options rated highly will involve the lowest capital costs.
Operating Costs	Operating cost describes the ongoing annual costs to managing comingled feedstocks that the MoA will need to finance. Options rated highly will involve the lowest operating costs.
Cost per Ton	Cost per ton defines the unit cost for feedstocks at a MRF, based off of capital and operating costs. Options rated highly will involve the lowest cost per ton.
Recycling End-Market Stability	Options rated highly will provide the most capacity to produce high quality recyclable materials for market.

Table 8-4 below provides an initial multi-criteria analysis ranking the priority of the recycling recapture scenarios with regards to financial considerations using nominal value comparison highlighted in Table 8-3.

Table 8-4: Financial Scenario Comparison

Scenario	Financial Considerations				Score (/12)
Criteria	**Capital Cost** (3 – Low Capital Costs, 1 – High Capital Costs)	**Operating Cost** (3 – Low Operating Costs, 1 – High Operating Costs)	**Cost per Ton** (3 – Low Cost per Ton, 1 – High Cost per Ton)	**Recycling End-Market Stability**	
Scenario 1	3	3	1	2	**9**
Scenario 2	2	2	2	3	**9**
Scenario 3	1	1	3	3	**8**

Using the financial nominal weighting system, Scenario 1 and Scenario 2 produced the highest score at nine points. Scenario 3 followed with 8 points respectively.

9.0 CLOSURE

We trust this document meets your present requirements. If you have any questions or comments, please contact the undersigned.

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APPENDIX A

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LIMITATIONS ON USE OF THIS DOCUMENT

GEOENVIRONMENTAL

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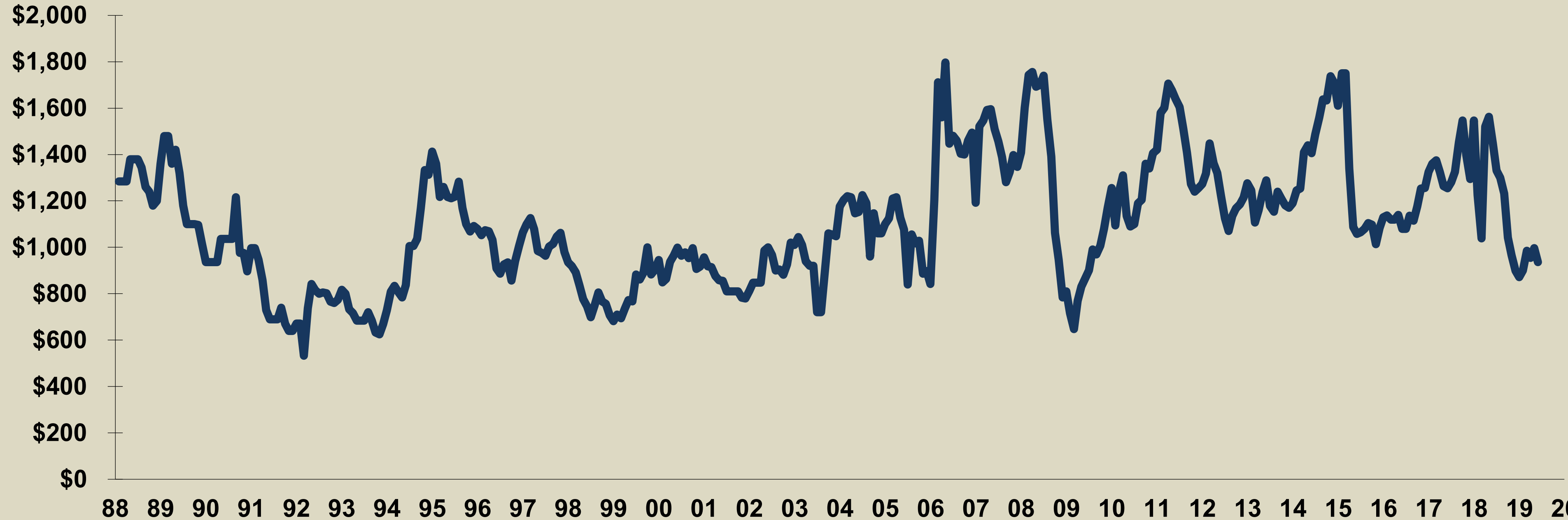
APPENDIX B

HISTORICAL COMMODITY PRICES FROM SOUND RESOURCE MANAGEMENT

Puget Sound Recycling Market Prices
Used Aluminum Beverage Cans
February 1988 - June 2019



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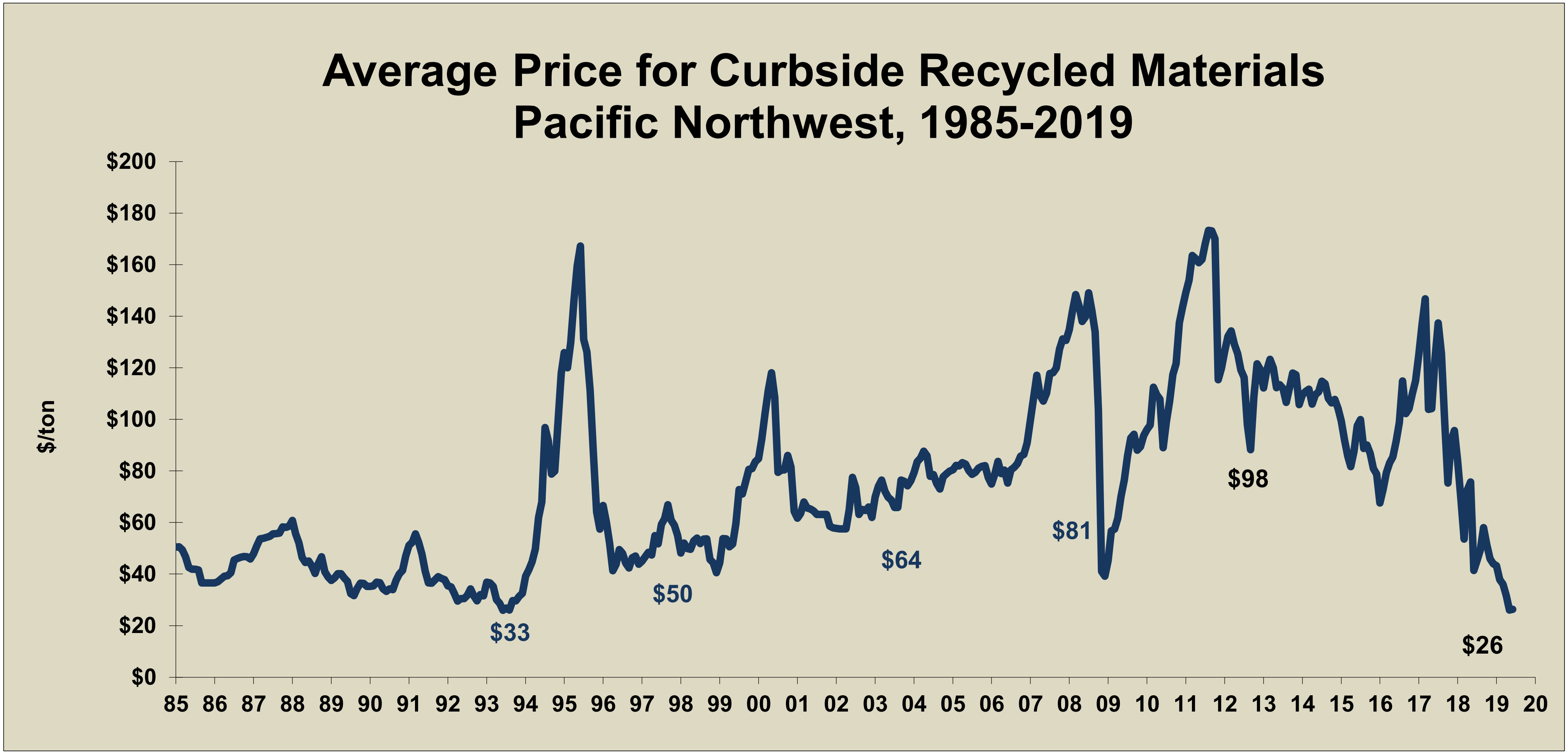

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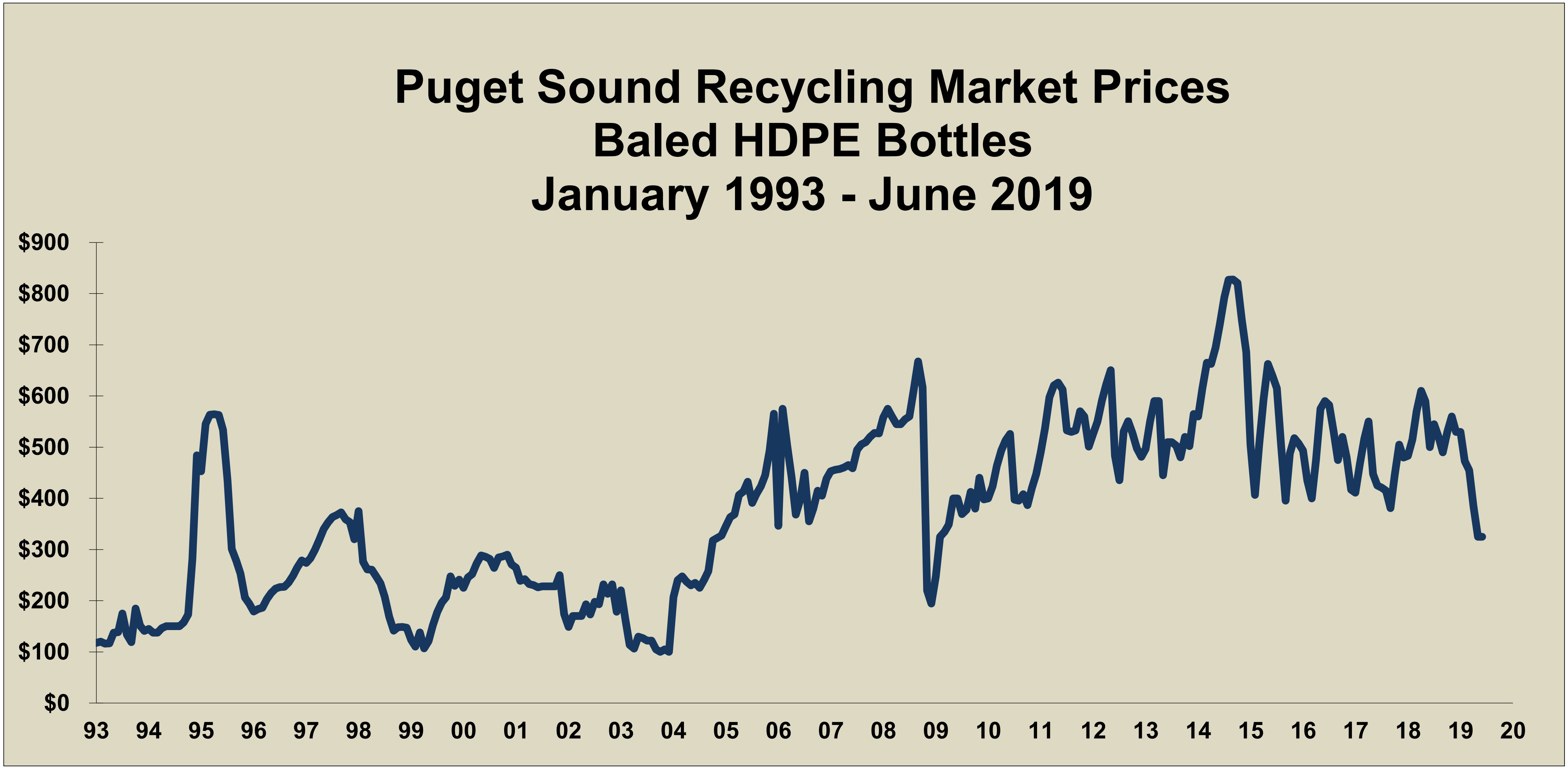

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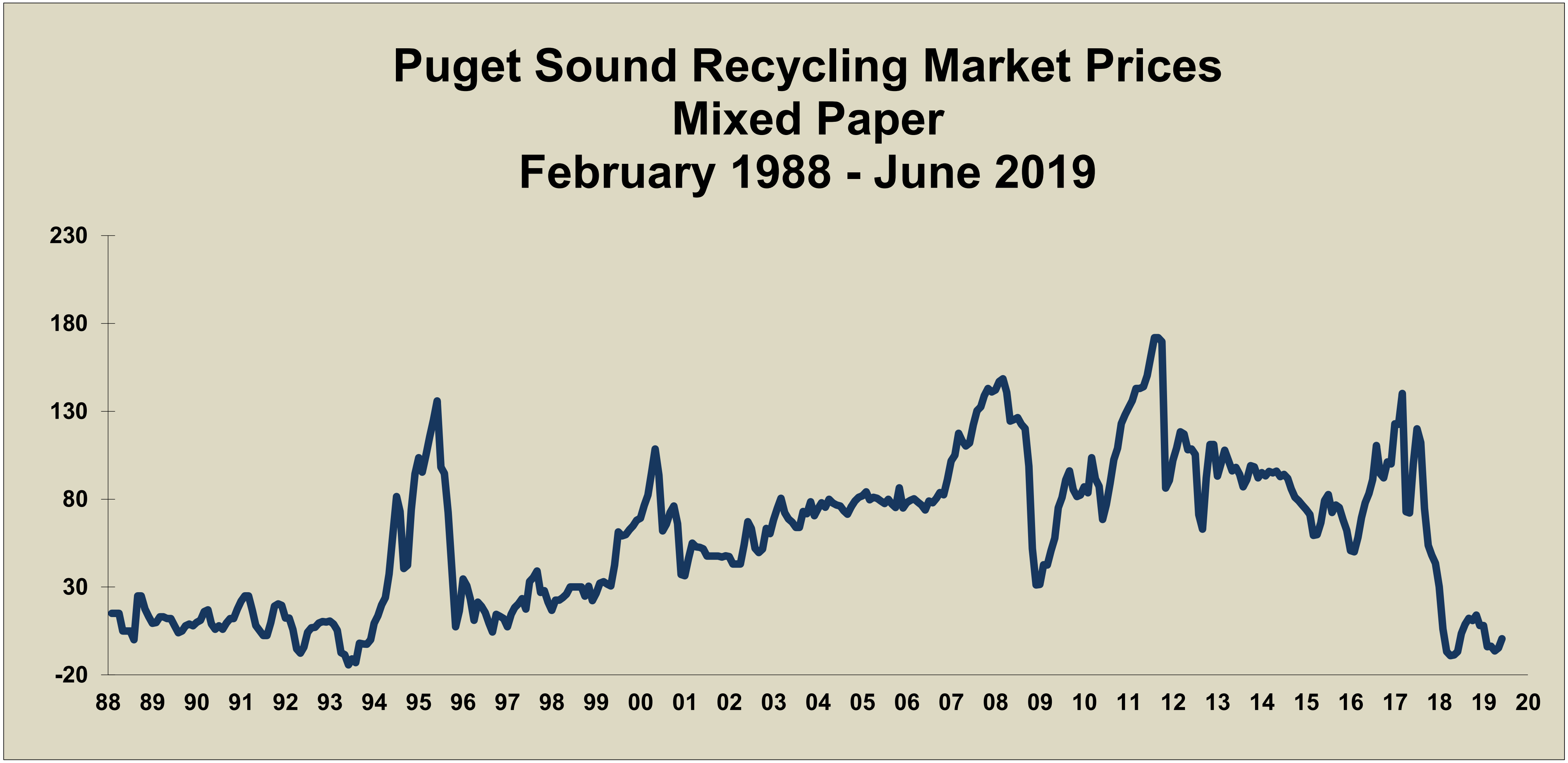

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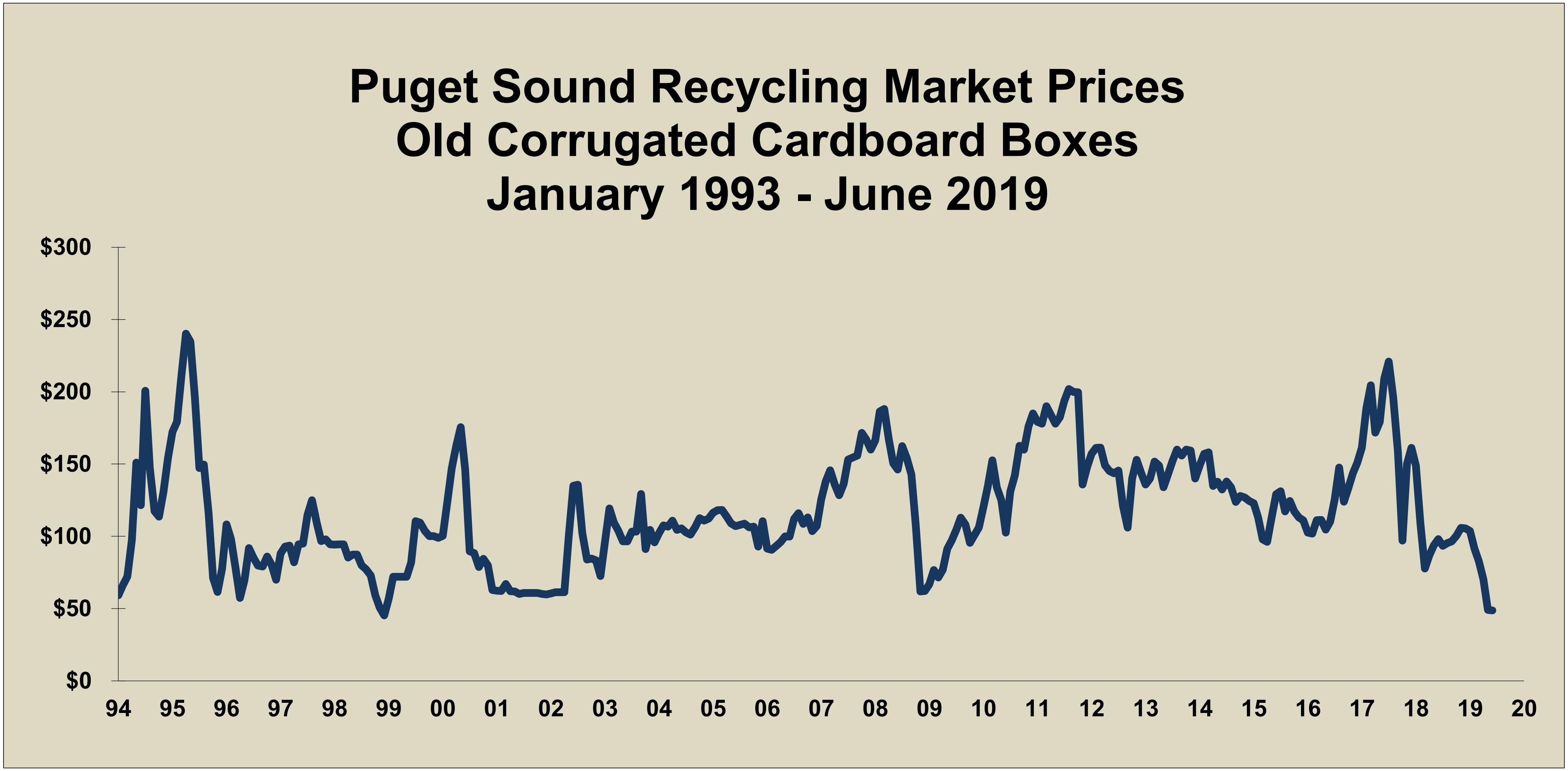

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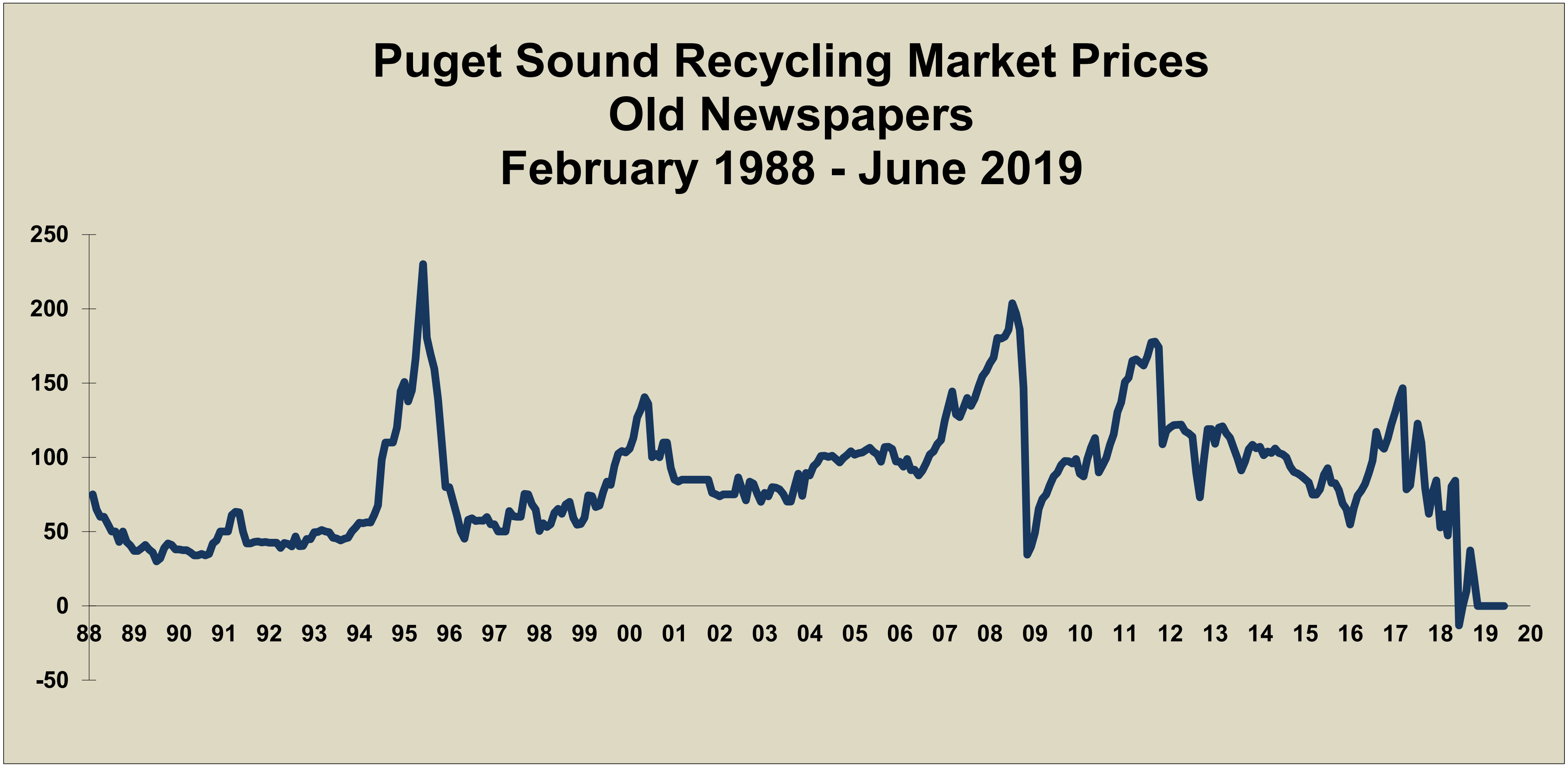

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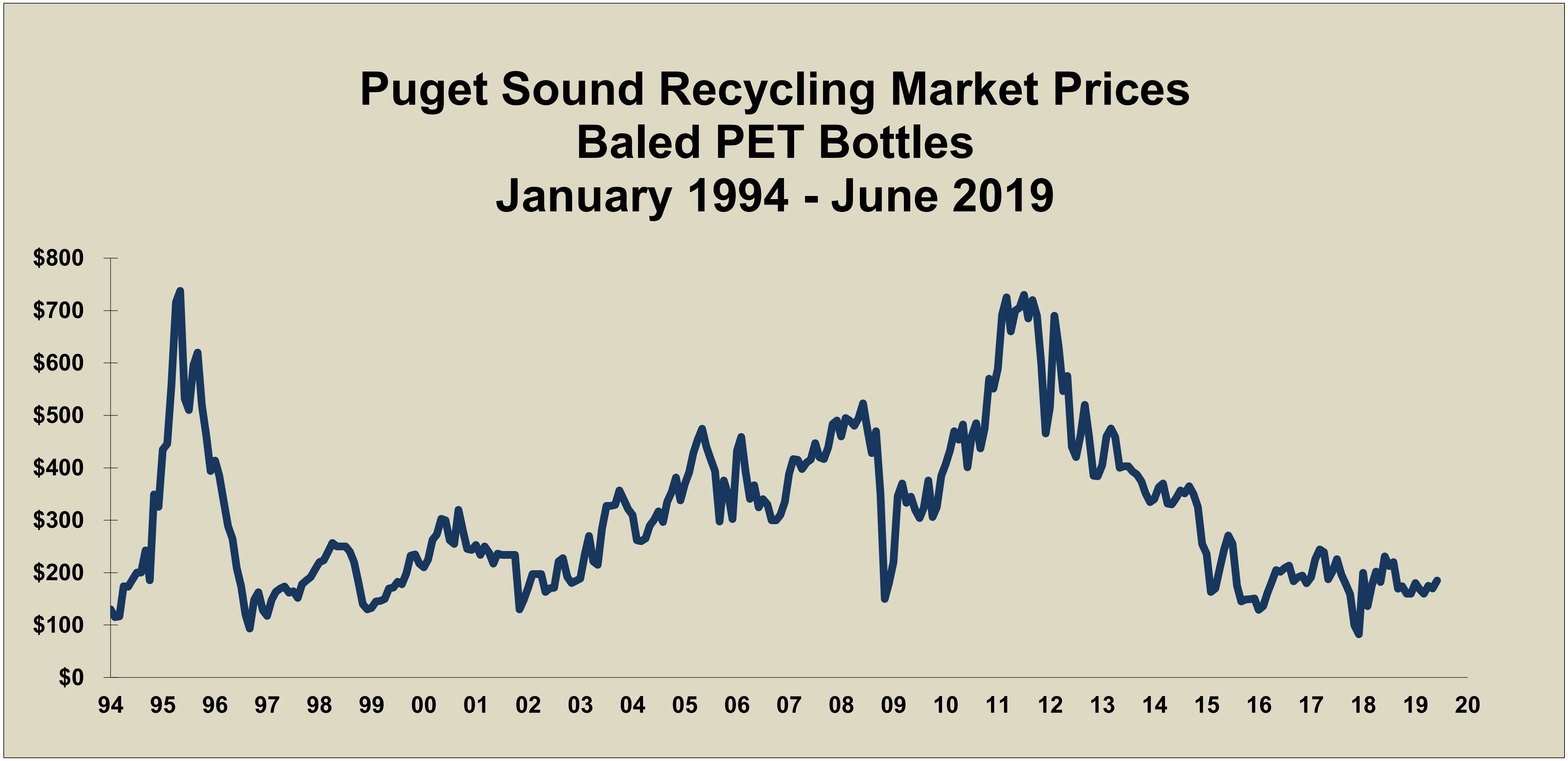
Puget Sound Recycling Market Prices
Baled PET Bottles
January 1994 - June 2019
$800
$700
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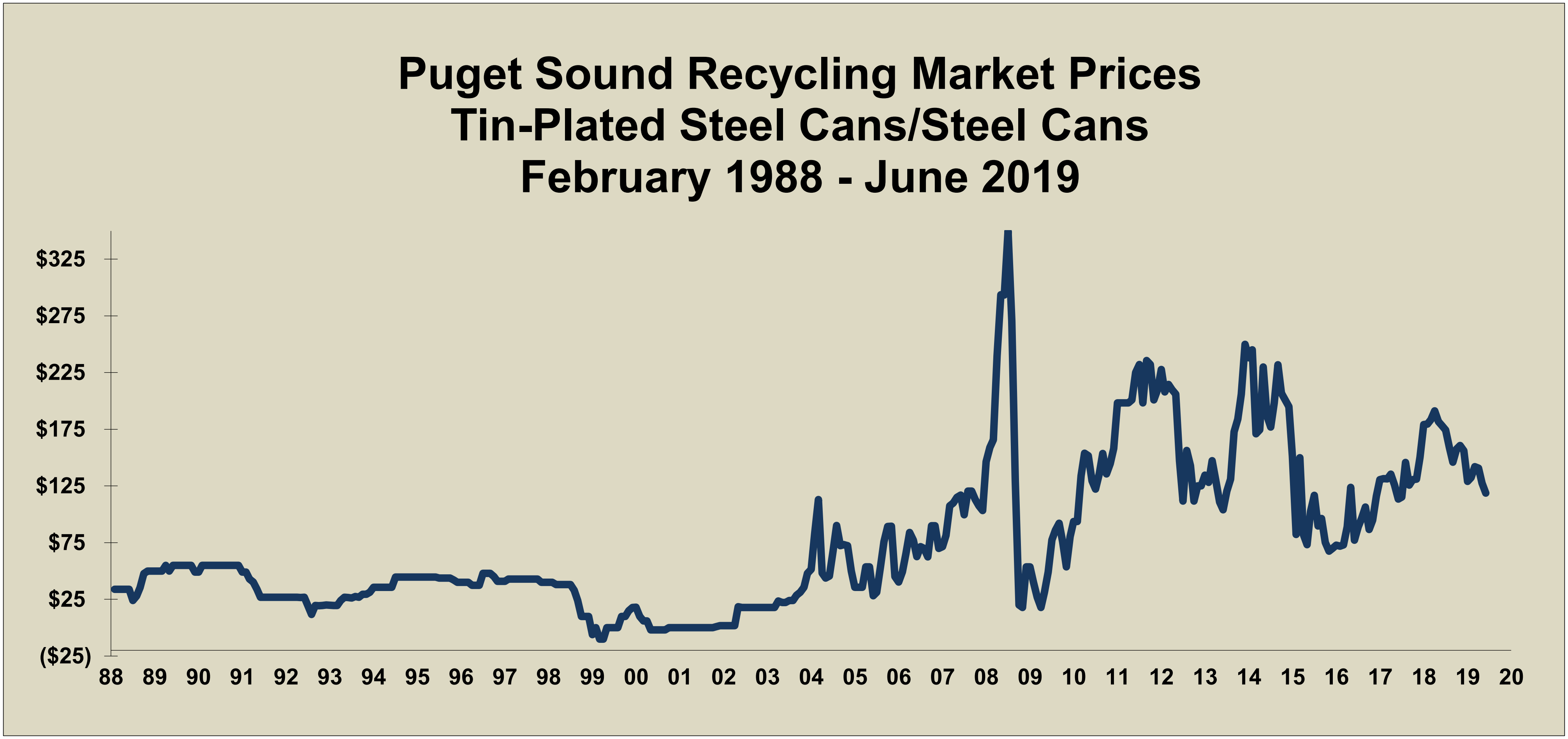

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APPENDIX H

WHITE PAPER REPORT DEVELOPMENT OF A WASTE-TO-ENERGY PROJECT FOR THE MOA, ALASKA

WHITE PAPER REPORT

Development of a Waste-to-Energy Project for the Municipality of Anchorage, Alaska

Geosyntec Project Number: ME1784
25 September 2019

Prepared by:

Geosyntec consultants

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Prepared for:

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StreamlineAM, LLC

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White Paper Report:

Development of a Waste-to-Energy Project for the Municipality of Anchorage, Alaska

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Prepared for:
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Geosyntec Project Number: ME1784
25 September 2019

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ABBREVIATIONS AND ACRONYMS

AD	Anaerobic Digestion
ARL	Anchorage Regional Landfill
AWWU	Anchorage Water and Wastewater Utility
ARL	Anchorage Regional Landfill
Btu	British Thermal Unit
CAA	Clean Air Act
Census Bureau	U.S. Census Bureau
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CTS	Central Transfer Station
DOE	United States Department of Energy
EPA	United States Environmental Protection Agency
ESIA	Environmental and Social Impact Assessment
ESP	Electrostatic Precipitators
GHG	Greenhouse Gas
HCl	Hydrogen chloride

HHV	Higher Heating Value
IPP	Independent Power Producer
JBER	Joint Base Elmendorf-Richardson
kw	Kilowatts
kWh	Kilowatt Hour
LFG	Landfill Gas
Mat-Su	Matanuska-Susitna Borough
MOA	Municipality of Anchorage
MSW	Municipal Solid Waste
MW	Megawatt
NOx	Nitrous Oxides
O&M	Operation and Maintenance
PIC	Products of Incomplete Combustion
PM	Particulate Matter
PPA	Power Purchase Agreement
PPP/P3	Public Private Partnership
PTC	Permit to Construct
PTO	Permit to Operate
RDF	Refuse-Derived Fuel
SOx	Sulphur Oxides
SWS	Solid Waste Services
tpd	Tons Per Day
WTE	Waste to Energy
WWTF	Wastewater Treatment Facility

DISCLAIMER

This Pre-Feasibility Report (Report) was prepared for the Municipality of Anchorage (MOA), Department of Solid Waste Service (SWS) by Geosyntec Consultants, Inc. (Geosyntec) of Anchorage, Alaska, USA to provide a pre-feasibility assessment for development of a waste-to-energy (WTE) project to serve the MOA. This Report was completed in accordance with the scope of work for the Project outlined in the executed agreement between StreamlineAM, LLC and Geosyntec, dated 1 May 2019.

EXECUTIVE SUMMARY

In 2018, the Municipality of Anchorage (MOA) and the Department of Solid Waste Services (SWS) authorized development of an integrated solid waste master plan (ISWMP) in order to optimize its system and assets through improved operational efficiencies, capital improvements and new practices/programs that increase landfill life, improve safety and customer service, protect the environment and increase waste reduction, improve reuse and recycling of materials that are currently disposed of as waste.

As a community of almost 300,000 people, Anchorage generates a large quantity of waste each year (approximately 330,000 tons in 2016). SWS provides refuse collection services within its certificated service area, which services approximately 20% of the population of the MOA, and the remainder is serviced by the private sector. SWS services also include the disposal of solid waste, collection of household hazardous waste, drop off recycling at the Anchorage Regional Landfill (ARL), curbside organics collection within its service area and seasonal food scraps collection programs at both the ARL and the Central Transfer Station (CTS). ARL is the only operating landfill within the MOA and accepts more tonnage than any other landfill in the state.

The purpose of this pre-feasibility study is to implement the recommendations of the ISWMP to evaluate alternative technologies to landfill disposal for addressing SWS and potentially Anchorage Water Wastewater Utility (AWWU) and neighboring solid waste utility's needs. These include: the appropriate capacity of the Waste-to-Energy (WTE) plant, the reliability and composition of the available waste stream, the scope of the energy and materials use agreements and other fee structures that would be required, and other risks to the financial sustainability of the facility's operation.

In this Report, Geosyntec presents the criteria and assumptions for recommending the most appropriate biological or thermochemical technology to be considered by the MOA for this project. Mass-burn incineration is recommended, which is the most well-established and reliable WTE technology in the marketplace today. Overall, this Report assumes the development of a 1,000 to 1,200 ton per day WTE facility with associated air emission controls, plus the development of a controlled landfill cell for management of generated ash. It is further assumed that pre- and post-incineration recovery of non-ferrous and ferrous metals, as well as co-incineration of biosolids, will take place, from which additional revenues from sale of secondary materials and tipping fees can be earned. Recycling also helps promote the project's environmental credentials.

As described within the analyses within this Report, the feasibility of the project is highly dependent upon the ability of the MOA to reliably collect revenue from tipping fees and electricity sales at the facility, with secondary dependence on revenues from ferrous and non-ferrous metals recovered. Therefore, obtaining secure and reliable contracts for both tipping fees and the sale of electricity are foundational to the project in order to generate the revenue needed to pay for financing and operation of the WTE facility.

The readers should be forewarned that it is not within the scope of this White Paper to address all environmental issues related to WTE technology. For example, the character/type of per- and polyfluoroalkyl (PFAS) substances present in the waste stream in MOA is unknown/unquantified at this time and is something that should be studied when SWS is ready to fully characterize

waste streams that would be used as municipal solid waste (MSW) feedstock in a WTE facility. As emerging contaminant research evolves, our collective understanding of how WTE technology performs in destroying such compounds will evolve too – and should be part of the detailed evaluations once a WTE technology is settled upon.

Overall, developing a WTE project in the MOA appears a practical goal of the ISWMP and should be desirable by the municipal government, and potentially neighboring Boroughs. A Microsoft Excel™-based, pro forma model (Model) was constructed to help guide the MOA with the implementation steps of the proposed WTE facility project. Various scenarios (36) were constructed using Excel's Scenario Manager, which will enable the MOA to understand the projected tipping fee impacts of additional tonnage from the neighboring Boroughs, inclusion of biosolids in the incoming waste tonnage to the WTE plant, and potential fee-in tariffs from avoided energy sales to the local electric power utilities.

As shown on Figure 1 below the required tipping fees ranged from \$58.04 - \$85.67 depending on the scenario assumptions. Scenario 5 (1,000 tpd WTE facility) reveals the lowest projected average tipping fee of \$58.04 a ton for the first year of operation (2025).

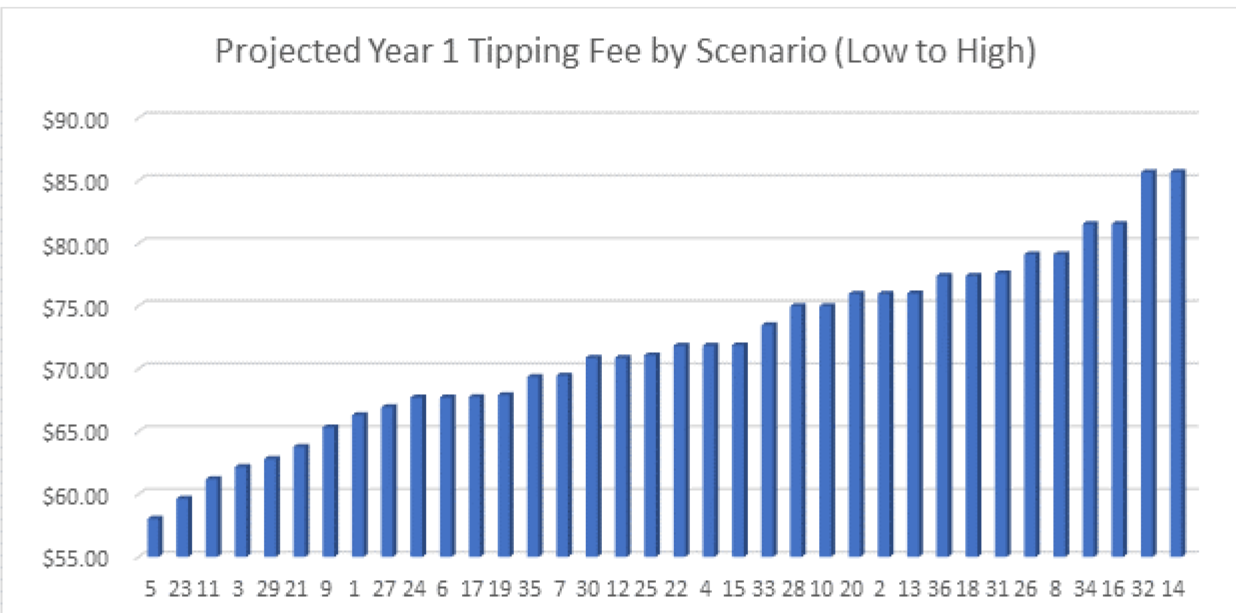


Figure 1: Projected Year 1 Tipping Fees by Scenario (Low to High)

1. INTRODUCTION

1.1 Terms of Reference

Geosyntec Consultants, Inc. (Geosyntec) has prepared this Pre-Feasibility Report (Report) for completion of a pre-feasibility assessment and feasibility study for development of a waste-to-energy (WTE) project to serve the MOA. This report was prepared for StreamlineAM, LLC as the client.

The purpose for completing a pre-feasibility study is to reveal potential fatal flaws and identify fundamental questions that must be addressed for the project to continue forward. These include the appropriate capacity of the WTE plant, the reliability and composition of the available waste stream, the scope of the power purchase agreement and other fee structures that would be required, and other risks to the financial sustainability of the facility's operation.

1.2 Project Understanding

The primary purpose of this Report is to provide the MOA with a preliminary understanding of the potential opportunity and challenges associated with implementing a WTE project in the Municipality the near future. Geosyntec understands that the Municipality intends to invest in developing the WTE project subject to resolving several issues, including obtaining a satisfactory power purchase agreement (PPA) and waste delivery contract with refuse collection services within the MOA and neighboring Boroughs.

As a pre-feasibility study that is focused on review of broad economic and demographic factors, an evaluation of specific candidate sites has not been performed at this stage.

1.3 Background and Motivation

In 2018, the MOA and the SWS authorized development of an integrated solid waste master plan (ISWMP) in order to optimize its system and assets through improved operational efficiencies, capital improvements and new practices/programs that increase landfill life, improve safety and customer service, protect the environment and increase waste reduction, improve reuse and recycling of materials that are currently disposed of as waste. Within that plan, a recommendation was made to conduct a feasibility study of technology alternatives including biological or thermal treatment for addressing SWS and potentially Anchorage Water Wastewater Utility (AWWU) needs. This pre-feasibility study is the first step in executing upon that recommendation.

Against this backdrop, WTE presents an opportunity to improve solid waste management within the MOA as well as to reduce dependence on fossil fuels for energy. For example, producing and utilizing energy from the combustion of solid waste is a mature technology. Over 2,200 operational WTE facilities exist worldwide, mostly in European and East Asian countries. Much of the motivation behind these WTE projects has been the same concerns that exist in the Municipality regarding improving management of solid waste and developing renewable energy capacity to reduce dependence on fossil fuels. The WTE process can produce about 700 kWh per ton of solid waste, prevent one ton of fossil fuel carbon dioxide release for every ton of waste incinerated, and reduce the community's landfilling needs by up to 90%.

2. WASTE-TO-ENERGY TECHNOLOGY ASSESSMENT

In this section, a brief overview of current commercially available WTE technology is presented along with Geosyntec's assumptions regarding the most appropriate WTE technology to be considered by MOA for this project.

2.1 The Status of the WTE Industry Worldwide

Producing and utilizing energy from the combustion of solid waste is a concept which has been practiced in Europe since the turn of the last century. Prompted by a concern for groundwater quality and the scarcity of land for landfilling, many European countries and Japan embarked on massive construction programs for WTE programs in the 1960's.

Based on data available from 2018, there are about 2,179 WTE facilities worldwide (Deltaway, 2018). Asian countries (Japan, Taiwan, Singapore, and China) have the largest number of WTE facilities, followed by European and North American countries. Many countries that have aggressively pursued WTE face issues with having limited open space for the siting of landfills and large urban populations. For example, Japan currently manages about 70% of its solid waste in WTE facilities.

2.1.1 United States and Canada

Transfer of this technology to North America first began in the late 1960's and early 1970's. In addition, many other projects utilizing American technology in shredded and prepared fuels were constructed. Most of these projects were problematic, however, because they were unable to overcome materials handling and boiler operations problems. It was these failures that made local government leaders initially cautious in funding construction of WTE projects.

Nevertheless, several WTE projects were developed in the U.S. in the mid to late 1970's in communities such as Saugus, Massachusetts; Pinellas County, Florida; and Ames, Iowa which were experiencing severe landfill problems. These three WTE facilities are still processing MSW today. Success of these projects helped the WTE industry gain acceptance by local government leaders, and the financial community. Tax incentives made available by the federal government for WTE projects attracted private capital investment in such projects assisting in the maturing of this industry in the United States and sparked the development of many new projects.

During the 1990s, the WTE industry in the U.S. experienced several setbacks, which resulted in no new WTE facilities being constructed from 1995 through 2014. Expiration of tax incentives, significant public opposition in facility siting, and the U.S. Supreme Court decision in Carbone dealing with solid waste flow control forced many communities in the United States to opt for long-haul transport of their solid waste to less costly regional landfills. A more recent Supreme Court decision on flow control has restored the ability of communities to enact flow control ordinances and enable them to direct their wastes to WTE facilities. As a result, some WTE facilities have recently begun to expand by adding new processing lines to their existing operations. These facilities are basing their requests for financing and permitting on their successful records of operation and environmental compliance.

In 2014, the first new WTE facility since 1995 was constructed by the Solid Waste Authority (SWA) of Palm Beach County, Florida. The SWA's Renewable Energy Facility 2 (REF2) is a

$672,000,000, state-of-the-art WTE facility. The REF2 project is the first of its kind in more than 15 years and the most advanced and cleanest WTE power plant in North America.

Recent expansions and additions in the U.S. and Canada include the following installations:

- A retrofit (1,000 tpd unit Tampa, FL in 2000);
- Three expansions (636 tpd WTE unit in Lee County, FL in 2006; 600 tpd WTE fourth unit in Hillsborough County, FL in 2007; and 200 tpd unit in Olmsted, MN in 2010);
- Two new WTE facilities (1,000 tpd unit in Honolulu, HI in 2013, and 3,000 tpd WTE in Palm Beach County, FL in 2015); and
- One new WTE facility was added in Canada (436 metric tpd (480 tpd) WTE in Durham York, Ontario in 2015).

As of this writing, there are currently 77 WTE plants operating in 25 U.S. states managing about seven percent of the nation's MSW, or about 90,000 tons per day. This is the equivalent of a baseload electrical generation capacity of approximately 2,700 megawatts to meet the power needs of more than two million homes, while servicing the waste disposal needs of more than 35 million people. Three general combustion technologies are utilized in North America for reliable and proven processing of MSW: massburn, RDF (refuse derived fuel), and modular massburn. Massburn is the most commonly implemented combustion technology, with 64 installations (60 in US, 4 in Canada), followed by RDF (12), and lastly, modular (7). Two facilities have a combination of massburn and one other combustion technology (Honolulu and Tulsa). Recent expansions and additions in the U.S. include one retrofit, three expansions, and two new WTE facilities. One new WTE facility was added in Canada (2015).

Confirmed facility ownership arrangements are about half, divided between public (40) and private (42) entities. WTE facilities are typically operated by private (69) entities, while operation by public entities (13) has been gaining traction. It should be noted that the facilities operated by public entities typically have smaller throughput, with the largest publicly operated WTE facility being 800 tpd (Spokane, WA). In the case of the Spokane WTE facility, the City assumed operations from Wheelabrator after the initial 23 years' operating contract expired. The City essentially hired the Wheelabrator staff and has continued to operate the facility. The capacity of WTE facilities do range widely, from 12 tpd to 3,300 tpd.

Currently, operating WTE facilities located on the west coast of North America include the following:

- Vancouver, British Columbia (850 tpd massburn)
- Spokane, Washington (800 tpd massburn)
- Portland, Oregon (Marion County, 550 tpd massburn)
- Stanislaus, California (800 tpd massburn)
- Long Beach, California (1,380 tpd massburn)

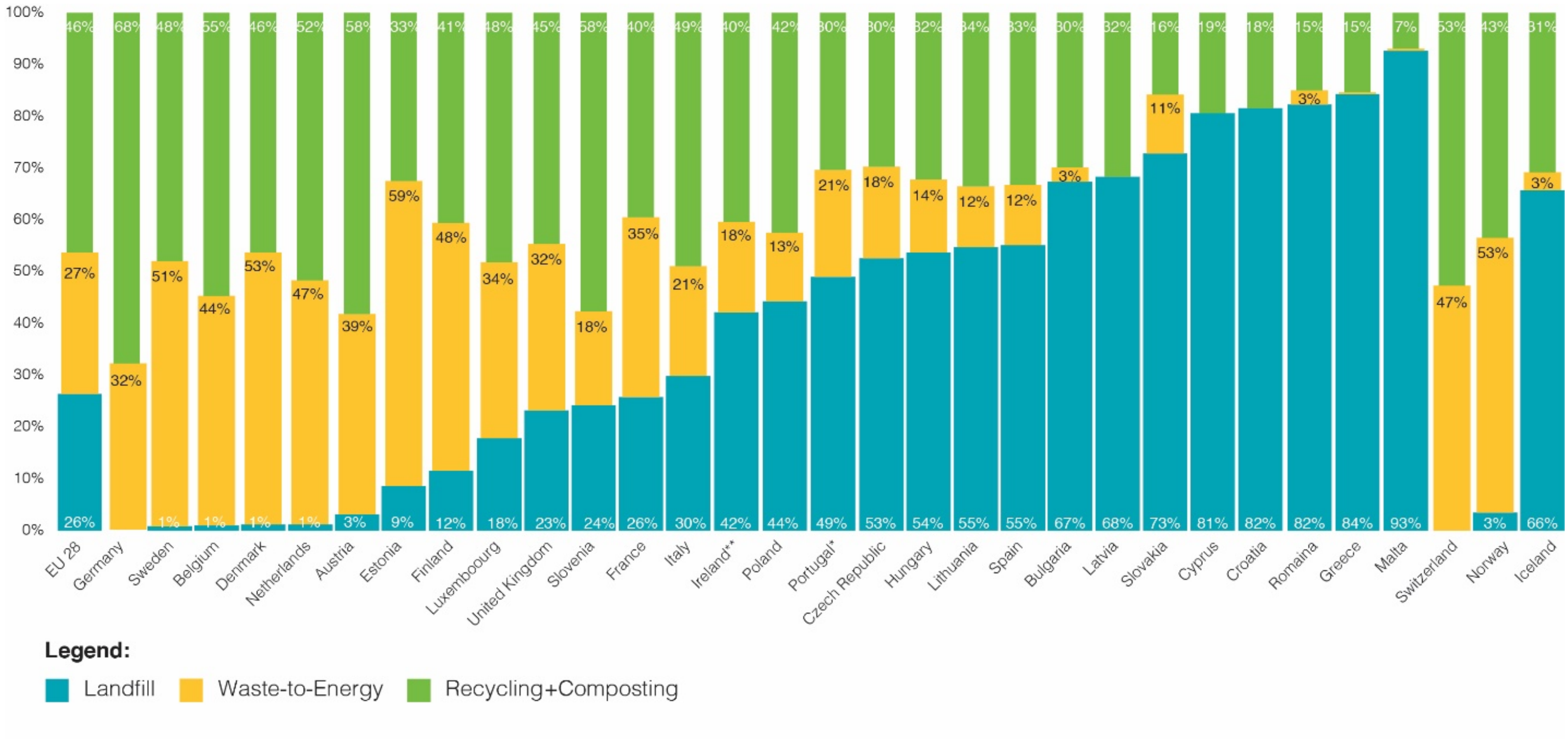
Eleven major trends in the North American WTE market include the following:

1. In the US, the higher heating value (HHV) of municipal solid waste appears to be holding steady, or slightly increasing, with many WTE communities processing MSW at greater than 5,000 Btu/lb. This may be primarily related to the growing presence of plastics and other high BTU fuels present in MSW (used tires, asphalt shingles, and rigid plastics).
2. Those communities with WTE exhibit the highest curbside recycling rates suggesting that there WTE is compatible with recycling.
3. Advanced combustion controls for the plants which result in reduced combustion air, improved combustion and burnout of waste, and reduced emissions which require downstream treatments.
4. Addition and upgrade of existing metal recovery systems with advanced ferrous and nonferrous metal recovery systems using high strength magnets and eddy current separator technology. In conjunction with greater recovery of metals from WTE bottom ash, the opportunity for beneficial bottom ash reuse includes aggregates for road base and construction products, along with the partial inclusion as feedstock in the production of Portland cement.
5. Advanced air pollution control systems for reduced use of reagents and chemicals used in treatment processes for reduction of emissions of acid gasses, nitrogen oxides, dioxins, heavy metals, and particulates. WTE facilities have also demonstrated the ability to operate in full compliance with more stringent regulatory emission limits. The new WTE facility in Palm Beach County, Florida is the first WTE facility in the U.S. to employ Selective Catalytic Reduction (SCR) technology for reduced emissions of NOx compounds.
6. Improved operation and maintenance techniques (non-destructive testing for predictive and preventive maintenance such as monthly vibration tests, quarterly oil sampling, infrared thermography, ultrasonic testing for metal thickness, acoustic data, and motor electrical signature tests).
7. Use of reclaimed water for cooling systems, when available, or in many cases, use of air-cooled condensers to minimize need for makeup water and eliminate visible plumes from wet cooling towers.
8. Increase in energy and cost efficiencies by the synergistic usage of the energy (both heat and power) of publicly owned WTE facilities for the community's own utilities (water, wastewater) and public works and institutional facilities. Hillsborough County, Florida is currently operating one of its waste water treatment and water treatment plants with electricity generated by its 1,800 tpd WTE facility. They are also currently evaluating additional "behind the meter" uses for their internal use of power to include an adjacent Public Works campus.
9. Additionally, the concept for the integration of ISWM with recycling and manufacturing industries in an eco-park have been proposed in number of locations in North America. The new WTE facility in Palm Beach County, FL is located on a 1,320-acre campus which has two WTE facilities, two landfills, a biosolids drying facility powered by landfill gas, and a material recovery facility for processing single stream recyclables.

10. Greater attention to plant aesthetics and Leadership in Energy and Environmental Design (LEED)™ standards.
11. Use of special wastes, tires, out-of-date pharmaceuticals and biosolids. For example, the new H-Power WTE facility in Honolulu, Hawaii includes the co-combustion of 80,000 wet tpy of sewage sludge biosolids from wastewater plants on the island. Several other WTE facilities in Florida are permitted to co-combust up to five percent of their incoming wastes as biosolids.

2.1.2 Europe

Large numbers of WTE plants (Figure 2) are in Europe, primarily because of regulations that require a 65% reduction in the landfilling of biodegradable MSW by 2030 with a binding landfill target to reduce landfill to a maximum of 10 % of MSW. Nonetheless, a large part of the EU's waste stream (40%) is still landfilled. These WTE plants converted about 69 million metric tons of MSW (or about 20% of the EU waste stream) generating 30 TWh of electricity and 55 TWh of heat. This is roughly equivalent to supplying the annual needs of 13 million inhabitants with electricity and 12 million inhabitants with heat in these countries. Given the EU's directive on landfilling, estimates of new WTE facility construction range from 60 to 80 new plants by 2020. Scandinavian counties (Denmark and Sweden) have historically been significant proponents of WTE.



Source: Rogoff, 2019.

Figure 2: WTE Facilities in Europe

Recent trends in the European WTE industry include the following:

1. Most of the new WTE facilities utilize massburn technology.
2. Dramatic increase in WTE facilities to allow countries to meet very strict landfill reduction requirements (Landfill Directive, more formally Council Directive 1999/31/EC of 26 April 1999). These reduce raw landfilling of MSW to a maximum of 10%.
3. Implementation of numerous advanced systems for on-line cleaning and operation and maintenance practices for optimization of annual availability.
4. Extensive innovative technologies for maximizing recovery rates of metals, minerals, glass from bottom ash.
5. Incorporation of extensive air emissions control technology, some far more rigorous than the regulatory requirements.
6. Expansion and additions to WTE facilities have also been completed, like the experience in the U.S.
7. Production of refuse derived fuel (RDF) and combustion of the RDF in fluidized bed combustion units, cement kilns and grate fired boilers to allow for more flexibility in waste composition, with the realization that the requirements for fluidized bed combustion are more stringent regarding impurities (metals, C&D waste).
8. Widespread use of distributed heating, including use of hot water for community benefits, such as heating community centers, pools, greenhouses, and adding community specific unique architectural features that offer new economic opportunities, such as the slope/hiking trail feature which has been constructed over much of a new WTE facility in Copenhagen, Denmark.

2.1.3 China

Economic development and rapid urbanization in China over the past few decades have resulted in a rapid generation of 200 million tons MSW requiring disposal in 2016. Currently, one of the largest markets for WTE plant construction is in China. According to the World Bank, China surpassed the United States as the largest generator of MSW in 2004. This has produced an unprecedented trash crisis in many of its cities. Due to a deficiency of land for continued landfilling of MSW, China has embarked on a major construction program of WTE facilities.

The Chinese WTE capacity has increased steadily from 14 million tons in 2007 to nearly 75 million tons by 2016, although landfilling remains the dominant means of waste disposal in China. Since the beginning of the 21st century, China has become the fourth largest user of waste-to-energy (WTE), after the EU, Japan, and the US, with most plants (259) located in the heavily industrialized cities in southeastern China. China is building an average of 50 new WTE facilities every year. Almost all these new WTE facilities utilize massburn technology. The world's largest WTE facility is currently being designed for the city of Shenzhen and will include six processing lines with a total capacity of 5,600 tpd. This plant is essentially two plants located side by side and under a common roof. It will also provide electricity to produce 125 mgd of desalinated potable water.

2.2 Criteria and Assumptions for Technology Selection

One of the first questions an agency must answer is what technology will be chosen to convert its solid waste into energy. Each agency or developer must identify and evaluate the various WTE technologies that are available and make its own selection based upon the requirements specific to its project. This includes consideration of factors (which will be discussed later) such as: available energy and materials markets; the size of the community's waste flow; capital and operating costs; ownership and financing considerations; and the level of risk to be assumed by the community or the facility owner.

In evaluating whether one technology better suits its needs than another, a community may often discover that one or more of their goals established for the project may conflict with others. A technology, for example, may produce the greatest amount of energy for the MOA's waste, albeit at the highest projected capital and operating costs. The selection of a technology, therefore, is not a simple one, but one which can require tradeoffs between one agency's goal with others. Since the risks associated with WTE technology can be substantial, it is critical that MOA attempt to minimize these risks at best it can. The following criteria can be utilized to assess the relative risk of a WTE technology:

- State of Technology – This addresses the documented track record of the vendor(s) with both pilot and commercial facilities. Some technologies only have been proven in pilot or laboratory operations, or with raw materials other than municipal solid waste. Other technologies have only been commercially operated in small facilities and the scale up to larger sized plants may result in unforeseen problems. The operational history of all process steps, from waste receipt through energy conversion to management of material side streams and residuals are considered under the state of the technology. Specific factors assessed include waste types and quantities processed, demonstrated operational reliability, predictable electricity generation.
- Technical Performance - This criterion addresses the ability of the WTE technology to address the full spectrum of the potential needs of the users and rate payers of the solid waste management system. Also addressed is whether the proposed process can safely and efficiently process the types of wastes which are generated by the MOA solid waste system users, the need for source separation and/or pre-treatment (removal of items, sorting, and size reduction). The percentage of waste by-passed to the landfill or other waste disposal options is also of importance.
- Technical Resources – This criterion addresses whether vendors are available to bid on the project and can provide continuing local resources. Typically, emerging technologies often will have one project leader. The preferred case would be for the vendor to have a broader pool of resources that can sustain the project in case these project technical leaders move on.

Based on these criteria, there are currently only two widely used and commercially available WTE technologies that should be considered by the Municipality – mass-burn and refuse-derived fuel (RDF). It is noted that there are several other "next generation" technologies (e.g., fluidized bed and gasification) that are used in a limited number of WTE facilities in advanced economies, often at relatively small scale. However, because the vast majority of WTE facilities currently operating throughout the world are either mass burn or RDF plants, these are considered the two technologies that could meet the above criteria for further consideration by the MOA.

2.3 Mass Burn WTE Technology

Mass-burn refers to WTE technology that incinerates minimally processed solid waste. An illustration of a typical mass-burn WTE facility is shown in Figure 3 overleaf. Major components of a mass-burn facility include:

- A structure to house the furnace and its appurtenances;
- A tipping floor where the solid waste from collection and transfer vehicles is unloaded;
- A large storage pit that is sized to allow two to three days storage or stockpiling of refuse so that plant operations can continue over weekends and holidays when deliveries will not occur (WTE plants operate on a seven-day per week, twenty-four hour per day basis; storage space is provided to enable this continuous operation);
- A charging system (normally overhead cranes, but could also be a front-end loader and conveyor combination), which mixes the various solid wastes received to develop a somewhat uniform material and then moves it from the storage pit or floor to feed (charge) the furnace;
- One or more furnace systems (sometimes referred to as combustion trains or units) that burn the solid waste to heat the boilers, generating steam to power electricity generating turbines;
- A stoker unit to move the solid waste through the furnaces; the most common stoker designs being:
    - Reciprocating grates: This grate design resembles stairs with moving grate sections which push the solid waste through the furnace;
    - Rocking grates: This grate design has pivoted or rocking grate sections which produce an upward and/or forward motion to move the solid waste through the furnace; or
    - Roller grates: This grate design has a series of rotating steep drums or rollers which agitate and move the solid waste through the furnace;
- Air pollution control subsystems to treat combustion gases; and
- An ash handling subsystem to manage the fly ash and bottom ash produced from the combustion of solid waste.

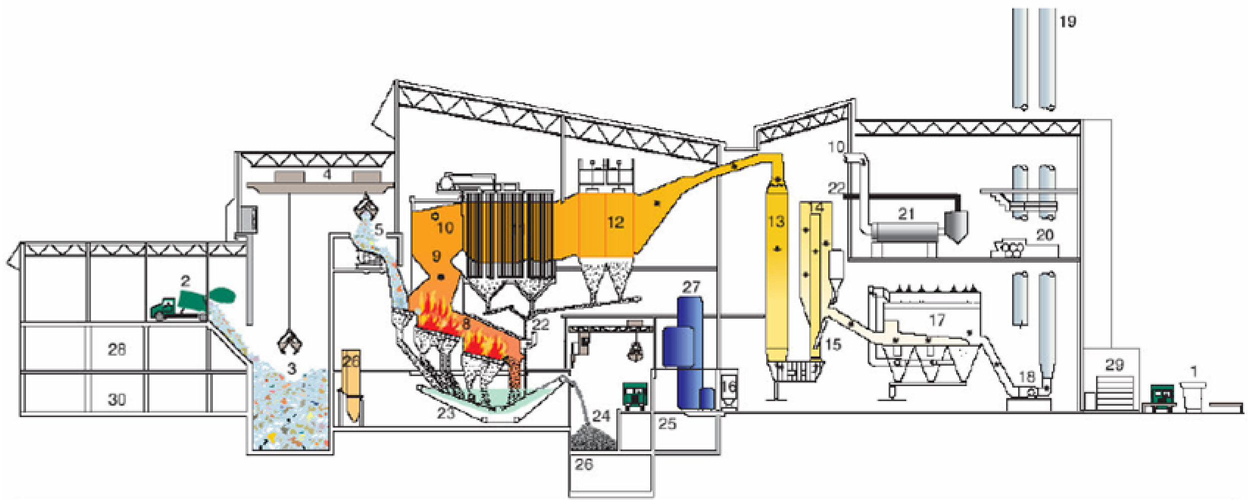


Figure 3: Example of a Mass-Burn WTE Facilty

Notes: 1. Inbound truck scales; 2. Tipping floor; 3. Waste storage pit; 4. Cranes; 5. Feed chute; 6. Feed table; 7. Incineration grates; 8. Furnace; 9. Secondary air injection; 10. First path; 11. Boiler; 12. Electrostatic precipitators; 13. Flue gas cooling tower; 14. Scrubber; 15. Lime injection; 16. Activated carbon metering bin; 17. Baghouse; 18. Blower; 19. Stack; 20. Sludge filter press; 21. Sludge dryer; 22. Dryer gas exhaust; 23. Ash extractor; 24. Bottom ash pit; 25. Wastewater tank; 26. Wastewater treatment; 27. Boiler feedwater purification; 28. Maintenance workshop; 29. Dry sludge loading; 30. Spare parts storage.
Source: Deltaway Energy, Inc.

The only waste pre-processing that occurs as part of the mass-burn WTE operation is the removal of large or unusual objects from the waste stream that would otherwise be a problem or cause damage if fed into the furnace. Examples include very large metal or concrete objects, appliances, telephone poles, or compressed gas cylinders. The operator that charges the furnace is also responsible to visually monitor the nature of the incoming waste so that materials with different moisture contents (e.g., food and plant wastes are relatively wet, while paper and plastics are usually dry) are gradually mixed to achieve a relatively uniform moisture content.

In modern waterwall incinerators, proper combustion of the waste is achieved through the introduction of air at two locations in the furnace. One location introduces air underneath the grate system (underfire air), the second location introduces air above the burning waste (overfire air). During the combustion process, flue gases, which are heated to temperatures as high as 1,800 degrees F, move from the furnace through the boiler tube section, where the contained water is heated to form saturated steam and dry steam. The flue gases continue through the economizer section to the air pollution control device, such as an electrostatic precipitator, baghouse, or acid gas scrubber, where the flue gases are cleaned before being released into the atmosphere through a stack.

After the combustion process is completed, the grate system or rotary combustor gradually moves the waste onto the burnout grate where it is discharged into a wet or dry ash handling system that cools the residue and prevents dust from being created. The bottom ash that is produced from the combustion process in the furnace, and the fly ash or other materials produced in the air pollution control device, are transported to landfills by truck or to a temporary onsite ash storage pit for later transport. The bottom and fly ash may be combined or handled separately.

Mass burn incineration produces ash residues amounting to 15 to 30% by weight and 5 to 10% by volume of the incoming solid waste. The amount of ash is dependent of the composition of the waste being incinerated. Generally, recovery of ferrous metals from the ash residue is possible in mass-burn WTE by using magnetic separators (with or without trommels). Some systems recover the remaining non-magnetic fraction in the ash, such as aluminum and glass, using various trommels, screens, jigs and fluid separators.

Mass burning incinerators have been used in Europe and Japan for municipal solid waste disposal for nearly 70 years where their acceptance has been rapid and widespread. With over thousands of facilities in operation worldwide in sizes ranging from 18 to 4,200 tons per day, mass fired incineration is the most thoroughly demonstrated technology in the WTE field at this time.

This technology was introduced into the United States in 1967 at the U.S. Naval Station in Norfolk, Virginia with the construction of a 360 ton per day waterwall plant to produce process energy for the Naval Shipyard. This plant was designed in America and equipped with American equipment. Later plants, which were constructed, were almost entirely designed using state-of-the-art European mass incineration technology.

The introduction of European technology into the United States has not been without difficulties and several of the earlier constructed plants encountered some mechanical problems. These highly reliable and rugged European systems had been designed to burn solid waste that was somewhat different in composition than American wastes. Consequently, systems that had been designed for European conditions required designers to adjust in the grate areas and furnace heat release rates of American plants. In addition, the higher chloride corrosion of the superheaters in American plants meant that designers needed to change the metallurgy of these boiler tubes, as well as limiting the upper stream pressures and temperatures to minimize tube corrosion. Scale-up problems also had to be overcome since many of the European units were designed for the 300 to 500 tons per day range. These problems have been corrected, and most mass-burn systems that have been constructed are still in operation today.

2.4 Refuse Derived Fuel (RDF) Systems

Several American corporations have developed technologies that pre-process solid waste to varying degrees to separate the non-combustibles from the waste stream. By undergoing processing steps of hammering, shredding, or hydropulping, the combustible fraction of the waste is transformed into a fuel, which can then be fired in a boiler unit specifically dedicated for this type of refuse-derived fuel, or co-fired with another fuel, such as coal, shredded tires, or wood chips. The fuel produced can thus be utilized in equipment that can have higher efficiencies than mass-fired units resulting in greater electricity or steam output. However, the front-end processing of the solid waste into a fuel has been one of the problem areas of this type of refuse disposal technology.

2.4.1 Processing Systems

The processing of solid waste into a refuse-derived fuel has been approached using dry processing systems, and more recently organic processing system.

Since the early 1970's, there have been several dozen facilities which have been constructed in the United States to process solid waste into a refuse-derived fuel using dry processing systems. Such dry processing systems are classified according to the type of products that can be produced: fluff RDF, densified RDF, and powdered RDF. A cross-section of a typical RDF system is illustrated in Figure 4.

Given the number of potential products, the type of specific technology used to process the solid waste into a refuse derived fuel can vary from one location to another. Typically, however, solid waste delivered to an RDF facility is unloaded onto the receiving floor, or at some locations into a refuse storage pit. The waste is then transported with the use of a feed conveyor system to a size reduction unit, which reduces the particle size of the waste. At many facilities, machinery such as flail mills, trommels, and magnetic separators, are used to pre-sort the waste prior to its being fed into a hammermill or shredder for size reduction. Depending on the particular type of RDF fuel required, further processing equipment is utilized after shredding, such as air classifiers, densifiers, and trammel screens. The end result of the dry processing system is a refuse-derived fuel which can be combusted in either existing utility boilers, or in boilers specifically designed for the type of RDF produced (dedicated boilers).

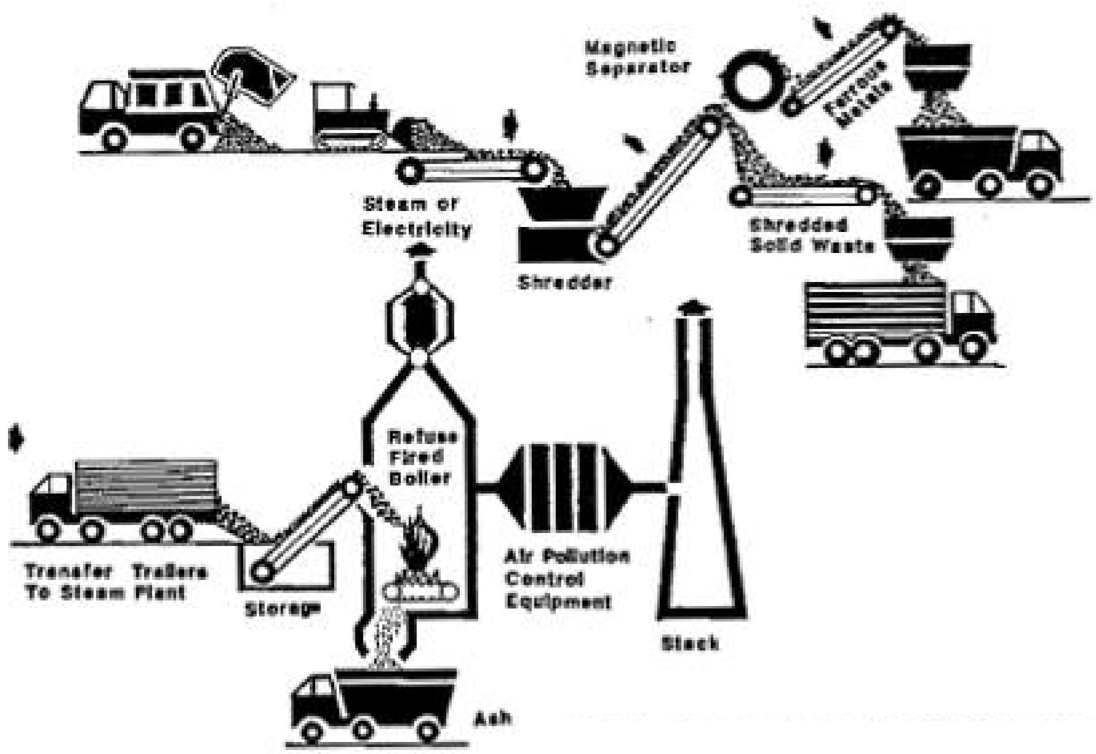


Figure 4: Cross-Section of Typical RDF System

For many years, the plan of burning RDF in existing electric utility boilers seemed an obvious solution for communities which needed a good way to dispose of garbage. It was hoped that existing boilers and air pollution control equipment could be utilized thus saving these communities considerable capital expense. Since the early 1970s, RDF has been tried, however, as a supplemental utility fuel with mixed success. Since 1970, utilities in the United States have co-fired RDF in their system boilers; only three are still burning RDF.

Shortly after the beginning of the first demonstration project in St. Louis in 1972, it became apparent that burning RDF in utility boilers resulted in a lowering of their normal efficiency and reliability. When RDF was fired in the high temperature, utility boilers, the non-combustible materials in solid waste, such as glass and metals, melted into slag that fouled the boiler tubes, heat exchangers, and furnace walls. Burning of the plastic compounds in the solid waste, which released chlorine, also resulted in increased corrosion of boiler parts. In addition to these problems, ash handling, air pollution control, and materials handling systems soon became overloaded and were subject to frequent outages. In short, what had seemed to be a good way to dispose of solid waste resulted in an unexpected headache for utilities. The initial optimism of this technological fix to solve an emerging garbage disposal problem has consequently not been realized.

The recent emphasis on burning RDF has focused on systems using "dedicated" industrial type boilers. The term "dedicated" refers to a boiler system that is specifically designed and constructed to burn RDF as its primary, not supplemental, fuel. There are a variety of different types of technologies which had been used in such boilers: suspension-fired; semi-suspension fired (spreader stoker); pyrolysis; and fluidized bed.

The semi-suspension fired or spreader-stoker, furnace boiler is perhaps today's most commonly utilized technology. Spreader-stoker technology has been utilized successfully for decades for incineration of a variety of different solid fuels. With this system, RDF, which has been previously prepared to specific size characteristics, is introduced at a controlled rate to pneumatic RDF distributors located at the front wall of the furnace. High-pressure air is delivered to these distributors to assure that the RDF is fed evenly.

The RDF, so introduced, ignites over the grate area and burns partially in suspension. Materials, which are left unburned, fall to the traveling stoker where they are combusted before the ash is discharged.

The experience with these RDF systems has varied. It appears that most installations have had problems with RDF feeder equipment resulting in extensive retrofits and technical modifications. However, where high quality RDF has been introduced with most metals and glass removed, the RDF burning experience has generally been good. On the other hand, the experience of co-firing of RDF with coal has been generally poor. The combination of coal and RDF appears to increase problems with ash clinker and slagging and wear of the lower furnace walls.

In summary, RDF with waste shredding was supposed to be smart move to be able to burn garbage in a “cheaper” biomass or coal designed boiler. However, the cost of shredding and the safety risk involved is not optimal. Feeding is a major headache and “biomass” boiler with only one combustion empty path is generally cost prohibitive to maintain, is costlier and requires a huge site footprint.

In recent years, a “second generation” RDF facility design has evolved to best process waste with low energy content where incoming waste Low Heating Value (LHV) is lower than 5,800 kJ/kg. The facility treats the waste into RDF, where recyclables and organic matters have been removed to raise LHV of the RDF above 5,800 kJ/kg. It combined a simple front-end processing with a mass burn unit on the back. The front-end processing unit does not shred the waste, but is used only to open bags, sort, recycle, remove most of organic content, and increase waste LHV. The organic fraction is either sent to the landfill or to an anaerobic digester to produce biogas. This is the new wave of WTE plant that is adapted for emerging countries where waste contains a high percentage of putrescible that is greater than 40%.

2.5 Emerging Waste Conversion Technologies

Since 2004, several municipalities commissioned reports in order to evaluate new and emerging waste management technologies and approaches. New York City, the City of Los Angeles, Los Angeles County, and King County, WA are among the municipalities that commissioned studies in waste conversion technology. There are many technologies currently being proposed for the treatment and disposal of MSW throughout the world. Most of these involve thermal processing, but some others comprise biological or chemical decomposition of the organic fraction of the waste to produce useful products like compost, chemical feedstocks, or energy products. Technologies include the following: pyrolysis, gasification, anaerobic digestion, mixed waste composting, plasma arc, and chemical decomposition.

2.5.1 Summary of Technologies

Table 1 provides a very general comparative overview of these technologies. Throughout this section, we use the terms conversion technologies and alternative technologies interchangeably to describe technologies that are being considered for MSW processing and conversion to energy and other products.

Table 1: General Overview of Conversion Technologies

Technology	Amenable Feedstock	Feedstock Requirements	Emissions/Residues
Acid or Enzyme Hydrolysis	Cellulosic material	Cellulosic feedstock	Wastewater, CO_2
Gasification	Biomass, MSW	Drier feedstock, high carbon	Ammonia, NO_x, tars, oil
Anaerobic Digestion	Manure, Biosolids	Wet material, High nitrogen	Wastewater, CH_4, CO_2, H_2S
Plasma Arc	MSW	High carbon, high hydrogen content	Slag, scrubber water

Hydrolysis is a chemical decomposition process that uses water to split chemical bonds of substances. There are two types of hydrolysis, acid and enzymatic. Feedstock that may be appropriate for acid or enzymatic hydrolysis typically is plant-based materials containing cellulose. These include forest material and sawmill residue, agricultural residue, urban waste, and waste paper.

Ethanol facilities could be co-located at MRFs (Material Recovery Facilities) where existing materials are already collected, and the existing solid waste transportation infrastructure could be utilized. Ethanol facilities co-located at MRFs could take advantage of the existing solid waste collection and transportation infrastructure. Figure 5 includes a typical hydrolysis process.

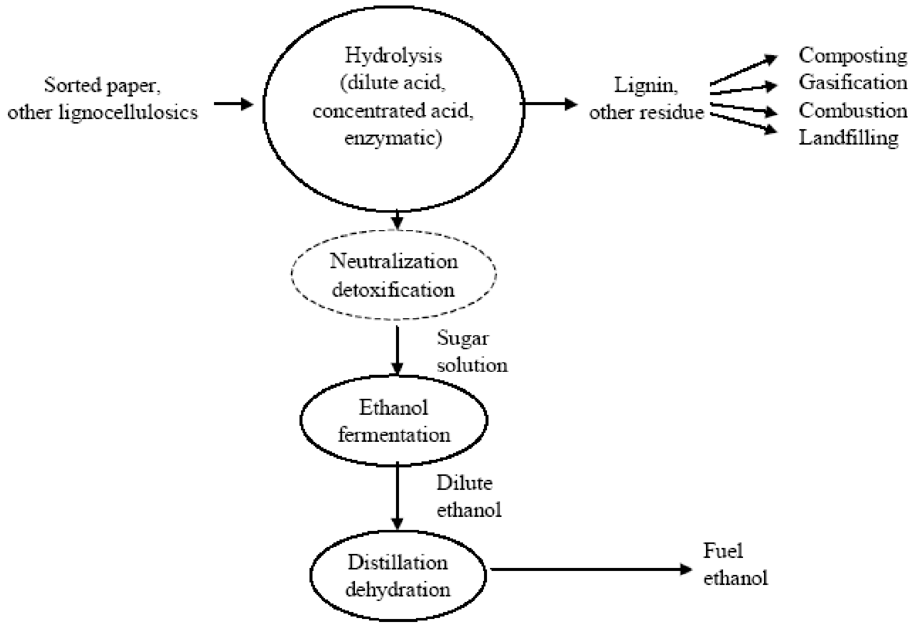


Figure 5: Typical Hydrolysis Process

2.5.1.1 Gasification

Gasification is a process that uses heat, pressure, and steam to convert materials directly into a gas composed primarily of carbon monoxide and hydrogen. Gasification technologies differ in many aspects but rely on four key engineering factors:

- Gasification reactor atmosphere (level of oxygen or air content).
- Reactor design.
- Internal and external heating.
- Operating temperature.

Typical raw materials used in gasification are coal, petroleum-based materials, and organic materials. The feedstock is prepared and fed, in either dry or slurried form, into a sealed reactor chamber called a gasifier. The feedstock is subjected to high heat, pressure, and either an oxygen-rich or oxygen-starved environment within the gasifier. Most commercial gasification technologies do not use oxygen. All require an energy source to generate heat and begin processing.

There are three primary products from gasification:

- Hydrocarbon gases (also called syngas)
- Hydrocarbon liquids (oils)
- Char (carbon black and ash)

Syngas is primarily carbon monoxide and hydrogen (more than 85 percent by volume) and smaller quantities of carbon dioxide and methane. Syngas can be used as a fuel to generate electricity or steam, or as a basic chemical building block for a multitude of uses. When mixed with air, syngas can be used in gasoline or diesel engines with few modifications to the engine.

As in the case of ethanol conversion facilities, gasification facilities could be co-located at MRFs to take advantage of the current solid waste transportation infrastructure. In addition, co-location at MRFs would ensure that recyclable materials would be removed beforehand and only residuals would be sent to a gasifier. If a gasification facility is co-located at a landfill that accepts MRF residuals, the gasification facility could utilize landfill gas in the gasification process or could work in tandem with a landfill gas-to-electricity project. Figure 6 shows a typical gasification system.

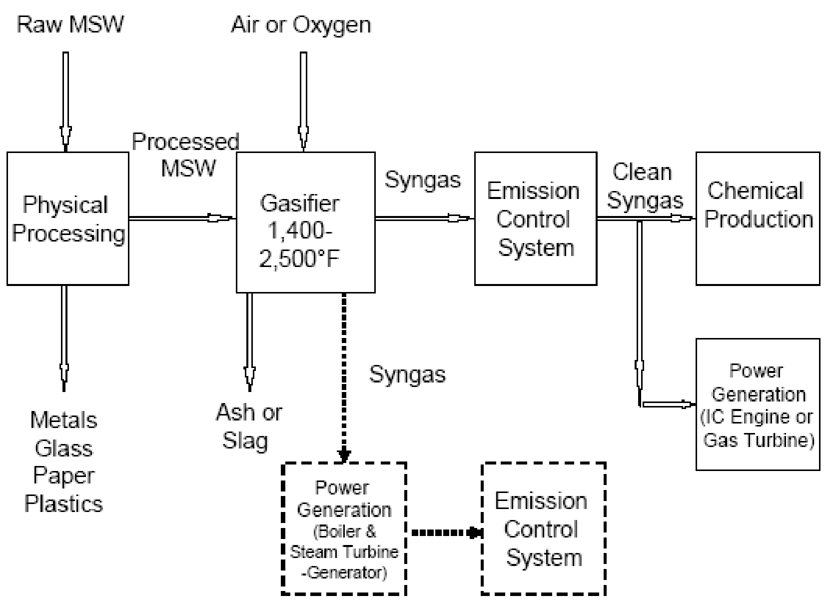


Figure 6: Typical Gasification System for Power Generation or Chemical Production

Seven plants with this technology are currently operating in Japan, with at least two of them firing MSW. The largest of these plants in Kurashibi has a reported boiler size of 185 tpd, with three units of this size. Another gasifier marketed for MSW is built by EnTech of Devon, England. They have constructed approximately 20 of these facilities, which are in operation on MSW in Europe and Asia. Most of them are relatively small (less than 10 tons per day), with none designed for more than 70 tons per day throughput.

2.5.1.2 Anaerobic Digestion

Anaerobic digestion is the bacterial breakdown of organic materials in the absence of oxygen. This biological process produces a gas, sometimes called biogas, principally composed of methane and carbon dioxide. This gas is produced from feedstock such as biosolids, livestock manure, and wet organic materials.

The anaerobic digestion process occurs in three steps:

- Decomposition of plant or animal matter by bacteria into molecules such as sugar
- Conversion of decomposed matter to organic acids
- Organic acid conversion to methane gas

Anaerobic processes can occur naturally or in a controlled environment such as a biogas plant. In controlled environments, organic materials such as biosolids and other relatively wet organic materials, along with various types of bacteria, are put in an airtight container called a digester where the process occurs. Depending on the waste feedstock and the system design, biogas is typically 55 to 75 percent pure methane. A typical anaerobic digestion process system is shown in Figure 7.

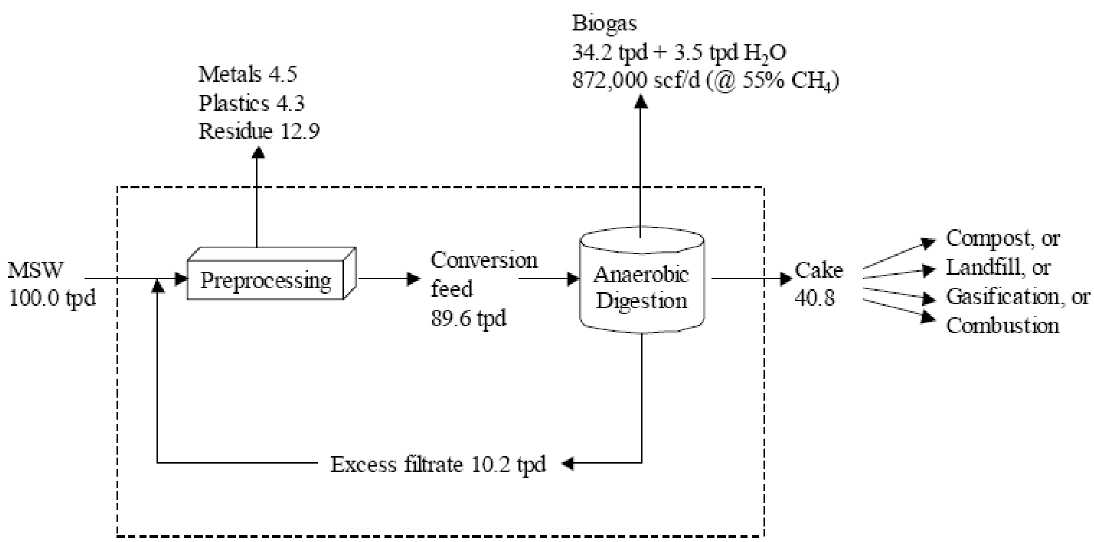


Figure 7: Typical MSW Anaerobic Digestion Process System

ArrowBio of Haifa, Israel, is a vendor offering to construct anaerobic digestion facilities to process MSW in the United States. They have responded to procurements in Los Angeles and New York. They operate a 100-TPD, full-scale MSW demonstration process line in Tel Aviv and have a 270-TPD, commercial scale plant for MSW operating in Australia.

2.5.1.3 Plasma Arc

Plasma arc technology is a non-incineration thermal process that uses extremely high temperatures in an oxygen-starved environment to completely decompose waste into very simple molecules. Plasma arc technology has been used for many years for metals processing. The heat source is a plasma arc torch, a device that produces a very high temperature plasma gas. A plasma gas is the hottest, sustainable heat source available, with temperatures ranging from 2,700 to 12,000 degrees F. A plasma arc system is designed specifically for the type, size and quantity of waste material to be processed. The very high temperature profile of the plasma gas provides an optimal processing zone with the reactor vessel through which all input material is forced to pass. The reactor vessel operates at atmospheric pressure.

The feedstock can be almost completely gasified, while non-combustible material, including glass and metal, is reduced to an inert slag. The product gas typically has a heating value approximately 1/4 to 1/3 the heating value of natural gas (natural gas has a value of approximately 1,040 Btu/standard cubic foot); therefore, it may be used as an efficient fuel source for industrial processes, including the generation of electricity, and the production of methanol and ethanol. The slag can be used in the construction industry or for road paving. All other byproducts, such as scrubber water and cyclone catch material, can be recycled into the process for reprocessing to alleviate disposal requirements. A typical plasma gasification system is shown in Figure 8.

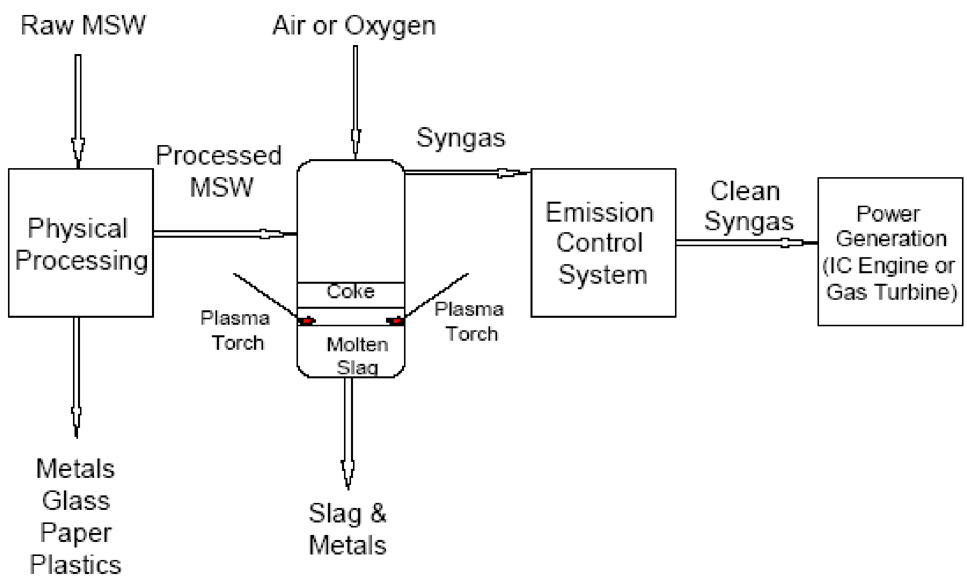


Figure 8: Typical Plasma Gasification System

There are no commercial-scale plasma arc facilities processing MSW in the U.S., although several companies are marketing some form of this technology and proposing facilities. There are three small plasma arc facilities processing MSW and/or auto-shredder residue in Japan reportedly using the Westinghouse plasma reactor. Few, if any of the plasma arc pilot facilities have been able to generate a fuel gas, and air emissions have been found to be no better than conventional incineration systems.

Two Canadian firms offer advanced gasification. Enerkem, headquartered in Montreal, Quebec, had an operating pilot gasification facility in Sherbrooke, Quebec, and built a commercial facility in Edmonton, Alberta, which processes 100,000 tpy which produce ethanol from the gas using a thermal/chemical process. The Plasco Energy Group, which had a 5 tpd research facility in Spain and operated a 400 tpd plant in Ottawa, Ontario. Both facilities have since closed due to mechanical issues.

2.5.2 Microwaves

Microwaves can be used as the external heat source for chemical decomposition or depolymerization. Microwave systems have been built to decompose some special wastes, particularly tires. Goodyear obtained a patent to “de-vulcanize” tires and built a facility in Lincoln, NE to process in-plant scrap in the late 1970s. Several small units have been operated on tires. The application of microwaves to drying and decomposition of various wastes, including medical waste and nuclear waste, is proven, but its application to municipal solid waste has not been proven.

2.6 Evaluation

The main difference between mass-burn and RDF technologies is that RDF requires pre-processing of the incoming solid waste to separate some of the non-combustibles and then shredding the remaining material to create a pelletized fuel that can be fired in a dedicated boiler unit. This additional front-end processing effort is performed in order to achieve higher energy efficiencies than mass-fired units. However, experience has shown that the front-end processing of raw solid waste into RDF is expensive and operationally intensive, with the shredders and pelletizers requiring significant routine and non-routine maintenance. Although touted as a step forward from mass-burn in the 1980s and 1990s, as a result of these additional challenges, RDF has not become as widespread a technology for WTE as mass-burn. RDF remains a distant second to mass-burn in the number of facilities in operation worldwide. The newer waste conversion technologies, which were discussed in the previous section, have emerged as potential waste processing technologies in the future. Experience to date has been spotty at best with a few plants closing due to technical design challenges that could not overcome even with significant infusions of capital.

In assessing the applicability of waste processing technologies for the MOA, one must consider the overall track record of each, including the operational/commercial experience of the technology, the size and scale of the successful facilities, their environmental performance and impacts, their overall economics, their reliability over time, and the availability of financially strong companies to offer them under full service arrangements.

Table 2 is a matrix summarizing the overall performance of the technologies reviewed in this white paper. Several columns address the technology, whether it has been employed commercially at the scale required for handling MOA’s (1,000 to 1,200 tpd) and its expected reliability. Based on the need to minimize risk and operational costs, Geosyntec considers mass-burn WTE technology to be the preferred and only option for further consideration by the MOA for this project.

Table 2: WTE Evaluation Matrix

Description of Criteria	TECHNOLOGY			Comments
	Massburn	RDF	Waste Conversion	
State of Technology				
Degree to which system has been proven on a commercial scale	Commercially proven over the past 50 years	Commercially proven over the past 25 years at numerous plants	Few facilities have long term proven operating experience	Identify status of technology: Bench Scale, Pilot, Demonstration (0-3 years), or Commercially Proven (+3 years)
Operating History	Yes, well proven >80 plants and over 1,000+ plants worldwide	5 RDF processing and WTE plants in U.S.	Several facilities in Japan and Canada	How many operational plants and years of successful operation have been shown?
Freedom from high risk failure modes	Yes, mature industry addressing high risks with design codes and operational procedures	High potential for shredder explosions has been experienced	A few very key projects have failed after major developer investment to correct major design and operational issues	Are there identified design problem areas with mitigation measures implemented to prevent high risk situations?
Demonstrated reliability of entire system	Yes, >92-96% plant availability, many facilities have life spans exceeding 20-30 years	Yes, high reliability (87%) has been demonstrated	Uncertain reliability at the current time at the size range anticipated by the MOA	What is the capacity and throughput and the historical annual plant availability?
Technical Performance				
Compatibility with the full spectrum of MOA waste stream	Yes, for the typical MSW waste stream, limited percentage of tires, HHW, treated lumber, mercury containing devices, limited percentage of tires, some co-combustion of biosolids	Yes, except non-processible materials removed prior to combustion	Requires significant pre-processing of the waste stream with current technology	Is the process compatible with the full spectrum of MOA potential needs (residential, commercial, HHW, C&D, medical wastes, E-waste, special wastes
Ability to produce marketable byproducts	Yes, gross electricity (>600 kwh per ton, hot water, steam, ferrous and non-ferrous metals, aggregates for landfill cover	Yes, electricity, hot water, steam, ferrous and non-ferrous metals, aggregates for landfill cover	Unknown due to the lack of commercially proven facilities	Does the technology produce a viable commodity that can be sold to a large local or regional market? What type of marketable by-products are produced?
Need for pre-processing	No, other than removal of a small percentage of bulky items (<1%) of waste delivered	Yes, the RDF process extracts metals, glass, and inert materials to create an RDF fuel for combustion	Requires significant pre-process to an engineered fuel for further processing	Does the process require source separation, sorting, or sizing
Technical Resources				
Proven contractor experience with technology	Yes	Yes	Uncertain	Are there vendors who have direct and applicable experience in the receipt, storage, handling, and processing of MSW
Proximity of technical support	U.S. based vendors	U.S. based vendors	Uncertain, vendors based in Europe or Asia	Do vendors have local resources to provide on-going technical support for the process, or will the support be based in the U.S. or offshore?
Availability to provide support on continuing basis	U.S. based vendors with significant pool of experienced professionals	U.S. based vendors with significant pool of experienced professionals	Uncertain, vendors based in Europe or Asia	Is there a key project leader without whom the project may fail, or does a broader industry team if a project leader becomes unavailable?

3. ENVIRONMENTAL AND PERMITTING CONSIDERATIONS

The environmental permitting process for WTE facilities can be potentially the most time-consuming and controversial step on the road to project implementation. This is due in large part to the extensive data needed for such projects, which often must be submitted to lenders and governmental agencies in the form of detailed permit applications and environmental impact statements. Section 3.6 provides a general overview of the major environmental permitting steps that should be expected. Prior to that, however, Section 3.1 provides a general review of the main environmental benefits of WTE over other solid waste management options such as landfills, while Sections 3.2 to 3.5 discuss operational aspects of mass burn WTE plants that may impact permitting and facility development decisions. When discussing permitting issues with governmental officials and the general public it is often beneficial to reiterate the environmental benefits of a WTE facility. Focusing on these benefits can help ease the decision-making process during the multiple steps involved in permit review and approval.

The readers should be forewarned that it is not within the scope of this White Paper to resolve all environmental issues related to WTE technology. For example, the character/type of per- and polyfluoroalkyl (PFAS) substances present in the waste stream in MOA is unknown/unquantified at this time and is something that should be studied when SWS is ready to fully characterize waste streams that would be used as MSW feedstock in a WTE facility. As emerging contaminant research evolves, our collective understanding of how WTE technology performs in destroying such compounds will evolve too – and should be part of the detailed evaluations once a WTE technology is settled upon.

3.1 Environmental Benefits

WTE facilities have several environmental benefits over other solid waste management solutions as outlined below.

<u>WTE is Renewable Energy</u>: Solid waste is typically comprised of over 50% biogenic materials, which are derived from biological processes. Combusting the biogenic fraction of solid waste in a WTE process is considered renewable energy generation by the U.S. Department of Energy (DOE). Similarly, European Council Directive 2000/76/EC considers biomass combustion a renewable energy source and defines biomass as including the biodegradable fraction of solid waste.

<u>Reduces Greenhouse Gas (GHG) Emissions</u>: Although WTE plants emit carbon dioxide (CO_2), which is the primary greenhouse gas accumulating in the atmosphere, a portion of these CO_2 emissions is considered to be part of the Earth's natural carbon cycle. The plants and trees that make up the paper and food waste (i.e., biogenic materials) in solid waste removed CO_2 from the atmosphere while they were growing, and this biogenic CO_2 is returned to the atmosphere when this material is burned. In contrast, when fossil fuels are burned to produce energy, they release fossil CO_2 that has not been part of the Earth's carbon cycle for a long time (i.e., within a human timescale).

Reduces Use of Fossil Fuel for Electricity Production: Every ton of solid waste processed in a WTE facility avoids consumption of about one barrel of oil (or an equivalent quantity of natural gas) for electricity production. Combusting waste in WTE facilities can also eliminate the environmental impacts associated with the drilling and processing of oil or other conventional, non-renewable fossil fuels. Fossil fuels such as coal, oil, and natural gas not only generate emissions of CO_2, sulfur dioxide, and nitrogen oxides during combustion but also emit methane, a potent GHG, during their processes of mining, transportation, and combustion.

Reduces Truck Traffic and Related Emissions: Assuming the WTE facility is developed close to where the generated is generated, only local transportation is required. Assuming construction of a WTE facility within the Anchorage Bowl will reduce truck traffic to the Anchorage Regional Landfill. This will reduce fuel consumption and CO_2 and other emissions from waste collection and transfer trucks.

Produces Clean, Reliable Energy: WTE technology is advanced and results in limited emissions. The U.S. Environmental Protection Agency (EPA) has concluded that modern WTE facilities produce electricity with less environmental impact than almost any other source. WTE facilities operate continuously and help reduce base load fossil fuel generation. Further, WTE facilities can be in proximity to urban areas where the power is needed the most. In these locations, the fuel feedstock for the facility – solid waste – is reliably generated by the urban population.

Reduces Reliance on Landfills: WTE facilities reduce the need for landfills and preserves natural resources that can otherwise be impacted by a landfill. The incoming solid waste is reduced to ash, which is only about 10% of the original volume. The potential environmental impact to groundwater and air quality of disposing of WTE ash in a landfill is generally much lower than that of a solid waste landfill.

Superior Performance to Landfills: WTE reduces GHG emissions, mainly by avoiding methane emissions at landfills. This is because WTE facilities recover the energy in waste much more efficiently than a landfill equipped with landfill gas (LFG) recovery. Methane is produced at landfills when the buried waste decomposes anaerobically. This methane can be captured in LFG collection systems. Data from these systems suggests that capture rates vary dramatically based on design and local conditions. As a result, large percentage of methane produced gets emitted as a GHG. A WTE plant that generates 100 MW will emit 38 tons of CO_2 per hour. Over a 20-year period, the WTE facility would emit 6.7 million tons of CO_2. Using the LFG generation model developed by the United Nations Intergovernmental Panel on Climate Change (IPCC), if the same amount of solid waste used to power a 100 MW WTE facility was instead disposed of at a landfill, the total methane emissions over a 20-year period would be equivalent to 28.7 million tons of CO_2. By this measure, WTE is over four times more efficient than landfills at managing methane emissions from solid waste disposal.

Complements Recycling: WTE facilities recover and recycle ferrous and other metals that pass through the combustion process and end up in the bottom ash. This reduce future reliance on mining operations.

3.2 Odor and Dust Management

Odor is not a significant problem as mass burn WTE plants are enclosed structures. WTE plants are typically designed such that odors from the tipping floor, waste storage pit, and ash storage areas are controlled by operating these areas under negative air pressure (i.e., air being drawn in from the outside) and exhausting the air from these areas to the furnace, where the air is used to aid combustion. Hence, any odorous compounds in the incoming municipal solid wastes are thermally destroyed during the plant's operation. Operating under negative pressure also minimizes the release of fugitive dust from the areas of the plant where ash is released from the combustion area.

3.3 Air Emissions Control and Monitoring

Air emissions control at mass burn WTE facilities may include the removal of particulate matter (PM) as well as scrubbing the flue gas of gaseous pollutants. For PM control, baghouses are the most commonly used means for WTE facilities to manage these emissions. Compared with other PM control technologies, baghouses have many decades of proven operating experience as highly cost effective, reliable, and easily serviceable PM control technologies that is robust to the high temperature of the WTE flue gas that would impair the effectiveness of many other control devices. With proper maintenance, baghouses can maintain PM removal efficiencies of 99% or more.

In addition to PM removal, many WTE facilities also employ emissions control equipment to remove gaseous pollutants such as hydrogen chloride (HCl), sulfur oxides (SOx), nitrous oxides (NOx), heavy metals such as cadmium, mercury, and lead, and products of incomplete combustion (PIC), including carbon monoxide (CO) and organics such as dioxins, furans, and PFAS. Polyfluoroalkyl substances (PFAS) are a class of chemicals used in a variety of products for the past 80 years. Despite their many beneficial uses, these chemicals have been dispersed around the world because of their use in thousands of industrial, food and textile applications. These compounds are found in biosolids. While there is limited research data in the solid waste industry, it appears that high-temperature incineration in a WTE facility is the best management strategy. More research in this area needs to be done.

Several technologies are available and in operation at multiple WTE facilities around the world to control emissions of these pollutants. These include wet or dry scrubbers, activated carbon or baghouse filters, and catalytic or non-catalytic reaction vessels. The specific technology and size of the air emission control equipment to be used for scrubbing non-particulate matter from WTE emissions varies depending on the regulatory limits placed on the air emissions to be permitted from the WTE facility.

Most WTE facilities are required to perform continuous and/or routine monitoring to demonstrate compliance with emission limits under the facility operating permit. Compliance monitoring typically includes continuous monitoring of oxygen levels at each stack flue along with routine monitoring of CO, SOx, and NOx. Stack tests for PM, opacity, heavy metals, HCl, and dioxins/furans are also required.

3.4 Ash Management

Combustion residue from mass burn WTE facilities is composed of fly ash, which is the fine airborne particles of ash entrained in flue gas and collected by air pollution control devices, and bottom ash, which is the non-airborne combustion ash discharged from the furnace at the end of the grates.

The characteristics of these two ash streams are significantly different. Fly ash contains PIC, including HCl, vaporized and volatilized heavy metals, and other complex organic and inorganic compounds. Bottom ash is essentially inert (incombustible) material discharged from the grates. Ash management practices can involve combining these two ash streams within the facility to form a single ash stream or managing them separately. Outside of Europe, the most common management method is to combine the bottom and fly ash into a single ash stream for disposal, which simplifies overall handling, transportation, and disposal into a single management strategy. For this pre-feasibility study, Geosyntec has assumed the proposed WTE facility will dispose of a combined ash stream.

Proper ash management from the WTE facility will require the development of an engineered landfill, which is defined as having at least the following characteristics:

- An engineered development plan and design;
- Site security and access control to prevent unauthorized dumping;
- A means to collect liquids (leachate) generated at the bottom of the landfill; and
- A systematic operation that places the ash in a controlled manner and covers filled areas with soil on a daily basis.

The landfill can be co-located with the WTE facility or located at a separate property. There are several benefits to co-locating the ash landfill with the WTE facility. These include eliminating offsite hauling costs, providing better security to prevent unauthorized dumping, the ability to use liquids collected from the landfill as recycled process water within the WTE facility, and support for landfill operations (which would generally be part-time) by WTE facility personnel. The primary disadvantage of co-locating the ash landfill would be that the landfill requires a substantial area of property that may not be available at the location that is most advantageous for siting the WTE facility.

Given that provision of an ash landfill is fundamental to WTE residuals management, the costs for developing a landfill are included in the pro forma developed in Section 6 of this Report.

3.5 Wastewater

Water is used in the WTE combustion process for several purposes, including as scrubber effluent for acid gas cleaning, cooling and quench water from bottom ash management, other air pollution control devices, and boiler feedwater production. Sources of wastewater from WTE plant operation thus include "operational" water from cooling towers, boilers, air pollution control devices, and ash management, as well as general facility cleanup waters and domestic wastewater from workers' sanitary facilities. Depending on stormwater management systems in place, runoff from the surface areas of the property may also end up as wastewater, although this can be minimized through best practices for stormwater management.

The wastewaters from the various uses at WTE facilities can contain high concentrations of solids, heavy metals, and soluble contaminants. Anticorrosion and antifouling agents (e.g., sodium bi- and triphosphates) and biocides (e.g., chlorine) are typically used in boilers and cooling towers. Onsite wastewater treatment methods include neutralization, removal of solids, precipitation, and sludge settling, filter pressing, and drying (see Figure 2-1). To avoid landfill disposal of sludge, most facilities dry the sludge and blend it back into the solid waste as it is burned in the boilers. When possible, wastewaters are treated and recycled for additional use; however, some offsite discharge is unavoidable.

In this pre-feasibility study, it is assumed that direct discharge to a municipal sewer will be possible, for which discharge criteria will be established by the municipal wastewater treatment company. Costs for sewer discharge are assumed to be equivalent to those charged to other industrial/commercial facilities.

3.6 Permitting Requirements

There are four main categories of emissions from WTE plants -acid-gases, particulate matter, heavy metals, and products of in-complete combustion (PICs). Within these three categories, there are many products of combustion, many of which are regulated under the international and national emissions regulations. In the United States, these WTE regulations are titled, "New Source Performance Standards" (NSPS) for new WTE sources and "Emission Guidelines" (EGs) for existing WTE facilities (Table 3). In this report, the discussions are limited to the following WTE air emissions:

- Particulate matter (PM),
- Cadmium (Cd), mercury (Hg) and lead (Pb),
- Hydrochloric acid (HCI) and sulfur oxides (SO),
- Nitrogen oxides (NOx),
- Carbon monoxide (CO), and
- Organics (dioxins and furans).

The hourly, daily, monthly, and yearly emissions concentrations from solid waste combustors vary. However, in general, the relative concentration and toxicity of any of the above contaminants in solid waste combustor gas will be affected by the following factors:

- Solid waste composition,
- Combustion temperature and residence time,
- Flow patterns and amounts of excess air, and

- Furnace design.

Particulate Matter. Particulate matter (PM) is any liquid or solid which is so finely divided as to be capable of becoming windblown or suspended in air or gas. Particle sizes for particulate matter from solid waste combustors usually range from 0.01 to 300 microns (micron -one millionth part of a meter) in diameters; 20 to 40 percent is less than 10 microns in diameter; and up to 10 percent is less than 2 microns in diameter. Particulate matter from solid waste combustors is usually composed of the following materials: carbon particles, water particles, and particles of incomplete combustion.

Heavy Metals. At the end of the 1990s, three heavy metals emissions were regulated, mercury (Hg), lead (Pb), and cadmium (Cd).

Although heavy metals are their own class of toxic emission, they are sometimes grouped with particulates. This may be attributed to the way they are collected. Heavy metal can be "trapped" with injection of activated carbon, or in scrubbers, then collected by the baghouse.

Acid Gas. Acid gases such as sulfur dioxide (SO_2) and hydrogen chloride (HCI) are formed during combustion. Sulfur oxide (SO_x) compounds are formed form the oxidation of elemental sulfur, and HCI is formed when chlorine in the solid waste combines with free hydrogen atoms (Licata et al. 1994).

Spray dryers, sometimes called dry scrubbers, are the most common acid gas control technology. Spray dryers inject a fine alkaline slurry (i.e., lime) into the flue gas stream. This slurry reacts with SO_x and HCI to form chlorine and sulfur salt precipitates, which are then collected by the electrostatic precipitators or fabric filters. Chlorine is more reactive than sulfur and reacts first with slurry. The USEPA regulations identify fabric filters as the best control technology (BCT) to combine with spray dryers for controlling acid gas emissions (USEPA 1997). The use of a spray dryer with a fabric filter can produce removal efficiencies of >95% for HCI and >85% for SO_x. When acid removal requirements are stringent, usage of double stage wet scrubbers may be required to further reduce emissions.

Table 3: Current US EPA Emission Limits for WTE Plants in the U.S.

Concentration units		Pollutant	Incinerators case[a]	Incinerators case[b]	Energy recovery units[c]	Waste burning kilns[d]	Small remote incinerators[e]
ppm	7% O_2 dry	SO_x (ppm at 7% O_2)	11	20	720	28	1.2
ppm	7% O_2 dry	HCl (ppm at 7% O_2)	0.091	62	14	3	200
ppm	7% O_2 dry	NO_x (ppm at 7% O_2)	23	388	76	200	170
ppm	7% O_2 dry	CO (ppm at 7% O_2)	17	157	35	90/190	13
mg/Nm^3	7% O_2 dry	Particulate matters/dust (mg/Nm^3 at 7% O_2)	18	70	110	4.9	270
TEQ ng/Nm^3	7% O_2 dry	Dioxins (TEQ ng/Nm^3 at 7% O_2)	0.13	0.41	0.093	0.075	31
µg/Nm^3	7% O_2 dry	Cadmium (µg/Nm^3 at 7% O_2)	2.3	4	23	1.4	670
µg/Nm^3	7% O_2 dry	Mercury (µg/Nm^3 at 7% O_2)	0.84	470	0.56	3.7	3.5

[a]Emission limitations for incinerators that commenced construction after June 4, 2010, or that commenced reconstruction or modification after August 7, 2014.

[b]Emission limitations for incinerators for which construction is commenced after November 30, 1999, but no later than June 4, 2010, or for which modification or reconstruction is commenced on or after June 1, 2001, but no later than August 7, 2014.

[c]Emission limitations for energy recovery units that commenced construction after June 4, 2010, or that commenced reconstruction or modification after August 7, 2014.

[d]Emission limitations for waste-burning kilns that commenced construction after June 4, 2010, August 7, 2013 or reconstruction or modification after August 7, 2014.

[e]Emission limitations for small, remote incinerators that commenced construction after June 4, 2010, or that commenced reconstruction or modification after August 7, 2014.

Products of Incomplete Combustion. Products of incomplete combustion (PICs) are of concern because carbon monoxide (CO) and organics such as dioxin or furan are formed by incomplete combustion. CO and organics emissions are regulated by the EPA.

Most organics and CO are destroyed when complete combustion occurs. This destruction requires ample amounts of oxygen. the EPA regulation of PICs from solid waste combustors has brought about the injection of excess oxygen to ensure that complete combustion will occur. In some cases, as much as 200% of what would be stoichiometrically needed for complete combustion is added. Even with high excess air, CO and organics are still formed. Most of the PICs combine with particles in the cooling flue gas produced by dry sprayers. the particles are then collected by electrostatic precipitators or fabric filters. This process alone can produce removal efficiencies as high as 99% for organics.

Nitrogen Oxides. Nitrogen oxides (NO_x) are produced during combustion. the two most important nitrogen oxides are nitric oxide (NO) and nitrogen dioxide (NO_2); these are collectively known as NO_x. Nitrogen oxides are formed from the organic nitrogen present in solid waste and from the nitrogen present in the air used for combustion. NO, emissions are of concern due to their contributions to the formation of ozone and the photochemical oxidants known as smog.

3.6.1 Compliance Monitoring

The USEPA monitoring requirements under the NSPS and EGs require major sources of air pollution (WTE plants are a major source) to provide enhanced air emissions monitoring in order to demonstrate compliance with the CAA. Compliance monitoring is discussed below.

Oxygen. Municipal solid waste combustors must conduct continuous emissions monitoring (CEMS) to measure oxygen at each stack flue within a municipal solid waste combustor where CO, SO_x, or NO_x emissions are monitored.

Particulate Matter and Opacity. The initial compliance tests for particulate matter emissions and opacity mud will be conducted within 60 days after a municipal solid waste combustor has achieved maximum operating capacity, but not later than 180 days after startup. Following initial compliance testing, performance tests for particulate matter and opacity are typically con- ducted annually.

Samples for particulate matter compliance are collected from the air emissions in the municipal solid waste combustor stack. Sampling equipment (sampling trains) with probes and filters traverse the interior diameter of the stack to collect samples of the air emissions leaving the stack. Temperature conditions, sampling sites, the number of traverses and the length of the sampling runs are dictated by EPA regulations. Other pollutant samples, e.g. metals and HCI, can be collected during the same sampling runs.

Municipal solid waste combustors are required to install a continuous opacity monitoring system (COMS) to measure opacity. Initial compliance with this USEPA requirement must occur within 180 days of startup. Opacity is defined as the apparent obscuration of an observer's vision to a degree equal to the apparent obscuration of smoke given on the Ringlemann Chart. The Ringlemann Chart is a well-established standard for measuring opacity and photographically reproduces illustrations of four shades of gray that an observer can use to estimate the density of smoke. A clear stack is recorded as 0 and a 100 percent black smoke as 5.

Metals. The initial tests for compliance with emission limits for cadmium (Cd), lead (Pb), and mercury (Hg) must be conducted within 60 days after a municipal solid waste combustor has achieved maximum operating capacity, but no later than 180 days after startup. Samples to determine compliance of these metals are collected from the air emissions in the municipal solid waste combustor stack (see Section on Particulate Matter and Opacity for stack sampling details).

Sulfur Dioxide. Municipal solid waste combustors are also required to install a GEM system to measure sulfur dioxide (SO_2) emissions. Compliance with SO_2 emission limits are determined by calculating a 24-hour daily geometric mean emission concentration. At a minimum, valid paired CEM hourly averages (i.e., SO_2 and 0_2) have to be obtained for 75% of the hours per day for 90% of the days per calendar quarter of operation. The initial performance test has to be completed within 180 days after startup.

Nitrogen Oxides. Municipal solid waste combustors are required to install a continuous emissions monitoring (CEM) system to measure nitrogen oxide (NO_x) emissions. Compliance with NOx emission limits are determined by calculating a 24-hour daily geometric mean emission concentration. At a minimum, valid paired CEM hourly emissions (NOx and 0_2) have to be obtained for 75 %of the hours per day, for 90% of the days per calendar quarter of operations.

Hydrogen Chloride. The initial tests for compliance with HCI emission limits must be conducted within 60 days after a municipal solid waste combustor has achieved maximum operating capacity, but no later than 180 days after startup. Following initial compliance testing, HCI compliance is determined by annual stack tests.

Samples for HCI compliance are collected from the air emissions in the municipal solid waste combustor stack (see Section on Particulate Matter and Opacity for stack sampling details).

Dioxin/Furans. The initial tests for compliance with emission limits for dioxin and furans must be conducted within 60 days after achieving maximum operating capacity, but no later than 180 days after startup. After initial compliance testing, dioxin/furan compliance is determined by annual stack tests. Compliance is based on either the total emitted or the Toxic Equivalency Factor for dioxins and furans.

3.6.2 Operating Standards

The EPA NSPS and EG requirements also require municipal solid waste combustors to demonstrate that the operations are being conducted at rated capacity and that the emissions comply at the tested and rated capacity of the facility. The EPA has established operating standards for several operational characteristics to ensure that the facility is operating at the tested and rated capacity. These standards address:

- Carbon monoxide - The amount of carbon monoxide in the emission gases is an indication of the degree of combustion; high carbon monoxide levels indicate insufficient air for complete combustion.
- Load level - A municipal solid waste combustor is tested for emission compliance at a rated capacity; defined by the steam load delivered. Therefore, the load level of steam being delivered is an indication how well the facility is meeting the rated capacity and its emission level limits;
- Particulate matter control device temperature - For maximum efficiency, particulate matter control devices must operate at their appropriate temperatures. Measuring the

temperature at the inlet of the device demonstrates that it is ready to provide the intended particulate matter removal.

- Municipal solid waste unit capacity - Each combustion train (unit) is rated at a certain capacity during compliance testing; measuring the 24-hour operating capacity demonstrates satisfaction of this requirement.
- Fly ash and bottom ash fugitive emissions - Municipal solid waste combustors must include means to prevent fugitive emissions from their ash handling system. Measuring the extent of fugitive emissions during the transfer of ash from a combustion unit to the ash storage facility determines compliance with this requirement.

3.6.3 Overview of Permitting Process

It is expected that several state and local agencies will have a role in the permitting of a new WTE plant in the MOA. At this pre-feasibility stage, the specific agencies that would be responsible for approving the construction and operation of the WTE plant were not identified, nor the directly relevant laws and regulations they administer. Rather, this section broadly identifies the components of permit applications that MOA should expect will be submitted, based on Geosyntec's experience with similar WTE projects in the U.S.

The level of effort required to prepare the required permit submittals, estimated costs for preparation of permit applications, and an estimated timeline for regulatory approval will be developed later, assuming MOA elects to proceed with development of a WTE project. However, it should be tentatively expected that the permitting process will take at least two to three years.

Permit requirements for solid waste management facilities generally include solid waste, air, and water discharge permits.

<u>Solid Waste Permit</u>: The solid waste permit can be considered a Permit to Construct (PTC) for the facility. The permit application typically includes:

- Preparation of engineering plans, reports, and specifications that comprehensively address the project in its environmental setting and comply with the required environmental and social impact assessments (ESIA);
- A location map with the site marked;
- Proof of property ownership and certified surveys of property boundaries;
- Plan of operations and maintenance, including contingency plans for waste control;
- Detailed decommissioning/closure plans for the facility;
- Information on the landfill that will receive the ash from the facility;
- Public notice and review requirements; and

- Payment of regulatory fees.

Air Permit: The air permit can be considered a Permit to Operate (PTO) for the facility. The permit application typically requires:

- Preparation of an air pollution control program that comprehensively addresses the project in its environmental setting and complies with imposed limits on air emissions and demonstrates use of best available control technology (BACT) and air quality monitoring to meet air quality standards;
- Identifying information, including owner/operator and plant name and address;
- A list of all emission units at the facility and description of all emission units' processes and byproducts;
- A list of all regulated air pollutants expected to be emitted from the facility;
- The type, rate, and quantity of expected emissions in sufficient detail to determine what requirements and emission limits are applicable to the facility;
- Demonstrated compliance with the ESIA and other required environmental assessments; and
- Payment of regulatory fees.

Water Discharge Permit: Water discharge permit conditions will vary depending on whether discharge will be to natural receiving waters or to a sewer system. Provision of onsite pre-treatment or full treatment prior to discharge also affects permit conditions. At this pre-feasibility stage, it is assumed that wastewater from the WTE facility will be discharged into the MOA sewer system. Wastewater treatment will be limited to that required to meet discharge permit conditions imposed by AWWU, which Geosyntec assumes will be broadly equivalent to those imposed on other industrial/commercial facilities in the MOA.

3.7 Other Plans

Two MOA planning documents potentially influence development of a WTE facility.

3.7.1 Solid Waste Master Plan

In 2017, the MOA authorized development of an integrated solid waste master plan (ISWMP) in order to optimize its system and assets through improved operational efficiencies, capital improvements and new practices/programs that increase landfill life, improve safety and customer service, protect the environment and increase waste reduction, improve reuse and recycling of materials that are currently disposed of as waste. As part of the ISWMP, a preliminary assessment of alternative waste conversion technologies was performed.

3.7.2 Climate Action Plan

The Climate Action Plan (CAP) for the MOA was adopted by the Anchorage Assembly on May 21, 2019. The Plan puts Anchorage on a path to reduce greenhouse gas emissions by 80 percent by 2050 with an interim goal of 40 percent by 2030. The CAP focuses on seven sectors including: Buildings and Energy, Land Use and Transportation, Consumption and Solid Waste, Health and Emergency Preparedness, Food Systems, urban Forest and Watersheds, and Outreach and Education.

Some specific objectives for solid waste management include the following:

- Develop anaerobic digestion or mass burn waste-to-energy facilities are other options that could reduce landfill dependence and provide additional benefits like compost, bio gas and electricity.
- Identify and implement additional means of energy collection from solid waste (e.g., organics digestion, mass burn).
- Explore internal operational and savings opportunities such as those outlined in the 2017 Anchorage Energy Landscape and Opportunities Analysis, including heat recovery, waste to energy, landfill methane recovery, and combined heat and power.
- Over-reliance on one energy source leaves Anchorage vulnerable to price volatility and supply interruptions. Adding renewable energy like WTE will diversify MOA's energy supply, improve air quality, and save money on fuel costs.

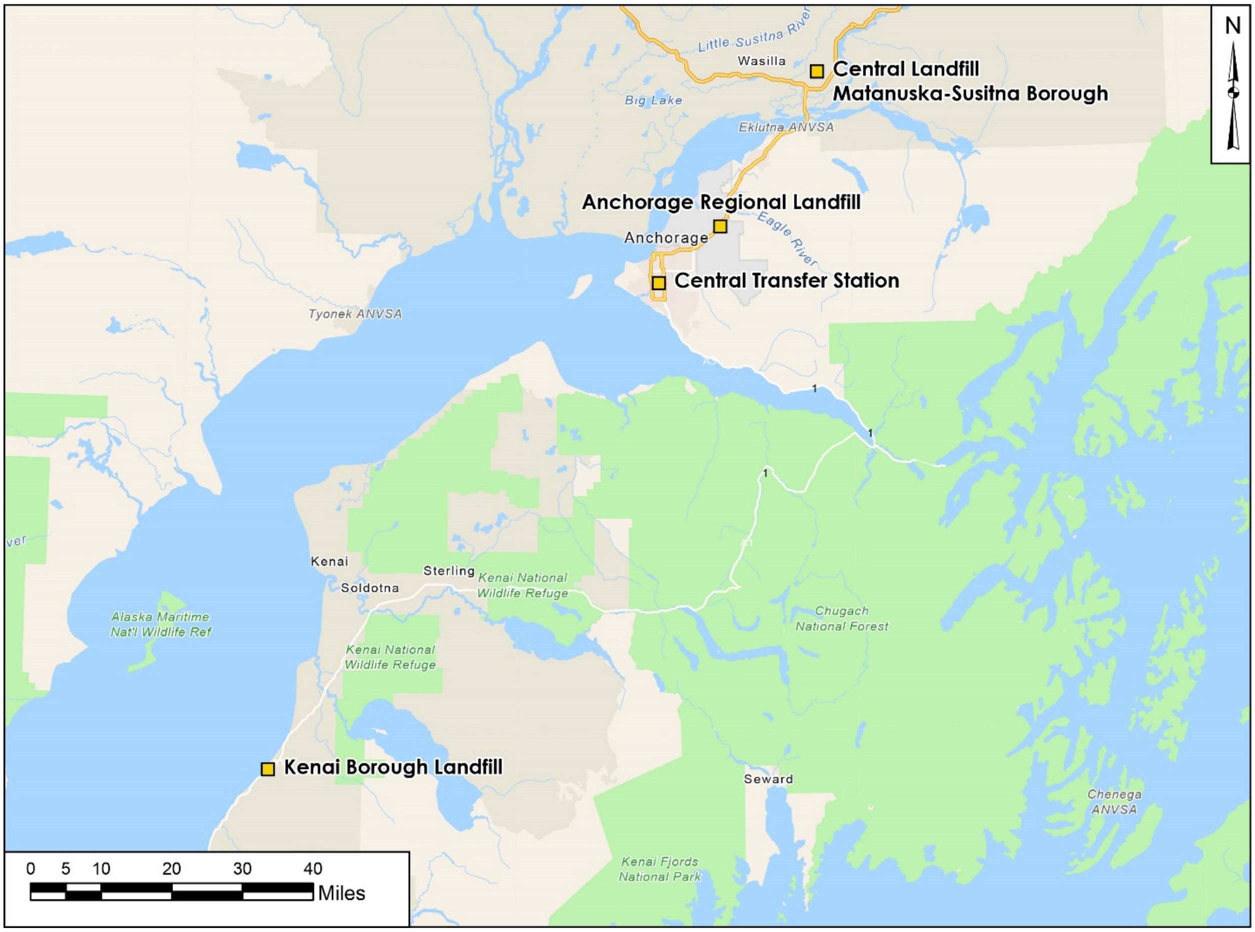
4. WASTE STREAM AND WASTESHED ANALYSIS

This section contains preliminary estimates of waste quantities currently generated in the projected wasteshed and expectations for growth in waste generation over the life of the plant, as well as a review of expected waste composition in the MOA. In preparing this section, Geosyntec reviewed existing data on the available waste streams, which included published sources as well as data provided by neighboring communities.

It is reiterated that this section only provides a preliminary analysis in support of the pre-feasibility study. Because waste quantity and composition are critical inputs to an investment analysis, Geosyntec recommends that a comprehensive assessment of waste generation and a detailed waste composition study are conducted as part of the next stage of the project.

4.1 Wasteshed

A "wasteshed" is typically defined by solid waste professionals as being an area that shares a common solid waste disposal system, or an appropriate area in which to develop a common disposal or recycling system. Solid waste agency staff and political leaders (Mayors and Chiefs of Staff) within the MOA have discussed, in the recent past, the feasibility of siting a regional WTE facility, which would dispose of solid waste generated within a wasteshed consisting of the Boroughs of MOA, Mat-Su, and the Kenai Peninsula. Figure 9 is a vicinity map, which shows locations of key facilities (landfills and transfer stations) and distances between these facilities. All three Boroughs are operating State permitted landfill facilities. Siting a joint WTE facility might have potential economies of scale and provide long-term solid waste disposal capacity for all three communities.



Source: Geosyntec Consultants, 2019

Figure 9: Wasteshed Vicinity Map

4.2 Population in Market Area

Waste generation is strongly correlated to population size and growth. To define the market area to be served by this project, Geosyntec began by evaluating population data and expected growth rates for the wasteshed, as defined in the paragraphs above.

In 2017, the Anchorage/Mat-Su/Kenai Peninsula Boroughs had an estimated population of 459,673, approximately 62.4% of the State's population. As shown in Table 5, the Alaska Department of Labor and Workforce Development produces population projections for Alaska for 2017-2045. As shown in this table, population increases in these three boroughs are dramatic, so that by 2045 they represent over two-thirds of the State's entire population.

These projections are based on the current population and historical birth, death, and migration trends in Alaska. Population projections are distinct from population estimates in that estimates use current and historical data to make statements about the present and past population while projections use expected or extrapolated data to make statements about future populations.

Table 4: Population Projections

Year	Population			
	Municipality of Anchorage	Matanuska-Susitna Borough	Kenai Peninsula Borough	Totals
2017	297,483	104,166	58,024	461,690
2020	299,970	110,218	58,696	470,904
2025	306,518	122,148	60,412	491,103
2030	311,237	134,138	61,702	509,107
2035	314,438	145,921	62,586	524,980
2040	316,577	157,177	63,147	538,941
2045	318,169	167,500	63,472	551,186

Source: Department of Labor and Workforce Development, 2017.

4.3 Waste Generation

4.3.1 Solid Waste

Solid waste disposal projections were developed based the following methodology. The ten-year (10) average of solid waste deliveries to the three respective Borough solid waste facilities (2009-2018) were projected over the initial twenty (20) year life of the proposed WTE facility (2023-2042). It was assumed, for projection purposes, that implementation of the facility would take at least three years (2020-2023). The State's annual population growth factors (0.1% to 0.4%) over the period were then used to calculate estimated waste fuel supplies for the proposed WTE facility. Two projections were then developed in terms of tons per day WTE capacity (Table 6): one with MOA solid waste supplies only and another with all three Boroughs jointly participating in the WTE project.

Table 5: Waste Projections

Year	Tons per Day	
	MOA Only	All Three Boroughs
2023	881	1,229
2027	894	1,247
2032	904	1,260
2037	908	1,267
2042	913	1,273

4.3.2 Biosolids

The Anchorage Water and Wastewater Utility (AWWU) is the largest water and wastewater utility in Alaska. AWWU currently serves the Municipality of Anchorage extending from Eklutna to as far south as Girdwood. To provide water and sewer services, AWWU owns and operates five Treatment Facilities (2 water and 3 wastewater), over 1,600 miles of pipe, and over 325,000 square feet of facility space distributed throughout the Municipality. ASU operates three wastewater treatment facilities to treat wastewater collected in three geographically separate but commonly managed sewer systems.

The largest of these is the John M. Asplund (Asplund) Wastewater Treatment Facility (WWTF) located at Point Woronzof. The Asplund WWTF was constructed in the early 1970's when Anchorage eliminated direct ocean discharges. It services the wastewater treatment needs of the Anchorage Bowl. The Asplund facility has received silver, gold, and platinum awards from the National Association of Clean Water Agencies for efficiency and environmental compliance.

Belt filter presses enable conversion of the wet sludge to dryer product (30 to 32 percent solids). An onsite biosolids incinerator is located at the Asplund WWTF with the ash and bypass biosolids disposed of at the SWS Landfill (ARL) when the incinerator is down for scheduled maintenance and/or unplanned repairs. Currently, roughly 2,032 tons of these materials were landfilled in 2018 at a cost of $58 per ton. Table 6 shows the actual tonnage of biosolids incinerated at the Asplund WWTF for 2012 through June 2019. AWWU staff indicate that about 20 tpd of biosolids are processed by the biosolids incinerator (Table 6). Their projections suggest that these quantities would increase to an estimated 28 tpd over 20 years.

The incinerator is nearing the end of its useful life and plans and estimated replacement costs were developed as part of a facility planning study in 2014.

Table 6: Actual Tonnage of Biosolids Produced at the Asplund WWTF (2012-2019)

Months	2012	2013	2014	2015	2016	2017	2018	2019	AVG
Jan	1,459.58	2,221.61	1,786.50	1,712.40	1,822.55	1,800.46	1,736.94	1,926.16	1,808.28
Feb	1,380.52	1,994.02	1,571.04	1,512.40	1,718.77	1,643.39	1,636.41	1,797.80	1,656.79
Mar	1,551.59	2,206.61	1,806.22	1,741.76	2,022.29	1,822.01	1,913.30	689.88	1,719.21
Apr	1,782.65	2,276.10	1,740.55	1,729.29	1,893.67	908.94	2,027.73	1,760.54	1,764.93
May	1,610.52	2,030.22	1,823.60	1,910.39	1,969.85	2,017.72	2,294.43	2,216.32	1,984.13
Jun	1,690.65	1,988.07	1,818.44	1,861.31	2,079.07	2,099.64	2,413.81	2,119.62	2,008.83
Jul	1,960.77	2,155.15	1,993.84	2,023.94	2,126.14	2,252.65	2,480.28		2,141.82
Aug	1,979.20	2,257.91	2,077.06	2,061.13	2,237.70	2,347.08	2,552.04		2,216.02
Sep	1,888.85	2,201.33	1,843.90	1,923.54	2,072.16	2,129.47	1,938.26		1,999.64
Oct	2,068.16	2,086.21	1,959.08	2,124.28	2,022.98	2,161.31	2,310.19		2,104.60
Nov	1,845.92	1,154.11	1,728.32	1,881.61	1,489.48	1,866.48	2,037.04		1,714.71
Dec	2,240.88	1,728.65	1,648.26	1,783.67	1,858.65	1,898.61	2,016.96		1,882.24
Total	21,459.29	24,299.99	21,796.81	22,265.72	23,313.31	22,947.76	25,357.39		23,062.90

4.4 Solid Waste Composition

There are thousands of published solid waste composition studies across the United States. The results vary by climatic region, socioeconomics, level of recycling in the community, and the type of survey (e.g., grab sampling versus scientific sorting of the waste stream). The results from a waste composition survey undertaken in one community may not reflect the characteristics of the waste stream in another community. Should the SWS move forward on construction of a WTE facility, it is recommended that a detailed waste composition study be undertaken to fully delineate the community's waste stream. That being said, a few waste composition studies undertaken by the SWS and the neighboring Mat-Su Borough are presented in the following paragraphs.

In October 2017, HDR Inc. conducted a limited waste composition study for SWS at the ARL. The study consisted of two spot assessments of 2,000 lbs. of waste from a randomly selected truck dumping at the active landfill face. The waste was sorted into 13 categories and weighed to determine a by-weight composition. Results across the two assessments found that the sorted waste was primarily composed of food scraps (18%), wood and yard waste (17%), inert material (16%), paper (10%), and plastics #3-7 (10%). Further grouping of the sorted categories into material groups illustrates that compostable organics (food scraps, yard waste, and other organics), paper (including cardboard), wood and construction waste, and plastics comprise most of the waste stream.

In 2018, Mat-Su Borough performed an initial waste composition analysis of both residential and commercial materials. Table 7 presents the data from an initial waste composition study performed in September through December 2018. Data was collected from 13 rear-load trucks during the sampling period. Nine trucks containing residential waste were analyzed between October and November 2018, and four trucks containing commercial and institutional waste were analyzed between December 11 and 15, 2018. The main components for commercial MSW in the "other' category include fines and super mix. As of this report, Mat-Su Borough indicates that it is continuing to perform waste sampling and more data will be available in the near future. No waste composition studies have been completed for the Kenai Borough.

Table 7: Waste Composition Survey Results, Mat-Su Borough, 2019

Residential		Commercial	
Material	**Composition (% of Total by Weight)**	**Component**	**Composition (% of Total by Weight)**
Paper	17.1	Paper	28.0
Durables	16.7	Other	22.3
Plastics	16.1	Plastics	14.4
Metals	11.4	HHW	7.6
C&D	8.2	Glass	7.5
Other	6.8	Food	6.1
Rubber, Leather and Textiles	6.5	Rubber, Leather and Textiles	4.4
Food	5.9	Durables	2.8
Wood	5.5	Wood	2.1
Glass	4.5	Metals	2.8
HHW	1.4	C&D	2.0
Yard Waste	0.0	Yard Waste	0.0

Source: Mat-Su Borough, 2019

4.5 WTE Plant Sizing

The proper size of a proposed WTE facility is oftentimes a balance among initially designing the plant to minimize landfilling of bypass waste, maximize available capacity in its initial year, provide excess capacity to accept MSW from other municipalities to fill unused capacity, and the additional capital costs incurred to allow this to happen.

WTE facility annual availability is assumed to be in the range of 92 to 96 percent of design capacity for annual MSW processed. Many of the private operators of "first generation" WTE facilities were bound by contract to maintain an annual availability guarantee of 85 percent. However, the percent of time in which newer generation WTE facilities are available to process MSW has increased over the last two decades of plant operations. This is due to advancements in the industry such as use of higher alloy overlay on boiler tubes, better refractory coverage, more through plant inspections to minimize introduction of unacceptable wastes (tree stumps and engine blocks), and optimized and automated combustion controls.

WTE combustion technology has demonstrated the ability to be scaled to meet the needs of the host community (city, county, or several counties), depending on the legal entities that want to build and operate (or have somebody build or operate) such a facility.

A review of the waste projections noted in Table 5 and the factors above suggests that the MOA should consider development of a 1,000 WTE facility, sized at two boiler units of 500 TPD, if it is to be the only project participant. If the two other Boroughs participate in the WTE project, then the sizing should be 1,200 TPD, with three 400 TPD boiler units.

4.6 Heating Value

Since the sale of energy plays an important role in the economic feasibility of a WTE project, the heating value of the waste stream is a key design factor. The heating value of the waste steam can be estimated based on waste composition data. The heating value of solid waste is typically measured in British thermal units (BTUs) per pound in the U.S., or KJ/kg elsewhere (1 BTU is approximately equal to 1055 J). The higher heating value (HHV) content of the various components of solid waste discussed in Section 4.3 is well documented as presented in Table 8 below.

Table 8: Average Heating Value of Solid Waste Components

Component	BTU/lb.	KJ/kg	Component	BTU/lb.	KJ/kg
Food waste	2,000	5,700	Glass	60	170
Paper/Cardboard	7,200	20,400	Ferrous Metals	300	850
Plastics	14,000	39,600	Non-Ferrous Metals	0	-
Textiles/Leather	7,500	21,200	Dirt, Ash, Bricks, etc.	3,000	8,500
Rubber	10,000	28,300	Mixed Solid Waste	4,500	12,700
Garden Trimmings	2,800	7,900	Waste Oil	21,000	59,400
Wood	8,000	22,600	Tires	13,500	38,200

Source: Rogoff, 2019

Typically, municipal solid waste exhibits a range of 2,500 to 8,500 BTU/lb. (7,100 to 24,000 KJ/kg). The range is dependent on the definition of solid waste, with higher values reported for waste that are defined as “highly combustible waste, paper, wood, cardboard, including up to 10% treated papers, plastic or rubber scraps; commercial and industrial sources” and lower values reported for waste that is defined as “wet animal and vegetable wastes from restaurants, hotels, markets and other similar sources. As would be expected, the higher the moisture and inert content of a solid waste stream, the lower the heating value.

The removal of organic waste (food and vegetation) typically results in driving up the HHV of the remaining waste. If the HHV increases beyond the design HHV value, it would result in lowering the waste processing capability for the WTE facility, which is designed based upon a specific HHV and throughput for total heat input. If plastics were also targeted in future waste diversion goals, along with organic materials, the two would tend to offset each other. However, if only plastics were targeted, the HHV would likely be reduced. If the reduction in HHV is less than the design HHV value, the WTE facility would be able to process more waste, up to its theoretical design heat input. Complicating this issue, the HHV of a community's waste typically varies on a daily basis (depending upon weather) and seasonal basis.

Based on the waste composition in Table 7 and the typical heating value for the components of solid waste described in Table 8, Geosyntec estimated the average expected heating value for waste in the wasteshed to be approximately 5,000 BTU/lb.

4.7 Existing Waste Management System

Management of solid waste in the MOA is provided through public (SWS) and private service providers. Figure 10 illustrates the solid waste management system in the MOA and the flow of solid waste through the System. The SWS is composed of two utilities, the Refuse Collection Utility (RCU) and the Solid Waste Disposal Utility (SWDU).

Source: Integrated Solid Waste Master Plan, 2018

Figure 10: Overview of the MOA Solid Waste System

4.7.1 Collection

Waste collection in the Anchorage area is a combination of public utilities, private haulers and self-haulers.

SWS is the public hauler. Its service area is limited by the Anchorage Municipal Code and Regulatory Commission of Alaska (RCA) to an area that encompasses the boundaries of the original City of Anchorage, which covers approximately 20% of the population in MOA. Garbage service within these boundaries is mandatory by municipal code. SWS provides commercial dumpster service, up to 8 CY cans served by front load truck. Rolloff and compactor service in the service area is provided by private haulers but the property owner must obtain an exemption from municipal code demonstrating that their service needs cannot be met by SWS prior to spotting the can. SWS also provides residential collection to approximately 12,000 residential customers using automated side load trucks and 32 gal to 96 gal rollcarts. Residential collection is weekly. As part of the service, comingled recycle (excluding glass and film) are collected on a bi-weekly basis. SWS is currently piloting curbside organics collection in some areas of the service area. Note that collection of recycled materials is not regulated by the RCA.

There are numerous private haulers, the largest of which is Alaska Waste (a subsidiary of Waste Connections). Alaska Waste provides commercial rolloff, compactor and dumpster service. They also provide residential garbage collection and residential comingled curbside recycling. Alaska Waste provides service in all areas of the municipality from Girdwood to Eklutna and are also the primary commercial hauler in populated areas of the Mat-Su Valley and Kenai Peninsula Borough. There are also several smaller operators (e.g., Ramsey, Red Box, Blue Arctic, Northern Waste, Bin There Dumped That) that come and go. These operators provide primarily commercial dumpster and rolloff service although Blue Arctic (and others) are making inroads into residential collection as well. Residential collection outside of the SWS service area is not mandatory and residents are free to contract with any service or self-haul. Alaska Waste residential service is by subscription and collected primarily by automated sideloader cans varying from 32 to 96 gallons. Rates are commensurate with size. Curbside comingled recycle is also available by subscription from Alaska Waste for a separate fee.

In addition to commercial and public waste collection utilities there is a fairly large contingent of self-haulers. There are public dropoff walls at the Central and Girdwood Transfer Stations as well as at ARL that are geared toward automobiles, pickup trucks and small trailers. Residential self-haul represents only a small portion of waste tonnage but contributes heavily to vehicle traffic. Servicing over 1,000 customers at CTS on a Saturday in the summer is a common occurrence. Many construction contractors (flooring, roofing, HVAC, and general contractors) as well as other commercial entities (tire shops, moving companies, beverage distributors, government entities, etc.) also haul directly to Central and ARL and space is provided for hand-unloading of larger trailers and vehicles.

Self-haul is much more prevalent in the Mat-Su and Kenai Boroughs as there are many residents and businesses in unincorporated areas. Both boroughs operate numerous satellite transfer stations which are basically rolloff containers spotted at a secure location at various points on the road system.

4.7.2 Recycling

The majority of recycled materials in the MOA is self-hauled to 21 drop-off locations, largely managed by the private sector. These include the Anchorage Recycling Center (ARC), operated by WestRock, as well as grocery stores, high schools, and other locations. Transportation of recyclables from the drop-off centers to the ARC recycling facility is conducted under contract between the recycler and Alaska Waste. Consolidation and bailing of these recyclable materials is conducted by ARC with subsidized shipping to west coast markets coordinated by Alaskans for Litter Prevention And Recycling (ALPAR).

The capacity to process recyclable materials in the MOA is currently limited since there is no sort line facility. Mixed recyclables are consolidated and baled at the ARC.

Divertible Construction and Demolition (C&D) materials are managed through Central Recycling Services (CRS), a private sector entity that processes C&D, clean wood/lumber, scrap metal, glass, asphalt and other commercial products at a materials recovery facility (MRF) facility in Anchorage.

4.7.3 Transfer

The SWS operates three transfer stations, one at the small community of Girdwood, one in midtown Anchorage (Central Transfer Station, or CTS), and one at ARL. The CTS (Figure 11) has an operating capacity of 1,600 tpd. Solid wastes disposed of and hauled from these transfer stations make up 75% of the total wastes disposed at the landfill, with almost all of it coming from the CTS. A replacement transfer station for the CTS has been approved by the Anchorage Assembly and is under design. An adjacent parcel has been acquired for its eventual construction, which might have applicability for construction of a WTE unit. Transportation of wastes consolidated at CTS is currently handled by SWS using open-top, transfer trailers for disposal at ARL.

Source: Solid Waste Master Plan, 2018.

Figure 11: Aerial View of the Central Transfer Station

4.7.4 Landfill Disposal

Disposal is provided through the ARL, a lined landfill, owned and operated by the SWS, near the community of Eagle River. It is the only operating landfill within the MOA and accepts more tonnage than any other landfill in the state. The next nearest landfill in Mat-Su Borough, is in Palmer, Alaska, about 27 miles north of the ARL. The ARL has a total land area of approximately 275 acres and is being developed in phases or cells. The last remaining cells are anticipated to begin development in 2020.

The ARL has both an active landfill gas (LFG) collection and control system and leachate collection and recovery installed. The ARL has an agreement with Doyon to supply LFG as fuel for their electrical generation facility which includes five Jenbacher generators (1.5 MW output each for a total of 7 MW). There are a number of LFG expansion opportunities at the ARL, including increasing the number of generation units, development of medium or high btu gas pipeline projects, or compressed natural gas vehicle fuel production.

Current tipping fees are set at $60.00 per ton for waste generated within the MOA and $120.00 per ton for wastes generated outside the MOA at ARL. Disposal fees at CTS are $70.00 per ton. No disposal fees are assessed for wastes generated at Fort Richardson.

5. ENERGY AND MATERIAL MARKETS

The primary objective of a WTE project is to dispose of solid waste in an economically efficient and environmentally acceptable manner. However, the energy derived from the combustion of solid waste in a WTE project is a secondary benefit. Revenues gained through the sale of electricity, steam, or recovered materials help offset the cost of WTE plant operation and enable WTE projects to compete against other waste disposal options, such as landfills, that are much less capital intensive. The financial viability of a WTE facility is, therefore, largely dependent upon its ability to realize these additional revenues.

5.1 Establishing Boundary Conditions for Analysis

Section 5 focuses on forecasting the amount of energy in the form of electricity that could be produced by a mass burn WTE project under certain assumptions for waste intake based on data from Section 4, and to estimate the revenues that could be realized. For this, Geosyntec reviewed the current power production market, legal framework, and potential power purchase agreements (PPAs). Other potential sources of revenues are ignored in this pre-feasibility study as discussed below.

- Steam: Revenues from direct sales of steam are also key economic drivers for many WTE projects. Steam can be the most desirable form of energy for a WTE facility to generate when it is able to meet a customer's steam needs on a continuous basis. This is because the generation of steam avoids the cost, complexity, and loss of efficiency require to convert the steam to electricity. Typically, however, this is only economically feasible when steam can be piped to end users within a 5 km radius of the WTE plant, in order to minimize energy losses and capital investment on the steam distribution network. Although Geosyntec conservatively elected to assess the viability of a WTE project neglecting potential revenues from steam sales, such revenues can be examined later if more detailed future analyses suggest that end user for steam may exist.
- Materials: Purchase agreements may also be available for recovery of materials. Materials in solid waste generally targeted for recycling as part of WTE operations include glass and ferrous/non-ferrous metals. Ferrous metals can be removed following combustion in the facility. If non-ferrous metals or glass are to be recovered, this must take place prior to combustion. Recovery of materials is highly dependent on the existing domestic scrap market for these materials. These were not investigated at this pre-feasibility stage as they do not significantly affect the economics of a WTE project.
- Ash: The WTE ash typically does not have value and is landfilled at a cost although, again, these costs are not investigated at this pre-feasibility stage.

5.2 Status of the Electricity Market

Chugach Electric Association Inc. (Chugach) is the largest cooperative utility in Alaska. Based in Anchorage, the utility provides wholesale and retail power to customers in southcentral Alaska, from the Kenai Peninsula to the south and as far north as Fairbanks. Anchorage Municipal Light & Power (ML&P) currently provides service to commercial and industrial customers in downtown Anchorage and to the north toward the Matanuska Valley. Platforms and drill sites located in and around the Cook Inlet produce the natural gas used to fuel their power plants. However, in 2018, Anchorage voters approved a proposition to sell ML&P to Chugach, subject to the RCA's approval. A rate filing has been submitted to the RCA by Chugach to review and approve this transaction.

Natural gas is the primary fuel for electricity production in southcentral Alaska. The most pressing concern for utilities in the region is an assured supply of natural gas. Well depletion in the Cook Inlet and the limited interest of large gas companies to invest in new wells only increases the risk of dwindling supplies in the future. Also, upstream outages have caused disruption of natural gas deliveries in the past.

5.2.1 Renewable Energy

A Renewable Portfolio Standard (RPS), also known as a renewable electricity standard, is a mandate intended to increase the amount of renewable energy production and use. Under these standards, a utility company can be required by a state to have a certain percentage of its electricity come from certain renewable energy resources. In addition, states may give tax credits to utility companies to fulfill these requirements. In the 2009-2010 legislative session, the Alaska legislature enacted House Bill 306 with the goal that "the state receive 50 percent of its electrical generation from renewable energy sources by 2025".

Alaskans produce about 650,000 tons of garbage annually and have seven class I landfills (landfills that accept 20 tons or more solid waste daily) throughout the state. From 1997-2007, Eielson Air Force Base near Fairbanks used 600-3,000 tons of densified paper from the Fairbanks landfill annually to co-burn with coal, producing up to 1.5% of the base's heat and power. Chena Power is developing a 400-kW biomass powerplant at the Fairbanks North Star Borough landfill that would run off 4,300 tons of waste paper, cardboard, and land waste annually.

The Anchorage Landfill Gas-to-Energy Project is a partnership between the Municipality and Doyon Utilities. The project uses landfill gas LFG), a byproduct of waste decomposition in the landfill to produce 7 Megawatts of electricity. The electricity is delivered to the Fort Richardson side of Joint Base Elmendorf Richardson (JBER). The plant output meets the off-peak power demand for the Fort Richardson side and approximately 25% of the JBER-wide electrical demand. As the largest green energy project in the U.S. Air Force Pacific Theater of Operations, the project far exceeds renewable energy requirements for federal facilities as required by the Energy Policy Act of 2005.

Chugach Electric purchases all the power generated by the Fire Island Wind Project, which is located west of the Ted Stevens International Airport. Fire Island Wind is comprised of 11, 1.6 MW wind turbines, which provide up to 17.6 MW of electric power. The Regulatory Commission of Alaska (RCA) approved in 2011 a 25-year power purchase agreement. Over the term of the agreement, Chugach pays a fixed price of $97 per megawatt hour or $0.097 per kwh. The agreement was justified to enable in order to protect the utility against significant fluctuations in the price of natural gas, which provides the bulk of Chugach's electric energy.

In accordance with Section 203 of the Energy Policy Act of 2005 (42 U.S.C. § 15852), each fiscal year the federal government must consume at least 7.5 percent of its total electricity from renewable sources, referred to as the renewable electricity requirement. As defined in 42 U.S.C. § 15852(b), renewable electricity is electric energy generated from solar, wind, biomass, landfill gas, ocean (including tidal, wave, current, and thermal), geothermal, municipal solid waste, or new hydroelectric generation capacity achieved from increased efficiency or additions of new capacity at an existing hydroelectric project.

5.3 Potential Feed in Tariffs for a Proposed WTE Facility

The conversion of MSW into electricity should be evaluated as an option for a MOA WTE facility. The electricity generated by the facility can be utilized for internal needs of the project with surplus power being available for sale to utilities, transferred (wheeled) over the transmission of one utility to another, or made available for use by other governmental operations. In some locations, WTE plants sell their whole power production and buy electricity for their own use under a separate contract.

Typically, utilities base their purchase price for the electricity upon the concept of "avoided costs". Avoided costs are the incremental costs of electric energy and/or capacity above a certain baseline that the utility would incur from self-generating or purchasing from another source in response to increasing demand.

Pursuant to the RCA, utilities are required to file their avoided cost projections with the RCA and update them on a regular basis. Avoided cost filings through 2021 for each utility serving Anchorage are presented in Table 9.

Table 9: Utility-Filed Avoided Energy

Calendar Year	Anchorage ML&P	Chugach Electric Association	Matanuska Electric Association
2016	3.56	3.8 – 4.4	8.365
2017	3.56	5.1 – 5.9	8.825
2018	3.56	5.0 – 5.7	9.176
2019	3.56	4.9 – 5.7	9.568
2020	3.56	5.0 - 5.8	9.764
2021	3.56	5.1 – 5.9	9.965

5.4 Electrical Interconnect Requirements

Chugach has established a set of guidelines containing the general requirements and technical operating parameters for interconnecting a co-generation facility like a WTE plant with the Chugach system. These can be found in the utility's *Interconnection and Operating Guidelines for Non-Utility Generation.* Prior to connection, the WTE facility would have pay for the cost of an Interconnection Study by Chugach which would detail interconnection requirements as well as the following other factors:

- The ability to dispatch the projected WTE facility.
- Reliability of the WTE facility.
- Terms of any contract.
- The ability of the WTE facility to be scheduled in a way which allow Chugach to avoid costs.
- Usefulness of the WTE facility during emergencies.
- The individual and aggregate value of energy and capacity from other qualifying facilities on Chugach's system.
- Impacts, if any, of capacity increments and lead times for construction of the WTE facility.

5.5 Preliminary Estimate of Energy Production

To calculate potential levels of electricity generation at a proposed WTE facility, it is necessary to make general assumptions regarding the heating value of the waste, thermal efficiency of the boiler, efficiency of the turbine generator, and energy requirements of the air pollution control system, and any other in-house energy use. There are a variety of turbine types and boiler designs that could be used for the proposed WTE facility with ramifications on overall capital costs for the facility and energy production efficiency.

Besides plant size and assumed heating value of waste feedstock, the design choices for a WTE facility that most impact its power production efficiency are:

- The pressure of the steam produced by boilers (standard at 40b/600psi or high pressure at 65b/950psi or higher)
- The type of condensing device (air cooled or water cooled)
- The heat source to pre-heat combustion air (if pre-heating is necessary): steam or energy recovered on flue gases.
- The number of boilers and turbines

Design assumptions, as well as estimated energy sales rates, have been made in the following section to help develop a Pro Forma Model for the proposed facility.

Table 10: Project Energy Production Estimates

Parameter	Value
LHV of Waste	5,000 BTU/lb.
Annual Capacity / Availability Factors, %	90/90
Power Produced per ton of waste combusted	700 kWh/ton
MSW consumed annually	328,500 (based on 1,000 tpd)
Annual power Produced for Sale to Grid	193,388 MWh (based on 1,000 tpd)

The lower heating value (LHV) of the waste was calculated based on waste composition and assumed moisture level. This figure is reasonable and comparable to values we observed in Pacific Northwest communities. A waste characterization study in the next phase will either validate or modify the LHV of the fuel, requiring an update to the cost and performance information provided in this section. Note that the LHV, with the amount of MSW to be processed per year, are key factors that affect the sizing, capital cost and performance parameters of the plant turbine generator, boilers and grates, as well as other plant auxiliary equipment.

Based on the capacity/availability factors of 90% and an assumed daily throughout of 1,000 tons, the average annual throughput to the WTE plant is estimated at 328,500 tons. These factors are reasonable estimates for a well operated and maintained mass burn WTE facility.

The amount of electricity produced and provided to the grid for sale, based on the above assumptions for annual MSW processed and a net power production factor of 609 kWh per ton, is estimated at 193,388 MWh annually.

6. COST AND PERFORMANCE ESTIMATES

Geosyntec developed a pro forma model specifically for this pre-feasibility study to provide preliminary, planning-level cost estimates that can be used to evaluate alternative strategies for financing the proposed WTE project. The model is intended to serve as the basis for comparing and evaluating future strategies should assumptions change as progress is made on the project.

The model is a Microsoft Excel™ spreadsheet program that projects annual costs to construct, operate, administer, and maintain the WTE facility. The model addresses major capital and operational costs under various scenarios, as described in more detail below. Several conservative assumptions were made regarding annual solid waste quantities, demographic information, escalation factors for waste growth and costs, administration costs, and WTE development costs.

Sensitivity analyses were developed using Excel's Scenario Manager to discern differences within the scenarios evaluated. The costs of various programs and disposal options were estimated using published information on the MOA's existing solid waste system and neighboring Boroughs, Geosyntec's experience on other similar projects, input from the private solid waste industry, and other published information. The scenarios evaluated and key assumptions made are described in the subsections below. A copy the pro forma including input assumptions, and cash flow calculations is provided in Attachment A to this Report.

6.1 Input Assumptions and Elements

To calculate potential levels of electricity generation at a proposed WTE facility, it is necessary to make general assumptions regarding the plant size (i.e., throughput capacity); lower heating value (LHV) of the solid waste feedstock; the overall efficiency of the boiler, turbine generator, and other WTE equipment and systems to covert thermal energy into electricity; and parasitic energy consumption from plant operation (e.g., to operate the air pollution control system). These factors all have ramifications on overall capital costs for the facility and energy production efficiency.

It is noted that all cost and performance estimates for the pre-feasibility study are an order-of-magnitude estimate only. Many different factors may cause costs to be higher or lower than shown. Examples include changes in plant configuration and/or actual systems and equipment; seasonal and long-term changes in solid waste generation and composition; cost of commodities due to market variability; labor rates for salaries and benefits, and the fabrication location of major plant components.

6.1.1 Operating Revenues

For modelling purposes, we have assumed annual operating revenues of about $3.1 million for biosolids incineration (roughly equal to $484 per ton), electric energy revenues to Chugach, and revenues for the sale of recovered metals from the ash stream. These are more fully discussed in the paragraphs below.

6.1.2 Waste Flow

To calculate annual throughput for the proposed WTE facility, an average MSW incoming stream of 1,000 tpd was assumed for the Base Case (Scenario #1) along with 20 tpd of biosolids.

6.1.3 Waste Composition and Btu Value of Incoming Waste Stream

The typical waste stream composition has changed over time. Yard waste, metals, and construction and demolition materials in MSW have been reduced by local recycling programs and waste segregation, while plastic containers have become more prevalent, driving up the energy value in MSW. Based on recent waste composition data nationwide, we have assumed a Btu value of 5,500 Btus per pound for preliminary feasibility analysis. A MOA-based waste composition and fuel analysis would be needed to confirm this calculation.

6.1.4 Capital Costs

Capital costs include the plant components, infrastructure construction, engineering design, procurement, and construction/commissioning costs. Planning-level estimates of the capital required for a mass-burn WTE facility with the components and configuration assumptions listed above were developed. As is typical for WTE projects, costs are assessed as a function of the size of the facility. Note that these costs should be considered to provide an order of magnitude expectation with a margin of error on each input assumption of +/- 20%. The cost model is based on Geosyntec's internal database of over ten projects in the U.S. ranging in size from about 900 to 3,000 tpd as well as up-to-date plant component cost data.

The pre-feasibility total capital cost (CAPEX) is estimated at $322,679 per daily ton capacity or $322,679,000, This assumes a 17% increase in WTE costs from the lower 48 U.S., and a 5% increase in rates to account for anticipated seismic conditions in Alaska. Given the Municipality's location to Asian manufacturers, the CAPEX may be significantly less if major parts are procured in Asia rather than North America. However, due to trade issues at the current time, it is unknown if this could occur in the foreseeable future.

The CAPEX also includes Municipality implementation costs during multi-year construction and start-up periods. The balance accounts for fixed equipment shipping/delivery, engineering, procurement, administration, vehicles and non-fixed equipment (e.g., bulldozers, loaders, and trucks), civil construction for the facility (including roadways, building enclosure with administration offices, tipping floor, pit, air emission control equipment, wastewater treatment system, and ash handling system. We have assumed that the SWS will include the cost of an ash monofill in its operating budget for the landfill.

6.1.5 Cost of Debt

It is assumed that the cost of bond debt for the MOA to fund construction of the facility could range from 3.5 and 5.0%. These ranges have been experienced by Alaska communities and agencies over the last few years.

6.1.6 Inflation Rate

The inflation rate since the Great Recession (2007-2019) has been relatively low, somewhere in the 2.0% range. We have used this rate over the five-year planning (2019 – 2024) and operating periods (2025-2055).

6.1.7 Gross Electrical Generation

The gross electrical generation rate has been assumed at 700 kWh/ton of MSW processed. The industry wide trend has been toward greater electrical output as boiler operating conditions (pressure / temperatures) have increased over the past years to result in higher gross electrical generation.

6.1.8 Internal Use of Electricity

The internal use of electricity for WTE plant operations has been conservatively assumed at 13 percent of gross electrical generation. Often referred to as parasitic load, this portion of the electric generation is used to power the motors and electrical systems which are necessary to operate the WTE process equipment and supporting facilities. Typical parasitic loads range from 11 – 15 percent, depending upon the processes employed at the WTE facility.

6.1.9 Net Electrical Energy Generation

The net electrical energy generation rate for a modern WTE facility in the MOA has been calculated at 609 kWh/ton of MSW processed based upon the above two assumed parameters (700 kWh/ton gross electric generation less a 13 percent parasitic load).

6.1.10 Average Electrical Energy Sales Price

Several sources of electrical prices were reviewed. For modelling purposes, we utilized avoided cost projections made by Chugach for the planning period. Various scenarios were constructed increasing and decreasing these tariffs by 10 percent.

6.1.11 Ferrous Metal Recovery Rate

The ferrous metal recovery rate has been assumed at 3.2 percent of processed MSW based upon the use of an advanced European style metal recovery system which recovers both the course and fine fraction of ferrous metals. In order to maximize the recovery of non-ferrous metals, a through removal of ferrous metals is required. The presence of ferrous metals affects the efficiency of the non-ferrous metal recovery system. As a result, there are typically multiple magnets employed in the advanced metal recovery systems, thereby maximizing the recovery of ferrous metals.

6.1.12 Non-Ferrous Metal Recovery Rate

The non-ferrous metal recovery rate has been assumed at 0.30 percent of processed MSW based upon an advanced European style metal recovery system. Non-ferrous metal recovery systems have been adopted by more and more WTE facilities in response to reliable eddy-current separation technology which has evolved over the past decade, primarily in the scrap automobile metal recovery industry. Nonferrous metals in the MSW stream originate from a wide variety of sources, many of which are not collected as a part of curbside recycling programs. These sources include: home appliances, automobile parts, patio furniture, and household items. Assuming 1 percent of the processed MSW is nonferrous metals (equal to 20 percent of all metals, which is typical of European composition of residual wastes) and assuming 80 percent efficiency of modern non-ferrous separators, the non-ferrous metal recovery rate is estimated at 0.8 percent. The advanced non-ferrous metal recovery systems typically employ multiple eddy current separators for each of the range of material sizes which are screened to optimize the recovery of the valuable non-ferrous metals.

6.1.13 Potable Water Cost

Potable water cost of $5.58/1,000 gallons has been estimated for this analysis (AWWU rate). The trend within the WTE industry has been to reduce potable water by using lower quality waters for plant cooling needs. In many cases, where locally available, reclaimed water could be used as makeup water for cooling towers, fire water storage tanks, and plant irrigation. The most recent WTE project in Palm Beach County, FL (2015) used an air -cooled condenser in lieu of an evaporative cooling tower to minimize the use of local water supplies. This can be further reduced by using rain water using underground cisterns at a capacity of several thousand cubic meters for storage, which has been built for relatively low cost in Germany in the area of the waste pit (below the parking areas of the waste cranes).

6.1.14 Wastewater Disposal/Treatment Cost

The wastewater disposal / treatment rate has been estimated at a cost of $7.89/1,000 gallons for treatment by AWWU. The wastewater treatment system would be designed with a cascading system with internal wastewater flows treated so that they can be used as process water with lower quality requirements in several stages, with the last stage being used for quenching of the bottom ash, and/or evaporation of the wastewater in the flue gas treatment system, if required. In Europe, it has been a common practice or all residues of the wastewater treatment system to be returned to the waste pit to be thermally treated.

6.1.15 Bottom Ash Recycling Rate

Bottom ash recycling rate will be assumed to be zero for the base analysis. There are viable options for recycling ash residue as an alternate daily cover on existing lined landfills, along with other technologies for beneficial use of ash residue as construction aggregates, and/or feedstock for production of Portland cement. The four primary ingredients used to manufacture Portland cement (Alumina (Al_2O_3), Ferric Oxide (Fe_2O_3), Lime (CaO), and Silica (SiO_2) have been found to be ideally matched in some WTE bottom ash sources. The opportunity to recycle a certain size fraction of bottom ash in local cement kilns could be explored with a local Seattle based recycling firm. The quality of bottom ash is improved by the removal of ferrous and non-ferrous metals and can be used in the manufacturing of Portland cement with the proper environmental approvals.

6.1.16 WTE Operation and Management Cost (Year 1)

The O&M fee for massburn WTE facilities depends upon many variables, ranging from size of plant, risks shared between owner and operator, pass-through costs for utilities, chemical and reagents, sharing of revenues associated with the sale of electricity, steam, and recovered metals. We have assumed that a private operator will be procured by the SWS due to the specialized nature of the WTE project. This year 1 O&M contractor service fee has been estimated at $30.00/ton of MSW processed for the 1,000 tpd plant, considering higher Alaska labor rates. Annual escalation of O&M service contract is typically based upon agreed upon inflation rates, which have been applied to this analysis.

6.1.17 Electrical Interconnection Costs

Typically, purchasing electric utilities charge up to $100,000 to perform a feasibility and reliability study to determine how the non-utility's distributed generation may affect their electric system. If the study reveals that there will not be any significant adverse impacts to the grid, a second investigation will be necessary to determine the specific design, hardware and electrical protection systems for the associated interconnect.

The cost of the second study along with purchasing and installing the associated hardware can be approximately $250,000. Ownership, operation and maintenance responsibilities for the newly installed interconnect equipment will reside with the incoming electric generating entity.

Additionally, any future modifications necessary to the interconnection facility, and costs associated with construction or upgrading the transmission line from the WTE facility to the nearest substation will be borne by the owner of the new generating plant. Since this project does not include a specific site, it will not be possible to accurately estimate these costs. However, as a place marker, a value of $1,000,000 has been assumed, included in the capital costs for the plant.

6.1.18 Site Acquisition Cost

A specific site has not been proposed for this study. For modelling purposes, we have assumed that the proposed plant would be sited on Borough-owned land near the CTS. No cost for site acquisition has been included at this stage of the analysis.

6.1.19 MOA Project Management Cost

Annual costs (salary plus benefits) assumed for 1.0 full time employee (FTE) for Project Manager and 0.5 FTE Assistant Project Manager is $210,000 in 2025$.

6.1.20 Municipality's Administration Cost

The estimated cost for the Municipality to develop this project, including public education, project siting and sizing, permitting, procurement, bid evaluation and contractor selection, and project management over the duration of the construction period and WTE facility acceptance testing is 1.0 percent of the construction cost. This value would cover a six-year period and includes the hiring of a Consulting Engineer to assist with some of the technical duties.

6.1.21 Alternate Financing Mechanisms

Although the local fuel (and electricity purchase prices) are key parameters, there may be options to improve revenues beyond the sale of electricity, such as steam/hot and chilled water sales (CHP), implementation of special waste programs (assured destruction) to local industries and businesses, which have been proven to be significant sources of additional revenues in many WTE communities with excess capacity. The sale of steam has not been incorporated into the financial model as it is dependent of the WTE site and would require a subsequent report.

Other incentives could be via grants from federal government (USDA, DOE, DOI, or possibly future Infrastructure Reinvestment programs). Local and state incentives may also be available in Alaska for development of regional WTE projects in which larger community helps smaller neighboring rural communities manage wastes for energy and material recovery.

6.2 Model Results

Overall, developing a WTE project in the MOA appears a practical goal of the ISWMP and should be desirable by the municipal government, and potentially neighboring Boroughs. A Microsoft Excel™-based, pro forma model (Model) was constructed to help guide the MOA with the implementation steps of the proposed WTE facility project. Various scenarios (36) were constructed using Excel's Scenario Manager, which will enable the MOA to understand the projected tipping fee impacts of additional tonnage from the neighboring Boroughs, inclusion of biosolids in the incoming waste tonnage to the WTE plant, and potential fee-in tariffs from avoided energy sales to the local electric power utilities.

As shown on Figure 12 below the required tipping fees ranged from $58.04 - $85.67 depending on the scenario assumptions. Scenario 5 (1,000 tpd WTE facility) reveals the lowest projected average tipping fee of $58.04 a ton for the first year of operation (2025).

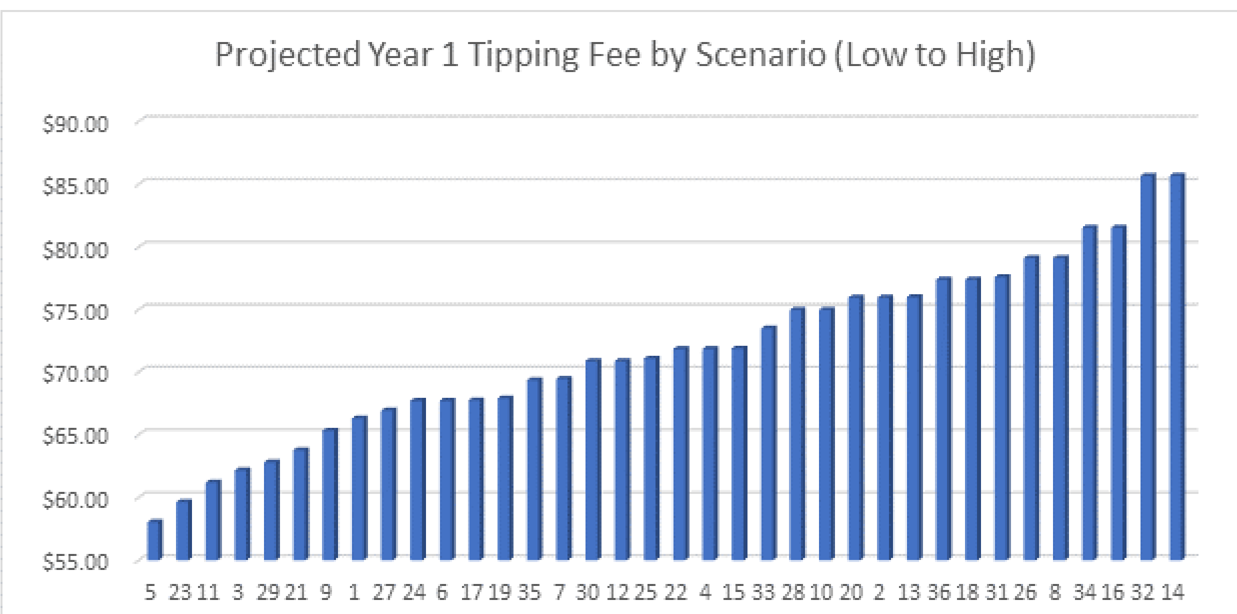


Figure 12: Projected Year 1 Tipping Fee (Low to High)

The Model assumes that the last 10 years of the bond debt would be zero, allowing the electricity and biosolids revenues to fully fund WTE plant operating costs enabling a zero-tip fee. A review of the results for the remaining 35 scenarios suggests the following observations:

- Inclusion of biosolids in the revenue mix for the prospective WTE plant lowers average (required?) tip fees by about $10.00 a ton.
- Increasing avoided cost revenue by 10% above current Chugach projections lowers average tip by $5.00 to $10.00 a ton.
- Increasing the size of the WTE plant by bringing in MSW from neighboring Boroughs lowers average tip fees by $8.00 to $10.00 a ton.

7. FINDINGS AND RECOMMENDATIONS

7.1 Summary of Main Findings

Based on the pro forma model and pre-feasibility review, it appears that the development of a WTE facility in the MOA should be considered further. In addition to the quantitative review, there are a few qualitative drivers that also support this conclusion, including the need to reduce airspace consumption at the ARL and the ability to reduce MOA's dependence on fossil fuels for electricity generation. However, it appears at this stage of analysis that the feasibility of the project is highly dependent upon the ability of MOA to reliably collect revenue from either tipping fees or electricity sales at the facility.

7.2 Roadmap to Implementation

Implementation of a WTE project is a complex process which consists of several phases requiring "go/no-go" decisions to be made by the project participants. Since no two WTE projects are identical, the discussion on project implementation in this section is by nature generic in approach. This Pre-Feasibility Study consisted of a preliminary investigation of the major project elements.

In subsequent phases, the feasibility of the WTE project is evaluated in more detail. For example, an analysis is undertaken of the facility's existing and projected waste stream to determine the ultimate size of a single or multiple unit, WTE system. Markets are examined to determine whether the energy and/or materials produced by this system can generate adequate revenues to offset the construction, operating, and financing costs for the facility. Feasible sites are investigated along with an analysis of the technical, environmental, and institutional requirements for permitting a facility.

7.2.1 Feasibility Study

A more-detailed Feasibility Study will build upon the results of this initial study. It is envisioned that MOA will request detailed regulatory, environmental, and social impact studies; engineering and geotechnical review of potential sites for the WTE facility; waste collection and transportation studies; a detailed implementation time line including procurement, financing and permitting activities; and further refining of the pro-forma model. The results of this analysis will be summarized into a formal Feasibility Report for the client's use in implementing the project.

A formal feasibility report, which is presented to the implementing entity, usually documents all activities in this phase. The feasibility analysis ends with a "go/no-go" decision on the part of the developer to either proceed with implementation of the project or to terminate activities for the foreseeable future.

7.2.2 Implementation

Subsequent phases of the project implementation typically include the following:

- Phase II – Intermediate Phase encompasses all of the intermediate steps leading up to the procurement of the WTE system. This includes securing the put or pay contract for the waste stream, the energy market contract and preliminary environmental permits. Typically, many WTE owners and operators initiate their public education program and develop a concept on plant architecture and visitor centers.
- Phase III - Procurement Phase II incorporates all the steps necessary to procure the WTE system desired by the community including contracts for waste supply, energy and materials markets, plant construction and operation (if applicable); acquiring the project site; obtaining all environmental permits and/or regulatory approvals; and securing the financing for the project. Phase II usually requires the development of specialized procurement documents such as a Request-for-Qualifications (RFQ) and Request-for-Proposal (RFP). Dependent on the financing approach selected by the community, documents such as a Bond or Trust Indenture, Engineer's Feasibility Report, and Bond Prospectus may need to be written.
- Phase IV - Plant Construction Phase III covers all the steps, necessary in the construction of the WTE facility including site preparation; final design; ordering facility equipment; installing this equipment; testing and startup of the facility; and completing acceptance tests. These tasks are usually undertaken by the selected facility contractor, although most communities obtain the services of a knowledgeable engineering consulting firm to independently monitor construction activities and the facility's acceptance tests. Phase III usually ends with the facility successfully completing the contractual acceptance test procedures and the community issuing a certificate of completion to the contractor.
- Phase V - Plant Operations. Phase IV covers the period from plant acceptance through the length of the operations period, which may last 20 years or more in the case of a full-service contractor for a publicly or privately- owned facility. These contracts usually have clauses allowing them to be renegotiated after this time period. In contrast, operations contracts for turnkey operators can be significantly shorter, generally five years or less.

7.3 Recommendations for Future Steps and Action Items

Timely implementation of a WTE facility will require a series of political, administrative, and technical actions by MOA. The following paragraphs briefly describe these future planning steps.

7.3.1 Securing Waste Flow Control

Historically, risks associated with assuring that a reliable supply of solid waste is delivered to a WTE facility are assumed by the project developer. This means that the developer must be able to fully guarantee that solid waste needed for plant operations will be delivered to its proposed

WTE facility. This is termed waste flow control and usually can be achieved through several methods such as: the use of interlocal legislation for solid waste flow control; long-term put-or-pay contracts by waste collectors; subsidized tipping fees; or governmental collection of solid waste.

7.3.2 Conducting a Waste Composition Study

In addition to guaranteeing delivery of solid waste to a WTE facility, the project developer usually must assume the risk of the quality of such waste. That is, the heating value or Btu content of the waste, its percentage of moisture, and percentage of combustibles. The developer typically guarantees a reference solid waste composition, which an equipment contractor assumes for design purposes.

7.3.3 Developing the Project Team

An extremely important aspect of assuring success of a program with the complexities of a WTE project is establishment of a strong project team that can guide such a long-term project to completion. While every project is unique to some extent, there are several fundamental actions, which the WTE developer must be prepared to take to place a project on the right course for the long-term. Such measures can enhance the project's potential for success.

At the outset of a project, a key action is the establishment of an internal team which will have support from the governing body of decision-makers. Since such projects will require significant up-front development costs for staff and consulting services over several years, it is critical that there be a long-term commitment by the community to support the project. Without this commitment, it is unlikely that the project will truly ever succeed.

Ideally, the internal project team, which will direct the activities of the developer's 's own staff and outside consultants or advisors, should have appropriate agency heads from their key administrative, public works, financial, legal, environmental, and communications areas. The purpose of this committee is to guide the project through key decision points and to provide policy recommendations to the political decision-makers.

As the project nears the procurement phase, other experts are sometimes added by some governments to their consulting team. For example, an insurance advisor is sometimes hired to develop the technical insurance requirements for the Request-for-Proposal or Tender, and to assist in securing insurance coverage for the project. In addition, special legal counsels are often retained to assist in environmental permitting; help negotiate energy sales contracts; or assist in the preparation and negotiation of construction and operations contracts with the selected contractor for the facility.

7.3.4 Negotiating a Power Purchase Agreement

The primary objectives of any proposed WTE project are to dispose of solid waste in an economically efficient and environmentally acceptable manner. Although the derived energy from the combustion of municipal solid waste in a WTE project is a secondary benefit, the revenues gained through the sale of electricity, steam, or recovered materials help offset the cost of solid waste disposal. By turning solid waste into useful energy and materials, these projects can compete against other waste disposal options, which are much less capital intensive. The financial viability of any WTE facility, therefore, is in large measure dependent upon its ability to sell energy to a long-term customer.

7.3.5 Select Facility Site and Path to Permitting

Another key milestone for the proposed WTE facility is selecting a site that is located near existing and future waste collection areas within the wasteshed. The closer the site is to the waste generation center, the lower the potential costs will be to transport the solid waste to the facility. Similarly, sites located in a line between the center of solid waste generation and the disposal landfill for the ash generated by the facility, have a higher comparative advantage as haul costs of the ash residue can be minimized. Further, distance to utilities such as potable water, waste water service, and electric grid interconnects are important considerations for facility siting.

7.3.6 Permitting Discussions

This WTE project would be a first for Alaska environmental permitting authorities. Clearly, some education would be necessary at the outset to familiarize them on the type of process, technology, and pollution control design.

7.3.7 Deciding on Facility Construction Procurement

The procurement of a WTE system by a developer is one of the final steps on the long road of project implementation. Prior to embarking on this final path of system procurement, each community would have already addressed the difficult decisions, as discussed in previous chapters, which are necessary to implement the project.

The process selected by a developer to procure a WTE facility can be approached in three different ways:

- Design, Bid, Build (D-B-B) Approach;
- Design, Build (D-B) Approach; and
- Design, Build, Operate (D-B-O) Approach

This conventional DBB approach has been modified slightly by owners in their procurement of WTE projects. Unlike the traditional DBB approach of bidding each individual piece of equipment for the project, the entire process line and turbine generator equipment, commonly referred to as the “chute-to-stack” in mass burn facilities, is bid as a single package. The A/E firm is still responsible for designing the ancillary facilities, which can then be broken out as individual bid packages such as site civil and structural foundations and building construction to minimize contractor/vendor markups for profit and risk. This approach has the advantage of minimizing the number of potential vendors that the local government or private owner must deal with, while providing a mechanism for government for sharing the risk of project performance with a private entity.

The Design Build approach differs from the Design, Bid, Build approach in that a single private firm called EPC contractor is responsible for the design, construction, and startup of the project. EPC stands for Engineering – Procurement – Construction. Under this approach, the ECP turnkey contractor is responsible for acquiring the necessary equipment and supplies for the project as well as ensuring that the architectural or engineering design work is prepared. Once startup and acceptance testing is completed, however, the turnkey contractor turns over the responsibility for operating the project to the community or owner. This approach may make perfect sense for those communities which have the technical capabilities to operate WTE facilities. Other communities or owners desiring to retain the option of operation may modify this approach by negotiating a short-term initial operating agreement which would require the contractor to solve design and operational problems after acceptance testing before turning over full operation to a municipal workforce.

Typically, the types of contracts drafted under this partial turnkey scheme include:

- Civil works contract
- Process EPC contract
- Engineer contract
- Interface contract
- Waste delivery
- Power purchase
- Slag tipping and slag recycling

A modification of the DB approach is for a community to assign total responsibility to a private firm, or to a consortium, over the conduct of the project, including the design, construction, startup, testing, operation, and possibly, the ownership and project financing responsibilities. The full service is defined with a concession agreement between the private firm and the community. The full-service approach can enable a community or owner to acquire the services of an WTE facility without making the community responsible for its long-term, day-to-day operation and maintenance. Design, Build, Operate, Transfer (DBOT) is a variation of this DBO approach, where the facility is transferred to the community at the end of the concession agreement period.

7.3.8 Facility Financing

WTE facilities are capital intensive, public works projects. Typically, they are usually financed by local governments through the issuance of long-term municipal debt, and/or corporate debt. Consequently, it will important for the SWS to discuss the implementation steps so that these institutions are familiar with the proposed MOA WTE project.

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ATTACHMENTS:

See Attached Files

Geosyntec consultants

engineers | scientists | innovators

Project No.:	ME 1784	Date:	9/25/2019
Client:			
By:	M. Rogoff, S. O'Donnell		

Item	Discussion
Purpose and Disclaimer	This pro forma is the work product of Geosyntec. It has been prepared for and on behalf of the Muncipality of Anchorage, Alaska for its sole use. The pro forma contains proprietary logic prepared to develop a pre-feasbility stage estimate of the capital, operational, and debt services expenses, and projected revenues for a Municipal Solid Waste Mass Burn Waste to Energy Facility to manage all or part of the City of Anchorage, AK waste stream.
Objectives	1. Estimate capital costs as a function of the input quantities of solid waste. 2. Estimate potential revenues from the sale of energy. 3. Estimate operational costs for a Waste to Energy facility as a function of the facility size. 4. Estimate debt service. 5. Prepare various metrics analysis to summarize the pro forma results.
General Description of Model	This pro forma model uses a concept that Geosyntec refers to as "Scenario Modeling" to consider the impact of various assumptions on the budget for the WTE facility. Scenario Modeling uses the Data Table function in Excel to automatically input discrete scenarios, which are grouping of assumptions, through the pro forma model (4.0 Pro Forma) and outputting the results to a summary table (3.0 Summary Tab). The groupings of assumptions are summarized in the 2.0 Assumptions tab and labeled. For this model, the primary scenarios evaluated involve considering the net costs associated with constructing and operating a Waste to Energy Facility.
Description of Tabs	
2.0 Assumptions	This tab lists and describes the assumptions used throughout the individual worksheet tabs. Each scenario is defined by a series of assumptions in each column. The Live Scenario column represents the scenario assumptions that are "Live" in the model. The Live Scenario can be changed on this tab, and then each worksheet reflects that "Live Scenario" input assumptions. The reference in Cell C5 is critical to the function of the scenario model. This cell controls the "Live Scenario" assumptions used for all subsequent tabs.

Item	Discussion
3.0 Summary Analysis	This tab summarizes the projected revenue and expenses and calculates various financial and other metrics. It also includes the summary table results for each scenario. This is the tab where the Live Scenario is selected.
4.0 Pro Forma	This tab provides an estimate of the revenues and expenses for the Waste to Energy facility. The inputs from Tab 2.0 Assumptions are cycled through the pro forma and output to Tab 3.0 Summary Analysis. Projected revenue and operational expenses, debt services, total operational costs, net operational costs and operational and net costs $/ton metrics are presented
5.0 Capex	This tab provides planning-level estimates of the capital cost for a mass-burn Waste to Energy facility as a function of the size of the facility. Capital and operational costs are factored as a function of the size.
6.0 6.0 Inflated Rev or Exp	This tab provides estimates of the key revenue and cost factors associated with the Waste to Energy Facility.
7.0 WTE Operating Stats	This tab provides supporting information for the various costs assumptions used throughout the pro forma model.

2.0 Assumptions

Cell C5 controls the selection of the Live Scenario for the pro forma model

		Live Scenario		Scenarios							
		1									
Item	Input Description	Quantity	Comments/Source	1	2	3	4	5	6	7	8
	GENERAL ASSUMPTIONS										
1.	Processing Rate (tons/day)	1,000	Scenario Analysis	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
2.	Annual Inflation Rate	2.0%	Geosyntec Assumed								
3.	Project Implementation	3 Yrs	3 Yrs Construction, Geosyntec Estimate								
4.	**Planning Period**	2025 - 2055	Geosyntec Assumed								
4.1	Base Year	2025	Geosyntec Assumed								
4.2	End Year	2055	Geosyntec Assumed								
5.	Ash Generation	25%	Processible Waste Flow, Geosyntec Assumed								
6.	Availability of Unit	90%	Geosyntec Assumed								
7.	**Metal Recovery**										
7.1	Ferrous	3.20%	Processible Waste Flow, Survey of Operating FL WTE Facilities								
7.2	Non Ferrous	0.30%	Processible Waste Flow, Survey of Operating FL WTE Facilities								
8.	Lower Heating Value, LHV	5100 kcal/kg	Geosyntec Assumed								
9.	Energy Production	609 kWh/ton	Processible Waste Flow, Survey of Operating FL WTE Facilities								
	DEBT										
10.	Estimated Construction Cost	$322,679,002	Scenario Analysis, Geosyntec Assumed								
10.1	Debt Financing Percent	100%	Geosyntec Assumed								
11.	Term	20 Yrs	Geosyntec Assumed								
12.	Interest Rate	3.50%	Geosyntec Assumed	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%	4.00%	4.00%
13.	Equity	$0	Geosyntec Assumed								
	REVENUE										
14.	Ferrous	$75/ton	Recycling Markets.Net								
15.	Non Ferrous	$1,200/ton	Recycling Markets.Net								
16.	Energy Revenues from Electricity	$0.061/kWh	Geosyntec Assumed	$0.061/kWh	$0.061/kWh	$0.068/kWh	$0.068/kWh	$0.075/kWh	$0.075/kWh	$0.061/kWh	$0.061/kWh
17.	Biosolids Incineration	$ 3,177,000	Geosyntec Assumed	$ 3,177,000	$ -	$ 3,177,000	$ -	$ 3,177,000	$ -	$ 3,177,000	$ -
	EXPENSES										
18.	Facility Operating Fee	$30.00/ton	Geosyntec Assumed								
19.	WTE Host Fee	$0.00/ton	Geosyntec Assumed								
20.	Ash Disposal	$60.00/ton	Geosyntec Assumed, Anchorage Regional Landfill								
21.	**Utility and Materials Costs**										
21.1	Potable Water Cost	$0.0558/gallon	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.2	Potable Water Usage	0.933 gallon/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.3	Wastewater Discharge Cost	$0.0789/gallon	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.4	Wastewater Discharge	5.7 gallon/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.5	Reclaimed Water Cost	$0.001/gallon	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.6	Reclaimed Water Usage	589 gallon/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.7	Propane Cost	$1.283/gallon	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.8	Propane Usage	0.35 gallon/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.9	Lime Pebble Cost	$204.84/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.10	Lime Pebble Usage	0.0082 ton/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.11	Lime Dolo Cost	$260.97/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.12	Lime Dolo Usage	0.0018 ton/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.13	Ammonia Cost	$807.79/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.14	Ammonia Usage	0.0010 ton/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.15	Urea Cost	$1.17/gallon	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.16	Urea Usage	0.2 gallon/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.17	Carbon Cost	$0.28/lb	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.18	Carbon Usage	0.8233 lbs/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								

2.0 Assumptions

Cell C5 controls the selection of the Live Scenario for the pro forma model

		Live Scenario									
		1									
Item	Input Description	Quantity	Comments/Source	9	10	11	12	13	14	15	16
	GENERAL ASSUMPTIONS										
1.	Processing Rate (tons/day)	1,000	Scenario Analysis	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
2.	Annual Inflation Rate	2.0%	Geosyntec Assumed								
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2.0 Assumptions

Cell C5 controls the selection of the Live Scenario for the pro forma model

		Live Scenario 1									
Item	Input Description	Quantity	Comments/Source	17	18	19	20	21	22	23	24
	GENERAL ASSUMPTIONS										
1.	Processing Rate (tons/day)	1,000	Scenario Analysis	1,000	1,000	1,200	1,200	1,200	1,200	1,200	1,200
2.	Annual Inflation Rate	2.0%	Geosyntec Assumed								
3.	Project Implementation	3 Yrs	3 Yrs Construction, Geosyntec Estimate								
4.	**Planning Period**	2025 - 2055	Geosyntec Assumed								
4.1	Base Year	2025	Geosyntec Assumed								
4.2	End Year	2055	Geosyntec Assumed								
5.	Ash Generation	25%	Processible Waste Flow, Geosyntec Assumed								
6.	Availability of Unit	90%	Geosyntec Assumed								
7.	**Metal Recovery**										
7.1	Ferrous	3.20%	Processible Waste Flow, Survey of Operating FL WTE Facilities								
7.2	Non Ferrous	0.30%	Processible Waste Flow, Survey of Operating FL WTE Facilities								
8.	Lower Heating Value, LHV	5100 kcal/kg	Geosyntec Assumed								
9.	Energy Production	609 kWh/ton	Processible Waste Flow, Survey of Operating FL WTE Facilities								
	DEBT										
10.	Estimated Construction Cost	$322,679,002	Scenario Analysis, Geosyntec Assumed								
10.1	Debt Financing Percent	100%	Geosyntec Assumed								
11.	Term	20 Yrs	Geosyntec Assumed								
12.	Interest Rate	3.50%	Geosyntec Assumed	5.00%	5.00%	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%
13.	Equity	$0	Geosyntec Assumed								
	REVENUE										
14.	Ferrous	$75/ton	Recycling Markets.Net								
15.	Non Ferrous	$1,200/ton	Recycling Markets.Net								
16.	Energy Revenues from Electricity	$0.061/kWh	Geosyntec Assumed	$0.075/kWh	$0.075/kWh	$0.061/kWh	$0.061/kWh	$0.068/kWh	$0.068/kWh	$0.075/kWh	$0.075/kWh
17.	Biosolids Incineration	$ 3,177,000	Geosyntec Assumed	$ 3,177,000	$ -	$ 3,177,000	$ -	$ 3,177,000	$ -	$ 3,177,000	$ -
	EXPENSES										
18.	Facility Operating Fee	$30.00/ton	Geosyntec Assumed								
19.	WTE Host Fee	$0.00/ton	Geosyntec Assumed								
20.	Ash Disposal	$60.00/ton	Geosyntec Assumed, Anchorage Regional Landfill								
21.	**Utility and Materials Costs**										
21.1	Potable Water Cost	$0.0558/gallon	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.2	Potable Water Usage	0.933 gallon/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.3	Wastewater Discharge Cost	$0.0789/gallon	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.4	Wastewater Discharge	5.7 gallon/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.5	Reclaimed Water Cost	$0.001/gallon	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.6	Reclaimed Water Usage	589 gallon/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.7	Propane Cost	$1.283/gallon	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.8	Propane Usage	0.35 gallon/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.9	Lime Pebble Cost	$204.84/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.10	Lime Pebble Usage	0.0082 ton/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.11	Lime Dolo Cost	$260.97/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.12	Lime Dolo Usage	0.0018 ton/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.13	Ammonia Cost	$807.79/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.14	Ammonia Usage	0.0010 ton/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.15	Urea Cost	$1.17/gallon	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.16	Urea Usage	0.2 gallon/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.17	Carbon Cost	$0.28/lb	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.18	Carbon Usage	0.8233 lbs/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								

2.0 Assumptions

Cell C5 controls the selection of the Live Scenario for the pro forma model

		Live Scenario 1									
Item	Input Description	Quantity	Comments/Source	25	26	27	28	29	30	31	32
	GENERAL ASSUMPTIONS										
1.	Processing Rate (tons/day)	1,000	Scenario Analysis	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200
2.	Annual Inflation Rate	2.0%	Geosyntec Assumed								
3.	Project Implementation	3 Yrs	3 Yrs Construction, Geosyntec Estimate								
4.	**Planning Period**	2025 - 2055	Geosyntec Assumed								
4.1	Base Year	2025	Geosyntec Assumed								
4.2	End Year	2055	Geosyntec Assumed								
5.	Ash Generation	25%	Processible Waste Flow, Geosyntec Assumed								
6.	Availability of Unit	90%	Geosyntec Assumed								
7.	**Metal Recovery**										
7.1	Ferrous	3.20%	Processible Waste Flow, Survey of Operating FL WTE Facilities								
7.2	Non Ferrous	0.30%	Processible Waste Flow, Survey of Operating FL WTE Facilities								
8.	Lower Heating Value, LHV	5100 kcal/kg	Geosyntec Assumed								
9.	Energy Production	609 kWh/ton	Processible Waste Flow, Survey of Operating FL WTE Facilities								
	DEBT										
10.	Estimated Construction Cost	$322,679,002	Scenario Analysis, Geosyntec Assumed								
10.1	Debt Financing Percent	100%	Geosyntec Assumed								
11.	Term	20 Yrs	Geosyntec Assumed								
12.	Interest Rate	3.50%	Geosyntec Assumed	4.00%	4.00%	4.00%	4.00%	4.00%	4.00%	5.00%	5.00%
13.	Equity	$0	Geosyntec Assumed								
	REVENUE										
14.	Ferrous	$75/ton	Recycling Markets.Net								
15.	Non Ferrous	$1,200/ton	Recycling Markets.Net								
16.	Energy Revenues from Electricity	$0.061/kWh	Geosyntec Assumed	$0.061/kWh	$0.061/kWh	$0.068/kWh	$0.068/kWh	$0.075/kWh	$0.075/kWh	$0.061/kWh	$0.061/kWh
17.	Biosolids Incineration	$ 3,177,000	Geosyntec Assumed	$ 3,177,000	$ -	$ 3,177,000	$ -	$ 3,177,000	$ -	$ 3,177,000	$ -
	EXPENSES										
18.	Facility Operating Fee	$30.00/ton	Geosyntec Assumed								
19.	WTE Host Fee	$0.00/ton	Geosyntec Assumed								
20.	Ash Disposal	$60.00/ton	Geosyntec Assumed, Anchorage Regional Landfill								
21.	**Utility and Materials Costs**										
21.1	Potable Water Cost	$0.0558/gallon	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.2	Potable Water Usage	0.933 gallon/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.3	Wastewater Discharge Cost	$0.0789/gallon	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.4	Wastewater Discharge	5.7 gallon/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.5	Reclaimed Water Cost	$0.001/gallon	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.6	Reclaimed Water Usage	589 gallon/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.7	Propane Cost	$1.283/gallon	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.8	Propane Usage	0.35 gallon/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.9	Lime Pebble Cost	$204.84/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.10	Lime Pebble Usage	0.0082 ton/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.11	Lime Dolo Cost	$260.97/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.12	Lime Dolo Usage	0.0018 ton/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.13	Ammonia Cost	$807.79/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.14	Ammonia Usage	0.0010 ton/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.15	Urea Cost	$1.17/gallon	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.16	Urea Usage	0.2 gallon/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.17	Carbon Cost	$0.28/lb	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.18	Carbon Usage	0.8233 lbs/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								

2.0 Assumptions

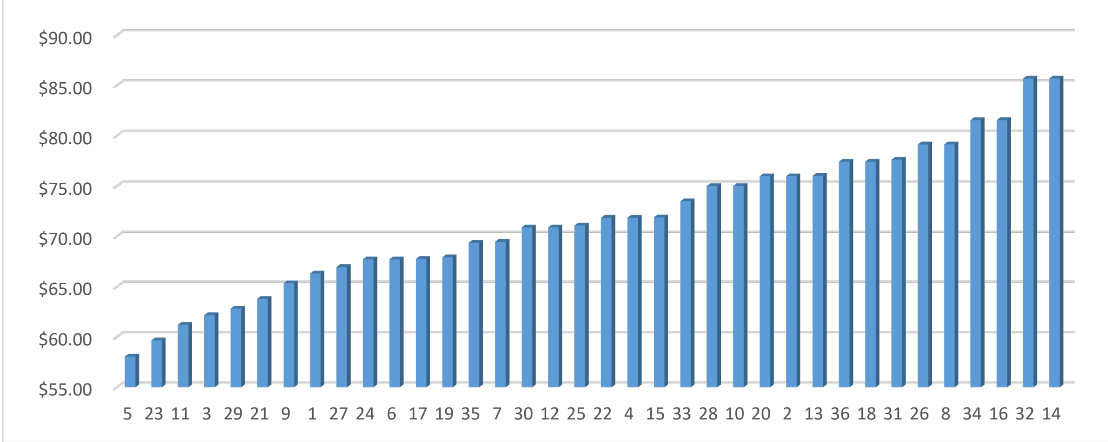
Cell C5 controls the selection of the Live Scenario for the pro forma model

		Live Scenario									
		1									
Item	Input Description	Quantity	Comments/Source	33	34	35	36	37	38	39	40
	GENERAL ASSUMPTIONS										
1.	Processing Rate (tons/day)	1,000	Scenario Analysis	1,200	1,200	1,200	1,200				
2.	Annual Inflation Rate	2.0%	Geosyntec Assumed								
3.	Project Implementation	3 Yrs	3 Yrs Construction, Geosyntec Estimate								
4.	**Planning Period**	2025 - 2055	Geosyntec Assumed								
4.1	Base Year	2025	Geosyntec Assumed								
4.2	End Year	2055	Geosyntec Assumed								
5.	Ash Generation	25%	Processible Waste Flow, Geosyntec Assumed								
6.	Availability of Unit	90%	Geosyntec Assumed								
7.	**Metal Recovery**										
7.1	Ferrous	3.20%	Processible Waste Flow, Survey of Operating FL WTE Facilities								
7.2	Non Ferrous	0.30%	Processible Waste Flow, Survey of Operating FL WTE Facilities								
8.	Lower Heating Value, LHV	5100 kcal/kg	Geosyntec Assumed								
9.	Energy Production	609 kWh/ton	Processible Waste Flow, Survey of Operating FL WTE Facilities								
	DEBT										
10.	Estimated Construction Cost	$322,679,002	Scenario Analysis, Geosyntec Assumed								
10.1	Debt Financing Percent	100%	Geosyntec Assumed								
11.	Term	20 Yrs	Geosyntec Assumed								
12.	Interest Rate	3.50%	Geosyntec Assumed	5.00%	5.00%	5.00%	5.00%				
13.	Equity	$0	Geosyntec Assumed								
	REVENUE										
14.	Ferrous	$75/ton	Recycling Markets.Net								
15.	Non Ferrous	$1,200/ton	Recycling Markets.Net								
16.	Energy Revenues from Electricity	$0.061/kWh	Geosyntec Assumed	$0.068/kWh	$0.068/kWh	$0.075/kWh	$0.075/kWh				
17.	Biosolids Incineration	$ 3,177,000	Geosyntec Assumed	$ 3,177,000	$ -	$ 3,177,000	$ -				
	EXPENSES										
18.	Facility Operating Fee	$30.00/ton	Geosyntec Assumed								
19.	WTE Host Fee	$0.00/ton	Geosyntec Assumed								
20.	Ash Disposal	$60.00/ton	Geosyntec Assumed, Anchorage Regional Landfill								
21.	**Utility and Materials Costs**										
21.1	Potable Water Cost	$0.0558/gallon	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.2	Potable Water Usage	0.933 gallon/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.3	Wastewater Discharge Cost	$0.0789/gallon	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.4	Wastewater Discharge	5.7 gallon/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.5	Reclaimed Water Cost	$0.001/gallon	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.6	Reclaimed Water Usage	589 gallon/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.7	Propane Cost	$1.283/gallon	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.8	Propane Usage	0.35 gallon/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.9	Lime Pebble Cost	$204.84/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.10	Lime Pebble Usage	0.0082 ton/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.11	Lime Dolo Cost	$260.97/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.12	Lime Dolo Usage	0.0018 ton/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.13	Ammonia Cost	$807.79/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.14	Ammonia Usage	0.0010 ton/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.15	Urea Cost	$1.17/gallon	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.16	Urea Usage	0.2 gallon/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.17	Carbon Cost	$0.28/lb	Geosyntec Assumed, Survey of Operating FL WTE Facilities								
21.18	Carbon Usage	0.8233 lbs/ton	Geosyntec Assumed, Survey of Operating FL WTE Facilities								

Scenario	Year 1 Tip Fee		Year 1 Tip Fee SORTED		Year 21 Tip Fee Required		Year 20 Operating Result
1	$ 66.30	5	$ 58.04	1	$ (4.27)	20	$ 3,983,000
2	$ 75.97	23	$ 59.65	2	$ 10.10	26	$ 3,983,000
3	$ 62.16	11	$ 61.20	3	$ (10.40)	32	$ 3,983,000
4	$ 71.84	3	$ 62.16	4	$ 3.97	2	$ 3,318,000
5	$ 58.04	29	$ 62.81	5	$ (16.54)	8	$ 3,318,000
6	$ 67.71	21	$ 63.77	6	$ (2.17)	14	$ 3,318,000
7	$ 69.46	9	$ 65.33	7	$ (4.27)	22	$ 1,565,000
8	$ 79.13	1	$ 66.30	8	$ 10.10	28	$ 1,565,000
9	$ 65.33	27	$ 66.94	9	$ (10.40)	34	$ 1,565,000
10	$ 75.00	24	$ 67.71	10	$ 3.97	4	$ 1,303,000
11	$ 61.20	6	$ 67.71	11	$ (16.54)	10	$ 1,303,000
12	$ 70.87	17	$ 67.74	12	$ (2.17)	16	$ 1,303,000
13	$ 76.00	19	$ 67.90	13	$ (4.27)	6	$ (713,000)
14	$ 85.67	35	$ 69.35	14	$ 10.10	12	$ (713,000)
15	$ 71.87	7	$ 69.46	15	$ (10.40)	18	$ (713,000)
16	$ 81.54	30	$ 70.87	16	$ 3.97	19	$ (737,880)
17	$ 67.74	12	$ 70.87	17	$ (16.54)	25	$ (737,880)
18	$ 77.42	25	$ 71.07	18	$ (2.17)	31	$ (737,880)
19	$ 67.90	22	$ 71.83	19	$ (1.87)	24	$ (854,000)
20	$ 75.96	4	$ 71.84	20	$ 10.10	30	$ (854,000)
21	$ 63.77	15	$ 71.87	21	$ (8.01)	36	$ (854,000)
22	$ 71.83	33	$ 73.48	22	$ 3.97	1	$ (1,402,880)
23	$ 59.65	28	$ 75.00	23	$ (14.14)	7	$ (1,402,880)
24	$ 67.71	10	$ 75.00	24	$ (2.17)	13	$ (1,402,880)
25	$ 71.07	20	$ 75.96	25	$ (1.87)	21	$ (3,155,880)
26	$ 79.13	2	$ 75.97	26	$ 10.10	27	$ (3,155,880)
27	$ 66.94	13	$ 76.00	27	$ (8.01)	33	$ (3,155,880)
28	$ 75.00	36	$ 77.41	28	$ 3.97	3	$ (3,417,880)
29	$ 62.81	18	$ 77.42	29	$ (14.14)	9	$ (3,417,880)
30	$ 70.87	31	$ 77.61	30	$ (2.17)	15	$ (3,417,880)
31	$ 77.61	26	$ 79.13	31	$ (1.87)	5	$ (5,433,880)
32	$ 85.67	8	$ 79.13	32	$ 10.10	11	$ (5,433,880)
33	$ 73.48	34	$ 81.54	33	$ (8.01)	17	$ (5,433,880)
34	$ 81.54	16	$ 81.54	34	$ 3.97	23	$ (5,574,880)
35	$ 69.35	32	$ 85.67	35	$ (14.14)	29	$ (5,574,880)
36	$ 77.41	14	$ 85.67	36	$ (2.17)	35	$ (5,574,880)

Projected Year 1 Tipping Fee by Scenario (Low to High)

Projected Year 1 Tipping Fee by Scenario (Low to High)



Chugach Electric Association, Inc. Estimated and Preliminary Projected Avoided Cost

Year	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Avoided Cost																					
Weighted Avg Market Price ($/MWh)	60.43	61.68	62.93	64.24	61.57	59.67	60.78	61.90	63.08	63.86	64.33	64.98	65.74	66.39	63.40	65.03	66.71	68.44	70.25	72.08	73.97

Chugach Electric Association, Inc. Estimated a

Year	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	
<u>Avoided Cost</u>															
Weighted Avg Market Price ($/MWh)	75.90	77.91	79.98	82.12	84.33	86.62	88.96	91.40	93.96	96.56	99.25	102.02	104.86	107.78	Model FIW1-Test Yr Solution.xml (Plexos output)

3.0 Summary

Item	Description	Live Scenario 1 Quantity	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 8	Scenario 9	Scenario 10	Scenario 11	Scenario 12	Scenario 13
	GENERAL ASSUMPTIONS														
1.	Processing Rate (tons/day)	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
2.	Interest Rate - Debt Financing	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%	4.00%	4.00%	4.00%	4.00%	4.00%	4.00%	5.00%
3.	Energy Revenues from Electricity	$0.06/kWh	$0.061/kWh	$0.061/kWh	$0.068/kWh	$0.068/kWh	$0.075/kWh	$0.075/kWh	$0.061/kWh	$0.061/kWh	$0.068/kWh	$0.068/kWh	$0.075/kWh	$0.075/kWh	$0.061/kWh
4.	Biosolids Incineration Revenue	$ 3,177,000	$ 3,177,000	$ -	$ 3,177,000	$ -	$ 3,177,000	$ -	$ 3,177,000	$ -	$ 3,177,000	$ -	$ 3,177,000	$ -	$ 3,177,000
5.	**Summary of Net Costs (Revenue - Expenses), $/ton**														
	2025 - 2029 average tip fee	$ 66.18	$ 66.18	$ 76.24	$ 61.88	$ 71.95	$ 57.58	$ 67.65	$ 69.34	$ 79.41	$ 65.04	$ 75.11	$ 60.75	$ 70.81	$ 75.88
	2030 - 2034 average tip fee	$ 65.87	$ 65.87	$ 76.99	$ 61.13	$ 72.24	$ 56.38	$ 67.50	$ 69.03	$ 80.15	$ 64.29	$ 75.40	$ 59.55	$ 70.66	$ 75.58
	2035 - 2039 average tip fee	$ 65.53	$ 65.53	$ 77.80	$ 60.29	$ 72.56	$ 55.06	$ 67.33	$ 68.70	$ 80.97	$ 63.46	$ 75.73	$ 58.22	$ 70.49	$ 75.24
	2040 - 2044 average tip fee	$ 65.16	$ 65.16	$ 78.71	$ 59.38	$ 72.92	$ 53.59	$ 67.14	$ 68.32	$ 81.87	$ 62.54	$ 76.09	$ 56.76	$ 70.30	$ 74.87
	2045 - 2049 average tip fee	$ (4.36)	$ (4.36)	$ 10.59	$ (10.75)	$ 4.21	$ (17.14)	$ (2.18)	$ (4.36)	$ 10.59	$ (10.75)	$ 4.21	$ (17.14)	$ (2.18)	$ (4.36)
	2050 - 2054 average tip fee	$ (4.82)	$ (4.82)	$ 11.70	$ (11.87)	$ 4.65	$ (18.92)	$ (2.40)	$ (4.82)	$ 11.70	$ (11.87)	$ 4.65	$ (18.92)	$ (2.40)	$ (4.82)
	2025 - 2054 average tip fee	$ 54.00	$ 42.26	$ 55.34	$ 36.68	$ 49.75	$ 31.09	$ 44.17	$ 44.37	$ 57.45	$ 38.79	$ 51.86	$ 33.20	$ 46.28	$ 48.73
6.	**Net Costs (Revenue - Expenses), $/ton**														
	2025	$ 66.30	$ 66.30	$ 75.97	$ 62.16	$ 71.84	$ 58.04	$ 67.71	$ 69.46	$ 79.13	$ 65.33	$ 75.00	$ 61.20	$ 70.87	$ 76.00
	2026	$ 66.23	$ 66.23	$ 76.10	$ 62.02	$ 71.89	$ 57.81	$ 67.68	$ 69.40	$ 79.26	$ 65.19	$ 75.05	$ 60.97	$ 70.84	$ 75.94
	2027	$ 66.18	$ 66.18	$ 76.24	$ 61.88	$ 71.95	$ 57.59	$ 67.65	$ 69.34	$ 79.40	$ 65.04	$ 75.11	$ 60.75	$ 70.81	$ 75.88
	2028	$ 66.12	$ 66.12	$ 76.38	$ 61.74	$ 72.00	$ 57.35	$ 67.62	$ 69.28	$ 79.55	$ 64.90	$ 75.16	$ 60.52	$ 70.78	$ 75.83
	2029	$ 66.06	$ 66.06	$ 76.53	$ 61.59	$ 72.06	$ 57.12	$ 67.59	$ 69.22	$ 79.69	$ 64.75	$ 75.22	$ 60.29	$ 70.75	$ 75.77
	2030	$ 66.00	$ 66.00	$ 76.68	$ 61.44	$ 72.12	$ 56.88	$ 67.56	$ 69.16	$ 79.84	$ 64.60	$ 75.28	$ 60.04	$ 70.72	$ 75.70
	2031	$ 65.94	$ 65.94	$ 76.83	$ 61.28	$ 72.18	$ 56.64	$ 67.53	$ 69.10	$ 79.99	$ 64.45	$ 75.34	$ 59.80	$ 70.69	$ 75.64
	2032	$ 65.87	$ 65.87	$ 76.98	$ 61.13	$ 72.24	$ 56.39	$ 67.49	$ 69.04	$ 80.14	$ 64.29	$ 75.40	$ 59.55	$ 70.66	$ 75.58
	2033	$ 65.81	$ 65.81	$ 77.14	$ 60.97	$ 72.30	$ 56.13	$ 67.46	$ 68.97	$ 80.30	$ 64.13	$ 75.46	$ 59.30	$ 70.63	$ 75.52
	2034	$ 65.74	$ 65.74	$ 77.30	$ 60.81	$ 72.37	$ 55.88	$ 67.43	$ 68.91	$ 80.46	$ 63.97	$ 75.53	$ 59.04	$ 70.59	$ 75.45
	2035	$ 65.67	$ 65.67	$ 77.46	$ 60.64	$ 72.43	$ 55.61	$ 67.40	$ 68.84	$ 80.63	$ 63.80	$ 75.59	$ 58.77	$ 70.56	$ 75.38
	2036	$ 65.61	$ 65.61	$ 77.63	$ 60.47	$ 72.50	$ 55.34	$ 67.36	$ 68.77	$ 80.79	$ 63.63	$ 75.66	$ 58.50	$ 70.53	$ 75.32
	2037	$ 65.53	$ 65.53	$ 77.80	$ 60.30	$ 72.56	$ 55.06	$ 67.33	$ 68.70	$ 80.96	$ 63.46	$ 75.73	$ 58.23	$ 70.49	$ 75.24
	2038	$ 65.46	$ 65.46	$ 77.98	$ 60.12	$ 72.63	$ 54.78	$ 67.29	$ 68.63	$ 81.14	$ 63.28	$ 75.80	$ 57.95	$ 70.45	$ 75.17
	2039	$ 65.39	$ 65.39	$ 78.15	$ 59.94	$ 72.70	$ 54.49	$ 67.25	$ 68.55	$ 81.32	$ 63.11	$ 75.87	$ 57.66	$ 70.42	$ 75.10
	2040	$ 65.32	$ 65.32	$ 78.33	$ 59.76	$ 72.78	$ 54.20	$ 67.22	$ 68.48	$ 81.50	$ 62.92	$ 75.94	$ 57.37	$ 70.38	$ 75.03
	2041	$ 65.24	$ 65.24	$ 78.52	$ 59.57	$ 72.85	$ 53.91	$ 67.18	$ 68.40	$ 81.68	$ 62.74	$ 76.01	$ 57.07	$ 70.34	$ 74.95
	2042	$ 65.16	$ 65.16	$ 78.71	$ 59.38	$ 72.92	$ 53.60	$ 67.14	$ 68.33	$ 81.87	$ 62.54	$ 76.09	$ 56.76	$ 70.30	$ 74.87
	2043	$ 65.08	$ 65.08	$ 78.90	$ 59.19	$ 73.00	$ 53.29	$ 67.10	$ 68.25	$ 82.06	$ 62.35	$ 76.16	$ 56.45	$ 70.26	$ 74.79
	2044	$ 65.00	$ 65.00	$ 79.09	$ 58.99	$ 73.08	$ 52.97	$ 67.06	$ 68.16	$ 82.26	$ 62.15	$ 76.24	$ 56.13	$ 70.23	$ 74.71
	2045	$ (4.19)	$ (4.19)	$ 10.18	$ (10.33)	$ 4.04	$ (16.46)	$ (2.09)	$ (4.19)	$ 10.18	$ (10.33)	$ 4.04	$ (16.46)	$ (2.09)	$ (4.19)
	2046	$ (4.28)	$ (4.28)	$ 10.38	$ (10.54)	$ 4.12	$ (16.79)	$ (2.13)	$ (4.28)	$ 10.38	$ (10.54)	$ 4.12	$ (16.79)	$ (2.13)	$ (4.28)
	2047	$ (4.36)	$ (4.36)	$ 10.59	$ (10.75)	$ 4.20	$ (17.13)	$ (2.18)	$ (4.36)	$ 10.59	$ (10.75)	$ 4.20	$ (17.13)	$ (2.18)	$ (4.36)
	2048	$ (4.45)	$ (4.45)	$ 10.80	$ (10.96)	$ 4.29	$ (17.47)	$ (2.22)	$ (4.45)	$ 10.80	$ (10.96)	$ 4.29	$ (17.47)	$ (2.22)	$ (4.45)
	2049	$ (4.54)	$ (4.54)	$ 11.02	$ (11.18)	$ 4.37	$ (17.82)	$ (2.26)	$ (4.54)	$ 11.02	$ (11.18)	$ 4.37	$ (17.82)	$ (2.26)	$ (4.54)
	2050	$ (4.63)	$ (4.63)	$ 11.24	$ (11.40)	$ 4.46	$ (18.18)	$ (2.31)	$ (4.63)	$ 11.24	$ (11.40)	$ 4.46	$ (18.18)	$ (2.31)	$ (4.63)
	2051	$ (4.72)	$ (4.72)	$ 11.46	$ (11.63)	$ 4.55	$ (18.54)	$ (2.36)	$ (4.72)	$ 11.46	$ (11.63)	$ 4.55	$ (18.54)	$ (2.36)	$ (4.72)
	2052	$ (4.82)	$ (4.82)	$ 11.69	$ (11.86)	$ 4.65	$ (18.91)	$ (2.40)	$ (4.82)	$ 11.69	$ (11.86)	$ 4.65	$ (18.91)	$ (2.40)	$ (4.82)
	2053	$ (4.91)	$ (4.91)	$ 11.93	$ (12.10)	$ 4.74	$ (19.29)	$ (2.45)	$ (4.91)	$ 11.93	$ (12.10)	$ 4.74	$ (19.29)	$ (2.45)	$ (4.91)
	2054	$ (5.01)	$ (5.01)	$ 12.16	$ (12.34)	$ 4.83	$ (19.67)	$ (2.50)	$ (5.01)	$ 12.16	$ (12.34)	$ 4.83	$ (19.67)	$ (2.50)	$ (5.01)
	2055	$ (5.11)	$ (5.11)	$ 12.41	$ (12.59)	$ 4.93	$ (20.07)	$ (2.55)	$ (5.11)	$ 12.41	$ (12.59)	$ 4.93	$ (20.07)	$ (2.55)	$ (5.11)
7.	**Total Revenue**														
	2025	$ 17,355,000	$ 17,355,000	$ 14,178,000	$ 18,712,000	$ 15,535,000	$ 20,068,000	$ 16,891,000	$ 17,355,000	$ 14,178,000	$ 18,712,000	$ 15,535,000	$ 20,068,000	$ 16,891,000	$ 17,355,000
	2026	$ 17,703,000	$ 17,703,000	$ 14,462,000	$ 19,086,000	$ 15,846,000	$ 20,470,000	$ 17,229,000	$ 17,703,000	$ 14,462,000	$ 19,086,000	$ 15,846,000	$ 20,470,000	$ 17,229,000	$ 17,703,000
	2027	$ 18,057,000	$ 18,057,000	$ 14,751,000	$ 19,468,000	$ 16,162,000	$ 20,879,000	$ 17,574,000	$ 18,057,000	$ 14,751,000	$ 19,468,000	$ 16,162,000	$ 20,879,000	$ 17,574,000	$ 18,057,000
	2028	$ 18,418,000	$ 18,418,000	$ 15,046,000	$ 19,857,000	$ 16,486,000	$ 21,297,000	$ 17,925,000	$ 18,418,000	$ 15,046,000	$ 19,857,000	$ 16,486,000	$ 21,297,000	$ 17,925,000	$ 18,418,000
	2029	$ 18,786,000	$ 18,786,000	$ 15,347,000	$ 20,254,000	$ 16,815,000	$ 21,722,000	$ 18,284,000	$ 18,786,000	$ 15,347,000	$ 20,254,000	$ 16,815,000	$ 21,722,000	$ 18,284,000	$ 18,786,000
	2030	$ 19,162,000	$ 19,162,000	$ 15,654,000	$ 20,659,000	$ 17,152,000	$ 22,157,000	$ 18,649,000	$ 19,162,000	$ 15,654,000	$ 20,659,000	$ 17,152,000	$ 22,157,000	$ 18,649,000	$ 19,162,000

Item	Description	Live Scenario 1 Quantity	Scenarios 1	2	3	4	5	6	7	8	9	10	11	12	13
	GENERAL ASSUMPTIONS														
	2031	$ 19,545,000	$ 19,545,000	$ 15,967,000	$ 21,073,000	$ 17,495,000	$ 22,600,000	$ 19,022,000	$ 19,545,000	$ 15,967,000	$ 21,073,000	$ 17,495,000	$ 22,600,000	$ 19,022,000	$ 19,545,000
	2032	$ 19,936,000	$ 19,936,000	$ 16,287,000	$ 21,494,000	$ 17,845,000	$ 23,052,000	$ 19,403,000	$ 19,936,000	$ 16,287,000	$ 21,494,000	$ 17,845,000	$ 23,052,000	$ 19,403,000	$ 19,936,000
	2033	$ 20,335,000	$ 20,335,000	$ 16,612,000	$ 21,924,000	$ 18,202,000	$ 23,513,000	$ 19,791,000	$ 20,335,000	$ 16,612,000	$ 21,924,000	$ 18,202,000	$ 23,513,000	$ 19,791,000	$ 20,335,000
	2034	$ 20,741,000	$ 20,741,000	$ 16,945,000	$ 22,362,000	$ 18,566,000	$ 23,983,000	$ 20,187,000	$ 20,741,000	$ 16,945,000	$ 22,362,000	$ 18,566,000	$ 23,983,000	$ 20,187,000	$ 20,741,000
	2035	$ 21,156,000	$ 21,156,000	$ 17,283,000	$ 22,810,000	$ 18,937,000	$ 24,463,000	$ 20,590,000	$ 21,156,000	$ 17,283,000	$ 22,810,000	$ 18,937,000	$ 24,463,000	$ 20,590,000	$ 21,156,000
	2036	$ 21,579,000	$ 21,579,000	$ 17,629,000	$ 23,266,000	$ 19,316,000	$ 24,952,000	$ 21,002,000	$ 21,579,000	$ 17,629,000	$ 23,266,000	$ 19,316,000	$ 24,952,000	$ 21,002,000	$ 21,579,000
	2037	$ 22,011,000	$ 22,011,000	$ 17,982,000	$ 23,731,000	$ 19,702,000	$ 25,451,000	$ 21,422,000	$ 22,011,000	$ 17,982,000	$ 23,731,000	$ 19,702,000	$ 25,451,000	$ 21,422,000	$ 22,011,000
	2038	$ 22,451,000	$ 22,451,000	$ 18,341,000	$ 24,206,000	$ 20,096,000	$ 25,960,000	$ 21,851,000	$ 22,451,000	$ 18,341,000	$ 24,206,000	$ 20,096,000	$ 25,960,000	$ 21,851,000	$ 22,451,000
	2039	$ 22,900,000	$ 22,900,000	$ 18,708,000	$ 24,690,000	$ 20,498,000	$ 26,480,000	$ 22,288,000	$ 22,900,000	$ 18,708,000	$ 24,690,000	$ 20,498,000	$ 26,480,000	$ 22,288,000	$ 22,900,000
	2040	$ 23,358,000	$ 23,358,000	$ 19,082,000	$ 25,184,000	$ 20,908,000	$ 27,009,000	$ 22,733,000	$ 23,358,000	$ 19,082,000	$ 25,184,000	$ 20,908,000	$ 27,009,000	$ 22,733,000	$ 23,358,000
	2041	$ 23,825,000	$ 23,825,000	$ 19,464,000	$ 25,687,000	$ 21,326,000	$ 27,549,000	$ 23,188,000	$ 23,825,000	$ 19,464,000	$ 25,687,000	$ 21,326,000	$ 27,549,000	$ 23,188,000	$ 23,825,000
	2042	$ 24,302,000	$ 24,302,000	$ 19,853,000	$ 26,201,000	$ 21,753,000	$ 28,100,000	$ 23,652,000	$ 24,302,000	$ 19,853,000	$ 26,201,000	$ 21,753,000	$ 28,100,000	$ 23,652,000	$ 24,302,000
	2043	$ 24,788,000	$ 24,788,000	$ 20,250,000	$ 26,725,000	$ 22,188,000	$ 28,662,000	$ 24,125,000	$ 24,788,000	$ 20,250,000	$ 26,725,000	$ 22,188,000	$ 28,662,000	$ 24,125,000	$ 24,788,000
	2044	$ 25,284,000	$ 25,284,000	$ 20,655,000	$ 27,260,000	$ 22,631,000	$ 29,236,000	$ 24,607,000	$ 25,284,000	$ 20,655,000	$ 27,260,000	$ 22,631,000	$ 29,236,000	$ 24,607,000	$ 25,284,000
	2045	$ 25,789,000	$ 25,789,000	$ 21,068,000	$ 27,805,000	$ 23,084,000	$ 29,820,000	$ 25,099,000	$ 25,789,000	$ 21,068,000	$ 27,805,000	$ 23,084,000	$ 29,820,000	$ 25,099,000	$ 25,789,000
	2046	$ 26,305,000	$ 26,305,000	$ 21,490,000	$ 28,361,000	$ 23,546,000	$ 30,417,000	$ 25,601,000	$ 26,305,000	$ 21,490,000	$ 28,361,000	$ 23,546,000	$ 30,417,000	$ 25,601,000	$ 26,305,000
	2047	$ 26,831,000	$ 26,831,000	$ 21,920,000	$ 28,928,000	$ 24,017,000	$ 31,025,000	$ 26,113,000	$ 26,831,000	$ 21,920,000	$ 28,928,000	$ 24,017,000	$ 31,025,000	$ 26,113,000	$ 26,831,000
	2048	$ 27,368,000	$ 27,368,000	$ 22,358,000	$ 29,507,000	$ 24,497,000	$ 31,646,000	$ 26,636,000	$ 27,368,000	$ 22,358,000	$ 29,507,000	$ 24,497,000	$ 31,646,000	$ 26,636,000	$ 27,368,000
	2049	$ 27,915,000	$ 27,915,000	$ 22,805,000	$ 30,097,000	$ 24,987,000	$ 32,278,000	$ 27,168,000	$ 27,915,000	$ 22,805,000	$ 30,097,000	$ 24,987,000	$ 32,278,000	$ 27,168,000	$ 27,915,000
	2050	$ 28,473,000	$ 28,473,000	$ 23,261,000	$ 30,699,000	$ 25,487,000	$ 32,924,000	$ 27,712,000	$ 28,473,000	$ 23,261,000	$ 30,699,000	$ 25,487,000	$ 32,924,000	$ 27,712,000	$ 28,473,000
	2051	$ 29,043,000	$ 29,043,000	$ 23,726,000	$ 31,313,000	$ 25,996,000	$ 33,583,000	$ 28,266,000	$ 29,043,000	$ 23,726,000	$ 31,313,000	$ 25,996,000	$ 33,583,000	$ 28,266,000	$ 29,043,000
	2052	$ 29,624,000	$ 29,624,000	$ 24,201,000	$ 31,939,000	$ 26,516,000	$ 34,254,000	$ 28,831,000	$ 29,624,000	$ 24,201,000	$ 31,939,000	$ 26,516,000	$ 34,254,000	$ 28,831,000	$ 29,624,000
	2053	$ 30,216,000	$ 30,216,000	$ 24,685,000	$ 32,578,000	$ 27,047,000	$ 34,939,000	$ 29,408,000	$ 30,216,000	$ 24,685,000	$ 32,578,000	$ 27,047,000	$ 34,939,000	$ 29,408,000	$ 30,216,000
	2054	$ 30,821,000	$ 30,821,000	$ 25,179,000	$ 33,229,000	$ 27,587,000	$ 35,638,000	$ 29,996,000	$ 30,821,000	$ 25,179,000	$ 33,229,000	$ 27,587,000	$ 35,638,000	$ 29,996,000	$ 30,821,000
	2055	$ 31,437,000	$ 31,437,000	$ 25,682,000	$ 33,894,000	$ 28,139,000	$ 36,351,000	$ 30,596,000	$ 31,437,000	$ 25,682,000	$ 33,894,000	$ 28,139,000	$ 36,351,000	$ 30,596,000	$ 31,437,000
8.	**Total Costs**														
	2025	$ 39,133,000	$ 39,133,000	$ 39,133,000	$ 39,133,000	$ 39,133,000	$ 39,133,000	$ 39,133,000	$ 40,172,000	$ 40,172,000	$ 40,172,000	$ 40,172,000	$ 40,172,000	$ 40,172,000	$ 42,322,000
	2026	$ 39,461,000	$ 39,461,000	$ 39,461,000	$ 39,461,000	$ 39,461,000	$ 39,461,000	$ 39,461,000	$ 40,500,000	$ 40,500,000	$ 40,500,000	$ 40,500,000	$ 40,500,000	$ 40,500,000	$ 42,650,000
	2027	$ 39,796,000	$ 39,796,000	$ 39,796,000	$ 39,796,000	$ 39,796,000	$ 39,796,000	$ 39,796,000	$ 40,835,000	$ 40,835,000	$ 40,835,000	$ 40,835,000	$ 40,835,000	$ 40,835,000	$ 42,985,000
	2028	$ 40,138,000	$ 40,138,000	$ 40,138,000	$ 40,138,000	$ 40,138,000	$ 40,138,000	$ 40,138,000	$ 41,177,000	$ 41,177,000	$ 41,177,000	$ 41,177,000	$ 41,177,000	$ 41,177,000	$ 43,327,000
	2029	$ 40,487,000	$ 40,487,000	$ 40,487,000	$ 40,487,000	$ 40,487,000	$ 40,487,000	$ 40,487,000	$ 41,526,000	$ 41,526,000	$ 41,526,000	$ 41,526,000	$ 41,526,000	$ 41,526,000	$ 43,676,000
	2030	$ 40,842,000	$ 40,842,000	$ 40,842,000	$ 40,842,000	$ 40,842,000	$ 40,842,000	$ 40,842,000	$ 41,881,000	$ 41,881,000	$ 41,881,000	$ 41,881,000	$ 41,881,000	$ 41,881,000	$ 44,031,000
	2031	$ 41,205,000	$ 41,205,000	$ 41,205,000	$ 41,205,000	$ 41,205,000	$ 41,205,000	$ 41,205,000	$ 42,244,000	$ 42,244,000	$ 42,244,000	$ 42,244,000	$ 42,244,000	$ 42,244,000	$ 44,394,000
	2032	$ 41,575,000	$ 41,575,000	$ 41,575,000	$ 41,575,000	$ 41,575,000	$ 41,575,000	$ 41,575,000	$ 42,614,000	$ 42,614,000	$ 42,614,000	$ 42,614,000	$ 42,614,000	$ 42,614,000	$ 44,764,000
	2033	$ 41,953,000	$ 41,953,000	$ 41,953,000	$ 41,953,000	$ 41,953,000	$ 41,953,000	$ 41,953,000	$ 42,992,000	$ 42,992,000	$ 42,992,000	$ 42,992,000	$ 42,992,000	$ 42,992,000	$ 45,142,000
	2034	$ 42,338,000	$ 42,338,000	$ 42,338,000	$ 42,338,000	$ 42,338,000	$ 42,338,000	$ 42,338,000	$ 43,377,000	$ 43,377,000	$ 43,377,000	$ 43,377,000	$ 43,377,000	$ 43,377,000	$ 45,527,000
	2035	$ 42,730,000	$ 42,730,000	$ 42,730,000	$ 42,730,000	$ 42,730,000	$ 42,730,000	$ 42,730,000	$ 43,769,000	$ 43,769,000	$ 43,769,000	$ 43,769,000	$ 43,769,000	$ 43,769,000	$ 45,919,000
	2036	$ 43,131,000	$ 43,131,000	$ 43,131,000	$ 43,131,000	$ 43,131,000	$ 43,131,000	$ 43,131,000	$ 44,170,000	$ 44,170,000	$ 44,170,000	$ 44,170,000	$ 44,170,000	$ 44,170,000	$ 46,320,000
	2037	$ 43,539,000	$ 43,539,000	$ 43,539,000	$ 43,539,000	$ 43,539,000	$ 43,539,000	$ 43,539,000	$ 44,578,000	$ 44,578,000	$ 44,578,000	$ 44,578,000	$ 44,578,000	$ 44,578,000	$ 46,728,000
	2038	$ 43,956,000	$ 43,956,000	$ 43,956,000	$ 43,956,000	$ 43,956,000	$ 43,956,000	$ 43,956,000	$ 44,995,000	$ 44,995,000	$ 44,995,000	$ 44,995,000	$ 44,995,000	$ 44,995,000	$ 47,145,000
	2039	$ 44,381,000	$ 44,381,000	$ 44,381,000	$ 44,381,000	$ 44,381,000	$ 44,381,000	$ 44,381,000	$ 45,420,000	$ 45,420,000	$ 45,420,000	$ 45,420,000	$ 45,420,000	$ 45,420,000	$ 47,570,000
	2040	$ 44,815,000	$ 44,815,000	$ 44,815,000	$ 44,815,000	$ 44,815,000	$ 44,815,000	$ 44,815,000	$ 45,854,000	$ 45,854,000	$ 45,854,000	$ 45,854,000	$ 45,854,000	$ 45,854,000	$ 48,004,000
	2041	$ 45,257,000	$ 45,257,000	$ 45,257,000	$ 45,257,000	$ 45,257,000	$ 45,257,000	$ 45,257,000	$ 46,296,000	$ 46,296,000	$ 46,296,000	$ 46,296,000	$ 46,296,000	$ 46,296,000	$ 48,446,000
	2042	$ 45,708,000	$ 45,708,000	$ 45,708,000	$ 45,708,000	$ 45,708,000	$ 45,708,000	$ 45,708,000	$ 46,747,000	$ 46,747,000	$ 46,747,000	$ 46,747,000	$ 46,747,000	$ 46,747,000	$ 48,897,000
	2043	$ 46,168,000	$ 46,168,000	$ 46,168,000	$ 46,168,000	$ 46,168,000	$ 46,168,000	$ 46,168,000	$ 47,207,000	$ 47,207,000	$ 47,207,000	$ 47,207,000	$ 47,207,000	$ 47,207,000	$ 49,357,000
	2044	$ 46,637,000	$ 46,637,000	$ 46,637,000	$ 46,637,000	$ 46,637,000	$ 46,637,000	$ 46,637,000	$ 47,676,000	$ 47,676,000	$ 47,676,000	$ 47,676,000	$ 47,676,000	$ 47,676,000	$ 49,826,000
	2045	$ 24,412,000	$ 24,412,000	$ 24,412,000	$ 24,412,000	$ 24,412,000	$ 24,412,000	$ 24,412,000	$ 24,412,000	$ 24,412,000	$ 24,412,000	$ 24,412,000	$ 24,412,000	$ 24,412,000	$ 24,412,000
	2046	$ 24,900,000	$ 24,900,000	$ 24,900,000	$ 24,900,000	$ 24,900,000	$ 24,900,000	$ 24,900,000	$ 24,900,000	$ 24,900,000	$ 24,900,000	$ 24,900,000	$ 24,900,000	$ 24,900,000	$ 24,900,000
	2047	$ 25,398,000	$ 25,398,000	$ 25,398,000	$ 25,398,000	$ 25,398,000	$ 25,398,000	$ 25,398,000	$ 25,398,000	$ 25,398,000	$ 25,398,000	$ 25,398,000	$ 25,398,000	$ 25,398,000	$ 25,398,000
	2048	$ 25,906,000	$ 25,906,000	$ 25,906,000	$ 25,906,000	$ 25,906,000	$ 25,906,000	$ 25,906,000	$ 25,906,000	$ 25,906,000	$ 25,906,000	$ 25,906,000	$ 25,906,000	$ 25,906,000	$ 25,906,000
	2049	$ 26,424,000	$ 26,424,000	$ 26,424,000	$ 26,424,000	$ 26,424,000	$ 26,424,000	$ 26,424,000	$ 26,424,000	$ 26,424,000	$ 26,424,000	$ 26,424,000	$ 26,424,000	$ 26,424,000	$ 26,424,000
	2050	$ 26,953,000	$ 26,953,000	$ 26,953,000	$ 26,953,000	$ 26,953,000	$ 26,953,000	$ 26,953,000	$ 26,953,000	$ 26,953,000	$ 26,953,000	$ 26,953,000	$ 26,953,000	$ 26,953,000	$ 26,953,000
	2051	$ 27,492,000	$ 27,492,000	$ 27,492,000	$ 27,492,000	$ 27,492,000	$ 27,492,000	$ 27,492,000	$ 27,492,000	$ 27,492,000	$ 27,492,000	$ 27,492,000	$ 27,492,000	$ 27,492,000	$ 27,492,000
	2052	$ 28,042,000	$ 28,042,000	$ 28,042,000	$ 28,042,000	$ 28,042,000	$ 28,042,000	$ 28,042,000	$ 28,042,000	$ 28,042,000	$ 28,042,000	$ 28,042,000	$ 28,042,000	$ 28,042,000	$ 28,042,000
	2053	$ 28,603,000	$ 28,603,000	$ 28,603,000	$ 28,603,000	$ 28,603,000	$ 28,603,000	$ 28,603,000	$ 28,603,000	$ 28,603,000	$ 28,603,000	$ 28,603,000	$ 28,603,000	$ 28,603,000	$ 28,603,000
	2054	$ 29,175,000	$ 29,175,000	$ 29,175,000	$ 29,175,000	$ 29,175,000	$ 29,175,000	$ 29,175,000	$ 29,175,000	$ 29,175,000	$ 29,175,000	$ 29,175,000	$ 29,175,000	$ 29,175,000	$ 29,175,000
	2055	$ 29,758,000	$ 29,758,000	$ 29,758,000	$ 29,758,000	$ 29,758,000	$ 29,758,000	$ 29,758,000	$ 29,758,000	$ 29,758,000	$ 29,758,000	$ 29,758,000	$ 29,758,000	$ 29,758,000	$ 29,758,000

		Live Scenario													
		1	Scenarios												
Item	Description	Quantity	1	2	3	4	5	6	7	8	9	10	11	12	13
	GENERAL ASSUMPTIONS														
9.	**Operating Costs**														
	2025	$ 16,429,000	$ 16,429,000	$ 16,429,000	$ 16,429,000	$ 16,429,000	$ 16,429,000	$ 16,429,000	$ 16,429,000	$ 16,429,000	$ 16,429,000	$ 16,429,000	$ 16,429,000	$ 16,429,000	$ 16,429,000
	2026	$ 16,757,000	$ 16,757,000	$ 16,757,000	$ 16,757,000	$ 16,757,000	$ 16,757,000	$ 16,757,000	$ 16,757,000	$ 16,757,000	$ 16,757,000	$ 16,757,000	$ 16,757,000	$ 16,757,000	$ 16,757,000
	2027	$ 17,092,000	$ 17,092,000	$ 17,092,000	$ 17,092,000	$ 17,092,000	$ 17,092,000	$ 17,092,000	$ 17,092,000	$ 17,092,000	$ 17,092,000	$ 17,092,000	$ 17,092,000	$ 17,092,000	$ 17,092,000
	2028	$ 17,434,000	$ 17,434,000	$ 17,434,000	$ 17,434,000	$ 17,434,000	$ 17,434,000	$ 17,434,000	$ 17,434,000	$ 17,434,000	$ 17,434,000	$ 17,434,000	$ 17,434,000	$ 17,434,000	$ 17,434,000
	2029	$ 17,783,000	$ 17,783,000	$ 17,783,000	$ 17,783,000	$ 17,783,000	$ 17,783,000	$ 17,783,000	$ 17,783,000	$ 17,783,000	$ 17,783,000	$ 17,783,000	$ 17,783,000	$ 17,783,000	$ 17,783,000
	2030	$ 18,138,000	$ 18,138,000	$ 18,138,000	$ 18,138,000	$ 18,138,000	$ 18,138,000	$ 18,138,000	$ 18,138,000	$ 18,138,000	$ 18,138,000	$ 18,138,000	$ 18,138,000	$ 18,138,000	$ 18,138,000
	2031	$ 18,501,000	$ 18,501,000	$ 18,501,000	$ 18,501,000	$ 18,501,000	$ 18,501,000	$ 18,501,000	$ 18,501,000	$ 18,501,000	$ 18,501,000	$ 18,501,000	$ 18,501,000	$ 18,501,000	$ 18,501,000
	2032	$ 18,871,000	$ 18,871,000	$ 18,871,000	$ 18,871,000	$ 18,871,000	$ 18,871,000	$ 18,871,000	$ 18,871,000	$ 18,871,000	$ 18,871,000	$ 18,871,000	$ 18,871,000	$ 18,871,000	$ 18,871,000
	2033	$ 19,249,000	$ 19,249,000	$ 19,249,000	$ 19,249,000	$ 19,249,000	$ 19,249,000	$ 19,249,000	$ 19,249,000	$ 19,249,000	$ 19,249,000	$ 19,249,000	$ 19,249,000	$ 19,249,000	$ 19,249,000
	2034	$ 19,634,000	$ 19,634,000	$ 19,634,000	$ 19,634,000	$ 19,634,000	$ 19,634,000	$ 19,634,000	$ 19,634,000	$ 19,634,000	$ 19,634,000	$ 19,634,000	$ 19,634,000	$ 19,634,000	$ 19,634,000
	2035	$ 20,026,000	$ 20,026,000	$ 20,026,000	$ 20,026,000	$ 20,026,000	$ 20,026,000	$ 20,026,000	$ 20,026,000	$ 20,026,000	$ 20,026,000	$ 20,026,000	$ 20,026,000	$ 20,026,000	$ 20,026,000
	2036	$ 20,427,000	$ 20,427,000	$ 20,427,000	$ 20,427,000	$ 20,427,000	$ 20,427,000	$ 20,427,000	$ 20,427,000	$ 20,427,000	$ 20,427,000	$ 20,427,000	$ 20,427,000	$ 20,427,000	$ 20,427,000
	2037	$ 20,835,000	$ 20,835,000	$ 20,835,000	$ 20,835,000	$ 20,835,000	$ 20,835,000	$ 20,835,000	$ 20,835,000	$ 20,835,000	$ 20,835,000	$ 20,835,000	$ 20,835,000	$ 20,835,000	$ 20,835,000
	2038	$ 21,252,000	$ 21,252,000	$ 21,252,000	$ 21,252,000	$ 21,252,000	$ 21,252,000	$ 21,252,000	$ 21,252,000	$ 21,252,000	$ 21,252,000	$ 21,252,000	$ 21,252,000	$ 21,252,000	$ 21,252,000
	2039	$ 21,677,000	$ 21,677,000	$ 21,677,000	$ 21,677,000	$ 21,677,000	$ 21,677,000	$ 21,677,000	$ 21,677,000	$ 21,677,000	$ 21,677,000	$ 21,677,000	$ 21,677,000	$ 21,677,000	$ 21,677,000
	2040	$ 22,111,000	$ 22,111,000	$ 22,111,000	$ 22,111,000	$ 22,111,000	$ 22,111,000	$ 22,111,000	$ 22,111,000	$ 22,111,000	$ 22,111,000	$ 22,111,000	$ 22,111,000	$ 22,111,000	$ 22,111,000
	2041	$ 22,553,000	$ 22,553,000	$ 22,553,000	$ 22,553,000	$ 22,553,000	$ 22,553,000	$ 22,553,000	$ 22,553,000	$ 22,553,000	$ 22,553,000	$ 22,553,000	$ 22,553,000	$ 22,553,000	$ 22,553,000
	2042	$ 23,004,000	$ 23,004,000	$ 23,004,000	$ 23,004,000	$ 23,004,000	$ 23,004,000	$ 23,004,000	$ 23,004,000	$ 23,004,000	$ 23,004,000	$ 23,004,000	$ 23,004,000	$ 23,004,000	$ 23,004,000
	2043	$ 23,464,000	$ 23,464,000	$ 23,464,000	$ 23,464,000	$ 23,464,000	$ 23,464,000	$ 23,464,000	$ 23,464,000	$ 23,464,000	$ 23,464,000	$ 23,464,000	$ 23,464,000	$ 23,464,000	$ 23,464,000
	2044	$ 23,933,000	$ 23,933,000	$ 23,933,000	$ 23,933,000	$ 23,933,000	$ 23,933,000	$ 23,933,000	$ 23,933,000	$ 23,933,000	$ 23,933,000	$ 23,933,000	$ 23,933,000	$ 23,933,000	$ 23,933,000
	2045	$ 24,412,000	$ 24,412,000	$ 24,412,000	$ 24,412,000	$ 24,412,000	$ 24,412,000	$ 24,412,000	$ 24,412,000	$ 24,412,000	$ 24,412,000	$ 24,412,000	$ 24,412,000	$ 24,412,000	$ 24,412,000
	2046	$ 24,900,000	$ 24,900,000	$ 24,900,000	$ 24,900,000	$ 24,900,000	$ 24,900,000	$ 24,900,000	$ 24,900,000	$ 24,900,000	$ 24,900,000	$ 24,900,000	$ 24,900,000	$ 24,900,000	$ 24,900,000
	2047	$ 25,398,000	$ 25,398,000	$ 25,398,000	$ 25,398,000	$ 25,398,000	$ 25,398,000	$ 25,398,000	$ 25,398,000	$ 25,398,000	$ 25,398,000	$ 25,398,000	$ 25,398,000	$ 25,398,000	$ 25,398,000
	2048	$ 25,906,000	$ 25,906,000	$ 25,906,000	$ 25,906,000	$ 25,906,000	$ 25,906,000	$ 25,906,000	$ 25,906,000	$ 25,906,000	$ 25,906,000	$ 25,906,000	$ 25,906,000	$ 25,906,000	$ 25,906,000
	2049	$ 26,424,000	$ 26,424,000	$ 26,424,000	$ 26,424,000	$ 26,424,000	$ 26,424,000	$ 26,424,000	$ 26,424,000	$ 26,424,000	$ 26,424,000	$ 26,424,000	$ 26,424,000	$ 26,424,000	$ 26,424,000
	2050	$ 26,953,000	$ 26,953,000	$ 26,953,000	$ 26,953,000	$ 26,953,000	$ 26,953,000	$ 26,953,000	$ 26,953,000	$ 26,953,000	$ 26,953,000	$ 26,953,000	$ 26,953,000	$ 26,953,000	$ 26,953,000
	2051	$ 27,492,000	$ 27,492,000	$ 27,492,000	$ 27,492,000	$ 27,492,000	$ 27,492,000	$ 27,492,000	$ 27,492,000	$ 27,492,000	$ 27,492,000	$ 27,492,000	$ 27,492,000	$ 27,492,000	$ 27,492,000
	2052	$ 28,042,000	$ 28,042,000	$ 28,042,000	$ 28,042,000	$ 28,042,000	$ 28,042,000	$ 28,042,000	$ 28,042,000	$ 28,042,000	$ 28,042,000	$ 28,042,000	$ 28,042,000	$ 28,042,000	$ 28,042,000
	2053	$ 28,603,000	$ 28,603,000	$ 28,603,000	$ 28,603,000	$ 28,603,000	$ 28,603,000	$ 28,603,000	$ 28,603,000	$ 28,603,000	$ 28,603,000	$ 28,603,000	$ 28,603,000	$ 28,603,000	$ 28,603,000
	2054	$ 29,175,000	$ 29,175,000	$ 29,175,000	$ 29,175,000	$ 29,175,000	$ 29,175,000	$ 29,175,000	$ 29,175,000	$ 29,175,000	$ 29,175,000	$ 29,175,000	$ 29,175,000	$ 29,175,000	$ 29,175,000
	2055	$ 29,758,000	$ 29,758,000	$ 29,758,000	$ 29,758,000	$ 29,758,000	$ 29,758,000	$ 29,758,000	$ 29,758,000	$ 29,758,000	$ 29,758,000	$ 29,758,000	$ 29,758,000	$ 29,758,000	$ 29,758,000
10.	**Debt Service**														
	2025	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 25,893,000
	2026	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 25,893,000
	2027	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 25,893,000
	2028	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 25,893,000
	2029	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 25,893,000
	2030	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 25,893,000
	2031	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 25,893,000
	2032	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 25,893,000
	2033	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 25,893,000
	2034	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 25,893,000
	2035	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 25,893,000
	2036	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 25,893,000
	2037	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 25,893,000
	2038	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 25,893,000
	2039	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 25,893,000
	2040	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 25,893,000
	2041	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 25,893,000
	2042	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 25,893,000
	2043	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 25,893,000
	2044	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 22,704,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 23,743,000	$ 25,893,000
	2045	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	2046	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	2047	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -

Item	Description	Live Scenario 1 Quantity	Scenarios 1	2	3	4	5	6	7	8	9	10	11	12	13
	GENERAL ASSUMPTIONS														
	2048	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	2049	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	2050	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	2051	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	2052	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	2053	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	2054	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	2055	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
11.	**Waste Processed (tons)**														
	2025	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500
	2026	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500
	2027	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500
	2028	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500
	2029	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500
	2030	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500
	2031	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500
	2032	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500
	2033	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500
	2034	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500
	2035	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500
	2036	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500
	2037	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500
	2038	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500
	2039	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500
	2040	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500
	2041	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500
	2042	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500
	2043	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500
	2044	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500
	2045	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500
	2046	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500
	2047	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500
	2048	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500
	2049	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500
	2050	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500
	2051	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500
	2052	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500
	2053	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500
	2054	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500
	2055	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500	328,500

3.0 Summary

Item	Description	Live Scenario 1 Quantity	14	15	16	17	18	19	20	21	22	23	24	25	26
	GENERAL ASSUMPTIONS														
1.	Processing Rate (tons/day)	1,000	1,000	1,000	1,000	1,000	1,000	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200
2.	Interest Rate - Debt Financing	3.50%	5.00%	5.00%	5.00%	5.00%	5.00%	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%	4.00%	4.00%
3.	Energy Revenues from Electricity	$0.06/kWh	$0.061/kWh	$0.068/kWh	$0.068/kWh	$0.075/kWh	$0.075/kWh	$0.061/kWh	$0.061/kWh	$0.068/kWh	$0.068/kWh	$0.075/kWh	$0.075/kWh	$0.061/kWh	$0.061/kWh
4.	Biosolids Incineration Revenue	$ 3,177,000	$ -	$ 3,177,000	$ -	$ 3,177,000	$ -	$ 3,177,000	$ -	$ 3,177,000	$ -	$ 3,177,000	$ -	$ 3,177,000	$ -
5.	**Summary of Net Costs (Revenue - Expenses), $/ton**														
	2025 - 2029 average tip fee	$ 66.18	$ 85.95	$ 71.59	$ 81.65	$ 67.29	$ 77.36	$ 67.86	$ 76.24	$ 63.56	$ 71.95	$ 59.26	$ 67.65	$ 71.02	$ 79.41
	2030 - 2034 average tip fee	$ 65.87	$ 86.69	$ 70.83	$ 81.95	$ 66.09	$ 77.20	$ 67.73	$ 76.99	$ 62.98	$ 72.24	$ 58.23	$ 67.50	$ 70.89	$ 80.15
	2035 - 2039 average tip fee	$ 65.53	$ 87.51	$ 70.00	$ 82.27	$ 64.76	$ 77.03	$ 67.58	$ 77.81	$ 62.34	$ 72.57	$ 57.10	$ 67.33	$ 70.74	$ 80.97
	2040 - 2044 average tip fee	$ 65.16	$ 88.42	$ 69.09	$ 82.63	$ 63.30	$ 76.85	$ 67.42	$ 78.71	$ 61.64	$ 72.93	$ 55.85	$ 67.14	$ 70.58	$ 81.87
	2045 - 2049 average tip fee	$ (4.36)	$ 10.59	$ (10.75)	$ 4.21	$ (17.14)	$ (2.18)	$ (1.87)	$ 10.59	$ (8.26)	$ 4.21	$ (14.64)	$ (2.18)	$ (1.87)	$ 10.59
	2050 - 2054 average tip fee	$ (4.82)	$ 11.70	$ (11.87)	$ 4.65	$ (18.92)	$ (2.40)	$ (2.07)	$ 11.70	$ (9.12)	$ 4.65	$ (16.17)	$ (2.40)	$ (2.07)	$ 11.70
	2025 - 2054 average tip fee	$ 54.00	$ 61.81	$ 43.15	$ 56.23	$ 37.57	$ 50.64	$ 44.44	$ 55.34	$ 38.86	$ 49.76	$ 33.27	$ 44.17	$ 46.55	$ 57.45
6.	**Net Costs (Revenue - Expenses), $/ton**														
	2025	$ 66.30	$ 85.67	$ 71.87	$ 81.54	$ 67.74	$ 77.42	$ 67.90	$ 75.96	$ 63.77	$ 71.83	$ 59.65	$ 67.71	$ 71.07	$ 79.13
	2026	$ 66.23	$ 85.81	$ 71.73	$ 81.60	$ 67.52	$ 77.39	$ 67.88	$ 76.10	$ 63.67	$ 71.89	$ 59.46	$ 67.68	$ 71.05	$ 79.27
	2027	$ 66.18	$ 85.95	$ 71.59	$ 81.65	$ 67.29	$ 77.35	$ 67.86	$ 76.24	$ 63.56	$ 71.95	$ 59.26	$ 67.65	$ 71.02	$ 79.40
	2028	$ 66.12	$ 86.09	$ 71.45	$ 81.71	$ 67.06	$ 77.33	$ 67.83	$ 76.38	$ 63.45	$ 72.00	$ 59.07	$ 67.62	$ 70.99	$ 79.55
	2029	$ 66.06	$ 86.24	$ 71.30	$ 81.77	$ 66.83	$ 77.30	$ 67.80	$ 76.53	$ 63.34	$ 72.06	$ 58.87	$ 67.59	$ 70.97	$ 79.69
	2030	$ 66.00	$ 86.38	$ 71.15	$ 81.82	$ 66.59	$ 77.27	$ 67.78	$ 76.68	$ 63.22	$ 72.12	$ 58.66	$ 67.56	$ 70.94	$ 79.84
	2031	$ 65.94	$ 86.54	$ 70.99	$ 81.88	$ 66.34	$ 77.24	$ 67.75	$ 76.83	$ 63.10	$ 72.18	$ 58.45	$ 67.53	$ 70.92	$ 79.99
	2032	$ 65.87	$ 86.69	$ 70.84	$ 81.95	$ 66.09	$ 77.20	$ 67.73	$ 76.98	$ 62.98	$ 72.24	$ 58.24	$ 67.50	$ 70.89	$ 80.15
	2033	$ 65.81	$ 86.85	$ 70.68	$ 82.01	$ 65.84	$ 77.17	$ 67.70	$ 77.14	$ 62.86	$ 72.30	$ 58.02	$ 67.46	$ 70.86	$ 80.30
	2034	$ 65.74	$ 87.01	$ 70.52	$ 82.07	$ 65.58	$ 77.14	$ 67.67	$ 77.30	$ 62.73	$ 72.36	$ 57.80	$ 67.43	$ 70.83	$ 80.46
	2035	$ 65.67	$ 87.17	$ 70.35	$ 82.14	$ 65.32	$ 77.11	$ 67.64	$ 77.47	$ 62.61	$ 72.43	$ 57.57	$ 67.40	$ 70.80	$ 80.63
	2036	$ 65.61	$ 87.34	$ 70.18	$ 82.20	$ 65.05	$ 77.07	$ 67.61	$ 77.63	$ 62.48	$ 72.50	$ 57.34	$ 67.36	$ 70.77	$ 80.79
	2037	$ 65.53	$ 87.51	$ 70.01	$ 82.27	$ 64.77	$ 77.04	$ 67.58	$ 77.80	$ 62.34	$ 72.57	$ 57.11	$ 67.33	$ 70.75	$ 80.97
	2038	$ 65.46	$ 87.68	$ 69.83	$ 82.34	$ 64.49	$ 77.00	$ 67.55	$ 77.98	$ 62.21	$ 72.64	$ 56.87	$ 67.29	$ 70.72	$ 81.14
	2039	$ 65.39	$ 87.86	$ 69.65	$ 82.41	$ 64.20	$ 76.96	$ 67.52	$ 78.15	$ 62.07	$ 72.71	$ 56.62	$ 67.26	$ 70.68	$ 81.32
	2040	$ 65.32	$ 88.04	$ 69.47	$ 82.48	$ 63.91	$ 76.93	$ 67.49	$ 78.33	$ 61.93	$ 72.78	$ 56.37	$ 67.22	$ 70.65	$ 81.50
	2041	$ 65.24	$ 88.23	$ 69.28	$ 82.56	$ 63.61	$ 76.89	$ 67.46	$ 78.52	$ 61.79	$ 72.85	$ 56.12	$ 67.18	$ 70.62	$ 81.68
	2042	$ 65.16	$ 88.41	$ 69.09	$ 82.63	$ 63.31	$ 76.85	$ 67.42	$ 78.71	$ 61.64	$ 72.92	$ 55.86	$ 67.14	$ 70.59	$ 81.87
	2043	$ 65.08	$ 88.61	$ 68.89	$ 82.71	$ 63.00	$ 76.81	$ 67.39	$ 78.90	$ 61.49	$ 73.00	$ 55.59	$ 67.10	$ 70.55	$ 82.06
	2044	$ 65.00	$ 88.80	$ 68.69	$ 82.79	$ 62.68	$ 76.77	$ 67.35	$ 79.09	$ 61.34	$ 73.08	$ 55.32	$ 67.06	$ 70.51	$ 82.26
	2045	$ (4.19)	$ 10.18	$ (10.33)	$ 4.04	$ (16.46)	$ (2.09)	$ (1.80)	$ 10.18	$ (7.94)	$ 4.04	$ (14.07)	$ (2.09)	$ (1.80)	$ 10.18
	2046	$ (4.28)	$ 10.38	$ (10.54)	$ 4.12	$ (16.79)	$ (2.13)	$ (1.83)	$ 10.38	$ (8.09)	$ 4.12	$ (14.35)	$ (2.14)	$ (1.83)	$ 10.38
	2047	$ (4.36)	$ 10.59	$ (10.75)	$ 4.20	$ (17.13)	$ (2.18)	$ (1.87)	$ 10.59	$ (8.25)	$ 4.21	$ (14.64)	$ (2.18)	$ (1.87)	$ 10.59
	2048	$ (4.45)	$ 10.80	$ (10.96)	$ 4.29	$ (17.47)	$ (2.22)	$ (1.91)	$ 10.80	$ (8.42)	$ 4.29	$ (14.93)	$ (2.22)	$ (1.91)	$ 10.80
	2049	$ (4.54)	$ 11.02	$ (11.18)	$ 4.37	$ (17.82)	$ (2.26)	$ (1.95)	$ 11.02	$ (8.59)	$ 4.38	$ (15.23)	$ (2.27)	$ (1.95)	$ 11.02
	2050	$ (4.63)	$ 11.24	$ (11.40)	$ 4.46	$ (18.18)	$ (2.31)	$ (1.99)	$ 11.24	$ (8.76)	$ 4.46	$ (15.53)	$ (2.31)	$ (1.99)	$ 11.24
	2051	$ (4.72)	$ 11.46	$ (11.63)	$ 4.55	$ (18.54)	$ (2.36)	$ (2.02)	$ 11.46	$ (8.93)	$ 4.55	$ (15.84)	$ (2.36)	$ (2.02)	$ 11.46
	2052	$ (4.82)	$ 11.69	$ (11.86)	$ 4.65	$ (18.91)	$ (2.40)	$ (2.06)	$ 11.69	$ (9.11)	$ 4.64	$ (16.16)	$ (2.40)	$ (2.06)	$ 11.69
	2053	$ (4.91)	$ 11.93	$ (12.10)	$ 4.74	$ (19.29)	$ (2.45)	$ (2.11)	$ 11.93	$ (9.29)	$ 4.74	$ (16.48)	$ (2.45)	$ (2.11)	$ 11.93
	2054	$ (5.01)	$ 12.16	$ (12.34)	$ 4.83	$ (19.67)	$ (2.50)	$ (2.15)	$ 12.17	$ (9.48)	$ 4.83	$ (16.81)	$ (2.50)	$ (2.15)	$ 12.17
	2055	$ (5.11)	$ 12.41	$ (12.59)	$ 4.93	$ (20.07)	$ (2.55)	$ (2.19)	$ 12.41	$ (9.67)	$ 4.93	$ (17.15)	$ (2.55)	$ (2.19)	$ 12.41
7.	**Total Revenue**														
	2025	$ 17,355,000	$ 14,178,000	$ 18,712,000	$ 15,535,000	$ 20,068,000	$ 16,891,000	$ 20,191,000	$ 17,014,000	$ 21,819,000	$ 18,642,000	$ 23,446,000	$ 20,269,000	$ 20,191,000	$ 17,014,000
	2026	$ 17,703,000	$ 14,462,000	$ 19,086,000	$ 15,846,000	$ 20,470,000	$ 17,229,000	$ 20,595,000	$ 17,354,000	$ 22,255,000	$ 19,015,000	$ 23,915,000	$ 20,675,000	$ 20,595,000	$ 17,354,000
	2027	$ 18,057,000	$ 14,751,000	$ 19,468,000	$ 16,162,000	$ 20,879,000	$ 17,574,000	$ 21,007,000	$ 17,702,000	$ 22,700,000	$ 19,395,000	$ 24,394,000	$ 21,088,000	$ 21,007,000	$ 17,702,000
	2028	$ 18,418,000	$ 15,046,000	$ 19,857,000	$ 16,486,000	$ 21,297,000	$ 17,925,000	$ 21,427,000	$ 18,056,000	$ 23,154,000	$ 19,783,000	$ 24,882,000	$ 21,510,000	$ 21,427,000	$ 18,056,000
	2029	$ 18,786,000	$ 15,347,000	$ 20,254,000	$ 16,815,000	$ 21,722,000	$ 18,284,000	$ 21,856,000	$ 18,417,000	$ 23,617,000	$ 20,178,000	$ 25,379,000	$ 21,940,000	$ 21,856,000	$ 18,417,000
	2030	$ 19,162,000	$ 15,654,000	$ 20,659,000	$ 17,152,000	$ 22,157,000	$ 18,649,000	$ 22,293,000	$ 18,785,000	$ 24,090,000	$ 20,582,000	$ 25,887,000	$ 22,379,000	$ 22,293,000	$ 18,785,000

Item	Description	Live Scenario 1 Quantity	14	15	16	17	18	19	20	21	22	23	24	25	26
	GENERAL ASSUMPTIONS														
	2031	$ 19,545,000	$ 15,967,000	$ 21,073,000	$ 17,495,000	$ 22,600,000	$ 19,022,000	$ 22,738,000	$ 19,161,000	$ 24,572,000	$ 20,994,000	$ 26,405,000	$ 22,827,000	$ 22,738,000	$ 19,161,000
	2032	$ 19,936,000	$ 16,287,000	$ 21,494,000	$ 17,845,000	$ 23,052,000	$ 19,403,000	$ 23,193,000	$ 19,544,000	$ 25,063,000	$ 21,414,000	$ 26,933,000	$ 23,283,000	$ 23,193,000	$ 19,544,000
	2033	$ 20,335,000	$ 16,612,000	$ 21,924,000	$ 18,202,000	$ 23,513,000	$ 19,791,000	$ 23,657,000	$ 19,935,000	$ 25,564,000	$ 21,842,000	$ 27,471,000	$ 23,749,000	$ 23,657,000	$ 19,935,000
	2034	$ 20,741,000	$ 16,945,000	$ 22,362,000	$ 18,566,000	$ 23,983,000	$ 20,187,000	$ 24,130,000	$ 20,333,000	$ 26,075,000	$ 22,279,000	$ 28,021,000	$ 24,224,000	$ 24,130,000	$ 20,333,000
	2035	$ 21,156,000	$ 17,283,000	$ 22,810,000	$ 18,937,000	$ 24,463,000	$ 20,590,000	$ 24,613,000	$ 20,740,000	$ 26,597,000	$ 22,724,000	$ 28,581,000	$ 24,708,000	$ 24,613,000	$ 20,740,000
	2036	$ 21,579,000	$ 17,629,000	$ 23,266,000	$ 19,316,000	$ 24,952,000	$ 21,002,000	$ 25,105,000	$ 21,155,000	$ 27,129,000	$ 23,179,000	$ 29,153,000	$ 25,203,000	$ 25,105,000	$ 21,155,000
	2037	$ 22,011,000	$ 17,982,000	$ 23,731,000	$ 19,702,000	$ 25,451,000	$ 21,422,000	$ 25,607,000	$ 21,578,000	$ 27,672,000	$ 23,642,000	$ 29,736,000	$ 25,707,000	$ 25,607,000	$ 21,578,000
	2038	$ 22,451,000	$ 18,341,000	$ 24,206,000	$ 20,096,000	$ 25,960,000	$ 21,851,000	$ 26,119,000	$ 22,010,000	$ 28,225,000	$ 24,115,000	$ 30,330,000	$ 26,221,000	$ 26,119,000	$ 22,010,000
	2039	$ 22,900,000	$ 18,708,000	$ 24,690,000	$ 20,498,000	$ 26,480,000	$ 22,288,000	$ 26,642,000	$ 22,450,000	$ 28,789,000	$ 24,597,000	$ 30,937,000	$ 26,745,000	$ 26,642,000	$ 22,450,000
	2040	$ 23,358,000	$ 19,082,000	$ 25,184,000	$ 20,908,000	$ 27,009,000	$ 22,733,000	$ 27,175,000	$ 22,899,000	$ 29,365,000	$ 25,089,000	$ 31,556,000	$ 27,280,000	$ 27,175,000	$ 22,899,000
	2041	$ 23,825,000	$ 19,464,000	$ 25,687,000	$ 21,326,000	$ 27,549,000	$ 23,188,000	$ 27,718,000	$ 23,357,000	$ 29,953,000	$ 25,591,000	$ 32,187,000	$ 27,826,000	$ 27,718,000	$ 23,357,000
	2042	$ 24,302,000	$ 19,853,000	$ 26,201,000	$ 21,753,000	$ 28,100,000	$ 23,652,000	$ 28,272,000	$ 23,824,000	$ 30,552,000	$ 26,103,000	$ 32,831,000	$ 28,382,000	$ 28,272,000	$ 23,824,000
	2043	$ 24,788,000	$ 20,250,000	$ 26,725,000	$ 22,188,000	$ 28,662,000	$ 24,125,000	$ 28,838,000	$ 24,300,000	$ 31,163,000	$ 26,625,000	$ 33,487,000	$ 28,950,000	$ 28,838,000	$ 24,300,000
	2044	$ 25,284,000	$ 20,655,000	$ 27,260,000	$ 22,631,000	$ 29,236,000	$ 24,607,000	$ 29,415,000	$ 24,786,000	$ 31,786,000	$ 27,158,000	$ 34,157,000	$ 29,529,000	$ 29,415,000	$ 24,786,000
	2045	$ 25,789,000	$ 21,068,000	$ 27,805,000	$ 23,084,000	$ 29,820,000	$ 25,099,000	$ 30,003,000	$ 25,282,000	$ 32,422,000	$ 27,701,000	$ 34,840,000	$ 30,119,000	$ 30,003,000	$ 25,282,000
	2046	$ 26,305,000	$ 21,490,000	$ 28,361,000	$ 23,546,000	$ 30,417,000	$ 25,601,000	$ 30,603,000	$ 25,788,000	$ 33,070,000	$ 28,255,000	$ 35,537,000	$ 30,722,000	$ 30,603,000	$ 25,788,000
	2047	$ 26,831,000	$ 21,920,000	$ 28,928,000	$ 24,017,000	$ 31,025,000	$ 26,113,000	$ 31,215,000	$ 26,304,000	$ 33,731,000	$ 28,820,000	$ 36,248,000	$ 31,336,000	$ 31,215,000	$ 26,304,000
	2048	$ 27,368,000	$ 22,358,000	$ 29,507,000	$ 24,497,000	$ 31,646,000	$ 26,636,000	$ 31,839,000	$ 26,830,000	$ 34,406,000	$ 29,396,000	$ 36,973,000	$ 31,963,000	$ 31,839,000	$ 26,830,000
	2049	$ 27,915,000	$ 22,805,000	$ 30,097,000	$ 24,987,000	$ 32,278,000	$ 27,168,000	$ 32,476,000	$ 27,366,000	$ 35,094,000	$ 29,984,000	$ 37,712,000	$ 32,602,000	$ 32,476,000	$ 27,366,000
	2050	$ 28,473,000	$ 23,261,000	$ 30,699,000	$ 25,487,000	$ 32,924,000	$ 27,712,000	$ 33,126,000	$ 27,913,000	$ 35,796,000	$ 30,584,000	$ 38,466,000	$ 33,254,000	$ 33,126,000	$ 27,913,000
	2051	$ 29,043,000	$ 23,726,000	$ 31,313,000	$ 25,996,000	$ 33,583,000	$ 28,266,000	$ 33,788,000	$ 28,472,000	$ 36,512,000	$ 31,196,000	$ 39,236,000	$ 33,919,000	$ 33,788,000	$ 28,472,000
	2052	$ 29,624,000	$ 24,201,000	$ 31,939,000	$ 26,516,000	$ 34,254,000	$ 28,831,000	$ 34,464,000	$ 29,041,000	$ 37,242,000	$ 31,819,000	$ 40,020,000	$ 34,598,000	$ 34,464,000	$ 29,041,000
	2053	$ 30,216,000	$ 24,685,000	$ 32,578,000	$ 27,047,000	$ 34,939,000	$ 29,408,000	$ 35,153,000	$ 29,622,000	$ 37,987,000	$ 32,456,000	$ 40,821,000	$ 35,290,000	$ 35,153,000	$ 29,622,000
	2054	$ 30,821,000	$ 25,179,000	$ 33,229,000	$ 27,587,000	$ 35,638,000	$ 29,996,000	$ 35,856,000	$ 30,214,000	$ 38,747,000	$ 33,105,000	$ 41,637,000	$ 35,995,000	$ 35,856,000	$ 30,214,000
	2055	$ 31,437,000	$ 25,682,000	$ 33,894,000	$ 28,139,000	$ 36,351,000	$ 30,596,000	$ 36,573,000	$ 30,819,000	$ 39,522,000	$ 33,767,000	$ 42,470,000	$ 36,715,000	$ 36,573,000	$ 30,819,000
8.	**Total Costs**														
	2025	$ 39,133,000	$ 42,322,000	$ 42,322,000	$ 42,322,000	$ 42,322,000	$ 42,322,000	$ 46,959,000	$ 46,959,000	$ 46,959,000	$ 46,959,000	$ 46,959,000	$ 46,959,000	$ 48,206,000	$ 48,206,000
	2026	$ 39,461,000	$ 42,650,000	$ 42,650,000	$ 42,650,000	$ 42,650,000	$ 42,650,000	$ 47,354,000	$ 47,354,000	$ 47,354,000	$ 47,354,000	$ 47,354,000	$ 47,354,000	$ 48,601,000	$ 48,601,000
	2027	$ 39,796,000	$ 42,985,000	$ 42,985,000	$ 42,985,000	$ 42,985,000	$ 42,985,000	$ 47,756,000	$ 47,756,000	$ 47,756,000	$ 47,756,000	$ 47,756,000	$ 47,756,000	$ 49,003,000	$ 49,003,000
	2028	$ 40,138,000	$ 43,327,000	$ 43,327,000	$ 43,327,000	$ 43,327,000	$ 43,327,000	$ 48,166,000	$ 48,166,000	$ 48,166,000	$ 48,166,000	$ 48,166,000	$ 48,166,000	$ 49,413,000	$ 49,413,000
	2029	$ 40,487,000	$ 43,676,000	$ 43,676,000	$ 43,676,000	$ 43,676,000	$ 43,676,000	$ 48,584,000	$ 48,584,000	$ 48,584,000	$ 48,584,000	$ 48,584,000	$ 48,584,000	$ 49,831,000	$ 49,831,000
	2030	$ 40,842,000	$ 44,031,000	$ 44,031,000	$ 44,031,000	$ 44,031,000	$ 44,031,000	$ 49,011,000	$ 49,011,000	$ 49,011,000	$ 49,011,000	$ 49,011,000	$ 49,011,000	$ 50,258,000	$ 50,258,000
	2031	$ 41,205,000	$ 44,394,000	$ 44,394,000	$ 44,394,000	$ 44,394,000	$ 44,394,000	$ 49,447,000	$ 49,447,000	$ 49,447,000	$ 49,447,000	$ 49,447,000	$ 49,447,000	$ 50,694,000	$ 50,694,000
	2032	$ 41,575,000	$ 44,764,000	$ 44,764,000	$ 44,764,000	$ 44,764,000	$ 44,764,000	$ 49,891,000	$ 49,891,000	$ 49,891,000	$ 49,891,000	$ 49,891,000	$ 49,891,000	$ 51,138,000	$ 51,138,000
	2033	$ 41,953,000	$ 45,142,000	$ 45,142,000	$ 45,142,000	$ 45,142,000	$ 45,142,000	$ 50,343,000	$ 50,343,000	$ 50,343,000	$ 50,343,000	$ 50,343,000	$ 50,343,000	$ 51,590,000	$ 51,590,000
	2034	$ 42,338,000	$ 45,527,000	$ 45,527,000	$ 45,527,000	$ 45,527,000	$ 45,527,000	$ 50,805,000	$ 50,805,000	$ 50,805,000	$ 50,805,000	$ 50,805,000	$ 50,805,000	$ 52,052,000	$ 52,052,000
	2035	$ 42,730,000	$ 45,919,000	$ 45,919,000	$ 45,919,000	$ 45,919,000	$ 45,919,000	$ 51,277,000	$ 51,277,000	$ 51,277,000	$ 51,277,000	$ 51,277,000	$ 51,277,000	$ 52,524,000	$ 52,524,000
	2036	$ 43,131,000	$ 46,320,000	$ 46,320,000	$ 46,320,000	$ 46,320,000	$ 46,320,000	$ 51,757,000	$ 51,757,000	$ 51,757,000	$ 51,757,000	$ 51,757,000	$ 51,757,000	$ 53,004,000	$ 53,004,000
	2037	$ 43,539,000	$ 46,728,000	$ 46,728,000	$ 46,728,000	$ 46,728,000	$ 46,728,000	$ 52,248,000	$ 52,248,000	$ 52,248,000	$ 52,248,000	$ 52,248,000	$ 52,248,000	$ 53,495,000	$ 53,495,000
	2038	$ 43,956,000	$ 47,145,000	$ 47,145,000	$ 47,145,000	$ 47,145,000	$ 47,145,000	$ 52,748,000	$ 52,748,000	$ 52,748,000	$ 52,748,000	$ 52,748,000	$ 52,748,000	$ 53,995,000	$ 53,995,000
	2039	$ 44,381,000	$ 47,570,000	$ 47,570,000	$ 47,570,000	$ 47,570,000	$ 47,570,000	$ 53,258,000	$ 53,258,000	$ 53,258,000	$ 53,258,000	$ 53,258,000	$ 53,258,000	$ 54,505,000	$ 54,505,000
	2040	$ 44,815,000	$ 48,004,000	$ 48,004,000	$ 48,004,000	$ 48,004,000	$ 48,004,000	$ 53,778,000	$ 53,778,000	$ 53,778,000	$ 53,778,000	$ 53,778,000	$ 53,778,000	$ 55,025,000	$ 55,025,000
	2041	$ 45,257,000	$ 48,446,000	$ 48,446,000	$ 48,446,000	$ 48,446,000	$ 48,446,000	$ 54,309,000	$ 54,309,000	$ 54,309,000	$ 54,309,000	$ 54,309,000	$ 54,309,000	$ 55,556,000	$ 55,556,000
	2042	$ 45,708,000	$ 48,897,000	$ 48,897,000	$ 48,897,000	$ 48,897,000	$ 48,897,000	$ 54,850,000	$ 54,850,000	$ 54,850,000	$ 54,850,000	$ 54,850,000	$ 54,850,000	$ 56,097,000	$ 56,097,000
	2043	$ 46,168,000	$ 49,357,000	$ 49,357,000	$ 49,357,000	$ 49,357,000	$ 49,357,000	$ 55,402,000	$ 55,402,000	$ 55,402,000	$ 55,402,000	$ 55,402,000	$ 55,402,000	$ 56,649,000	$ 56,649,000
	2044	$ 46,637,000	$ 49,826,000	$ 49,826,000	$ 49,826,000	$ 49,826,000	$ 49,826,000	$ 55,965,000	$ 55,965,000	$ 55,965,000	$ 55,965,000	$ 55,965,000	$ 55,965,000	$ 57,212,000	$ 57,212,000
	2045	$ 24,412,000	$ 24,412,000	$ 24,412,000	$ 24,412,000	$ 24,412,000	$ 24,412,000	$ 29,294,000	$ 29,294,000	$ 29,294,000	$ 29,294,000	$ 29,294,000	$ 29,294,000	$ 29,294,000	$ 29,294,000
	2046	$ 24,900,000	$ 24,900,000	$ 24,900,000	$ 24,900,000	$ 24,900,000	$ 24,900,000	$ 29,880,000	$ 29,880,000	$ 29,880,000	$ 29,880,000	$ 29,880,000	$ 29,880,000	$ 29,880,000	$ 29,880,000
	2047	$ 25,398,000	$ 25,398,000	$ 25,398,000	$ 25,398,000	$ 25,398,000	$ 25,398,000	$ 30,478,000	$ 30,478,000	$ 30,478,000	$ 30,478,000	$ 30,478,000	$ 30,478,000	$ 30,478,000	$ 30,478,000
	2048	$ 25,906,000	$ 25,906,000	$ 25,906,000	$ 25,906,000	$ 25,906,000	$ 25,906,000	$ 31,087,000	$ 31,087,000	$ 31,087,000	$ 31,087,000	$ 31,087,000	$ 31,087,000	$ 31,087,000	$ 31,087,000
	2049	$ 26,424,000	$ 26,424,000	$ 26,424,000	$ 26,424,000	$ 26,424,000	$ 26,424,000	$ 31,709,000	$ 31,709,000	$ 31,709,000	$ 31,709,000	$ 31,709,000	$ 31,709,000	$ 31,709,000	$ 31,709,000
	2050	$ 26,953,000	$ 26,953,000	$ 26,953,000	$ 26,953,000	$ 26,953,000	$ 26,953,000	$ 32,343,000	$ 32,343,000	$ 32,343,000	$ 32,343,000	$ 32,343,000	$ 32,343,000	$ 32,343,000	$ 32,343,000
	2051	$ 27,492,000	$ 27,492,000	$ 27,492,000	$ 27,492,000	$ 27,492,000	$ 27,492,000	$ 32,990,000	$ 32,990,000	$ 32,990,000	$ 32,990,000	$ 32,990,000	$ 32,990,000	$ 32,990,000	$ 32,990,000
	2052	$ 28,042,000	$ 28,042,000	$ 28,042,000	$ 28,042,000	$ 28,042,000	$ 28,042,000	$ 33,650,000	$ 33,650,000	$ 33,650,000	$ 33,650,000	$ 33,650,000	$ 33,650,000	$ 33,650,000	$ 33,650,000
	2053	$ 28,603,000	$ 28,603,000	$ 28,603,000	$ 28,603,000	$ 28,603,000	$ 28,603,000	$ 34,323,000	$ 34,323,000	$ 34,323,000	$ 34,323,000	$ 34,323,000	$ 34,323,000	$ 34,323,000	$ 34,323,000
	2054	$ 29,175,000	$ 29,175,000	$ 29,175,000	$ 29,175,000	$ 29,175,000	$ 29,175,000	$ 35,010,000	$ 35,010,000	$ 35,010,000	$ 35,010,000	$ 35,010,000	$ 35,010,000	$ 35,010,000	$ 35,010,000
	2055	$ 29,758,000	$ 29,758,000	$ 29,758,000	$ 29,758,000	$ 29,758,000	$ 29,758,000	$ 35,710,000	$ 35,710,000	$ 35,710,000	$ 35,710,000	$ 35,710,000	$ 35,710,000	$ 35,710,000	$ 35,710,000

Item	Description	Live Scenario 1 Quantity	14	15	16	17	18	19	20	21	22	23	24	25	26
	GENERAL ASSUMPTIONS														
9.	**Operating Costs**														
	2025	$ 16,429,000	$ 16,429,000	$ 16,429,000	$ 16,429,000	$ 16,429,000	$ 16,429,000	$ 19,714,000	$ 19,714,000	$ 19,714,000	$ 19,714,000	$ 19,714,000	$ 19,714,000	$ 19,714,000	$ 19,714,000
	2026	$ 16,757,000	$ 16,757,000	$ 16,757,000	$ 16,757,000	$ 16,757,000	$ 16,757,000	$ 20,109,000	$ 20,109,000	$ 20,109,000	$ 20,109,000	$ 20,109,000	$ 20,109,000	$ 20,109,000	$ 20,109,000
	2027	$ 17,092,000	$ 17,092,000	$ 17,092,000	$ 17,092,000	$ 17,092,000	$ 17,092,000	$ 20,511,000	$ 20,511,000	$ 20,511,000	$ 20,511,000	$ 20,511,000	$ 20,511,000	$ 20,511,000	$ 20,511,000
	2028	$ 17,434,000	$ 17,434,000	$ 17,434,000	$ 17,434,000	$ 17,434,000	$ 17,434,000	$ 20,921,000	$ 20,921,000	$ 20,921,000	$ 20,921,000	$ 20,921,000	$ 20,921,000	$ 20,921,000	$ 20,921,000
	2029	$ 17,783,000	$ 17,783,000	$ 17,783,000	$ 17,783,000	$ 17,783,000	$ 17,783,000	$ 21,339,000	$ 21,339,000	$ 21,339,000	$ 21,339,000	$ 21,339,000	$ 21,339,000	$ 21,339,000	$ 21,339,000
	2030	$ 18,138,000	$ 18,138,000	$ 18,138,000	$ 18,138,000	$ 18,138,000	$ 18,138,000	$ 21,766,000	$ 21,766,000	$ 21,766,000	$ 21,766,000	$ 21,766,000	$ 21,766,000	$ 21,766,000	$ 21,766,000
	2031	$ 18,501,000	$ 18,501,000	$ 18,501,000	$ 18,501,000	$ 18,501,000	$ 18,501,000	$ 22,202,000	$ 22,202,000	$ 22,202,000	$ 22,202,000	$ 22,202,000	$ 22,202,000	$ 22,202,000	$ 22,202,000
	2032	$ 18,871,000	$ 18,871,000	$ 18,871,000	$ 18,871,000	$ 18,871,000	$ 18,871,000	$ 22,646,000	$ 22,646,000	$ 22,646,000	$ 22,646,000	$ 22,646,000	$ 22,646,000	$ 22,646,000	$ 22,646,000
	2033	$ 19,249,000	$ 19,249,000	$ 19,249,000	$ 19,249,000	$ 19,249,000	$ 19,249,000	$ 23,098,000	$ 23,098,000	$ 23,098,000	$ 23,098,000	$ 23,098,000	$ 23,098,000	$ 23,098,000	$ 23,098,000
	2034	$ 19,634,000	$ 19,634,000	$ 19,634,000	$ 19,634,000	$ 19,634,000	$ 19,634,000	$ 23,560,000	$ 23,560,000	$ 23,560,000	$ 23,560,000	$ 23,560,000	$ 23,560,000	$ 23,560,000	$ 23,560,000
	2035	$ 20,026,000	$ 20,026,000	$ 20,026,000	$ 20,026,000	$ 20,026,000	$ 20,026,000	$ 24,032,000	$ 24,032,000	$ 24,032,000	$ 24,032,000	$ 24,032,000	$ 24,032,000	$ 24,032,000	$ 24,032,000
	2036	$ 20,427,000	$ 20,427,000	$ 20,427,000	$ 20,427,000	$ 20,427,000	$ 20,427,000	$ 24,512,000	$ 24,512,000	$ 24,512,000	$ 24,512,000	$ 24,512,000	$ 24,512,000	$ 24,512,000	$ 24,512,000
	2037	$ 20,835,000	$ 20,835,000	$ 20,835,000	$ 20,835,000	$ 20,835,000	$ 20,835,000	$ 25,003,000	$ 25,003,000	$ 25,003,000	$ 25,003,000	$ 25,003,000	$ 25,003,000	$ 25,003,000	$ 25,003,000
	2038	$ 21,252,000	$ 21,252,000	$ 21,252,000	$ 21,252,000	$ 21,252,000	$ 21,252,000	$ 25,503,000	$ 25,503,000	$ 25,503,000	$ 25,503,000	$ 25,503,000	$ 25,503,000	$ 25,503,000	$ 25,503,000
	2039	$ 21,677,000	$ 21,677,000	$ 21,677,000	$ 21,677,000	$ 21,677,000	$ 21,677,000	$ 26,013,000	$ 26,013,000	$ 26,013,000	$ 26,013,000	$ 26,013,000	$ 26,013,000	$ 26,013,000	$ 26,013,000
	2040	$ 22,111,000	$ 22,111,000	$ 22,111,000	$ 22,111,000	$ 22,111,000	$ 22,111,000	$ 26,533,000	$ 26,533,000	$ 26,533,000	$ 26,533,000	$ 26,533,000	$ 26,533,000	$ 26,533,000	$ 26,533,000
	2041	$ 22,553,000	$ 22,553,000	$ 22,553,000	$ 22,553,000	$ 22,553,000	$ 22,553,000	$ 27,064,000	$ 27,064,000	$ 27,064,000	$ 27,064,000	$ 27,064,000	$ 27,064,000	$ 27,064,000	$ 27,064,000
	2042	$ 23,004,000	$ 23,004,000	$ 23,004,000	$ 23,004,000	$ 23,004,000	$ 23,004,000	$ 27,605,000	$ 27,605,000	$ 27,605,000	$ 27,605,000	$ 27,605,000	$ 27,605,000	$ 27,605,000	$ 27,605,000
	2043	$ 23,464,000	$ 23,464,000	$ 23,464,000	$ 23,464,000	$ 23,464,000	$ 23,464,000	$ 28,157,000	$ 28,157,000	$ 28,157,000	$ 28,157,000	$ 28,157,000	$ 28,157,000	$ 28,157,000	$ 28,157,000
	2044	$ 23,933,000	$ 23,933,000	$ 23,933,000	$ 23,933,000	$ 23,933,000	$ 23,933,000	$ 28,720,000	$ 28,720,000	$ 28,720,000	$ 28,720,000	$ 28,720,000	$ 28,720,000	$ 28,720,000	$ 28,720,000
	2045	$ 24,412,000	$ 24,412,000	$ 24,412,000	$ 24,412,000	$ 24,412,000	$ 24,412,000	$ 29,294,000	$ 29,294,000	$ 29,294,000	$ 29,294,000	$ 29,294,000	$ 29,294,000	$ 29,294,000	$ 29,294,000
	2046	$ 24,900,000	$ 24,900,000	$ 24,900,000	$ 24,900,000	$ 24,900,000	$ 24,900,000	$ 29,880,000	$ 29,880,000	$ 29,880,000	$ 29,880,000	$ 29,880,000	$ 29,880,000	$ 29,880,000	$ 29,880,000
	2047	$ 25,398,000	$ 25,398,000	$ 25,398,000	$ 25,398,000	$ 25,398,000	$ 25,398,000	$ 30,478,000	$ 30,478,000	$ 30,478,000	$ 30,478,000	$ 30,478,000	$ 30,478,000	$ 30,478,000	$ 30,478,000
	2048	$ 25,906,000	$ 25,906,000	$ 25,906,000	$ 25,906,000	$ 25,906,000	$ 25,906,000	$ 31,087,000	$ 31,087,000	$ 31,087,000	$ 31,087,000	$ 31,087,000	$ 31,087,000	$ 31,087,000	$ 31,087,000
	2049	$ 26,424,000	$ 26,424,000	$ 26,424,000	$ 26,424,000	$ 26,424,000	$ 26,424,000	$ 31,709,000	$ 31,709,000	$ 31,709,000	$ 31,709,000	$ 31,709,000	$ 31,709,000	$ 31,709,000	$ 31,709,000
	2050	$ 26,953,000	$ 26,953,000	$ 26,953,000	$ 26,953,000	$ 26,953,000	$ 26,953,000	$ 32,343,000	$ 32,343,000	$ 32,343,000	$ 32,343,000	$ 32,343,000	$ 32,343,000	$ 32,343,000	$ 32,343,000
	2051	$ 27,492,000	$ 27,492,000	$ 27,492,000	$ 27,492,000	$ 27,492,000	$ 27,492,000	$ 32,990,000	$ 32,990,000	$ 32,990,000	$ 32,990,000	$ 32,990,000	$ 32,990,000	$ 32,990,000	$ 32,990,000
	2052	$ 28,042,000	$ 28,042,000	$ 28,042,000	$ 28,042,000	$ 28,042,000	$ 28,042,000	$ 33,650,000	$ 33,650,000	$ 33,650,000	$ 33,650,000	$ 33,650,000	$ 33,650,000	$ 33,650,000	$ 33,650,000
	2053	$ 28,603,000	$ 28,603,000	$ 28,603,000	$ 28,603,000	$ 28,603,000	$ 28,603,000	$ 34,323,000	$ 34,323,000	$ 34,323,000	$ 34,323,000	$ 34,323,000	$ 34,323,000	$ 34,323,000	$ 34,323,000
	2054	$ 29,175,000	$ 29,175,000	$ 29,175,000	$ 29,175,000	$ 29,175,000	$ 29,175,000	$ 35,010,000	$ 35,010,000	$ 35,010,000	$ 35,010,000	$ 35,010,000	$ 35,010,000	$ 35,010,000	$ 35,010,000
	2055	$ 29,758,000	$ 29,758,000	$ 29,758,000	$ 29,758,000	$ 29,758,000	$ 29,758,000	$ 35,710,000	$ 35,710,000	$ 35,710,000	$ 35,710,000	$ 35,710,000	$ 35,710,000	$ 35,710,000	$ 35,710,000
10.	**Debt Service**														
	2025	$ 22,704,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 28,492,000	$ 28,492,000
	2026	$ 22,704,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 28,492,000	$ 28,492,000
	2027	$ 22,704,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 28,492,000	$ 28,492,000
	2028	$ 22,704,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 28,492,000	$ 28,492,000
	2029	$ 22,704,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 28,492,000	$ 28,492,000
	2030	$ 22,704,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 28,492,000	$ 28,492,000
	2031	$ 22,704,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 28,492,000	$ 28,492,000
	2032	$ 22,704,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 28,492,000	$ 28,492,000
	2033	$ 22,704,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 28,492,000	$ 28,492,000
	2034	$ 22,704,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 28,492,000	$ 28,492,000
	2035	$ 22,704,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 28,492,000	$ 28,492,000
	2036	$ 22,704,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 28,492,000	$ 28,492,000
	2037	$ 22,704,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 28,492,000	$ 28,492,000
	2038	$ 22,704,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 28,492,000	$ 28,492,000
	2039	$ 22,704,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 28,492,000	$ 28,492,000
	2040	$ 22,704,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 28,492,000	$ 28,492,000
	2041	$ 22,704,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 28,492,000	$ 28,492,000
	2042	$ 22,704,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 28,492,000	$ 28,492,000
	2043	$ 22,704,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 28,492,000	$ 28,492,000
	2044	$ 22,704,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 25,893,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 27,245,000	$ 28,492,000	$ 28,492,000
	2045	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	2046	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	2047	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -

Live Scenario
1

Item	Description	Quantity	14	15	16	17	18	19	20	21	22	23	24	25	26
	GENERAL ASSUMPTIONS														
	2048	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	2049	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	2050	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	2051	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	2052	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	2053	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	2054	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	2055	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
11.	**Waste Processed (tons)**														
	2025	328,500	328,500	328,500	328,500	328,500	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200
	2026	328,500	328,500	328,500	328,500	328,500	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200
	2027	328,500	328,500	328,500	328,500	328,500	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200
	2028	328,500	328,500	328,500	328,500	328,500	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200
	2029	328,500	328,500	328,500	328,500	328,500	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200
	2030	328,500	328,500	328,500	328,500	328,500	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200
	2031	328,500	328,500	328,500	328,500	328,500	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200
	2032	328,500	328,500	328,500	328,500	328,500	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200
	2033	328,500	328,500	328,500	328,500	328,500	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200
	2034	328,500	328,500	328,500	328,500	328,500	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200
	2035	328,500	328,500	328,500	328,500	328,500	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200
	2036	328,500	328,500	328,500	328,500	328,500	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200
	2037	328,500	328,500	328,500	328,500	328,500	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200
	2038	328,500	328,500	328,500	328,500	328,500	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200
	2039	328,500	328,500	328,500	328,500	328,500	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200
	2040	328,500	328,500	328,500	328,500	328,500	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200
	2041	328,500	328,500	328,500	328,500	328,500	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200
	2042	328,500	328,500	328,500	328,500	328,500	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200
	2043	328,500	328,500	328,500	328,500	328,500	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200
	2044	328,500	328,500	328,500	328,500	328,500	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200
	2045	328,500	328,500	328,500	328,500	328,500	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200
	2046	328,500	328,500	328,500	328,500	328,500	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200
	2047	328,500	328,500	328,500	328,500	328,500	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200
	2048	328,500	328,500	328,500	328,500	328,500	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200
	2049	328,500	328,500	328,500	328,500	328,500	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200
	2050	328,500	328,500	328,500	328,500	328,500	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200
	2051	328,500	328,500	328,500	328,500	328,500	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200
	2052	328,500	328,500	328,500	328,500	328,500	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200
	2053	328,500	328,500	328,500	328,500	328,500	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200
	2054	328,500	328,500	328,500	328,500	328,500	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200
	2055	328,500	328,500	328,500	328,500	328,500	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200

3.0 Summary

Item	Description	Live Scenario 1 Quantity	27	28	29	30	31	32	33	34	35	36	37	38	39
	GENERAL ASSUMPTIONS														
1.	Processing Rate (tons/day)	1,000	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200			
2.	Interest Rate - Debt Financing	3.50%	4.00%	4.00%	4.00%	4.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%			
3.	Energy Revenues from Electricity	$0.06/kWh	$0.068/kWh	$0.068/kWh	$0.075/kWh	$0.075/kWh	$0.061/kWh	$0.061/kWh	$0.068/kWh	$0.068/kWh	$0.075/kWh	$0.075/kWh			
4.	Biosolids Incineration Revenue	$ 3,177,000	$ 3,177,000	$ -	$ 3,177,000	$ -	$ 3,177,000	$ -	$ 3,177,000	$ -	$ 3,177,000	$ -			
5.	**Summary of Net Costs (Revenue - Expenses), $/ton**														
	2025 - 2029 average tip fee	$ 66.18	$ 66.72	$ 75.11	$ 62.42	$ 70.81	$ 77.56	$ 85.95	$ 73.26	$ 81.65	$ 68.97	$ 77.36			
	2030 - 2034 average tip fee	$ 65.87	$ 66.14	$ 75.40	$ 61.40	$ 70.66	$ 77.43	$ 86.69	$ 72.69	$ 81.95	$ 67.94	$ 77.20			
	2035 - 2039 average tip fee	$ 65.53	$ 65.51	$ 75.73	$ 60.27	$ 70.49	$ 77.29	$ 87.51	$ 72.05	$ 82.27	$ 66.81	$ 77.03			
	2040 - 2044 average tip fee	$ 65.16	$ 64.80	$ 76.09	$ 59.02	$ 70.31	$ 77.13	$ 88.42	$ 71.34	$ 82.63	$ 65.56	$ 76.85			
	2045 - 2049 average tip fee	$ (4.36)	$ (8.26)	$ 4.21	$ (14.64)	$ (2.18)	$ (1.87)	$ 10.59	$ (8.26)	$ 4.21	$ (14.64)	$ (2.18)			
	2050 - 2054 average tip fee	$ (4.82)	$ (9.12)	$ 4.65	$ (16.17)	$ (2.40)	$ (2.07)	$ 11.70	$ (9.12)	$ 4.65	$ (16.17)	$ (2.40)			
	2025 - 2054 average tip fee	$ 54.00	$ 40.97	$ 51.86	$ 35.38	$ 46.28	$ 50.91	$ 61.81	$ 45.33	$ 56.23	$ 39.74	$ 50.64			
6.	**Net Costs (Revenue - Expenses), $/ton**														
	2025	$ 66.30	$ 66.94	$ 75.00	$ 62.81	$ 70.87	$ 77.61	$ 85.67	$ 73.48	$ 81.54	$ 69.35	$ 77.41			
	2026	$ 66.23	$ 66.83	$ 75.05	$ 62.62	$ 70.84	$ 77.59	$ 85.81	$ 73.38	$ 81.60	$ 69.17	$ 77.38			
	2027	$ 66.18	$ 66.73	$ 75.11	$ 62.43	$ 70.81	$ 77.56	$ 85.95	$ 73.27	$ 81.65	$ 68.97	$ 77.36			
	2028	$ 66.12	$ 66.61	$ 75.16	$ 62.23	$ 70.78	$ 77.54	$ 86.09	$ 73.16	$ 81.71	$ 68.77	$ 77.33			
	2029	$ 66.06	$ 66.50	$ 75.22	$ 62.03	$ 70.75	$ 77.51	$ 86.23	$ 73.04	$ 81.77	$ 68.57	$ 77.30			
	2030	$ 66.00	$ 66.38	$ 75.28	$ 61.82	$ 70.72	$ 77.48	$ 86.38	$ 72.92	$ 81.82	$ 68.37	$ 77.27			
	2031	$ 65.94	$ 66.27	$ 75.34	$ 61.62	$ 70.69	$ 77.46	$ 86.53	$ 72.81	$ 81.88	$ 68.16	$ 77.23			
	2032	$ 65.87	$ 66.15	$ 75.40	$ 61.40	$ 70.66	$ 77.43	$ 86.69	$ 72.69	$ 81.95	$ 67.95	$ 77.20			
	2033	$ 65.81	$ 66.02	$ 75.46	$ 61.18	$ 70.63	$ 77.40	$ 86.84	$ 72.56	$ 82.01	$ 67.73	$ 77.17			
	2034	$ 65.74	$ 65.90	$ 75.53	$ 60.96	$ 70.59	$ 77.37	$ 87.01	$ 72.44	$ 82.07	$ 67.50	$ 77.14			
	2035	$ 65.67	$ 65.77	$ 75.60	$ 60.74	$ 70.56	$ 77.35	$ 87.17	$ 72.31	$ 82.14	$ 67.28	$ 77.11			
	2036	$ 65.61	$ 65.64	$ 75.66	$ 60.50	$ 70.53	$ 77.32	$ 87.34	$ 72.18	$ 82.20	$ 67.05	$ 77.07			
	2037	$ 65.53	$ 65.51	$ 75.73	$ 60.27	$ 70.49	$ 77.29	$ 87.51	$ 72.05	$ 82.27	$ 66.81	$ 77.03			
	2038	$ 65.46	$ 65.37	$ 75.80	$ 60.03	$ 70.46	$ 77.26	$ 87.68	$ 71.92	$ 82.34	$ 66.58	$ 77.00			
	2039	$ 65.39	$ 65.24	$ 75.87	$ 59.79	$ 70.42	$ 77.22	$ 87.86	$ 71.78	$ 82.41	$ 66.33	$ 76.96			
	2040	$ 65.32	$ 65.09	$ 75.94	$ 59.54	$ 70.38	$ 77.19	$ 88.04	$ 71.64	$ 82.48	$ 66.08	$ 76.93			
	2041	$ 65.24	$ 64.95	$ 76.01	$ 59.28	$ 70.35	$ 77.16	$ 88.22	$ 71.49	$ 82.56	$ 65.82	$ 76.89			
	2042	$ 65.16	$ 64.80	$ 76.09	$ 59.02	$ 70.31	$ 77.13	$ 88.41	$ 71.34	$ 82.63	$ 65.56	$ 76.85			
	2043	$ 65.08	$ 64.65	$ 76.16	$ 58.76	$ 70.27	$ 77.09	$ 88.60	$ 71.19	$ 82.71	$ 65.30	$ 76.81			
	2044	$ 65.00	$ 64.50	$ 76.24	$ 58.49	$ 70.23	$ 77.06	$ 88.80	$ 71.04	$ 82.78	$ 65.03	$ 76.77			
	2045	$ (4.19)	$ (7.94)	$ 4.04	$ (14.07)	$ (2.09)	$ (1.80)	$ 10.18	$ (7.94)	$ 4.04	$ (14.07)	$ (2.09)			
	2046	$ (4.28)	$ (8.09)	$ 4.12	$ (14.35)	$ (2.14)	$ (1.83)	$ 10.38	$ (8.09)	$ 4.12	$ (14.35)	$ (2.14)			
	2047	$ (4.36)	$ (8.25)	$ 4.21	$ (14.64)	$ (2.18)	$ (1.87)	$ 10.59	$ (8.25)	$ 4.21	$ (14.64)	$ (2.18)			
	2048	$ (4.45)	$ (8.42)	$ 4.29	$ (14.93)	$ (2.22)	$ (1.91)	$ 10.80	$ (8.42)	$ 4.29	$ (14.93)	$ (2.22)			
	2049	$ (4.54)	$ (8.59)	$ 4.38	$ (15.23)	$ (2.27)	$ (1.95)	$ 11.02	$ (8.59)	$ 4.38	$ (15.23)	$ (2.27)			
	2050	$ (4.63)	$ (8.76)	$ 4.46	$ (15.53)	$ (2.31)	$ (1.99)	$ 11.24	$ (8.76)	$ 4.46	$ (15.53)	$ (2.31)			
	2051	$ (4.72)	$ (8.93)	$ 4.55	$ (15.84)	$ (2.36)	$ (2.02)	$ 11.46	$ (8.93)	$ 4.55	$ (15.84)	$ (2.36)			
	2052	$ (4.82)	$ (9.11)	$ 4.64	$ (16.16)	$ (2.40)	$ (2.06)	$ 11.69	$ (9.11)	$ 4.64	$ (16.16)	$ (2.40)			
	2053	$ (4.91)	$ (9.29)	$ 4.74	$ (16.48)	$ (2.45)	$ (2.11)	$ 11.93	$ (9.29)	$ 4.74	$ (16.48)	$ (2.45)			
	2054	$ (5.01)	$ (9.48)	$ 4.83	$ (16.81)	$ (2.50)	$ (2.15)	$ 12.17	$ (9.48)	$ 4.83	$ (16.81)	$ (2.50)			
	2055	$ (5.11)	$ (9.67)	$ 4.93	$ (17.15)	$ (2.55)	$ (2.19)	$ 12.41	$ (9.67)	$ 4.93	$ (17.15)	$ (2.55)			
7.	**Total Revenue**														
	2025	$ 17,355,000	$ 21,819,000	$ 18,642,000	$ 23,446,000	$ 20,269,000	$ 20,191,000	$ 17,014,000	$ 21,819,000	$ 18,642,000	$ 23,446,000	$ 20,269,000			
	2026	$ 17,703,000	$ 22,255,000	$ 19,015,000	$ 23,915,000	$ 20,675,000	$ 20,595,000	$ 17,354,000	$ 22,255,000	$ 19,015,000	$ 23,915,000	$ 20,675,000			
	2027	$ 18,057,000	$ 22,700,000	$ 19,395,000	$ 24,394,000	$ 21,088,000	$ 21,007,000	$ 17,702,000	$ 22,700,000	$ 19,395,000	$ 24,394,000	$ 21,088,000			
	2028	$ 18,418,000	$ 23,154,000	$ 19,783,000	$ 24,882,000	$ 21,510,000	$ 21,427,000	$ 18,056,000	$ 23,154,000	$ 19,783,000	$ 24,882,000	$ 21,510,000			
	2029	$ 18,786,000	$ 23,617,000	$ 20,178,000	$ 25,379,000	$ 21,940,000	$ 21,856,000	$ 18,417,000	$ 23,617,000	$ 20,178,000	$ 25,379,000	$ 21,940,000			
	2030	$ 19,162,000	$ 24,090,000	$ 20,582,000	$ 25,887,000	$ 22,379,000	$ 22,293,000	$ 18,785,000	$ 24,090,000	$ 20,582,000	$ 25,887,000	$ 22,379,000			

Item	Description	Quantity	27	28	29	30	31	32	33	34	35	36	37	38	39
		Live Scenario 1													
	GENERAL ASSUMPTIONS														
	2031	$ 19,545,000	$ 24,572,000	$ 20,994,000	$ 26,405,000	$ 22,827,000	$ 22,738,000	$ 19,161,000	$ 24,572,000	$ 20,994,000	$ 26,405,000	$ 22,827,000			
	2032	$ 19,936,000	$ 25,063,000	$ 21,414,000	$ 26,933,000	$ 23,283,000	$ 23,193,000	$ 19,544,000	$ 25,063,000	$ 21,414,000	$ 26,933,000	$ 23,283,000			
	2033	$ 20,335,000	$ 25,564,000	$ 21,842,000	$ 27,471,000	$ 23,749,000	$ 23,657,000	$ 19,935,000	$ 25,564,000	$ 21,842,000	$ 27,471,000	$ 23,749,000			
	2034	$ 20,741,000	$ 26,075,000	$ 22,279,000	$ 28,021,000	$ 24,224,000	$ 24,130,000	$ 20,333,000	$ 26,075,000	$ 22,279,000	$ 28,021,000	$ 24,224,000			
	2035	$ 21,156,000	$ 26,597,000	$ 22,724,000	$ 28,581,000	$ 24,708,000	$ 24,613,000	$ 20,740,000	$ 26,597,000	$ 22,724,000	$ 28,581,000	$ 24,708,000			
	2036	$ 21,579,000	$ 27,129,000	$ 23,179,000	$ 29,153,000	$ 25,203,000	$ 25,105,000	$ 21,155,000	$ 27,129,000	$ 23,179,000	$ 29,153,000	$ 25,203,000			
	2037	$ 22,011,000	$ 27,672,000	$ 23,642,000	$ 29,736,000	$ 25,707,000	$ 25,607,000	$ 21,578,000	$ 27,672,000	$ 23,642,000	$ 29,736,000	$ 25,707,000			
	2038	$ 22,451,000	$ 28,225,000	$ 24,115,000	$ 30,330,000	$ 26,221,000	$ 26,119,000	$ 22,010,000	$ 28,225,000	$ 24,115,000	$ 30,330,000	$ 26,221,000			
	2039	$ 22,900,000	$ 28,789,000	$ 24,597,000	$ 30,937,000	$ 26,745,000	$ 26,642,000	$ 22,450,000	$ 28,789,000	$ 24,597,000	$ 30,937,000	$ 26,745,000			
	2040	$ 23,358,000	$ 29,365,000	$ 25,089,000	$ 31,556,000	$ 27,280,000	$ 27,175,000	$ 22,899,000	$ 29,365,000	$ 25,089,000	$ 31,556,000	$ 27,280,000			
	2041	$ 23,825,000	$ 29,953,000	$ 25,591,000	$ 32,187,000	$ 27,826,000	$ 27,718,000	$ 23,357,000	$ 29,953,000	$ 25,591,000	$ 32,187,000	$ 27,826,000			
	2042	$ 24,302,000	$ 30,552,000	$ 26,103,000	$ 32,831,000	$ 28,382,000	$ 28,272,000	$ 23,824,000	$ 30,552,000	$ 26,103,000	$ 32,831,000	$ 28,382,000			
	2043	$ 24,788,000	$ 31,163,000	$ 26,625,000	$ 33,487,000	$ 28,950,000	$ 28,838,000	$ 24,300,000	$ 31,163,000	$ 26,625,000	$ 33,487,000	$ 28,950,000			
	2044	$ 25,284,000	$ 31,786,000	$ 27,158,000	$ 34,157,000	$ 29,529,000	$ 29,415,000	$ 24,786,000	$ 31,786,000	$ 27,158,000	$ 34,157,000	$ 29,529,000			
	2045	$ 25,789,000	$ 32,422,000	$ 27,701,000	$ 34,840,000	$ 30,119,000	$ 30,003,000	$ 25,282,000	$ 32,422,000	$ 27,701,000	$ 34,840,000	$ 30,119,000			
	2046	$ 26,305,000	$ 33,070,000	$ 28,255,000	$ 35,537,000	$ 30,722,000	$ 30,603,000	$ 25,788,000	$ 33,070,000	$ 28,255,000	$ 35,537,000	$ 30,722,000			
	2047	$ 26,831,000	$ 33,731,000	$ 28,820,000	$ 36,248,000	$ 31,336,000	$ 31,215,000	$ 26,304,000	$ 33,731,000	$ 28,820,000	$ 36,248,000	$ 31,336,000			
	2048	$ 27,368,000	$ 34,406,000	$ 29,396,000	$ 36,973,000	$ 31,963,000	$ 31,839,000	$ 26,830,000	$ 34,406,000	$ 29,396,000	$ 36,973,000	$ 31,963,000			
	2049	$ 27,915,000	$ 35,094,000	$ 29,984,000	$ 37,712,000	$ 32,602,000	$ 32,476,000	$ 27,366,000	$ 35,094,000	$ 29,984,000	$ 37,712,000	$ 32,602,000			
	2050	$ 28,473,000	$ 35,796,000	$ 30,584,000	$ 38,466,000	$ 33,254,000	$ 33,126,000	$ 27,913,000	$ 35,796,000	$ 30,584,000	$ 38,466,000	$ 33,254,000			
	2051	$ 29,043,000	$ 36,512,000	$ 31,196,000	$ 39,236,000	$ 33,919,000	$ 33,788,000	$ 28,472,000	$ 36,512,000	$ 31,196,000	$ 39,236,000	$ 33,919,000			
	2052	$ 29,624,000	$ 37,242,000	$ 31,819,000	$ 40,020,000	$ 34,598,000	$ 34,464,000	$ 29,041,000	$ 37,242,000	$ 31,819,000	$ 40,020,000	$ 34,598,000			
	2053	$ 30,216,000	$ 37,987,000	$ 32,456,000	$ 40,821,000	$ 35,290,000	$ 35,153,000	$ 29,622,000	$ 37,987,000	$ 32,456,000	$ 40,821,000	$ 35,290,000			
	2054	$ 30,821,000	$ 38,747,000	$ 33,105,000	$ 41,637,000	$ 35,995,000	$ 35,856,000	$ 30,214,000	$ 38,747,000	$ 33,105,000	$ 41,637,000	$ 35,995,000			
	2055	$ 31,437,000	$ 39,522,000	$ 33,767,000	$ 42,470,000	$ 36,715,000	$ 36,573,000	$ 30,819,000	$ 39,522,000	$ 33,767,000	$ 42,470,000	$ 36,715,000			
8.	**Total Costs**														
	2025	$ 39,133,000	$ 48,206,000	$ 48,206,000	$ 48,206,000	$ 48,206,000	$ 50,785,000	$ 50,785,000	$ 50,785,000	$ 50,785,000	$ 50,785,000	$ 50,785,000			
	2026	$ 39,461,000	$ 48,601,000	$ 48,601,000	$ 48,601,000	$ 48,601,000	$ 51,180,000	$ 51,180,000	$ 51,180,000	$ 51,180,000	$ 51,180,000	$ 51,180,000			
	2027	$ 39,796,000	$ 49,003,000	$ 49,003,000	$ 49,003,000	$ 49,003,000	$ 51,582,000	$ 51,582,000	$ 51,582,000	$ 51,582,000	$ 51,582,000	$ 51,582,000			
	2028	$ 40,138,000	$ 49,413,000	$ 49,413,000	$ 49,413,000	$ 49,413,000	$ 51,992,000	$ 51,992,000	$ 51,992,000	$ 51,992,000	$ 51,992,000	$ 51,992,000			
	2029	$ 40,487,000	$ 49,831,000	$ 49,831,000	$ 49,831,000	$ 49,831,000	$ 52,410,000	$ 52,410,000	$ 52,410,000	$ 52,410,000	$ 52,410,000	$ 52,410,000			
	2030	$ 40,842,000	$ 50,258,000	$ 50,258,000	$ 50,258,000	$ 50,258,000	$ 52,837,000	$ 52,837,000	$ 52,837,000	$ 52,837,000	$ 52,837,000	$ 52,837,000			
	2031	$ 41,205,000	$ 50,694,000	$ 50,694,000	$ 50,694,000	$ 50,694,000	$ 53,273,000	$ 53,273,000	$ 53,273,000	$ 53,273,000	$ 53,273,000	$ 53,273,000			
	2032	$ 41,575,000	$ 51,138,000	$ 51,138,000	$ 51,138,000	$ 51,138,000	$ 53,717,000	$ 53,717,000	$ 53,717,000	$ 53,717,000	$ 53,717,000	$ 53,717,000			
	2033	$ 41,953,000	$ 51,590,000	$ 51,590,000	$ 51,590,000	$ 51,590,000	$ 54,169,000	$ 54,169,000	$ 54,169,000	$ 54,169,000	$ 54,169,000	$ 54,169,000			
	2034	$ 42,338,000	$ 52,052,000	$ 52,052,000	$ 52,052,000	$ 52,052,000	$ 54,631,000	$ 54,631,000	$ 54,631,000	$ 54,631,000	$ 54,631,000	$ 54,631,000			
	2035	$ 42,730,000	$ 52,524,000	$ 52,524,000	$ 52,524,000	$ 52,524,000	$ 55,103,000	$ 55,103,000	$ 55,103,000	$ 55,103,000	$ 55,103,000	$ 55,103,000			
	2036	$ 43,131,000	$ 53,004,000	$ 53,004,000	$ 53,004,000	$ 53,004,000	$ 55,583,000	$ 55,583,000	$ 55,583,000	$ 55,583,000	$ 55,583,000	$ 55,583,000			
	2037	$ 43,539,000	$ 53,495,000	$ 53,495,000	$ 53,495,000	$ 53,495,000	$ 56,074,000	$ 56,074,000	$ 56,074,000	$ 56,074,000	$ 56,074,000	$ 56,074,000			
	2038	$ 43,956,000	$ 53,995,000	$ 53,995,000	$ 53,995,000	$ 53,995,000	$ 56,574,000	$ 56,574,000	$ 56,574,000	$ 56,574,000	$ 56,574,000	$ 56,574,000			
	2039	$ 44,381,000	$ 54,505,000	$ 54,505,000	$ 54,505,000	$ 54,505,000	$ 57,084,000	$ 57,084,000	$ 57,084,000	$ 57,084,000	$ 57,084,000	$ 57,084,000			
	2040	$ 44,815,000	$ 55,025,000	$ 55,025,000	$ 55,025,000	$ 55,025,000	$ 57,604,000	$ 57,604,000	$ 57,604,000	$ 57,604,000	$ 57,604,000	$ 57,604,000			
	2041	$ 45,257,000	$ 55,556,000	$ 55,556,000	$ 55,556,000	$ 55,556,000	$ 58,135,000	$ 58,135,000	$ 58,135,000	$ 58,135,000	$ 58,135,000	$ 58,135,000			
	2042	$ 45,708,000	$ 56,097,000	$ 56,097,000	$ 56,097,000	$ 56,097,000	$ 58,676,000	$ 58,676,000	$ 58,676,000	$ 58,676,000	$ 58,676,000	$ 58,676,000			
	2043	$ 46,168,000	$ 56,649,000	$ 56,649,000	$ 56,649,000	$ 56,649,000	$ 59,228,000	$ 59,228,000	$ 59,228,000	$ 59,228,000	$ 59,228,000	$ 59,228,000			
	2044	$ 46,637,000	$ 57,212,000	$ 57,212,000	$ 57,212,000	$ 57,212,000	$ 59,791,000	$ 59,791,000	$ 59,791,000	$ 59,791,000	$ 59,791,000	$ 59,791,000			
	2045	$ 24,412,000	$ 29,294,000	$ 29,294,000	$ 29,294,000	$ 29,294,000	$ 29,294,000	$ 29,294,000	$ 29,294,000	$ 29,294,000	$ 29,294,000	$ 29,294,000			
	2046	$ 24,900,000	$ 29,880,000	$ 29,880,000	$ 29,880,000	$ 29,880,000	$ 29,880,000	$ 29,880,000	$ 29,880,000	$ 29,880,000	$ 29,880,000	$ 29,880,000			
	2047	$ 25,398,000	$ 30,478,000	$ 30,478,000	$ 30,478,000	$ 30,478,000	$ 30,478,000	$ 30,478,000	$ 30,478,000	$ 30,478,000	$ 30,478,000	$ 30,478,000			
	2048	$ 25,906,000	$ 31,087,000	$ 31,087,000	$ 31,087,000	$ 31,087,000	$ 31,087,000	$ 31,087,000	$ 31,087,000	$ 31,087,000	$ 31,087,000	$ 31,087,000			
	2049	$ 26,424,000	$ 31,709,000	$ 31,709,000	$ 31,709,000	$ 31,709,000	$ 31,709,000	$ 31,709,000	$ 31,709,000	$ 31,709,000	$ 31,709,000	$ 31,709,000			
	2050	$ 26,953,000	$ 32,343,000	$ 32,343,000	$ 32,343,000	$ 32,343,000	$ 32,343,000	$ 32,343,000	$ 32,343,000	$ 32,343,000	$ 32,343,000	$ 32,343,000			
	2051	$ 27,492,000	$ 32,990,000	$ 32,990,000	$ 32,990,000	$ 32,990,000	$ 32,990,000	$ 32,990,000	$ 32,990,000	$ 32,990,000	$ 32,990,000	$ 32,990,000			
	2052	$ 28,042,000	$ 33,650,000	$ 33,650,000	$ 33,650,000	$ 33,650,000	$ 33,650,000	$ 33,650,000	$ 33,650,000	$ 33,650,000	$ 33,650,000	$ 33,650,000			
	2053	$ 28,603,000	$ 34,323,000	$ 34,323,000	$ 34,323,000	$ 34,323,000	$ 34,323,000	$ 34,323,000	$ 34,323,000	$ 34,323,000	$ 34,323,000	$ 34,323,000			
	2054	$ 29,175,000	$ 35,010,000	$ 35,010,000	$ 35,010,000	$ 35,010,000	$ 35,010,000	$ 35,010,000	$ 35,010,000	$ 35,010,000	$ 35,010,000	$ 35,010,000			
	2055	$ 29,758,000	$ 35,710,000	$ 35,710,000	$ 35,710,000	$ 35,710,000	$ 35,710,000	$ 35,710,000	$ 35,710,000	$ 35,710,000	$ 35,710,000	$ 35,710,000			

		Live Scenario												
		1												
Item	Description	Quantity	27	28	29	30	31	32	33	34	35	36	37	38	39
	GENERAL ASSUMPTIONS														
9.	**Operating Costs**														
	2025	$ 16,429,000	$ 19,714,000	$ 19,714,000	$ 19,714,000	$ 19,714,000	$ 19,714,000	$ 19,714,000	$ 19,714,000	$ 19,714,000	$ 19,714,000	$ 19,714,000			
	2026	$ 16,757,000	$ 20,109,000	$ 20,109,000	$ 20,109,000	$ 20,109,000	$ 20,109,000	$ 20,109,000	$ 20,109,000	$ 20,109,000	$ 20,109,000	$ 20,109,000			
	2027	$ 17,092,000	$ 20,511,000	$ 20,511,000	$ 20,511,000	$ 20,511,000	$ 20,511,000	$ 20,511,000	$ 20,511,000	$ 20,511,000	$ 20,511,000	$ 20,511,000			
	2028	$ 17,434,000	$ 20,921,000	$ 20,921,000	$ 20,921,000	$ 20,921,000	$ 20,921,000	$ 20,921,000	$ 20,921,000	$ 20,921,000	$ 20,921,000	$ 20,921,000			
	2029	$ 17,783,000	$ 21,339,000	$ 21,339,000	$ 21,339,000	$ 21,339,000	$ 21,339,000	$ 21,339,000	$ 21,339,000	$ 21,339,000	$ 21,339,000	$ 21,339,000			
	2030	$ 18,138,000	$ 21,766,000	$ 21,766,000	$ 21,766,000	$ 21,766,000	$ 21,766,000	$ 21,766,000	$ 21,766,000	$ 21,766,000	$ 21,766,000	$ 21,766,000			
	2031	$ 18,501,000	$ 22,202,000	$ 22,202,000	$ 22,202,000	$ 22,202,000	$ 22,202,000	$ 22,202,000	$ 22,202,000	$ 22,202,000	$ 22,202,000	$ 22,202,000			
	2032	$ 18,871,000	$ 22,646,000	$ 22,646,000	$ 22,646,000	$ 22,646,000	$ 22,646,000	$ 22,646,000	$ 22,646,000	$ 22,646,000	$ 22,646,000	$ 22,646,000			
	2033	$ 19,249,000	$ 23,098,000	$ 23,098,000	$ 23,098,000	$ 23,098,000	$ 23,098,000	$ 23,098,000	$ 23,098,000	$ 23,098,000	$ 23,098,000	$ 23,098,000			
	2034	$ 19,634,000	$ 23,560,000	$ 23,560,000	$ 23,560,000	$ 23,560,000	$ 23,560,000	$ 23,560,000	$ 23,560,000	$ 23,560,000	$ 23,560,000	$ 23,560,000			
	2035	$ 20,026,000	$ 24,032,000	$ 24,032,000	$ 24,032,000	$ 24,032,000	$ 24,032,000	$ 24,032,000	$ 24,032,000	$ 24,032,000	$ 24,032,000	$ 24,032,000			
	2036	$ 20,427,000	$ 24,512,000	$ 24,512,000	$ 24,512,000	$ 24,512,000	$ 24,512,000	$ 24,512,000	$ 24,512,000	$ 24,512,000	$ 24,512,000	$ 24,512,000			
	2037	$ 20,835,000	$ 25,003,000	$ 25,003,000	$ 25,003,000	$ 25,003,000	$ 25,003,000	$ 25,003,000	$ 25,003,000	$ 25,003,000	$ 25,003,000	$ 25,003,000			
	2038	$ 21,252,000	$ 25,503,000	$ 25,503,000	$ 25,503,000	$ 25,503,000	$ 25,503,000	$ 25,503,000	$ 25,503,000	$ 25,503,000	$ 25,503,000	$ 25,503,000			
	2039	$ 21,677,000	$ 26,013,000	$ 26,013,000	$ 26,013,000	$ 26,013,000	$ 26,013,000	$ 26,013,000	$ 26,013,000	$ 26,013,000	$ 26,013,000	$ 26,013,000			
	2040	$ 22,111,000	$ 26,533,000	$ 26,533,000	$ 26,533,000	$ 26,533,000	$ 26,533,000	$ 26,533,000	$ 26,533,000	$ 26,533,000	$ 26,533,000	$ 26,533,000			
	2041	$ 22,553,000	$ 27,064,000	$ 27,064,000	$ 27,064,000	$ 27,064,000	$ 27,064,000	$ 27,064,000	$ 27,064,000	$ 27,064,000	$ 27,064,000	$ 27,064,000			
	2042	$ 23,004,000	$ 27,605,000	$ 27,605,000	$ 27,605,000	$ 27,605,000	$ 27,605,000	$ 27,605,000	$ 27,605,000	$ 27,605,000	$ 27,605,000	$ 27,605,000			
	2043	$ 23,464,000	$ 28,157,000	$ 28,157,000	$ 28,157,000	$ 28,157,000	$ 28,157,000	$ 28,157,000	$ 28,157,000	$ 28,157,000	$ 28,157,000	$ 28,157,000			
	2044	$ 23,933,000	$ 28,720,000	$ 28,720,000	$ 28,720,000	$ 28,720,000	$ 28,720,000	$ 28,720,000	$ 28,720,000	$ 28,720,000	$ 28,720,000	$ 28,720,000			
	2045	$ 24,412,000	$ 29,294,000	$ 29,294,000	$ 29,294,000	$ 29,294,000	$ 29,294,000	$ 29,294,000	$ 29,294,000	$ 29,294,000	$ 29,294,000	$ 29,294,000			
	2046	$ 24,900,000	$ 29,880,000	$ 29,880,000	$ 29,880,000	$ 29,880,000	$ 29,880,000	$ 29,880,000	$ 29,880,000	$ 29,880,000	$ 29,880,000	$ 29,880,000			
	2047	$ 25,398,000	$ 30,478,000	$ 30,478,000	$ 30,478,000	$ 30,478,000	$ 30,478,000	$ 30,478,000	$ 30,478,000	$ 30,478,000	$ 30,478,000	$ 30,478,000			
	2048	$ 25,906,000	$ 31,087,000	$ 31,087,000	$ 31,087,000	$ 31,087,000	$ 31,087,000	$ 31,087,000	$ 31,087,000	$ 31,087,000	$ 31,087,000	$ 31,087,000			
	2049	$ 26,424,000	$ 31,709,000	$ 31,709,000	$ 31,709,000	$ 31,709,000	$ 31,709,000	$ 31,709,000	$ 31,709,000	$ 31,709,000	$ 31,709,000	$ 31,709,000			
	2050	$ 26,953,000	$ 32,343,000	$ 32,343,000	$ 32,343,000	$ 32,343,000	$ 32,343,000	$ 32,343,000	$ 32,343,000	$ 32,343,000	$ 32,343,000	$ 32,343,000			
	2051	$ 27,492,000	$ 32,990,000	$ 32,990,000	$ 32,990,000	$ 32,990,000	$ 32,990,000	$ 32,990,000	$ 32,990,000	$ 32,990,000	$ 32,990,000	$ 32,990,000			
	2052	$ 28,042,000	$ 33,650,000	$ 33,650,000	$ 33,650,000	$ 33,650,000	$ 33,650,000	$ 33,650,000	$ 33,650,000	$ 33,650,000	$ 33,650,000	$ 33,650,000			
	2053	$ 28,603,000	$ 34,323,000	$ 34,323,000	$ 34,323,000	$ 34,323,000	$ 34,323,000	$ 34,323,000	$ 34,323,000	$ 34,323,000	$ 34,323,000	$ 34,323,000			
	2054	$ 29,175,000	$ 35,010,000	$ 35,010,000	$ 35,010,000	$ 35,010,000	$ 35,010,000	$ 35,010,000	$ 35,010,000	$ 35,010,000	$ 35,010,000	$ 35,010,000			
	2055	$ 29,758,000	$ 35,710,000	$ 35,710,000	$ 35,710,000	$ 35,710,000	$ 35,710,000	$ 35,710,000	$ 35,710,000	$ 35,710,000	$ 35,710,000	$ 35,710,000			
10.	**Debt Service**														
	2025	$ 22,704,000	$ 28,492,000	$ 28,492,000	$ 28,492,000	$ 28,492,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000			
	2026	$ 22,704,000	$ 28,492,000	$ 28,492,000	$ 28,492,000	$ 28,492,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000			
	2027	$ 22,704,000	$ 28,492,000	$ 28,492,000	$ 28,492,000	$ 28,492,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000			
	2028	$ 22,704,000	$ 28,492,000	$ 28,492,000	$ 28,492,000	$ 28,492,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000			
	2029	$ 22,704,000	$ 28,492,000	$ 28,492,000	$ 28,492,000	$ 28,492,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000			
	2030	$ 22,704,000	$ 28,492,000	$ 28,492,000	$ 28,492,000	$ 28,492,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000			
	2031	$ 22,704,000	$ 28,492,000	$ 28,492,000	$ 28,492,000	$ 28,492,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000			
	2032	$ 22,704,000	$ 28,492,000	$ 28,492,000	$ 28,492,000	$ 28,492,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000			
	2033	$ 22,704,000	$ 28,492,000	$ 28,492,000	$ 28,492,000	$ 28,492,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000			
	2034	$ 22,704,000	$ 28,492,000	$ 28,492,000	$ 28,492,000	$ 28,492,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000			
	2035	$ 22,704,000	$ 28,492,000	$ 28,492,000	$ 28,492,000	$ 28,492,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000			
	2036	$ 22,704,000	$ 28,492,000	$ 28,492,000	$ 28,492,000	$ 28,492,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000			
	2037	$ 22,704,000	$ 28,492,000	$ 28,492,000	$ 28,492,000	$ 28,492,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000			
	2038	$ 22,704,000	$ 28,492,000	$ 28,492,000	$ 28,492,000	$ 28,492,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000			
	2039	$ 22,704,000	$ 28,492,000	$ 28,492,000	$ 28,492,000	$ 28,492,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000			
	2040	$ 22,704,000	$ 28,492,000	$ 28,492,000	$ 28,492,000	$ 28,492,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000			
	2041	$ 22,704,000	$ 28,492,000	$ 28,492,000	$ 28,492,000	$ 28,492,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000			
	2042	$ 22,704,000	$ 28,492,000	$ 28,492,000	$ 28,492,000	$ 28,492,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000			
	2043	$ 22,704,000	$ 28,492,000	$ 28,492,000	$ 28,492,000	$ 28,492,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000			
	2044	$ 22,704,000	$ 28,492,000	$ 28,492,000	$ 28,492,000	$ 28,492,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000	$ 31,071,000			
	2045	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -			
	2046	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -			
	2047	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -			

		Live Scenario													
		1													
Item	Description	Quantity	27	28	29	30	31	32	33	34	35	36	37	38	39
	GENERAL ASSUMPTIONS														
	2048	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -			
	2049	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -			
	2050	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -			
	2051	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -			
	2052	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -			
	2053	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -			
	2054	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -			
	2055	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -			
11.	**Waste Processed (tons)**														
	2025	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200			
	2026	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200			
	2027	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200			
	2028	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200			
	2029	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200			
	2030	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200			
	2031	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200			
	2032	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200			
	2033	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200			
	2034	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200			
	2035	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200			
	2036	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200			
	2037	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200			
	2038	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200			
	2039	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200			
	2040	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200			
	2041	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200			
	2042	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200			
	2043	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200			
	2044	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200			
	2045	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200			
	2046	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200			
	2047	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200			
	2048	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200			
	2049	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200			
	2050	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200			
	2051	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200			
	2052	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200			
	2053	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200			
	2054	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200			
	2055	328,500	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200	394,200			

3.0 Summary

Item	Description	Live Scenario 1	
		Quantity	40
	GENERAL ASSUMPTIONS		
1.	Processing Rate (tons/day)	1,000	
2.	Interest Rate - Debt Financing	3.50%	
3.	Energy Revenues from Electricity	$0.06/kWh	
4.	Biosolids Incineration Revenue	$ 3,177,000	

5.	**Summary of Net Costs (Revenue - Expenses), $/ton**		
	2025 - 2029 average tip fee	$	66.18
	2030 - 2034 average tip fee	$	65.87
	2035 - 2039 average tip fee	$	65.53
	2040 - 2044 average tip fee	$	65.16
	2045 - 2049 average tip fee	$	(4.36)
	2050 - 2054 average tip fee	$	(4.82)
	2025 - 2054 average tip fee	$	54.00
6.	**Net Costs (Revenue - Expenses), $/ton**		
	2025	$	66.30
	2026	$	66.23
	2027	$	66.18
	2028	$	66.12
	2029	$	66.06
	2030	$	66.00
	2031	$	65.94
	2032	$	65.87
	2033	$	65.81
	2034	$	65.74
	2035	$	65.67
	2036	$	65.61
	2037	$	65.53
	2038	$	65.46
	2039	$	65.39
	2040	$	65.32
	2041	$	65.24
	2042	$	65.16
	2043	$	65.08
	2044	$	65.00
	2045	$	(4.19)
	2046	$	(4.28)
	2047	$	(4.36)
	2048	$	(4.45)
	2049	$	(4.54)
	2050	$	(4.63)
	2051	$	(4.72)
	2052	$	(4.82)
	2053	$	(4.91)
	2054	$	(5.01)
	2055	$	(5.11)
7.	**Total Revenue**		
	2025	$	17,355,000
	2026	$	17,703,000
	2027	$	18,057,000
	2028	$	18,418,000
	2029	$	18,786,000
	2030	$	19,162,000

		Live Scenario	
		1	
Item	Description	Quantity	40
	GENERAL ASSUMPTIONS		
	2031	$ 19,545,000	
	2032	$ 19,936,000	
	2033	$ 20,335,000	
	2034	$ 20,741,000	
	2035	$ 21,156,000	
	2036	$ 21,579,000	
	2037	$ 22,011,000	
	2038	$ 22,451,000	
	2039	$ 22,900,000	
	2040	$ 23,358,000	
	2041	$ 23,825,000	
	2042	$ 24,302,000	
	2043	$ 24,788,000	
	2044	$ 25,284,000	
	2045	$ 25,789,000	
	2046	$ 26,305,000	
	2047	$ 26,831,000	
	2048	$ 27,368,000	
	2049	$ 27,915,000	
	2050	$ 28,473,000	
	2051	$ 29,043,000	
	2052	$ 29,624,000	
	2053	$ 30,216,000	
	2054	$ 30,821,000	
	2055	$ 31,437,000	
8.	**Total Costs**		
	2025	$ 39,133,000	
	2026	$ 39,461,000	
	2027	$ 39,796,000	
	2028	$ 40,138,000	
	2029	$ 40,487,000	
	2030	$ 40,842,000	
	2031	$ 41,205,000	
	2032	$ 41,575,000	
	2033	$ 41,953,000	
	2034	$ 42,338,000	
	2035	$ 42,730,000	
	2036	$ 43,131,000	
	2037	$ 43,539,000	
	2038	$ 43,956,000	
	2039	$ 44,381,000	
	2040	$ 44,815,000	
	2041	$ 45,257,000	
	2042	$ 45,708,000	
	2043	$ 46,168,000	
	2044	$ 46,637,000	
	2045	$ 24,412,000	
	2046	$ 24,900,000	
	2047	$ 25,398,000	
	2048	$ 25,906,000	
	2049	$ 26,424,000	
	2050	$ 26,953,000	
	2051	$ 27,492,000	
	2052	$ 28,042,000	
	2053	$ 28,603,000	
	2054	$ 29,175,000	
	2055	$ 29,758,000	

Item	Description		Live Scenario 1 Quantity	40
	GENERAL ASSUMPTIONS			
9.	**Operating Costs**			
	2025	$	16,429,000	
	2026	$	16,757,000	
	2027	$	17,092,000	
	2028	$	17,434,000	
	2029	$	17,783,000	
	2030	$	18,138,000	
	2031	$	18,501,000	
	2032	$	18,871,000	
	2033	$	19,249,000	
	2034	$	19,634,000	
	2035	$	20,026,000	
	2036	$	20,427,000	
	2037	$	20,835,000	
	2038	$	21,252,000	
	2039	$	21,677,000	
	2040	$	22,111,000	
	2041	$	22,553,000	
	2042	$	23,004,000	
	2043	$	23,464,000	
	2044	$	23,933,000	
	2045	$	24,412,000	
	2046	$	24,900,000	
	2047	$	25,398,000	
	2048	$	25,906,000	
	2049	$	26,424,000	
	2050	$	26,953,000	
	2051	$	27,492,000	
	2052	$	28,042,000	
	2053	$	28,603,000	
	2054	$	29,175,000	
	2055	$	29,758,000	
10.	**Debt Service**			
	2025	$	22,704,000	
	2026	$	22,704,000	
	2027	$	22,704,000	
	2028	$	22,704,000	
	2029	$	22,704,000	
	2030	$	22,704,000	
	2031	$	22,704,000	
	2032	$	22,704,000	
	2033	$	22,704,000	
	2034	$	22,704,000	
	2035	$	22,704,000	
	2036	$	22,704,000	
	2037	$	22,704,000	
	2038	$	22,704,000	
	2039	$	22,704,000	
	2040	$	22,704,000	
	2041	$	22,704,000	
	2042	$	22,704,000	
	2043	$	22,704,000	
	2044	$	22,704,000	
	2045	$	-	
	2046	$	-	
	2047	$	-	

Item	Description	Quantity	40
		Live Scenario	
		1	
	GENERAL ASSUMPTIONS		
	2048	$ -	
	2049	$ -	
	2050	$ -	
	2051	$ -	
	2052	$ -	
	2053	$ -	
	2054	$ -	
	2055	$ -	
11.	**Waste Processed (tons)**		
	2025	328,500	
	2026	328,500	
	2027	328,500	
	2028	328,500	
	2029	328,500	
	2030	328,500	
	2031	328,500	
	2032	328,500	
	2033	328,500	
	2034	328,500	
	2035	328,500	
	2036	328,500	
	2037	328,500	
	2038	328,500	
	2039	328,500	
	2040	328,500	
	2041	328,500	
	2042	328,500	
	2043	328,500	
	2044	328,500	
	2045	328,500	
	2046	328,500	
	2047	328,500	
	2048	328,500	
	2049	328,500	
	2050	328,500	
	2051	328,500	
	2052	328,500	
	2053	328,500	
	2054	328,500	
	2055	328,500	

4.0 Pro Forma Model

Live Scenario	1
Processing Rate (tons/day)	1,000
Annual Inflation Rate	2.00%
Energy Production	609 kWh/ton
Ferrous	3.20%
Non Ferrous	0.30%
Biosolids Incineration	$ 3,177,000
Facility Operating Fee	$30.00/ton
Ash Disposal	$60.00/ton
Ash Generation	25%
Availability of Unit	90%
Potable Water Usage	0.93 gal/ton
Wastewater Discharge	5.7 gal/ton
Reclaimed Water Usage	589 gal/ton
Propane Usage	0.35 gal/ton
Lime Pebble Usage	0.0082 ton/ton
Lime Dolo Usage	0.0018 ton/ton
Ammonia Usage	0.0010 ton/ton
Urea Usage	0.23 gal/ton
Carbon Usage	0.82 lbs/ton

YEAR		2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
PROJECTIONS														
Waste Processing Rate (tpd)		**1,000 tpd**	**1,000 tpd**	**1,000 tpd**	**1,000 tpd**	**1,000 tpd**	**1,000 tpd**	**1,000 tpd**	**1,000 tpd**	**1,000 tpd**	**1,000 tpd**	**1,000 tpd**	**1,000 tpd**	**1,000 tpd**
Facility Sizing (tpd)		**1,000 tpd**												
Waste Processed (tons)		**328,500**	**328,500**	**328,500**	**328,500**	**328,500**	**328,500**	**328,500**	**328,500**	**328,500**	**328,500**	**328,500**	**328,500**	**328,500**
Energy Produced (MWh)		**200,057**	**200,057**	**200,057**	**200,057**	**200,057**	**200,057**	**200,057**	**200,057**	**200,057**	**200,057**	**200,057**	**200,057**	**200,057**
Potable Water Needs (gal)		**306,575**	**306,575**	**306,575**	**306,575**	**306,575**	**306,575**	**306,575**	**306,575**	**306,575**	**306,575**	**306,575**	**306,575**	**306,575**
Wastewater Discharge (gal)		**1,886,120**	**1,886,120**	**1,886,120**	**1,886,120**	**1,886,120**	**1,886,120**	**1,886,120**	**1,886,120**	**1,886,120**	**1,886,120**	**1,886,120**	**1,886,120**	**1,886,120**
Reclaimed Water Needs (gal)		**193,621,269**	**193,621,269**	**193,621,269**	**193,621,269**	**193,621,269**	**193,621,269**	**193,621,269**	**193,621,269**	**193,621,269**	**193,621,269**	**193,621,269**	**193,621,269**	**193,621,269**
Propane Needs (gal)		**116,109**	**116,109**	**116,109**	**116,109**	**116,109**	**116,109**	**116,109**	**116,109**	**116,109**	**116,109**	**116,109**	**116,109**	**116,109**
Lime Pebble Needs (tons)		**2,691**	**2,691**	**2,691**	**2,691**	**2,691**	**2,691**	**2,691**	**2,691**	**2,691**	**2,691**	**2,691**	**2,691**	**2,691**
Lime Dolo Needs (tons)		**576**	**576**	**576**	**576**	**576**	**576**	**576**	**576**	**576**	**576**	**576**	**576**	**576**
Ammonia Needs (tons)		**339**	**339**	**339**	**339**	**339**	**339**	**339**	**339**	**339**	**339**	**339**	**339**	**339**
Urea Needs (gal)		**76,670**	**76,670**	**76,670**	**76,670**	**76,670**	**76,670**	**76,670**	**76,670**	**76,670**	**76,670**	**76,670**	**76,670**	**76,670**
Carbon Needs (lbs)		**270,461**	**270,461**	**270,461**	**270,461**	**270,461**	**270,461**	**270,461**	**270,461**	**270,461**	**270,461**	**270,461**	**270,461**	**270,461**
OPERATING REVENUES														
Energy Sales		$12,207,000	$12,452,000	$12,701,000	$12,955,000	$13,214,000	$13,478,000	$13,748,000	$14,023,000	$14,303,000	$14,589,000	$14,881,000	$15,178,000	$15,482,000
Metals Recovery														
Ferrous		$788,000	$809,000	$830,000	$851,000	$872,000	$894,000	$915,000	$936,000	$957,000	$978,000	$999,000	$1,020,000	$1,041,000
Non Ferrous		$1,183,000	$1,202,000	$1,222,000	$1,242,000	$1,271,000	$1,301,000	$1,330,000	$1,360,000	$1,390,000	$1,419,000	$1,449,000	$1,478,000	$1,508,000
Biosolids		$3,177,000	$3,240,540	$3,305,350	$3,371,460	$3,438,890	$3,507,670	$3,577,820	$3,649,380	$3,722,370	$3,796,820	$3,872,760	$3,950,220	$4,029,220
Subtotal, Revenue		**$17,355,000**	**$17,703,540**	**$18,058,350**	**$18,419,460**	**$18,795,890**	**$19,180,670**	**$19,570,820**	**$19,968,380**	**$20,372,370**	**$20,782,820**	**$21,201,760**	**$21,626,220**	**$22,060,220**
OPERATING EXPENSES														
Operating Fee		$9,855,000	$10,052,000	$10,253,000	$10,458,000	$10,667,000	$10,881,000	$11,098,000	$11,320,000	$11,547,000	$11,778,000	$12,013,000	$12,253,000	$12,499,000
Ash Disposal		$4,928,000	$5,026,000	$5,127,000	$5,229,000	$5,334,000	$5,440,000	$5,549,000	$5,660,000	$5,773,000	$5,889,000	$6,007,000	$6,127,000	$6,249,000
Potable Water		$17,000	$17,000	$18,000	$18,000	$19,000	$19,000	$19,000	$20,000	$20,000	$20,000	$21,000	$21,000	$22,000
Wastewater		$149,000	$152,000	$155,000	$158,000	$161,000	$164,000	$168,000	$171,000	$174,000	$178,000	$181,000	$185,000	$189,000
Reclaimed Water		$192,000	$196,000	$200,000	$204,000	$208,000	$212,000	$216,000	$220,000	$225,000	$229,000	$234,000	$239,000	$243,000
Propane		$149,000	$152,000	$155,000	$158,000	$161,000	$164,000	$168,000	$171,000	$175,000	$178,000	$182,000	$185,000	$189,000
Lime Pebble		$551,000	$562,000	$573,000	$585,000	$597,000	$609,000	$621,000	$633,000	$646,000	$659,000	$672,000	$685,000	$699,000
Lime Dolo		$150,000	$153,000	$156,000	$159,000	$163,000	$166,000	$169,000	$173,000	$176,000	$180,000	$183,000	$187,000	$191,000
Ammonia		$274,000	$279,000	$285,000	$291,000	$296,000	$302,000	$308,000	$314,000	$321,000	$327,000	$334,000	$340,000	$347,000
Urea		$90,000	$92,000	$93,000	$95,000	$97,000	$99,000	$101,000	$103,000	$105,000	$107,000	$109,000	$112,000	$114,000
Carbon		$74,000	$76,000	$77,000	$79,000	$81,000	$82,000	$84,000	$85,000	$87,000	$89,000	$91,000	$93,000	$94,000
Subtotal, Operating Expenses		**$16,429,000**	**$16,757,000**	**$17,092,000**	**$17,434,000**	**$17,784,000**	**$18,138,000**	**$18,501,000**	**$18,870,000**	**$19,249,000**	**$19,634,000**	**$20,027,000**	**$20,427,000**	**$20,836,000**
DEBT SERVICE, i=3.5%, Term=20 Yrs, $	$322,679,002	$22,704,000	$22,704,000	$22,704,000	$22,704,000	$22,704,000	$22,704,000	$22,704,000	$22,704,000	$22,704,000	$22,704,000	$22,704,000	$22,704,000	$22,704,000

YEAR		2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
PROJECTIONS														
TOTAL, OPERATING EXPENSES + DEBT, $		$39,133,000	$39,461,000	$39,796,000	$40,138,000	$40,488,000	$40,842,000	$41,205,000	$41,574,000	$41,953,000	$42,338,000	$42,731,000	$43,131,000	$43,540,000
REVENUE - (OPERATING EXPENSES + DEBT), $		$21,778,000	$21,757,460	$21,737,650	$21,718,540	$21,692,110	$21,661,330	$21,634,180	$21,605,620	$21,580,630	$21,555,180	$21,529,240	$21,504,780	$21,479,780
SUMMARY, $/ton STATISTICCS														
OPERATING EXPENSES + DEBT SERVICE ($/ton)		$119.13	$120.12	$121.14	$122.19	$123.25	$124.33	$125.43	$126.56	$127.71	$128.88	$130.08	$131.30	$132.54
REVENUE - (OPERATING EXPENSES + DEBT) ($/ton)		$66.30	$66.23	$66.17	$66.11	$66.03	$65.94	$65.86	$65.77	$65.69	$65.62	$65.54	$65.46	$65.39

Facility Nominal Size, tpd	1,000 tpd
Project Facility Capex, $	$322,679,002
Cash In-Lieu of Capacity Payments	$0
Finance Amount, $	$322,679,002

Average Tip Fee By Date Range	
2025-2029 average tip fee	$66.17/ton
2030-2034 average tip fee	$65.78/ton
2035-2039 average tip fee	$65.39/ton
2040-2044 average tip fee	$65.04/ton
2025-2044 average tip fee	$65.59/ton

2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055
1,000 tpd	**1,000 tpd**	**1,000 tpd**	**1,000 tpd**	**1,000 tpd**	**1,000 tpd**	**1,000 tpd**	**1,000 tpd**	**1,000 tpd**	**1,000 tpd**	**1,000 tpd**	**1,000 tpd**	**1,000 tpd**	**1,000 tpd**	**1,000 tpd**	**1,000 tpd**	**1,000 tpd**	**1,000 tpd**
328,500	**328,500**	**328,500**	**328,500**	**328,500**	**328,500**	**328,500**	**328,500**	**328,500**	**328,500**	**328,500**	**328,500**	**328,500**	**328,500**	**328,500**	**328,500**	**328,500**	**328,500**
200,057	**200,057**	**200,057**	**200,057**	**200,057**	**200,057**	**200,057**	**200,057**	**200,057**	**200,057**	**200,057**	**200,057**	**200,057**	**200,057**	**200,057**	**200,057**	**200,057**	**200,057**
306,575	**306,575**	**306,575**	**306,575**	**306,575**	**306,575**	**306,575**	**306,575**	**306,575**	**306,575**	**306,575**	**306,575**	**306,575**	**306,575**	**306,575**	**306,575**	**306,575**	**306,575**
1,886,120	**1,886,120**	**1,886,120**	**1,886,120**	**1,886,120**	**1,886,120**	**1,886,120**	**1,886,120**	**1,886,120**	**1,886,120**	**1,886,120**	**1,886,120**	**1,886,120**	**1,886,120**	**1,886,120**	**1,886,120**	**1,886,120**	**1,886,120**
193,621,269	**193,621,269**	**193,621,269**	**193,621,269**	**193,621,269**	**193,621,269**	**193,621,269**	**193,621,269**	**193,621,269**	**193,621,269**	**193,621,269**	**193,621,269**	**193,621,269**	**193,621,269**	**193,621,269**	**193,621,269**	**193,621,269**	**193,621,269**
116,109	**116,109**	**116,109**	**116,109**	**116,109**	**116,109**	**116,109**	**116,109**	**116,109**	**116,109**	**116,109**	**116,109**	**116,109**	**116,109**	**116,109**	**116,109**	**116,109**	**116,109**
2,691	**2,691**	**2,691**	**2,691**	**2,691**	**2,691**	**2,691**	**2,691**	**2,691**	**2,691**	**2,691**	**2,691**	**2,691**	**2,691**	**2,691**	**2,691**	**2,691**	**2,691**
576	**576**	**576**	**576**	**576**	**576**	**576**	**576**	**576**	**576**	**576**	**576**	**576**	**576**	**576**	**576**	**576**	**576**
339	**339**	**339**	**339**	**339**	**339**	**339**	**339**	**339**	**339**	**339**	**339**	**339**	**339**	**339**	**339**	**339**	**339**
76,670	**76,670**	**76,670**	**76,670**	**76,670**	**76,670**	**76,670**	**76,670**	**76,670**	**76,670**	**76,670**	**76,670**	**76,670**	**76,670**	**76,670**	**76,670**	**76,670**	**76,670**
270,461	**270,461**	**270,461**	**270,461**	**270,461**	**270,461**	**270,461**	**270,461**	**270,461**	**270,461**	**270,461**	**270,461**	**270,461**	**270,461**	**270,461**	**270,461**	**270,461**	**270,461**
$15,792,000	$16,107,000	$16,430,000	$16,758,000	$17,093,000	$17,435,000	$17,784,000	$18,140,000	$18,502,000	$18,872,000	$19,250,000	$19,635,000	$20,028,000	$20,428,000	$20,837,000	$21,253,000	$21,679,000	$22,112,000
$1,062,000	$1,083,000	$1,104,000	$1,125,000	$1,146,000	$1,167,000	$1,188,000	$1,209,000	$1,230,000	$1,251,000	$1,272,000	$1,293,000	$1,314,000	$1,346,000	$1,377,000	$1,409,000	$1,440,000	$1,472,000
$1,537,000	$1,567,000	$1,597,000	$1,626,000	$1,656,000	$1,685,000	$1,715,000	$1,744,000	$1,784,000	$1,823,000	$1,863,000	$1,902,000	$1,941,000	$1,981,000	$2,020,000	$2,060,000	$2,099,000	$2,139,000
$4,109,800	$4,192,000	$4,275,840	$4,361,360	$4,448,590	$4,537,560	$4,628,310	$4,720,880	$4,815,300	$4,911,610	$5,009,840	$5,110,040	$5,212,240	$5,316,480	$5,422,810	$5,531,270	$5,641,900	$5,754,740
$22,500,800	**$22,949,000**	**$23,406,840**	**$23,870,360**	**$24,343,590**	**$24,824,560**	**$25,315,310**	**$25,813,880**	**$26,331,300**	**$26,857,610**	**$27,394,840**	**$27,940,040**	**$28,495,240**	**$29,071,480**	**$29,656,810**	**$30,253,270**	**$30,859,900**	**$31,477,740**
$12,748,000	$13,003,000	$13,264,000	$13,529,000	$13,799,000	$14,075,000	$14,357,000	$14,644,000	$14,937,000	$15,236,000	$15,540,000	$15,851,000	$16,168,000	$16,492,000	$16,821,000	$17,158,000	$17,501,000	$17,851,000
$6,374,000	$6,502,000	$6,632,000	$6,764,000	$6,900,000	$7,038,000	$7,178,000	$7,322,000	$7,468,000	$7,618,000	$7,770,000	$7,926,000	$8,084,000	$8,246,000	$8,411,000	$8,579,000	$8,750,000	$8,925,000
$22,000	$23,000	$23,000	$23,000	$24,000	$24,000	$25,000	$25,000	$26,000	$26,000	$27,000	$28,000	$28,000	$29,000	$29,000	$30,000	$30,000	$31,000
$193,000	$196,000	$200,000	$204,000	$208,000	$213,000	$217,000	$221,000	$226,000	$230,000	$235,000	$239,000	$244,000	$249,000	$254,000	$259,000	$264,000	$270,000
$248,000	$253,000	$258,000	$263,000	$269,000	$274,000	$279,000	$285,000	$291,000	$297,000	$302,000	$309,000	$315,000	$321,000	$327,000	$334,000	$341,000	$347,000
$193,000	$197,000	$200,000	$204,000	$209,000	$213,000	$217,000	$221,000	$226,000	$230,000	$235,000	$240,000	$244,000	$249,000	$254,000	$259,000	$265,000	$270,000
$713,000	$727,000	$742,000	$757,000	$772,000	$787,000	$803,000	$819,000	$835,000	$852,000	$869,000	$887,000	$904,000	$922,000	$941,000	$960,000	$979,000	$998,000
$194,000	$198,000	$202,000	$206,000	$210,000	$215,000	$219,000	$223,000	$228,000	$232,000	$237,000	$242,000	$246,000	$251,000	$256,000	$262,000	$267,000	$272,000
$354,000	$361,000	$368,000	$376,000	$383,000	$391,000	$399,000	$407,000	$415,000	$423,000	$432,000	$440,000	$449,000	$458,000	$467,000	$477,000	$486,000	$496,000
$116,000	$118,000	$121,000	$123,000	$126,000	$128,000	$131,000	$133,000	$136,000	$139,000	$142,000	$144,000	$147,000	$150,000	$153,000	$156,000	$159,000	$163,000
$96,000	$98,000	$100,000	$102,000	$104,000	$106,000	$108,000	$111,000	$113,000	$115,000	$117,000	$120,000	$122,000	$125,000	$127,000	$130,000	$132,000	$135,000
$21,251,000	**$21,676,000**	**$22,110,000**	**$22,551,000**	**$23,004,000**	**$23,464,000**	**$23,933,000**	**$24,411,000**	**$24,901,000**	**$25,398,000**	**$25,906,000**	**$26,426,000**	**$26,951,000**	**$27,492,000**	**$28,040,000**	**$28,604,000**	**$29,174,000**	**$29,758,000**
$22,704,000	$22,704,000	$22,704,000	$22,704,000	$22,704,000	$22,704,000	$22,704,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055
$43,955,000	$44,380,000	$44,814,000	$45,255,000	$45,708,000	$46,168,000	$46,637,000	$24,411,000	$24,901,000	$25,398,000	$25,906,000	$26,426,000	$26,951,000	$27,492,000	$28,040,000	$28,604,000	$29,174,000	$29,758,000
$21,454,200	$21,431,000	$21,407,160	$21,384,640	$21,364,410	$21,343,440	$21,321,690	($1,402,880)	($1,430,300)	($1,459,610)	($1,488,840)	($1,514,040)	($1,544,240)	($1,579,480)	($1,616,810)	($1,649,270)	($1,685,900)	($1,719,740)
$133.81	$135.10	$136.42	$137.76	$139.14	$140.54	$141.97	$74.31	$75.80	$77.32	$78.86	$80.44	$82.04	$83.69	$85.36	$87.07	$88.81	$90.59
$65.31	$65.24	$65.17	$65.10	$65.04	$64.97	$64.91	-$4.27	-$4.35	-$4.44	-$4.53	-$4.61	-$4.70	-$4.81	-$4.92	-$5.02	-$5.13	-$5.24

5.0 Capital Costs

Unit Capital Costs	$ 223,333	$/ton	From Palm Beach County WTE project
Base Year for Unit Costs	2012		
Inflation 2012 - 2019	1.58%		
Inflation 2019 onward	2.00%		
Base Year for Project	2022		
Unit Capital Costs for Project	$ 264,491	$/ton	For project in lower 48
Adjustment for Alaska	17%		Adjust to Alaska prices for materials and labor
Adjustment for Seismic	5%		Adjust for seismic design of structure
Unit Capital Costs for Project	$ 322,679	$/ton	For Alaska

$672,000,000	6-26-2015	https://www.sun-sentinel.com/local/palm-beach/fl-palm-new-incinerator-20150626-story.html
3000		https://swana.org/Portals/0/Awards/2017/Winners/Excellence2017-WtE-gold.pdf
224000	$/ton	
700		
609		

6.0 Inflated Revenue and Expenses

Live Scenario	1
Facility Sizing (tpd)	1,000 tpd
Annual Inflation Rate	2.00%

Year	2025	2026	2027	2028	2029	2030	2031
Operating Fee	$30.00/ton	$30.60/ton	$31.21/ton	$31.84/ton	$32.47/ton	$33.12/ton	$33.78/ton
Ash Disposal	$60.00/ton	$61.20/ton	$62.42/ton	$63.67/ton	$64.95/ton	$66.24/ton	$67.57/ton
Potable Water	$0.056/gal	$0.06/gal	$0.06/gal	$0.06/gal	$0.06/gal	$0.06/gal	$0.06/gal
Wastewater	$0.079/gal	$0.08/gal	$0.08/gal	$0.08/gal	$0.09/gal	$0.09/gal	$0.09/gal
Reclaimed Water	$0.0010/gal	$0.00/gal	$0.00/gal	$0.00/gal	$0.00/gal	$0.00/gal	$0.00/gal
Propane	$1.28/gal	$1.31/gal	$1.33/gal	$1.36/gal	$1.39/gal	$1.42/gal	$1.44/gal
Lime Pebble	$204.84/ton	$208.93/ton	$213.11/ton	$217.38/ton	$221.72/ton	$226.16/ton	$230.68/ton
Lime Dolo	$260.97/ton	$266.19/ton	$271.51/ton	$276.95/ton	$282.48/ton	$288.13/ton	$293.90/ton
Ammonia	$807.79/ton	$823.95/ton	$840.43/ton	$857.23/ton	$874.38/ton	$891.87/ton	$909.70/ton
Urea	$1.17/gal	$1.19/ton	$1.22/ton	$1.24/ton	$1.27/ton	$1.29/ton	$1.32/ton
Carbon	$0.28/lb	$0.28/ton	$0.29/ton	$0.29/ton	$0.30/ton	$0.30/ton	$0.31/ton
Energy Sales	$0.0610/kWh	$0.0622/kWh	$0.0635/kWh	$0.0648/kWh	$0.0661/kWh	$0.0674/kWh	$0.0687/kWh
Ferrous	$75/ton	$77/ton	$79/ton	$81/ton	$83/ton	$85/ton	$87/ton
Non-Ferrous	$1,200/ton	$1,220/ton	$1,240/ton	$1,260/ton	$1,290/ton	$1,320/ton	$1,350/ton
Biosolids Incineration	$3,177,000	$3,240,540/ton	$3,305,350/ton	$3,371,460/ton	$3,438,890/ton	$3,507,670/ton	$3,577,820/ton

2032	2033	2034	2035	2036	2037	2038	2039	2040
$34.46/ton	$35.15/ton	$35.85/ton	$36.57/ton	$37.30/ton	$38.05/ton	$38.81/ton	$39.58/ton	$40.38/ton
$68.92/ton	$70.30/ton	$71.71/ton	$73.14/ton	$74.60/ton	$76.09/ton	$77.62/ton	$79.17/ton	$80.75/ton
$0.06/gal	$0.07/gal	$0.07/gal	$0.07/gal	$0.07/gal	$0.07/gal	$0.07/gal	$0.07/gal	$0.08/gal
$0.09/gal	$0.09/gal	$0.09/gal	$0.10/gal	$0.10/gal	$0.10/gal	$0.10/gal	$0.10/gal	$0.11/gal
$0.00/gal	$0.00/gal	$0.00/gal	$0.00/gal	$0.00/gal	$0.00/gal	$0.00/gal	$0.00/gal	$0.00/gal
$1.47/gal	$1.50/gal	$1.53/gal	$1.56/gal	$1.60/gal	$1.63/gal	$1.66/gal	$1.69/gal	$1.73/gal
$235.29/ton	$240.00/ton	$244.80/ton	$249.70/ton	$254.69/ton	$259.78/ton	$264.98/ton	$270.28/ton	$275.68/ton
$299.77/ton	$305.77/ton	$311.89/ton	$318.12/ton	$324.49/ton	$330.98/ton	$337.59/ton	$344.35/ton	$351.23/ton
$927.90/ton	$946.46/ton	$965.38/ton	$984.69/ton	$1,004.39/ton	$1,024.47/ton	$1,044.96/ton	$1,065.86/ton	$1,087.18/ton
$1.35/ton	$1.37/ton	$1.40/ton	$1.43/ton	$1.46/ton	$1.49/ton	$1.52/ton	$1.55/ton	$1.58/ton
$0.32/ton	$0.32/ton	$0.33/ton	$0.34/ton	$0.34/ton	$0.35/ton	$0.36/ton	$0.36/ton	$0.37/ton
$0.0701/kWh	$0.0715/kWh	$0.0729/kWh	$0.0744/kWh	$0.0759/kWh	$0.0774/kWh	$0.0789/kWh	$0.0805/kWh	$0.0821/kWh
$89/ton	$91/ton	$93/ton	$95/ton	$97/ton	$99/ton	$101/ton	$103/ton	$105/ton
$1,380/ton	$1,410/ton	$1,440/ton	$1,470/ton	$1,500/ton	$1,530/ton	$1,560/ton	$1,590/ton	$1,620/ton
$3,649,380/ton	$3,722,370/ton	$3,796,820/ton	$3,872,760/ton	$3,950,220/ton	$4,029,220/ton	$4,109,800/ton	$4,192,000/ton	$4,275,840/ton

2041	2042	2043	2044	2045	2046	2047	2048	2049
$41.18/ton	$42.01/ton	$42.85/ton	$43.70/ton	$44.58/ton	$45.47/ton	$46.38/ton	$47.31/ton	$48.25/ton
$82.37/ton	$84.01/ton	$85.69/ton	$87.41/ton	$89.16/ton	$90.94/ton	$92.76/ton	$94.61/ton	$96.51/ton
$0.08/gal	$0.08/gal	$0.08/gal	$0.08/gal	$0.08/gal	$0.08/gal	$0.09/gal	$0.09/gal	$0.09/gal
$0.11/gal	$0.11/gal	$0.11/gal	$0.11/gal	$0.12/gal	$0.12/gal	$0.12/gal	$0.12/gal	$0.13/gal
$0.00/gal	$0.00/gal	$0.00/gal	$0.00/gal	$0.00/gal	$0.00/gal	$0.00/gal	$0.00/gal	$0.00/gal
$1.76/gal	$1.80/gal	$1.83/gal	$1.87/gal	$1.91/gal	$1.94/gal	$1.98/gal	$2.02/gal	$2.06/gal
$281.20/ton	$286.82/ton	$292.56/ton	$298.41/ton	$304.38/ton	$310.47/ton	$316.67/ton	$323.01/ton	$329.47/ton
$358.26/ton	$365.42/ton	$372.73/ton	$380.19/ton	$387.79/ton	$395.55/ton	$403.46/ton	$411.53/ton	$419.76/ton
$1,108.92/ton	$1,131.10/ton	$1,153.72/ton	$1,176.80/ton	$1,200.33/ton	$1,224.34/ton	$1,248.83/ton	$1,273.80/ton	$1,299.28/ton
$1.61/ton	$1.64/ton	$1.67/ton	$1.71/ton	$1.74/ton	$1.78/ton	$1.81/ton	$1.85/ton	$1.88/ton
$0.38/ton	$0.39/ton	$0.39/ton	$0.40/ton	$0.41/ton	$0.42/ton	$0.43/ton	$0.43/ton	$0.44/ton
$0.0838/kWh	$0.0854/kWh	$0.0872/kWh	$0.0889/kWh	$0.0907/kWh	$0.0925/kWh	$0.0943/kWh	$0.0962/kWh	$0.0981/kWh
$107/ton	$109/ton	$111/ton	$113/ton	$115/ton	$117/ton	$119/ton	$121/ton	$123/ton
$1,650/ton	$1,680/ton	$1,710/ton	$1,740/ton	$1,770/ton	$1,810/ton	$1,850/ton	$1,890/ton	$1,930/ton
$4,361,360/ton	$4,448,590/ton	$4,537,560/ton	$4,628,310/ton	$4,720,880/ton	$4,815,300/ton	$4,911,610/ton	$5,009,840/ton	$5,110,040/ton

2050	2051	2052	2053	2054	2055			
$49.22/ton	$50.20/ton	$51.21/ton	$52.23/ton	$53.28/ton	$54.34/ton			
$98.44/ton	$100.41/ton	$102.41/ton	$104.46/ton	$106.55/ton	$108.68/ton			
$0.09/gal	$0.09/gal	$0.10/gal	$0.10/gal	$0.10/gal	$0.10/gal			
$0.13/gal	$0.13/gal	$0.13/gal	$0.14/gal	$0.14/gal	$0.14/gal			
$0.00/gal	$0.00/gal	$0.00/gal	$0.00/gal	$0.00/gal	$0.00/gal			
$2.10/gal	$2.15/gal	$2.19/gal	$2.23/gal	$2.28/gal	$2.32/gal			
$336.06/ton	$342.78/ton	$349.63/ton	$356.63/ton	$363.76/ton	$371.03/ton			
$428.15/ton	$436.71/ton	$445.45/ton	$454.36/ton	$463.44/ton	$472.71/ton			
$1,325.27/ton	$1,351.77/ton	$1,378.81/ton	$1,406.38/ton	$1,434.51/ton	$1,463.20/ton			
$1.92/ton	$1.96/ton	$2.00/ton	$2.04/ton	$2.08/ton	$2.12/ton			
$0.45/ton	$0.46/ton	$0.47/ton	$0.48/ton	$0.49/ton	$0.50/ton			
$0.1001/kWh	$0.1021/kWh	$0.1042/kWh	$0.1062/kWh	$0.1084/kWh	$0.1105/kWh			
$125/ton	$128/ton	$131/ton	$134/ton	$137/ton	$140/ton			
$1,970/ton	$2,010/ton	$2,050/ton	$2,090/ton	$2,130/ton	$2,170/ton			
$5,212,240/ton	$5,316,480/ton	$5,422,810/ton	$5,531,270/ton	$5,641,900/ton	$5,754,740/ton			

11.0 WTE Operating Stats

		Stats								
Location		**Owner**	**Operator**	**Plant Year Online or Expanded**	**Technology**	**Design Capacity (Tons/Day)**	**Annual Throughput (Tons)**	**Construction Cost (Million $)**	**Management/Vendor Operating Fee ($)/Ton**	**Guranteed Energy Production (mWe)**
Broward County	North Plant	Wheelabrator	Wheelabrator		Mass Burn					
	South Plant	Wheelabrator	Wheelabrator		Mass Burn					
Dade County			Covanta	1985	RDF	3000	1200000	650	50	1000MWH/day
City of Tampa		City of Tampa	Wheelabrator		Mass Burn	1000	310650		see note (3)	173475
Hillsborough County		Hillsborough County	Covanta	1985	Mass Burn	1,600	580000	140	39.55	469425MWh
Lake County		Covanta	Covanta		Mass Burn					
Lee County		Lee County	Covanta	1994	Mass Burn	1836	641821	250		393336
Palm Beach	REF #1	Solid Waste Authority	Babcock and Wilcox	1989	RDF	2000	see note (2)	189	38.91	see note (3)
	REF #2	Solid Waste Authority	Babcock and Wilcox	2015	Mass Burn	3000	969197	672	21.49	488001MWh
Pasco County		Pasco County	Covanta	1991	Mass Burn	1050	340000	90		225000MWH
Pinellas County		Pinellas County	Covanta	1983	Mass Burn	3,000	810000	555	20	430

Lee County Notes	1. Throughput – FY16 was a record year, FY 15 and	2. Electricity Purchaser – Seminole contract was		3. We currently receive no capacity payments,	4. Avoided energy – we only have one data point	Pebble Lime $891,012, Dolomitic Lime $326,937,	
Dade County Notes	Natural Gas: For the County it is about $ 600,000. There	Ammonia; N/A but we had to install a de-nitrification		Annual Management fee; It is a tiered system, but most	the average $/kWh in FY 15/16 was $ 0.021. From Duke –		
Palm Beach REF #1 Notes	(1) All numbers are based on the fiscal year from 10/1/15 to 9/30/16.	(2) 795,000 tons is the contractual guarantee. The actual for the fiscal year was 754,973 tons of processible waste and 543,572 tons of RDF burned.	(3) The annual "energy production" (gross) was 374,110 mW-hrs. The annual "energy production" (net to SWA) was 309,397 mW-hrs. The annual "energy production"		(4) PBREF#1 annual water usage (gallons): Potable Water (used by personnel = 971,023; Well water (cooling tower make-up and process water) = 366,800,456; Well water (irrigation) = 13,990,359; Non-potable water for boiler makeup = 50,108,000	(5) 64,670,571 gallons of wastewater disposed to county facility	(6) 760 tons of urea
City of Tampa	numbers are based off the City of Tampa fiscal year which is Oct 1 through Sept 30th	(1) City Water usage 30 million gallons, total reclaimed water usage for 2016 is 203 million gallons	(2) total gas usage for 2016 was 60,696 kcf (do not have actual cost	(3) O&M fee was $72.57/ton up to 206 K tons and the it drops to $35.22/ton			
Hillsborough County	Limestone cost = $537,078						
Palm Beach REF #2 Notes	(1) Water usage 88,563,464 gal	(2) 22,716,040 gal	(3) 627,264 lb	(4) 682,964 ccf	(5) receive a onetime advanced capacity payment of $ 56.6 M at the time the generator was installed. SWA made a commitment of 70 MW at that time and must retain a minimum of a 70% capacity factor in order to retain that		

Energy				Pass Throughs					Ferrous	Non- Ferrous
Average kwH/Ton	**Electricity Purchaser**	**Capacity Payment ($/Mwe)**	**Avoided Energy (cents/kwH)**	**Water Purchases (Annual $)**	**Wastewater Charges (Annual $)**	**Ammonia (Annual $)**	**Natural Gas (Annual $)**	**Ash Generation (Tons/Day)**	**Average Metals Recovery (Tons/Day)**	
470	Duke/FPL	0	2	160000	200000	n/a	600000	350	55	5
476.82	seminole			see note (1)		see note (2)		72661	9618	89
469.244	Seminole	NA	5-5.5	231000	430000	160058	273216	345	6	4
557	Seminole	4,586,518	2.29	266,499.00	28,394.43	601441	255602	444	42.7	6.6
569 rdf	FPL	1.55	see note (8)	see note (4)	see note (5)	see note (6)	see note (7)	317	70	11
504	FPL	see note (5)	3	see note (1)	see note (2)	see note (3)	see note (4)	782	64	3
570 net	Duke	75	market	county	county			22%	3.20%	0.30%
520	Duke	77.6	0.027	360000	1250000	n/a	1000000	750	80	4.5

(7) 272,032 therms	(8)"Avoided Energy (cents/kwH)" is not fixed. The Utility calculates that value on a hourly basis and this number can vary significantly. In addition, we are paid at an hourly rate of the lesser of the aforementioned calculation and the Utility's "Avoided Unit Energy Cost". Therefore, even if a "fixed" value was estimated, it would be misleading.

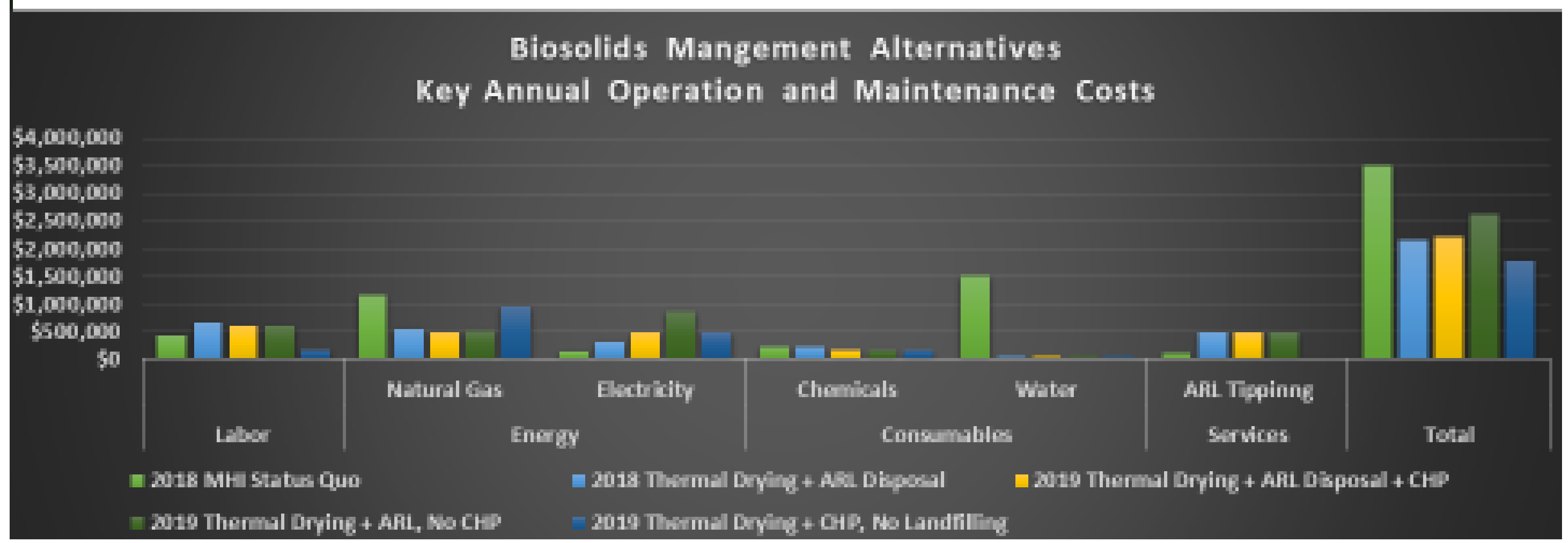
2018

	O&M Items	Reduction
Labor	$433,000	$398,000
Natural Gas	$1,140,000	$1,140,000
Electricity	$114,000	$99,000
Chemicals	$216,000	$196,000
Water	$1,506,000	$1,256,000
ARL Tipping	$88,000	$88,000
TOTAL	$3,497,000	$3,177,000

	20	tpd
	328.5	days
	6570	Tons a year
$	484	per ton

BIOSOLIDS MANAGEMENT ALTERNATIVES – O&M

Biosolids Management Alternative	Capital Cost Millions $	Key Annual Operations and Maintenance Costs, $1,000's						Total O&M $1000's
		Labor	Energy		Consumables		Services	
			Natural Gas	Electricity	Chemicals	Water	ARL Tippinng	
2018 MHI Status Quo*	$25.2	$433	$1,140	$114	$216	$1,506	$88	$3,720
*Includes Centrifuges But Not All Costs Due To Pause Of Centrifuge Design								
2018 Thermal Drying + ARL Disposal	$58.3	$645	$524	$291	$199	$10	$487	$2,250
2019 Thermal Drying + ARL Disposal + CHP	$70.0	$606	$471	$483	$164	$10	$487	$2,400
2019 Thermal Drying + ARL, No CHP	$64.9	$606	$506	$854	$164	$10	$487	$2,720
2019 Thermal Drying + CHP, No Landfilling	$70.0	$168	$954	$483	$164	$10	$0	$1,380



			AVERAGE			ANNISTON			BIRMINGHAM			BUTLER			DECATUR			DOTHAN	
						362			350 - 352			369			356				
		MAT.	INST.	TOTAL	MAT.	INST.	TOTAL		INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.		MAT.	INST.	TOTAL
015433	CONTRACTOR EQUIPMENT		100.0	100.0		106.4			106.6	106.6		103.9	103.9			106.4		103.9	103.9
0241, 31 - 34	SITE & INFRASTRUCTURE, DEMOLITION	100.0		100.0	86.9	94.1	91.9	94.4	94.3	94.4	100.6	89.4	92.8		93.5	91.7	98.2		
0310	Concrete Forming & Accessories	100.0	100.0	100.0	90.2		71.5	94.4	69.	72.5				.0	64.3	68.7	95.6	70.5	73.9
0330																			
03	CONCRETE	100.0	100.0	100.0	93.5	71.	83.2	93.3		83.2					68.2	81.6	93.8	7	
04	MASONRY	100.0	100.0	100.0	94.0		81.3	91.5	68.0	77.							100.3	73.5	83.8
05																			
06																			
07																			
08																			
0920	Plaster Gypsum Board	100.0	100.0					91.0	68.8	76.3							95.3	70.5	78.8
0970,	Painting/Coating																		
09	FINISHES																		
COVERS	DIVS. 25, 28, 41, 43, 44, 46																		
21,																			
26, ,	ELECTRICAL,																		
MF2014	WEIGHTED AVERAGE	100.0	100.0	100.0	7	70.0													

								HUNTSVILLE			JASPER			MOBILE			MONTGOMERY		
			364																
		MAT.	INST.	TOTAL													MAT.		
015433	CONTRACTOR EQUIPMENT																		
0241, 31 - 34	SITE INFRASTRUCTURE, DEMOLITION																		
0310	Forming & Accessories	83.2		72.0													93.7	68.5	71.9
0320																			
03	CONCRETE	94.9		84.2															
04	MASONRY		73.5	83.2					65.4	75.1									
05																			
07																			
08																			
0920	& Gypsum Board							93.9	65.9	75.3		68.8	76.2						
0970,	Painting/Coating																		
09	FINISHES								67.2		84.6	71.0							

09	FINISHES																		
COVERS	14, 25, 28, 41, 43,							100.0		96.4	100.0	74.9	94.3						
26,	ELECTRICAL,																		
MF2014	WEIGHTED AVERAGE	95.7	74.3	86.2	97.5		86.2	97.4		86.0	97.	72.1	86.5				95.8	73.6	86.0

		ALABAMA																	
																		998	
			INST.	TOTAL		INST.	TOTAL				MAT.	INST.	TOTAL		INST.	TOTAL	MAT.		
015433	EQUIPMENT		103.9			103.9									117.				
0241, 31 -	SITE & INFRASTRUCTURE, DEMOLITION	104.8		94.3	98.1		92.3								132.	129.9	143.2	132.1	135.4
0310	Concrete & Accessories		69.2	72.0		69.2					126.6	120.4		133.9	120.5	1			
03	CONCRETE	97.7	70.5		93.3	71.5					122.9		120.8	114.5	118.7				
04	MASONRY	98.8		83.2	102.2		84.5					122.3	144.0		122.3	147.8			
													.3						
													145.8						
													124.6						
0920	& Gypsum	89.3		75.6	87.4		75.0					119.8	126.6			135.6	153.0	119.8	130.9
	Painting/Coating													110.3					
	FINISHES		73.0	79.0	84.8	70.9	77.2		69.2	76.9	126.3			129.6	121.6	125.2			
COVERS	DIVS. 25, 28, 41, 43, 44,	100.0	85.2		100.0			100.0		96.6	100.0	110.4	102.4	100.0					
										85.2									
										75.6									
26,	ELECTRICAL,																		
	WEIGHTED	96.6	74.0	86.6	95.8	75.2		97.5		86.4	119.7		7.6	122.3	115.9				



MUNICIPALITY OF ANCHORAGE
SOLID WASTE SERVICES
INTEGRATED SOLID WASTE MATER PLAN