TETRA TECH

Material Recovery Facility Feasibility Study



PRESENTED TO

Municipality of Anchorage

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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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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.

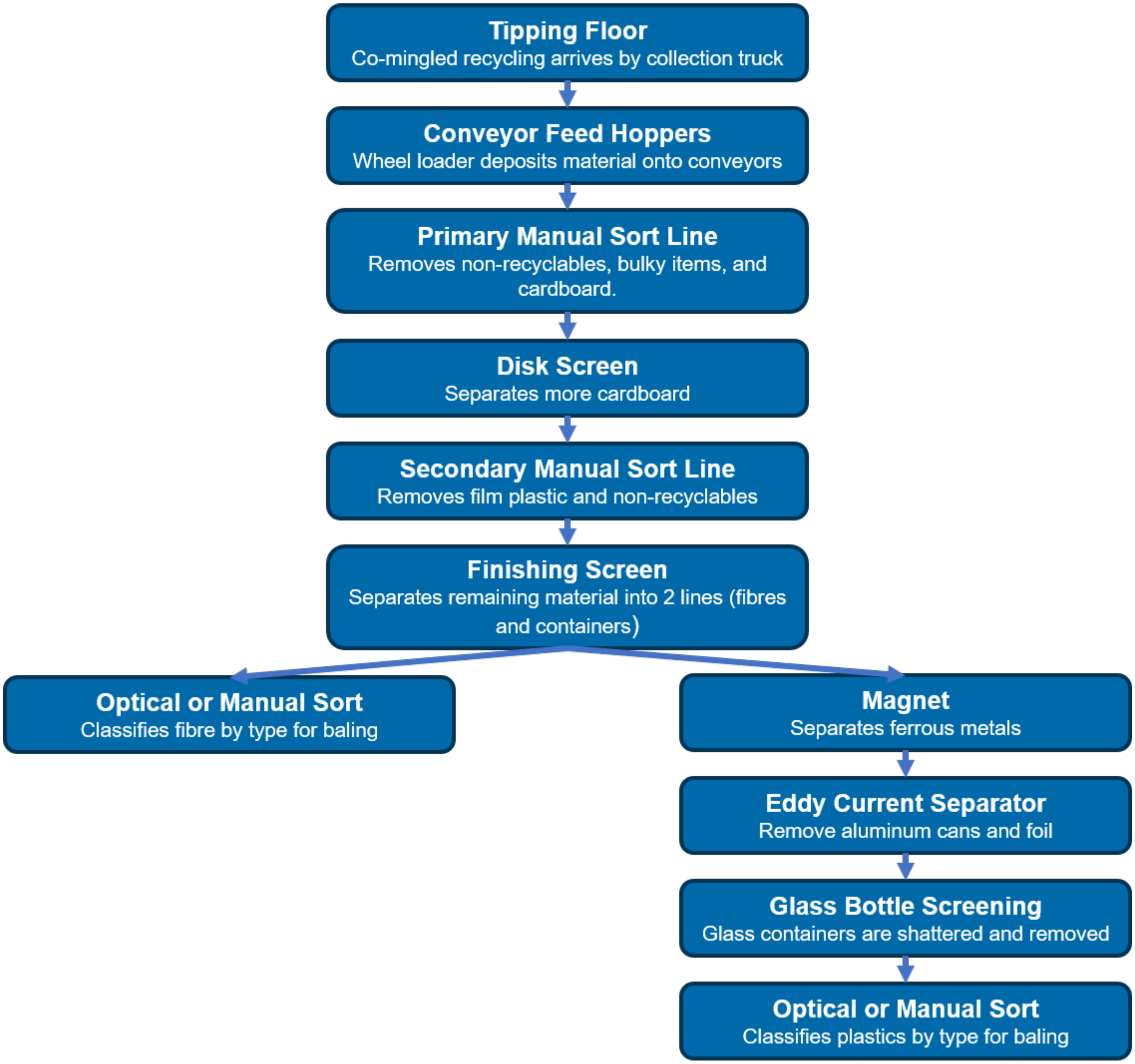

Figure 3-1: MRF Sorting Process

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.

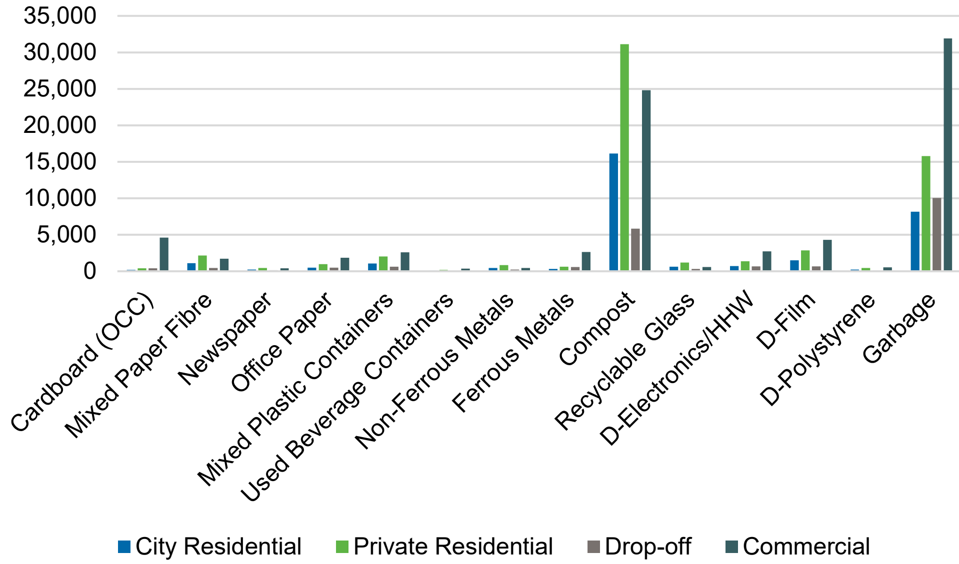

Figure 5-1: Average Tonnage Received at Anchorage Regional Landfill in 2016 and 2017

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.

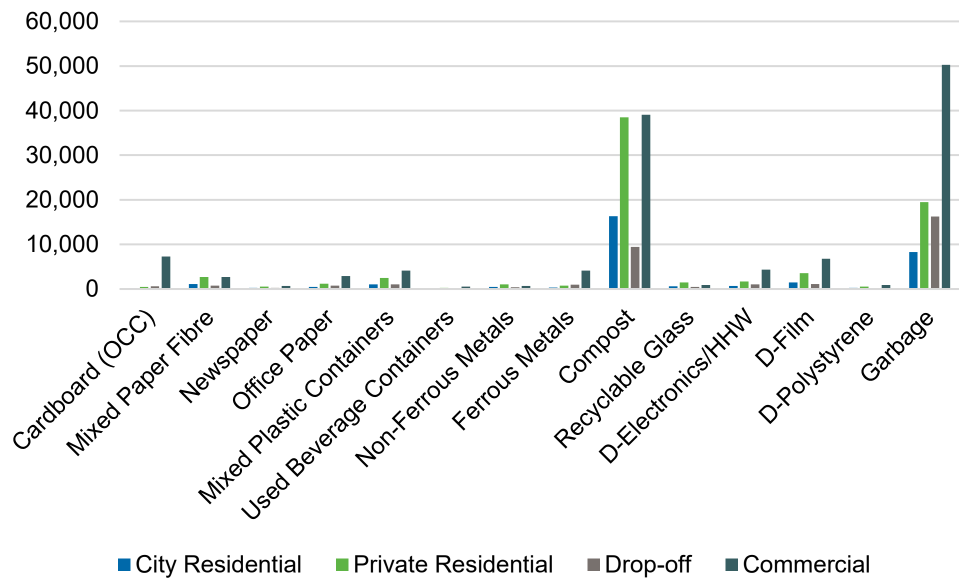

Figure 5-2: Average Tonnage Received at Central Transfer Station in 2016 and 2017

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.

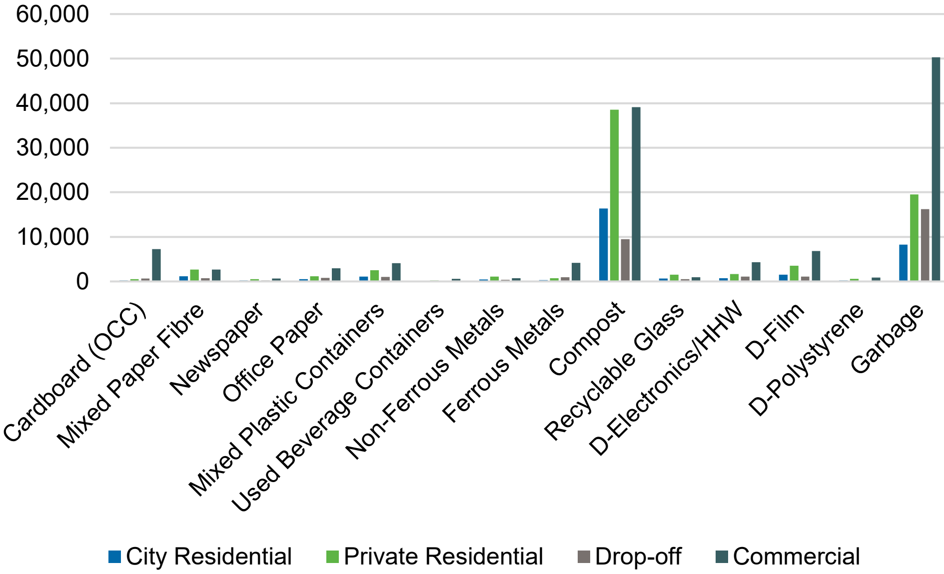

Figure 5-3: Average Tonnage Received in Municipality of Anchorage in 2016 and 2017

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.

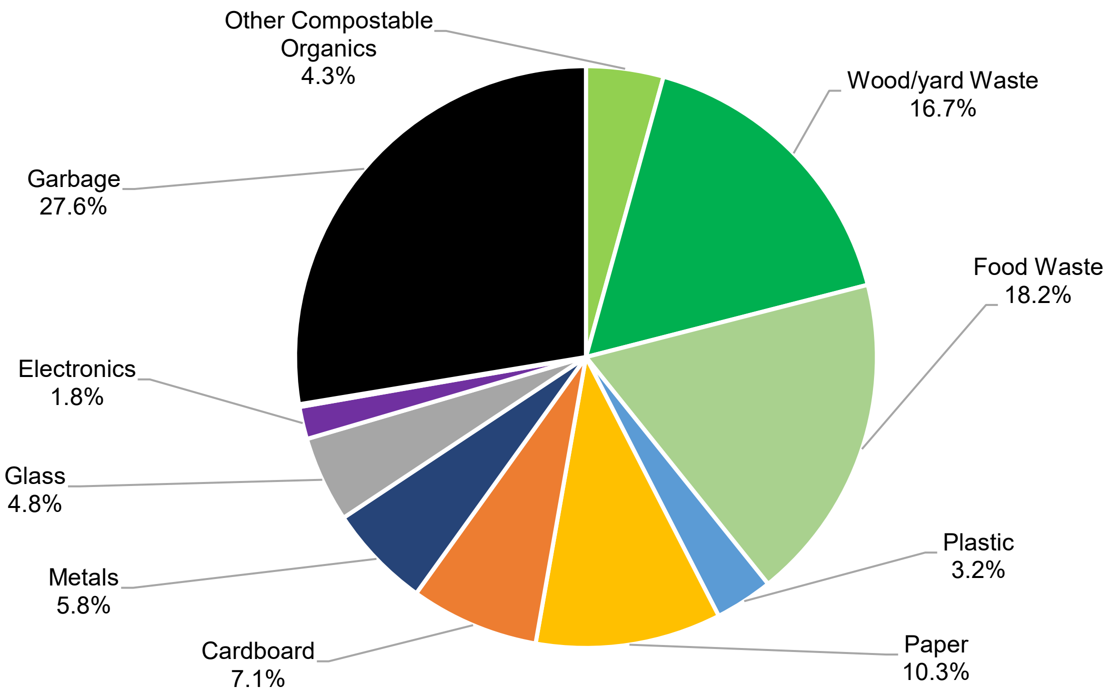

Figure 5-4: Total Anchorage Waste Composition

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.

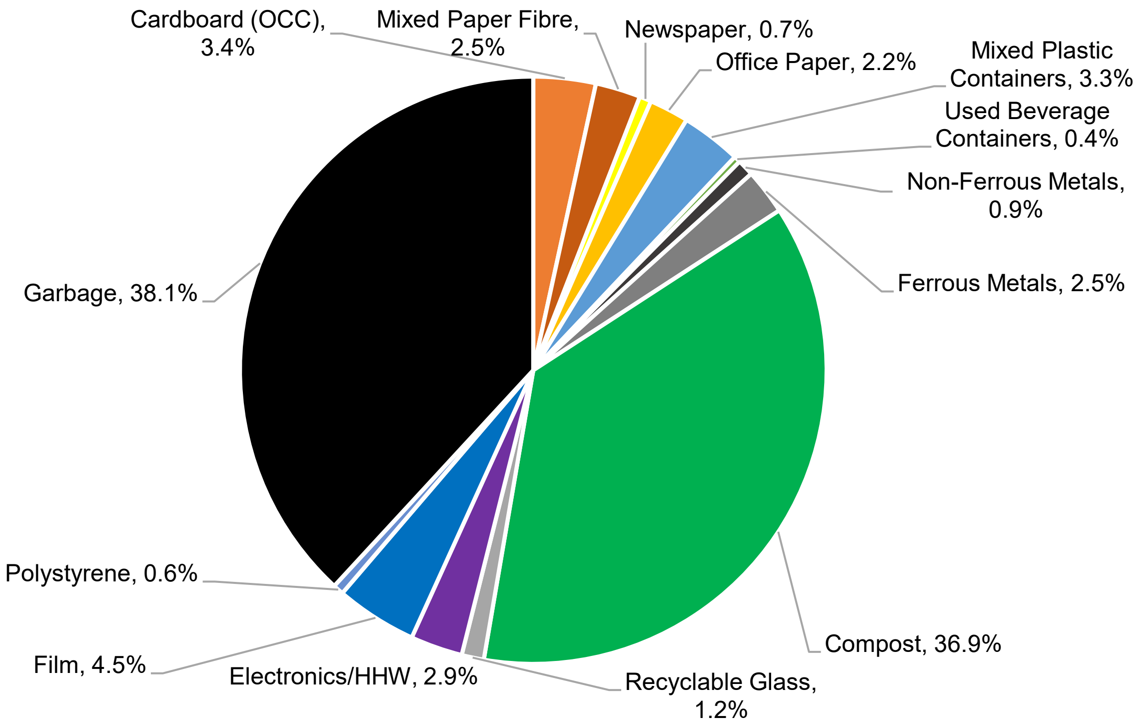

Figure 5-5: Total Peace River Waste Composition

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.

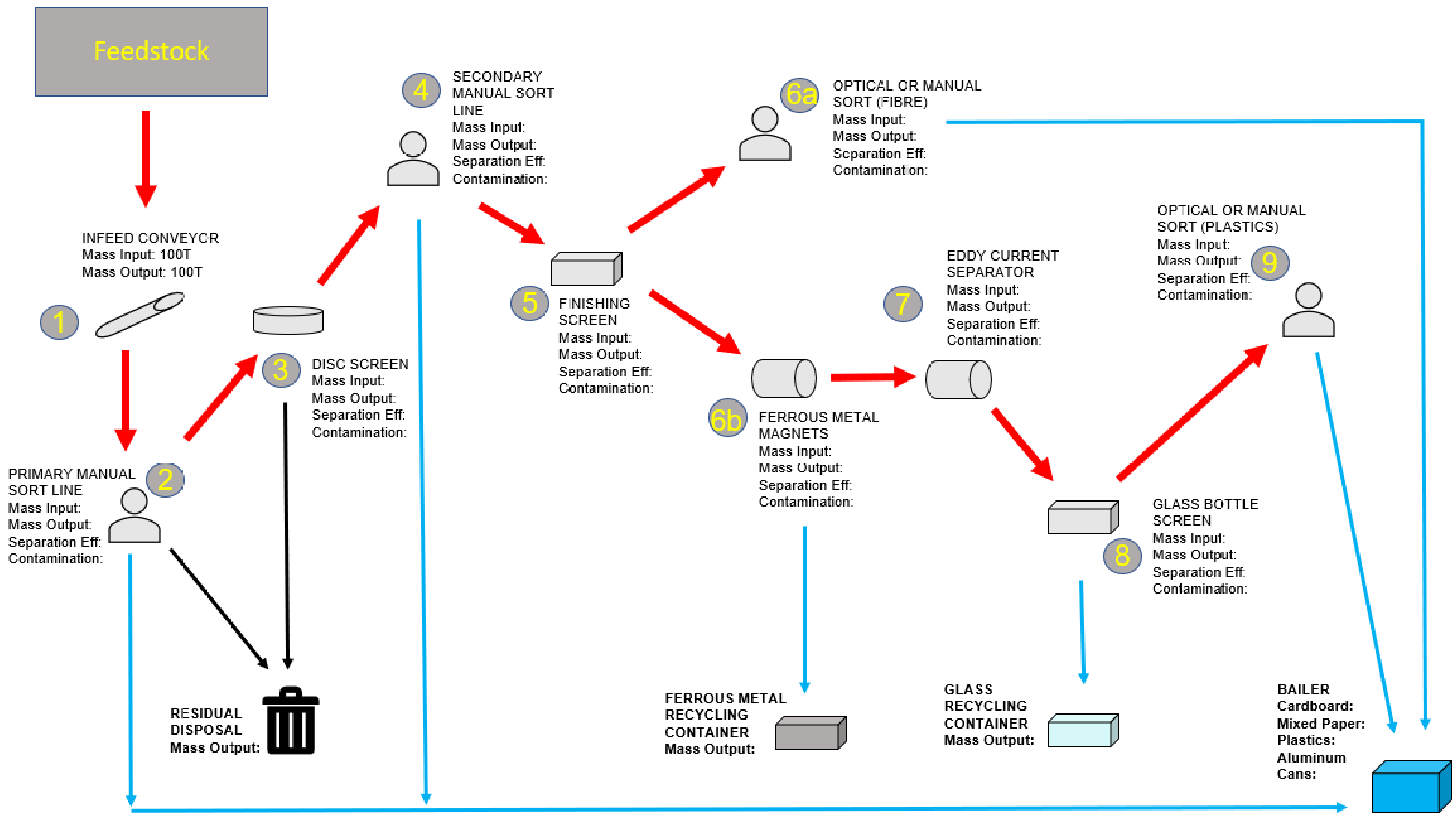

Figure 6-1: MRF Operational Features

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.

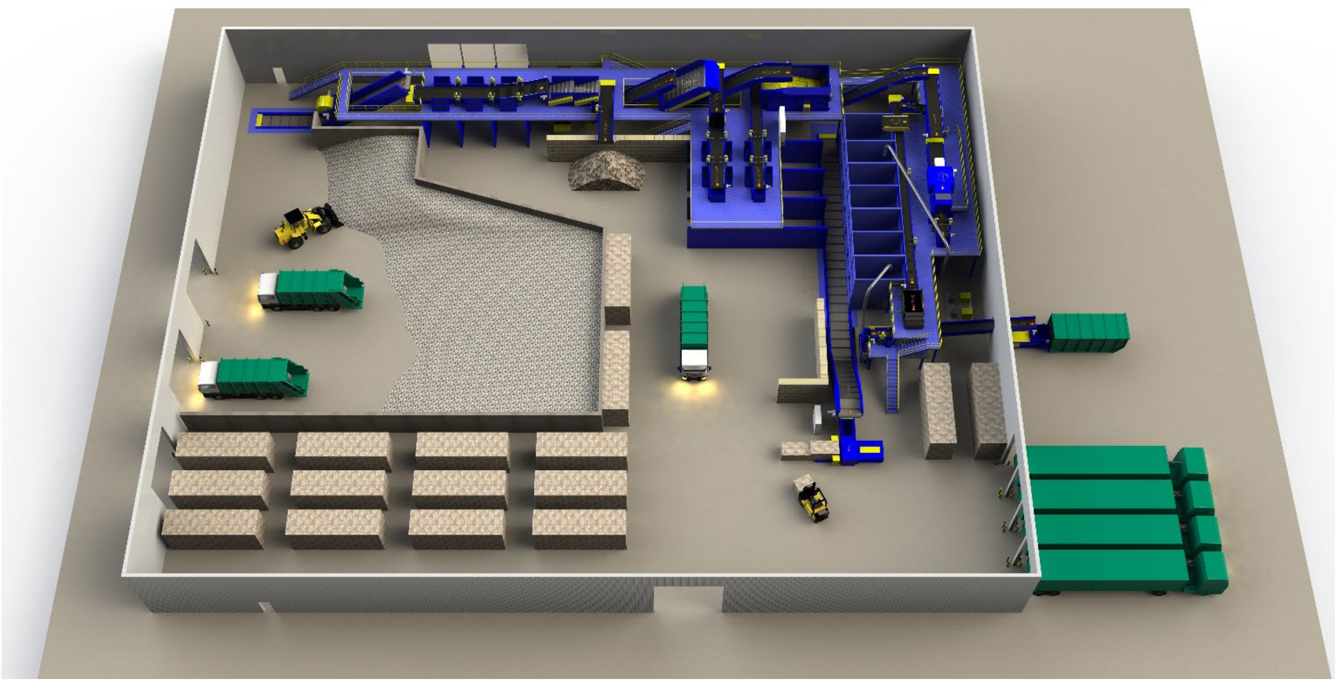

Figure 6-2: Example MRF Conceptual Layout

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.

Respectfully Submitted,
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APPENDIX A

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LIMITATIONS ON USE OF THIS DOCUMENT

GEOENVIRONMENTAL

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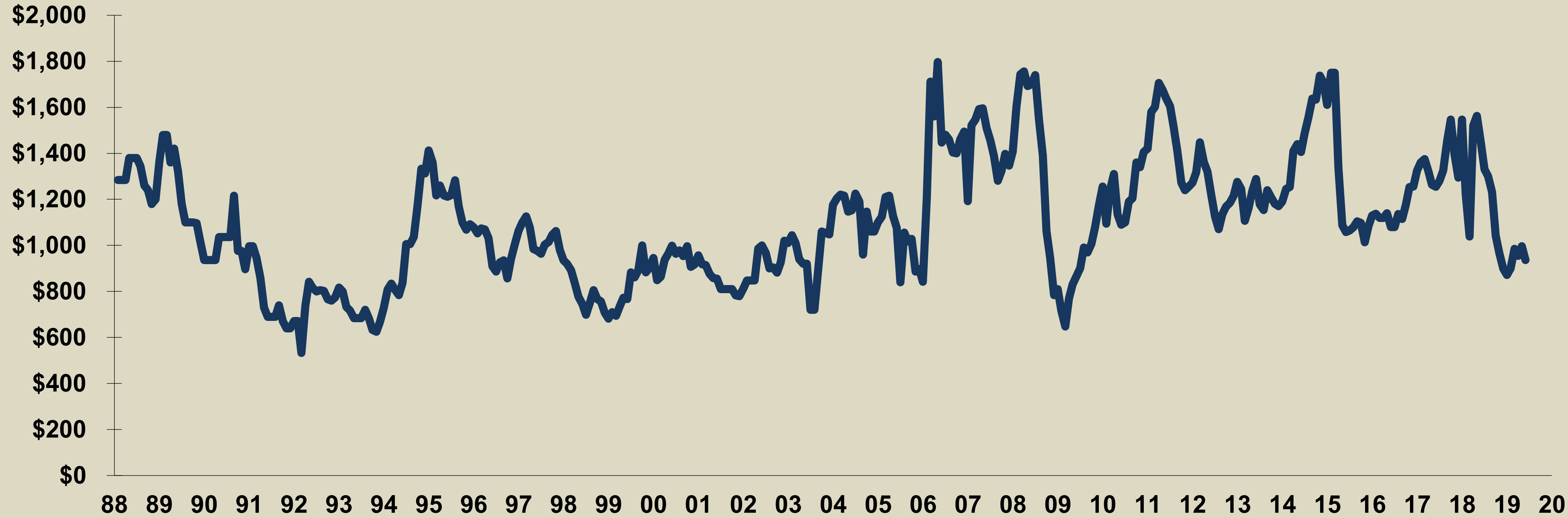
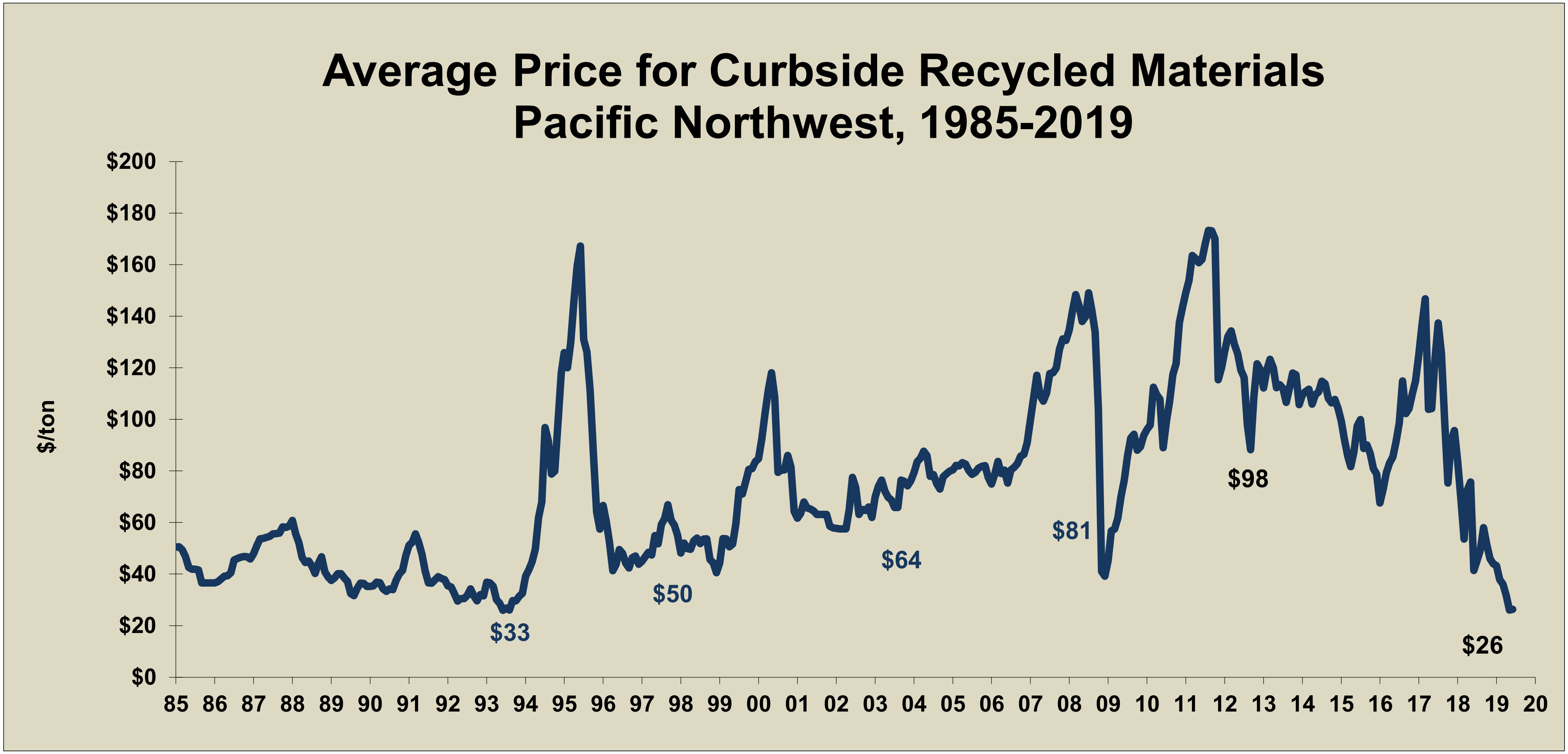
APPENDIX B

HISTORICAL COMMODITY PRICES FROM SOUND RESOURCE MANAGEMENT

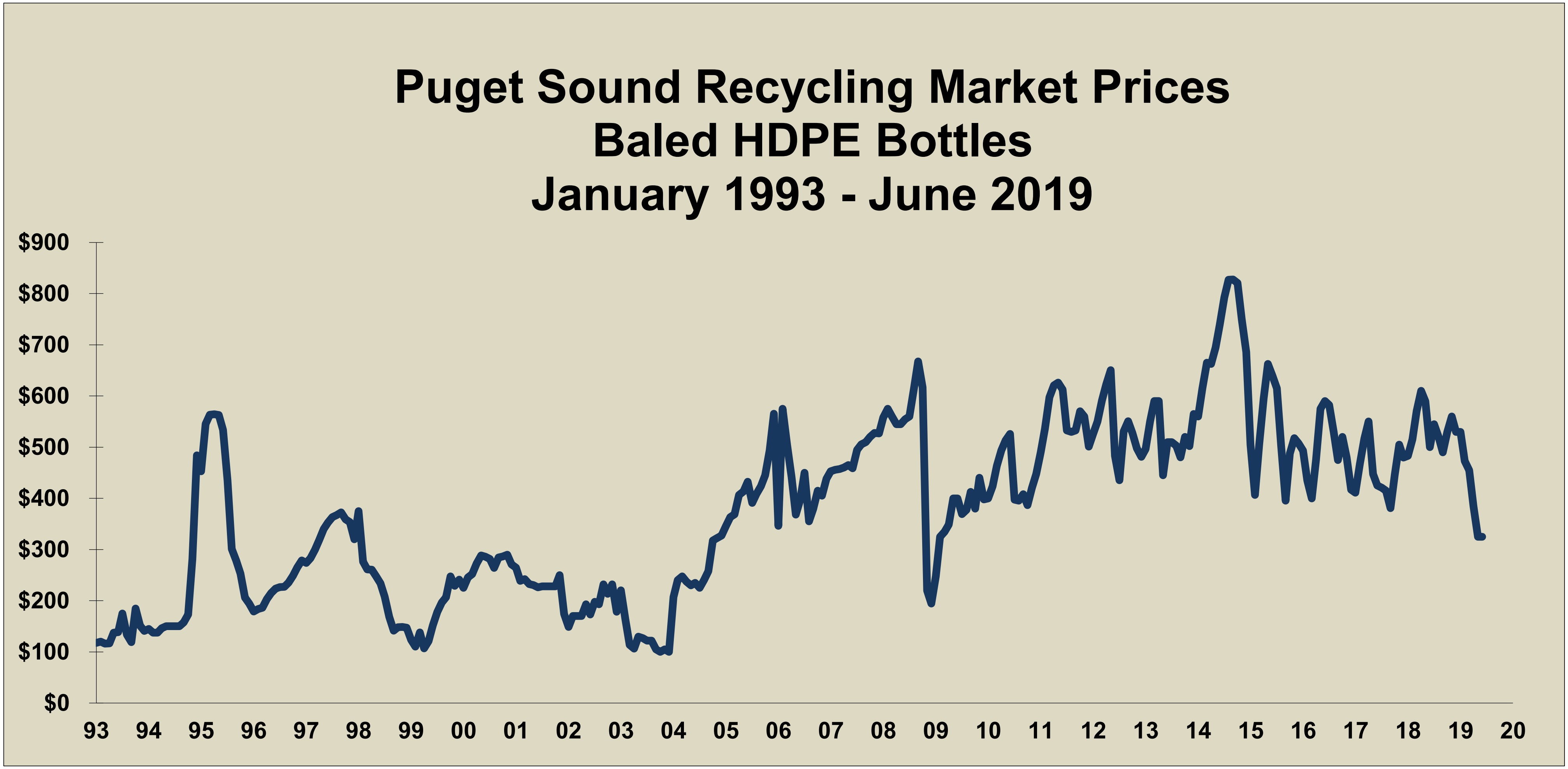
Puget Sound Recycling Market Prices
Used Aluminum Beverage Cans
February 1988 - June 2019

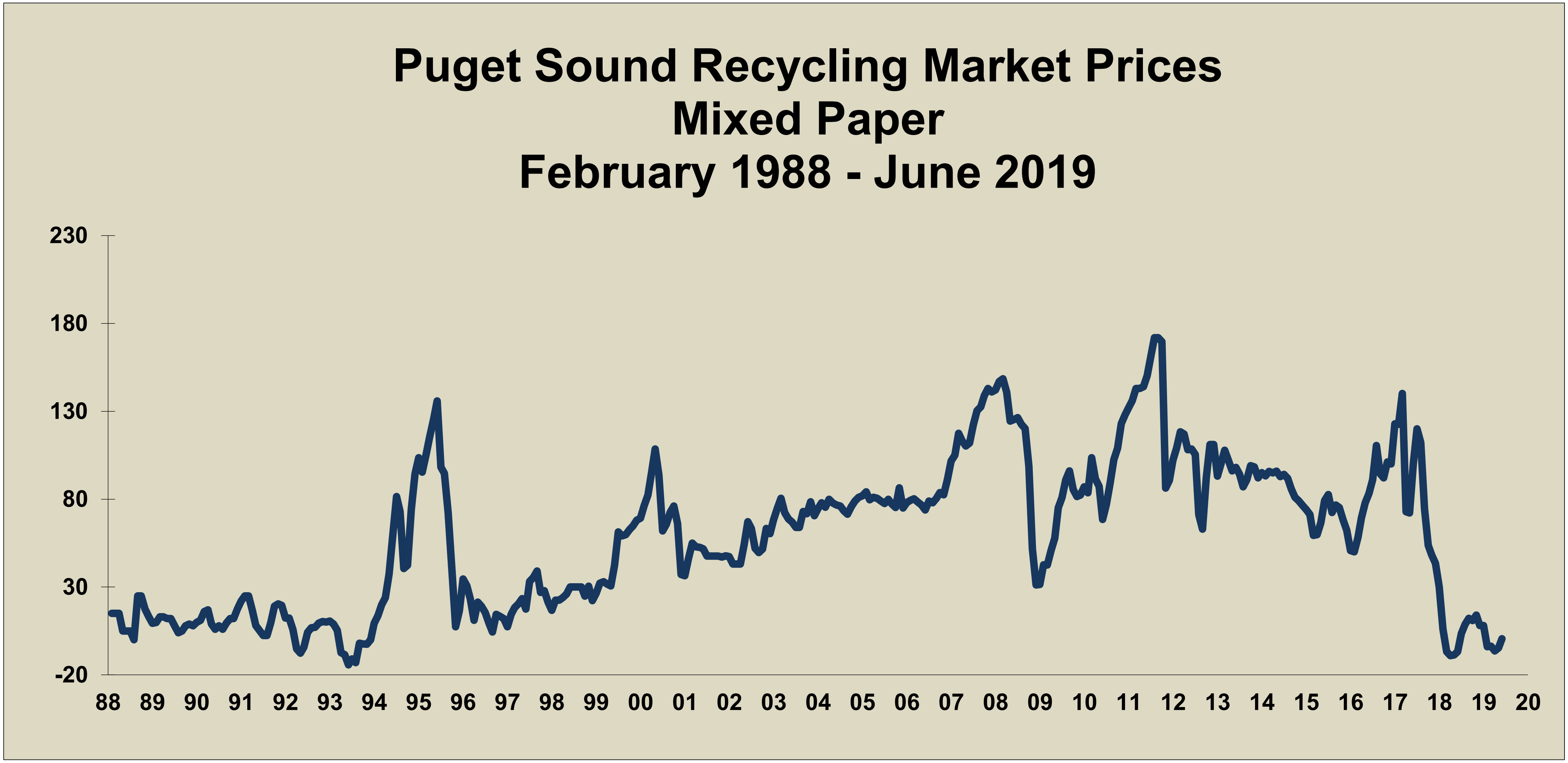


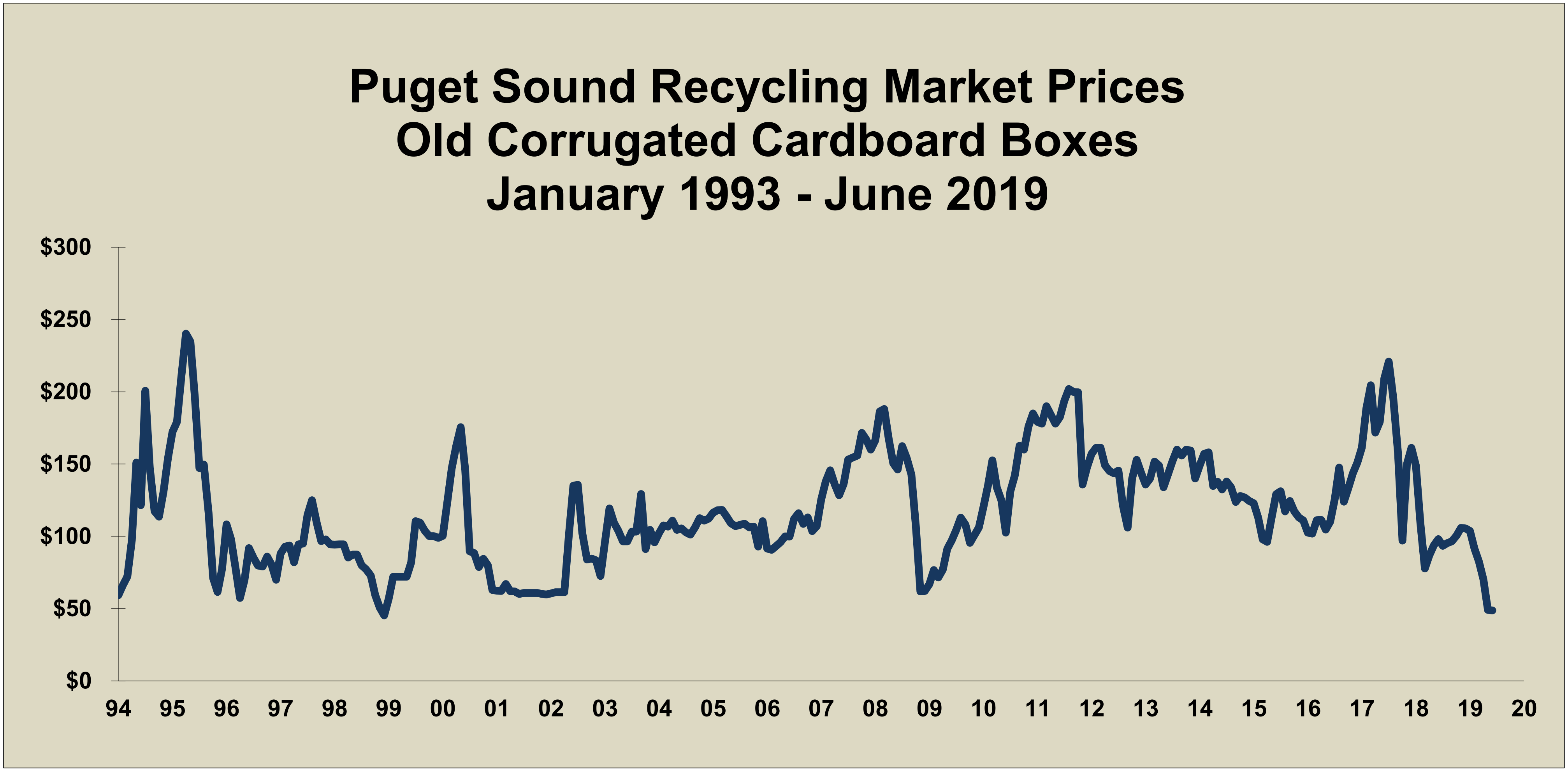


Sound Resource Management Group, Inc.

info@zerowaste.com


Puget Sound Recycling Market Prices
Baled HDPE Bottles
January 1993 - June 2019
$900
$800
$700
$600
$500
$400
$300
$200
$100
$0
93 94 95 96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20


Puget Sound Recycling Market Prices
Mixed Paper
February 1988 - June 2019
230
180
130
80
30
-20
88 89 90 91 92 93 94 95 96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20



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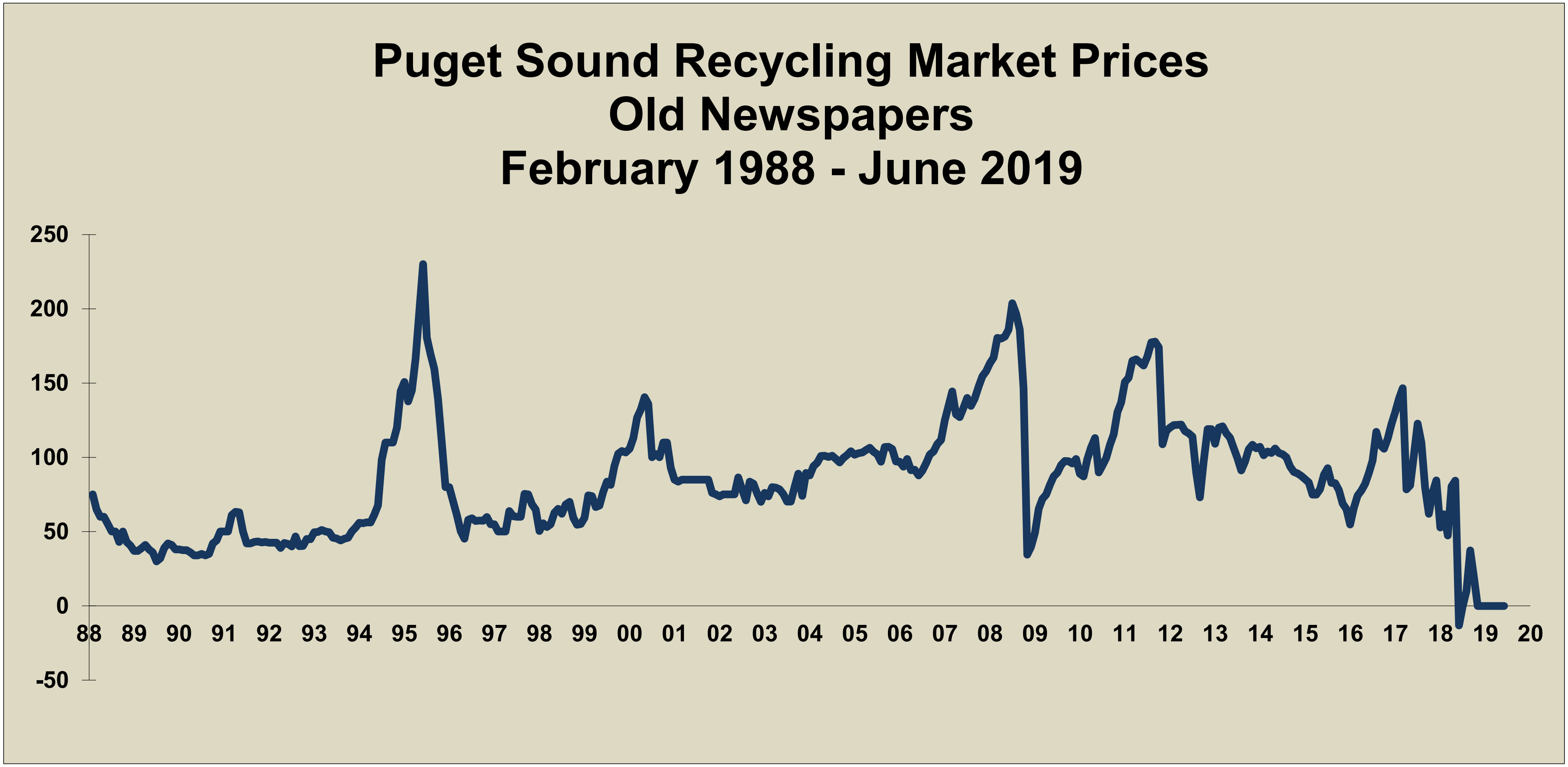
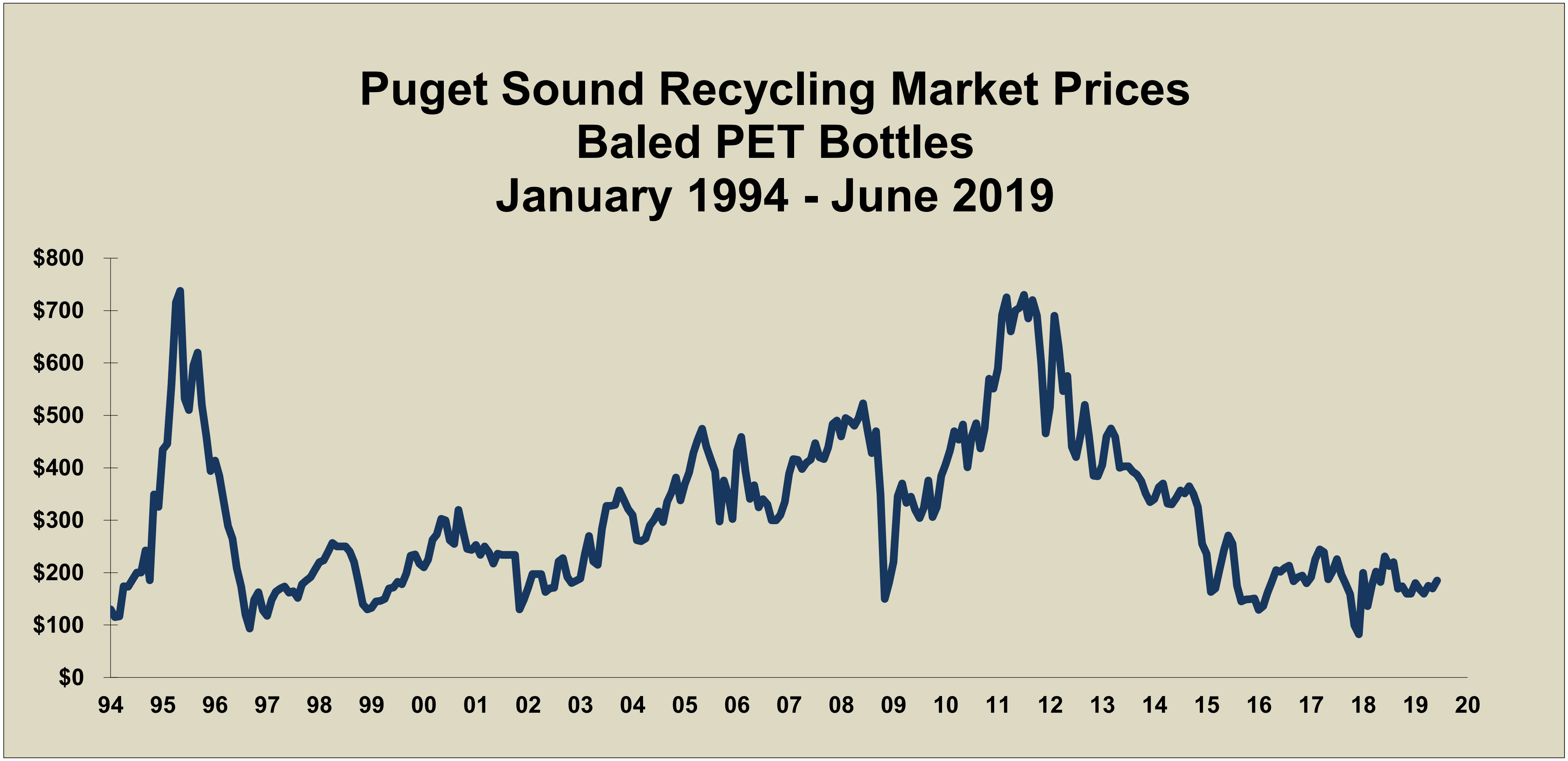

Puget Sound Recycling Market Prices
Old Newspapers
February 1988 - June 2019
250
200
150
100
50
0
-50
88 89 90 91 92 93 94 95 96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20


Puget Sound Recycling Market Prices
Baled PET Bottles
January 1994 - June 2019
$800
$700
$600
$500
$400
$300
$200
$100
$0
94
95
96
97
98
99
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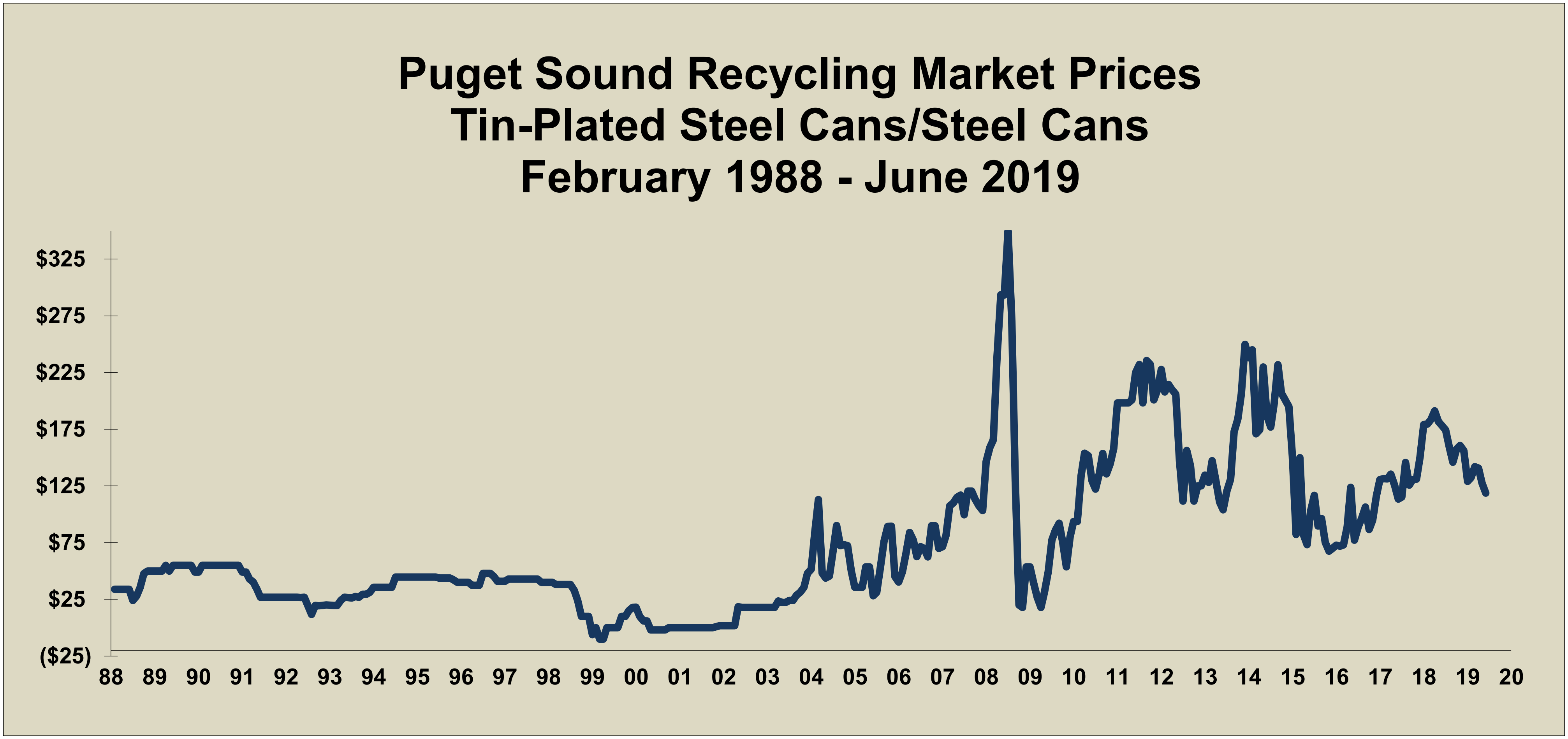
Puget Sound Recycling Market Prices
Tin-Plated Steel Cans/Steel Cans
February 1988 - June 2019
$325
$275
$225
$175
$125
$75
$25
($25)
88 89 90 91 92 93 94 95 96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20