Memorandum

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TO: Zack Hansen and Nikki Stewart
Ramsey/Washington Recycling & Energy Board Joint Leadership Team

FROM: Kate Bartelt, Jennefer Klennert, and Nathan Klett
Foth Infrastructure & Environment, LLC (Foth)

RE: Analysis for Recovery of Recyclable Commodities using Pre-Processing

Executive Summary

The Recycling & Energy Board (R&E Board) is interested in installing pre-processing equipment at the Recycling & Energy Center (R&E Center) to recover recyclables that remain in the municipal solid waste (MSW) after source-separation as a compliment to the ferrous and non-ferrous recovery systems already in operation. The R&E Board is interested in understanding the volume of recyclables potentially recoverable, the value of those recyclables and the economic factors to consider prior to investing in pre-processing equipment for recyclables recovery. At the R&E Board's direction, the goal of this memo is to identify the volume of recyclables potentially recoverable, the value of those recyclables and the economic factors to consider prior to investing in pre-processing equipment for recyclables recovery.

Recyclable materials are valuable commodities, with local and international end use markets. Local and regional prices are affected by many factors including, material quality as collected with the MSW and end use demand determined by domestic consumption and global exports. Recycling markets have been exceptionally volatile in 2017 and the first few months of 2018, which is a trend that is anticipated to continue into the foreseeable future. Despite the current market volatility, recyclable materials remain a valuable commodity with local and national markets. This memo represents a look at the markets as of Quarter 1 2018.[i]

Definitions

Pre-Processing	Mechanical systems that separate a recyclable commodity (-ies) from MSW. Formally called Mixed Waste Processing (MWP).
Diversion Rate	The percent of total recyclable commodities potentially removed from the total inbound MSW.
Recovery Rate	The percent of total recyclable commodities that can be removed from the MSW using existing technology.

Supporting Documents

1. Foth Infrastructure & Environment, Summary of 2016-2017 Seasonal Waste Characterizations, December 18, 2017.
2. Foth Infrastructure & Environment, Pre-Processing: End Market Analysis for Process Residue, March 30, 2018.
3. Burns & McDonnell, Solid Waste Composition Analyses – Letter Report, March 13, 2018.
4. Foth Infrastructure & Environment, *Waste Composition Study*, September 2014.
5. SAIC, Solid Waste Composition Study – Newport Resource Recovery Facility, September 17, 2012.
6. Foth Infrastructure & Environment, *History of Residential Recyclables Prices,* March 14, 2018.

Background: Recovering Recyclables at the R&E Center

The R&E Center is a facility that processes MSW to create refuse derived fuel (RDF). Ferrous recyclables have been recovered at the R&E Center from the waste stream since 1989 and non-ferrous recyclables have been recovered since 2000. During processing of inbound MSW into RDF, the MSW passes through a series of cross-belt magnets and eddy current separators to recover ferrous and non-ferrous materials for recycling. From 2008 to 2017, 7,200 tons of non-ferrous and 139,200 tons of ferrous materials were recovered from the inbound waste. Note, these tons were recovered after source separation of recyclables from trash occurred by the waste generator. The R&E Center staff have experience in recovering recyclables from MSW and have continuously worked to improve the volume and quality of materials being recovered.

Recovery Analysis: Projected Recovery Rates and Volumes Using Pre-Processing Technology

A. Waste Characterization Study Findings

A Waste Characterization study was completed in 2016 and 2017 to identify traditional recyclables that could be recovered from the residential waste stream as well as materials that could be composted or digested in an anaerobic digester. Traditional recyclables were classified as plastic bottles and containers, old corrugated containers (OCC), ferrous and non-ferrous materials.

Four (4) characterization events were conducted from October 2016 to August 2017 to evaluate the potential seasonal waste trends. The focus was on sorting incoming MSW by size and was not intended to adhere to ASTM D5231 *Standard Test Method for Determination of the Composition of Unprocessed Municipal Solid Waste.* See *Summary of 2016-2017 Seasonal Waste Characterizations*[ii] for full details on waste characterization methodology.

The study results indicate that there were limited but recoverable, amounts of traditional recyclables in the waste stream, see Table 1. The non-recyclable material portion of the waste stream comprised 89 to 95 percent of the total material sampled. Other relevant findings from the study include:

- *Bagged Waste* – Material was sorted into bagged and loose materials. Bagged waste represented 58 to 69 percent of the waste stream.
- *OCC* – OCC material represented approximately 0.5 to 2.0 percent of the waste stream. The study found that OCC from the residential waste characterization was not a major portion of the waste stream.
- *Recoverable Recyclables* – Plastics made up 3.4 to 4.9 percent of the waste stream. Plastic No. 1, PET, was the majority of plastics found during all seasonal characterization events, followed by Plastic No. 5, PP, and Plastic No. 2 (HDPE). Plastic observed in the characterization events may be recoverable using technology such as optical sorting.

Table 1
Waste Characterization Findings[iii]

	Oct-16	Mar-17	May-17	Aug-17
Pounds of Sample (lbs)	2,258	2,209	2,118	2,201
Percent of Bagged	56%	65%	69%	65%
Percent of Loose Material	39%	35%	31%	35%
Percent of Plastics	3.4%	4.9%	3.7%	4.1%
Percent of Polyethylene Terephthalate (PET)	1.2%	2.0%	1.7%	1.6%
Percent of HDPE	0.4%	1.2%	0.5%	0.8%
Percent of PVC	0.0%	0.0%	0.0%	0.0%
Percent of LDPE	0.0%	0.0%	0.0%	0.0%
Percent of PP	0.8%	0.9%	0.9%	0.8%
Percent of PS	0.3%	0.7%	0.5%	0.6%
Percent of Plastics #7 Other	0.2%	0.1%	0.1%	0.3%
Percent of Old Corrugated Containers (OCC)	0.46%	0.75%	1.88%	2.02%
Percent of Metals (non-Ferrous and Ferrous)	2.0%	2.4%	2.9%	2.0%
Percent of Ferrous	1.0%	1.4%	1.8%	1.0%
Percent of non-Ferrous	0.9%	1.0%	1.2%	1.0%
Percent of Glass	-	3.3%	2.2%	1.7%
Percent Waste	95%	89%	90%	90%
Percent in +12"	15.3%	14.5%	14.1%	13.7%
Percent in 6" to 12" fraction	29.6%	16.9%	14.1%	21.0%
Percent in 2" to 6" fraction	36.4%	34.2%	27.7%	26.7%
Percent of food waste in 2" to 6" fraction	-	5.3%	10.4%	12.3%
Percent in -2"	13.5%	18.0%	23.8%	16.6%

B. Projected Tonnage of Recoverable Recyclables

Recyclables remain within the inbound MSW received at the R&E Center. These recyclables can be recovered through the addition of pre-processing and post-processing equipment. Various equipment for recovery of the recyclables is available, but specific equipment has not been selected by the R&E Board.

To better understand the projected tonnage of recyclables that may be recovered, an analysis of the inbound residential only waste stream was conducted as described previously in Section A. Since 2012, there have been three (3) waste composition studies conducted. Results from these studies offer additional insight into the material composition in inbound residential and commercial MSW.

Table 2 displays the findings from the three waste sort studies in terms of the mean composition, by weight, of materials in the MSW, including both residential and commercial materials. Note: the 2012 and 2014 waste sorts were conducted in the summer of 2012 and 2014, respectively, and the 2018 waste sort was conducted during the winter of 2017.

The results show a decreasing tonnage of newsprint and an increasing tonnage of electronics and OCC and kraft bags in MSW. Both of these trends are being seen across the United States. The waste sort results also show an increasing tonnage of compostable paper and general variability in the percent of each material observed at any given time, which is one of the limitation of weeklong waste sorts (in terms of an accurate representation of the inbound waste stream). Additionally, the materials in each category were not consistent between the three waste sorts (e.g. mixed metal was only sorted in 2014), which poses a challenge when trying to compare data sets. Therefore, Table 2 is provided for reference (i.e. displays material variability through time), but the remaining analysis will focus on the results from the 2018 waste sort as this is the most recent data.

Table 2
Waste Sort Findings from Studies Conducted at the R&E Center, Residential and Commercial MSW

Category	Material	Burns & McDonnell (2018)	Ramsey Washington Waste Composition (2014)	SAIC (2012)
		Mean Composition by Weight	Mean Composition by Weight	Mean Composition by Weight
Paper	Newsprint	1.1%	1.2%	1.6%
	Old corrugated and Kraft bags	4.5%	4.0%	2.8%
	Mixed recycle paper	7.0%	4.7%	6.9%
	Compostable paper	9.2%	6.3%	---
	Non-recyclable/non-compostable paper	0.8%	1.5%	12.0%
	Subtotal Paper	22.5%	17.6%	23.1%
Plastic	PET bottles/jars	1.1%	1.1%	1.5%
	HDPE bottles/jars	0.5%	0.6%	0.8%

Category	Material	Burns & McDonnell (2018)	Ramsey Washington Waste Composition (2014)	SAIC (2012)
		Mean Composition by Weight	Mean Composition by Weight	Mean Composition by Weight
	PLA/compostable plastic	0.0%	----	---
	Film/wraps	5.5%	6.7%	5.7%
	Other packaging	1.5%	0.8%	1.0%
	Other non-packaging	5.3%	6.7%	8.1%
	Subtotal Plastic	14.0%	15.9%	17.1%
Metals	Aluminum containers	0.7%	0.5%	0.7%
	Ferrous containers	0.5%	0.5%	0.6%
	Other ferrous	1.3%	1.9%	2.6%
	Other non-ferrous	0.6%	0.3%	1.1%
	Mixed metal	----	2.0%	----
	Subtotal Metal	3.1%	5.3%	5.0%
Glass	Glass containers	2.0%	1.6%	2.2%
	Other (non-container) glass	1.1%	0.4%	0.4%
	Subtotal Glass	3.1%	1.9%	2.6%
Organics	Yard waste	2.0%	3.7%	3.4%
	Food waste	18.9%	22.2%	14.6%
	Wood waste	5.5%	8.8%	6.0%
	Other organic materials	5.1%	1.9%	4.3%
	Subtotal Organics	31.5%	36.6%	28.2%
Other	Hazardous wastes/HHW	0.1%	0.6%	0.2%
	Mercury containing lamps	0.0%	----	0.0%
	Household appliances	0.7%	0.2%	1.9%
	Electronics	2.5%	1.2%	1.6%
	Other bulky wastes	6.9%	8.3%	6.0%
	Textiles	6.2%	4.2%	6.7%
	Other inorganics	6.1%	4.9%	3.6%
	Fines/super mix	3.3%	----	----
	Construction demolition debris	-----	3.3%	3.9%
	Subtotal Other	25.9%	22.7%	23.9%

The data from the 2018 waste sort was used to estimate the tons of each material available in the inbound MSW at the R&E Center based on receiving 440,000 tons MSW annually, which is shown in Table 3. Additionally, Table 3 provides a range in the estimated percent recovery for each material based on communication with other facilities operating mixed waste processing equipment and vendor published literature on recovery rates (downgraded to provide a conservative estimate). Note, these recovery rates are an aggregate of the available data and are not intended to be based on specific technologies, vendors, or recovery methods. The range in recovery rates are provided to give the R&E Board a broad understanding of the potential recyclable tonnages that may be recovered with additional equipment.

Table 3
Potential Tonnage of Recoverable Recyclables

Category	Material	Percent Available in Inbound MSW[1]	Tons Available in Inbound MSW	Estimated Percent Recovery Using Mechanical Equipment (%)		Estimated Tons Recovered Using Mechanical Equipment (Tons)	
				Low	High	Low	High
Paper	Newsprint	1.1%	4,840	40%	65%	1,936	3,146
	Old corrugated and kraft bags	4.5%	19,800	40%	65%	7,920	12,870
	Mixed Recycle Paper	7.0%	30,580	35%	50%	10,703	15,290
	Compostable Paper	9.2%	40,480	25%	40%	10,120	16,192
	Non-recyclable/non-compostable paper	0.8%	3,520	15%	30%	528	1,056
Plastic	PET bottles/jars	1.1%	4,840	50%	85%	2,420	4,114
	HDPE bottles/jars	0.5%	2,200	50%	85%	1,100	1,870
	Film/wraps	5.5%	24,200	35%	60%	8,470	14,520
	Other Packaging	1.5%	6,600	40%	70%	2,640	4,620
	Other Nonpackaging	5.3%	23,320	25%	45%	5,830	10,494
Metals[a]	Aluminum containers	0.7%	3,080	60%	85%	1,848	2,618
	Ferrous containers	0.5%	2,200	60%	90%	1,320	1,980
	Other ferrous	1.3%	5,720	50%	85%	2,860	4,862
	Other non-ferrous	0.6%	2,640	40%	85%	1,056	2,244
Glass	Glass containers	2.0%	8,800	15%	35%	1,320	3,080
	Other (non-container) glass	1.1%	4,840	15%	35%	726	1,694
Organics	Yard waste	2.0%	8,800	30%	60%	2,640	5,280
	Food waste	18.9%	83,160	30%	50%	24,948	41,580
	Wood waste	5.5%	24,200	30%	40%	7,260	9,680
	Other organic materials	5.1%	22,440	30%	50%	6,732	11,220
Other	Fines/supermix	3.3%	14,520	30%	60%	4,356	8,712
Textiles[b]	Textiles	6.2%	27,280	25%	40%	6,820	10,912

a. Note: The 5-year average recovery rate at the R&E Center is approximately 900 tons per year of non-ferrous and 13,900 tons per year of ferrous. The "tons available" total for ferrous is less than the amount currently recovered, which is a limitation to using a "snapshot" in time from waste sort data. Additionally, the ferrous currently recovered at the R&E Center represents clean and dirty ferrous as delivered and includes other materials that are removed by the facility receiving the ferrous.

b. Textiles are included as a recoverable recyclable, but currently, there are limited examples of mechanical equipment designed to remove textiles.

An estimated recovery range, low to high, is provided in Table 3 to account for material integrity and contamination and assumes recovery using mechanical equipment. The total percentage recovery ranges from 25.8% to 42.7% or 113,500 tons to 188,000 tons of recoverable recyclables.

C. Material Quality and Factors Affecting Recovery

Contamination continues to be an important factor in the recycled commodities market. Contaminated materials require extra processing. The export market for these lower quality materials is also shrinking.

China's Market Demand - Market trends are being shaped in large part by China's market demands. In March 2018, China enacted a 25 percent duty, often called a tariff, on U.S. scrap aluminum. More than half of U.S. scrap aluminum exports are to Chinese markets[iv]. China's aluminum move is part of a larger tariff package in response to the tariffs President Donald Trump imposed on Chinese steel and aluminum. The 25 percent aluminum tariff targets used beverage cans (UBCs) and other forms of scrap aluminum. It would not include partially processed metal.

Traditional Recyclables – Quality or "cleanliness" of recyclable materials recovered from MSW using a pre-processing system is the primary concern. It is anticipated that the ferrous and non-ferrous will be similar or "cleaner" than that recovered using the current RDF processing system. Ferrous and non-ferrous currently has a market, and this is not anticipated to change. The containers (HDPE and PET plastics) and OCC may be "contaminated" with food waste and other wet organic material which may reduce or eliminate their value.

The moisture in the MSW can also impact the quality of OCC that is able to be recovered. The Waste Characterization Study[v] found that moisture levels in the MSW change seasonally. Thus higher quality OCC recovery may be possible when the moisture in inbound MSW is lower.

Much of the pre-processing equipment, similar to Material Recovery Facilities (MRFs), sorts and separates containers based on the anticipated shape and size of an item. Compacted MSW may change the shape and size of the items making recovery more difficult and may lead to more contamination issues.

Organic Waste - Similar to recyclable materials, the quality of the organics recovered using pre-processing equipment is an important factor related to the cost of organics end markets and the material produced from the organics (e.g. biogas, digestate, and compost). Conceptually, the pre-processing equipment will target organics from the fine material in MSW, which means there is potential to also recover broken glass fragments, grit, and small plastic pieces. These contaminants in the organic materials recovered will affect the cost to have a private vendor take the material and will affect the quality of the end product produced by the private vendor.

Technology Factors – The recovery rate for each recyclable commodity will greatly depend on the specific technology selected. A factor affecting all mechanical recovery technologies is system throughput including burden depth, speed and availability, which is the functional operation of the system excluding breaks and scheduled maintenance and cleaning. Recovery rate is also related to waste sort data, since waste sort data is critical information used when designing a system to recover recyclables. As the material composition changes, the recovery rate will likely change.

ii. Recyclables Market Analysis

A. Status of Recycling End Markets

Recyclable materials are valuable commodities, with local and international end use markets. Local and regional prices are affected by many factors including, material quality as collected, processing equipment and operations at the materials recovery/processing facility. Prices are also affected by end use demand determined by domestic consumption and global exports.

Regional and national commodity historical market price trends are presented below. The overall recent trend for the Midwest region is downward, the longer term trend for the Pacific Northwest is upward. Like all commodities, recyclables exhibit highly volatile price changes due to many factors, including the overall U.S. economy. The recycling market is currently depressed due to global market conditions. Given the amount and composition of residential recyclable materials collected from Ramsey County, the gross value of the commodities, after processing, as paid by end markets, has ranged from about $6.1 million annually in 2011 to $4.2 million annually in 2015. For Washington County, the gross value of commodities, after processing, as paid by end markets, has ranged from about $3.6 million annually in 2011 to $2.4 million annually in 2015. The equivalent price per ton ranged from a high of $149 per ton in 2011 to a low of $106 per ton in 2015, See *History of Residential Recyclables Prices*[vi]. This type of price variability is experienced by all recycling programs because of the global nature of recycling commodities.

Figure 1
Midwest Region Recycling Price Trends

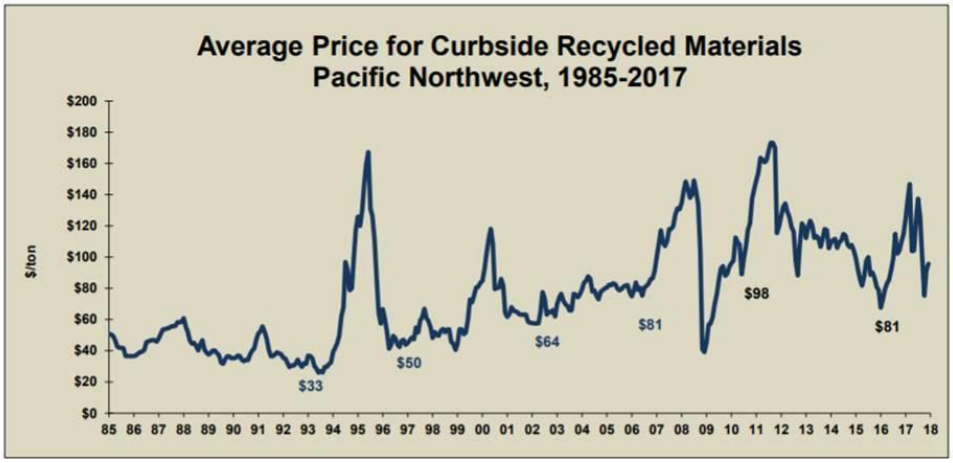
As Calculated by Foth based on local and regional data.

The eight (8) year prices in Figure 1 show both volatilities of the end market prices and an overall decline in the average price per ton during this period.

Price Data from Other Regions in the U.S.

Other national data from the Northwest Region captured by Sound Resource Management Group (SRMG) shows a similar general price trend for the same years (2010 through 2017). Figure 2 shows a relevant "Average Price for Curbside Recycled Materials" from 1985 through 2017 from the Northwest Region.

Figure 2
Northwest Region Curbside Recycling Trends - Average $ per Ton



By Sound Resource Management Group (SRMG), as published by Zero Waste.com
http://zerowaste.com/images/avgpr1217.pdf

The above graph by SRMG shows the weighted average market price. These prices are based on large quantities packed for shipment to end-use manufacturers, freight-on-board MRF. The materials are residential commodities collected by curbside programs in Washington State's Puget Sound region[vii]. For example, SRMG states in part:

> *"The recovery of recycling markets in 2016 and early 2017 breathes new optimism into recycling proponents. Yet it is too soon to tell if this recovery signals a return to the uptrends that previously lasted until the 2008 financial crisis. Optimism has been seriously tempered by China's National Sword campaign to root out trash that sometimes is included in bales of mixed paper and mixed plastics exported from the US."*

B. Economic Factors Affecting Availability of Markets and Pricing

When analyzing recycling economics and end market prices, it is best to consider the full range of materials collected. The ups and downs of each commodity are somewhat offset by the variability in market prices of other materials.

In general, recyclables are global commodities (paper, metal, plastics) affected by the uncertainties of worldwide economics and political factors. Glass and organics, however, have local markets and processing/disposal locations (e.g., compost facilities), respectively.

These global and domestic end market conditions are largely out of the control of local communities. However, local communities can influence other factors that have a significant impact on the value of recyclables. These local variables include:

- Pre-processing equipment and operations to reduce contamination of individual commodities.
- Clear specifications in contracts with standardized definitions of material grades, prohibited items, and contamination.

The economics of recycling is sustainable in the long term because of the high value of quality secondary materials used as a raw material that replaces expensive virgin resources.

C. Potential Revenues from Recyclables Extracted from R&E Center Incoming MSW

Commodities removed from the incoming MSW were evaluated for a Current Market Rate per Ton using various sources. An Assumed Market Price per Ton was calculated by assuming a downgraded Current Market Rate. The reduction percentage assumed by commodity is shown in Table 4.

Traditional recyclables, plastic containers (PET and HDPE), OCC, ferrous and non-ferrous, are marketable products that are considered a potential revenue source resulting from separation. The market for these materials is dependent on the quality (cleanliness) and is subject to fluctuations. Table 4 presents the market rates for the sale of marketable materials.

There are costs associated with the recovered organics, food waste, and yard waste. As identified in *Pre-Processing: End Market Analysis for Process Residue*[viii] memo, two Minnesota Compost Council membership surveys (2012/2013 and 2015/2016) mean processing costs of $52 per ton of finished compost were reported, with individual jurisdictions reporting as low as $5 per ton and as high as $104 per ton. While there are anticipated revenues from the sale of compost, it is assumed these revenues would go to the organics vendor. The ability to sell the finished compost would depend on the quality of organic materials, pre-and post-processing of organics by the R&E Center or its organic vendor, and local market need.

Note: Any changes due to the implementation of Waste Designation at the R&E Center are not accounted for as the impact is unknown at this time.

Table 4
Market Rates for Materials Recovered the R&E Center

Material	Current Market Rate/Ton	Downgraded percentage	Assumed Market Price/Ton
PET	$305[1]	80%	$61
HDPE	$380[1]	80%	$76
Cardboard	$93[1]	60%	$35
Ferrous (Tin/Steel containers)	$225[1]	55%	$101
Non-ferrous (Aluminum)	$1,440[1]	55%	$648
Mixed Paper	$2.50[1]	60%	$1
Compostable Paper	-$52[2]		-$52
Film/wrap	$0.12[1]	100%	$0
Mixed Metals	$68[3]	55%	$31
Glass	-$13[4]		-$60
Organic Material	-$52	0%	-$52
Textiles	$20[5]	80%	$4
Fines/supermix	-$52[2]		-$52

1. Current market prices from recyclingmarkets.net accessed on May 7, 2018. Note: with quality control of non-ferrous, the market rate would likely be higher.
2. Not a standard commodity: Assumed compostable paper and fines/supermix would be managed through composting at thus charged at current organics management rates.
3. Not a standard commodity: Assumed 55% downgrade for ferrous materials.
4. Given glass market, assuming a net disposal fee of $60 per ton (current landfill tipping fee).
5. Assumed lowest textile grade of $0.01 per pound of textiles with an 80% downgrade.

The market rates in Table 4 for the separated commodities were then used to calculate the projected revenue or costs for each of the commodities as shown in Table 5. Costs are indicated as a negative number.

Table 5
Potential Revenue of Recoverable Recyclables using Assumed Market Rate

Category	Material	Potential Revenue	
		Low	High
Paper	Newsprint	$968	$1,573
	Old corrugated and kraft bags	$280,368	$455,598
	Mixed Recycle Paper	$10,703	$15,290
	Compostable Paper	-$526,240	-$841,984
	Non-recyclable/non-compostable paper	-$27,456	-$54,912
Plastic	PET bottles/jars	$147,620	$250,954
	HDPE bottles/jars	$83,600	$142,120
	Film/wraps	$0	$0
	Other Packaging	$0	$0
	Other Nonpackaging	$0	$0
Metals	Aluminum containers	$1,197,504	$1,696,464
	Ferrous containers	$133,650	$200,475
	Other ferrous	$87,516	$148,777
	Other non-ferrous	$32,314	$68,666
Glass	Glass containers	-$79,200	-$184,800
	Other (non-container) glass	-$43,560	-$101,640
Organics	Yard waste	-$137,280	-$274,560
	Food waste	-$1,297,296	-$2,162,160
	Wood waste	-$377,520	-$503,360
	Other organic materials	-$350,064	-$583,440
Other	Fines/supermix	-$226,512	-$453,024
	Textiles	$27,280	$43,648
Total Potential Revenue		-$1,063,605	-$2,136,314

***Total Revenue Projection* –** If all potentially recoverable recyclables were recovered, given the assumed market rates, the total cost to the R&E Board would range from approximately one million to two million dollars annually. Note, the revenue projection does not factor in the cost of equipment for recovery of the material.

There will be additional costs associated with moving materials to end markets. Those costs would need to be subtracted from recycling revenues to give a true new net cost, see discussion in Section iii.B. There will also be costs associated with marketing recyclables. There are various options for marketing recyclables from hiring or contracting with a recycling broker, spot marketing with various end markets based on the daily pricing, and/or contracting with end market(s). Each alternative has pros and cons and will result in different commodity pricing. An evaluation of each alternative and the R&E Board's procurement rules will need to be conducted.

Many of the materials being identified in the tables above do not have current recycling or management markets.

iii. Economic Analysis

A. Factor for Considering Adding a New Material

Prior to considering adding a material for recovery, a **New Material Analysis Model** has been prepared. Each new material should be carefully considered prior to making a long-term capital investment in its recovery. This model is a tool for evaluating benefits and cost while identifying risks and/or concerns, see Appendix A. *Note*: The model is designed to be a flexible tool. Each time a material is considered, users should first look at the model questions to see if there are new questions to be added to reflect current knowledge of material recovery and recycling markets.

The model asks a series of twelve questions to assess the material quality, extractability using processing equipment at the R&E Center, understanding of how recovery would make progress toward County and R&E Board goals, and to quantify financial risk.

The model's total score will range from a low score of 12 to a high score of 180. In the model, a high score represents high potential for diversion and profit with low risk. A low score represents a low potential for diversion and profit with high risk.

Any score under a ranking of 108 or below would need to be carefully considered. The ranking of 108 means there are moderate risks but with net financial gains and increased diversion. A score above 108 indicates more positive findings and lower than 108 indicates there are key barriers to be addressed/overcome before proceeding.

B. Identify Options for Transporting Recyclables to End Markets

Transporting recyclables to end markets can be managed using several methods or a combination of methods.

- **Truck and Trailer could be owned by:**
  - R&E Board (Current practice for trailers only)
  - Recycling Vendor(s)
  - Contracted trucking service
  - Combination of services
- **Trucking could be staffed by:**
  - R&E Board employees
  - Recycling Vendor(s)
  - Contracted trucking service (Current practice)
  - Combination of services
- **Logistics could be managed by:**
  - R&E Board employees (current practice)
  - Recycling Vendor(s)
  - Contracted trucking service
  - Combination of services

The R&E Board owned trailers could be used to transport traditional recyclables to end markets, however, typically recycling vendors provide the trucks and trailers. This model could be explored through a Request for Proposal (RFP) process. If the R&E Board were to purchase trailers, modifications would need to be made to transport organic waste. Organic waste is higher in moisture content and should be transported using a sealed trailer with a leak proof walking floor. Final transportation cost cannot be projected or known as it will depend on market locations at the time of market sale. Further research will be necessary as markets are developed regarding transportation costs.

C. Potential Partnerships for the Sale and/or Further Processing of Recyclables

There are several potential partnership opportunities for the sale and/or further processing of recyclables.

Haulers. Ramsey and Washington Counties license over 100 waste hauling business to collect and transport MSW. Many of these haulers also offer recycling collection services. Haulers may be a potential partner for transportation of materials to end markets.

Material Recovery Facilities. There are eight Material Recovery Facilities (MRFs) processing recyclables for commodity markets in the Twin Cities Metropolitan area. These facilities are:

- Allied Waste Recyclery, Dakota County
- Allied Waste Recyclery of Minneapolis, Hennepin County
- Dem-Con Materials Recovery Facility, Scott County
- Dick's Sanitation, Washington County
- Eureka Recycling, Hennepin County
- Randy's Sanitation, Hennepin County
- Tennis Sanitation, Washington County
- WM Recycle America, Hennepin County

Each of these facilities accepts different materials but has an invested interest in finding additional materials for recycling and further processing.

Currently, the R&E Board contracts with AMG for ferrous metals and DLTL for non-ferrous metals for further processing and sale of extracted metals.

Recycling Facilities and Industries Using Recycled Materials. There is an active metal recycling market outside of the traditional recyclable markets. Locally, for example, there is South St. Paul Steel Supply Co., Inc. located next door the R&E Center at the border of St. Paul and the City of Newport, MN. These recyclers maybe a potential end market for the sale and/or further processing of extracted metals.

Known metal recycling facilities identified by the MPCA in its Metropolitan Solid Waste Management Policy Plan 2016-2036 include:

- AMG – Alliance LLC – Saint Paul
- Broadway Resource Recovery LLC
- Burg Electronic Recovery
- J&J Recycling
- Northern Metal Recycling – Savage
- Tech Dump – Saint Paul

Compost Facilities. The MPCA has permitted the following facilities to compost organics including food scraps. These facilities may be a potential end market for the processing and sale of organic waste.

- Creekside Organic Material Processing
- The Mulch Store
- Midwest Recycling Solutions/MFS Farms
- Mdewakanton Sioux Community Organics Recycling Facility
- Swift County Compost/ Recycling Facility
- Tri-County Organics
- WLSSD Source Separated Compost Facility

Appendix A
New Material Analysis Model

Instructions: To best evaluate risk and potential, a team should review the 12 questions below as part of considering a new material for recovery at the R&E Center. Answers to individual questions are as important as the total individual evaluation score.

Step 1: Each team member should give a numerical score for each question.
Step 2: Next, each team member should record his/her perspective on overall risk to the R&E Board for each question.
Step 3: Calculate final score. Final Score = Individual Score x Overall Risk to R&E Board
Step 4: Discuss results with evaluation team.

Material for consideration: _____

Projected tonnage of inbound material: _____

Category	Question Number	Question	Scoring Criteria	Individual Score	Overall Risk to R&E Board	Final Score
Material Quality	1	Is the material easy to extract?	1 – Found in bagged waste 3 – Found in bagged and loose waste 5 – Found in loose waste		1 - High 2 - Moderate 3 - Limited	
	2	How much control does the R&E Board have over material quality and/or volume?	1 - No/Low 3 - Medium 5 - High		1 - High 2 - Moderate 3 - Limited	
	3	Is the shape of the item changed due to transportation to R&E Center (i.e. flattened or misshapen due to compaction or transferring)?	1 - High 3 - Medium 5 – No/Low		1 - High 2 - Moderate 3 - Limited	
	4	Are there contamination concerns?	1 - High 3 - Medium 5 – No/Low		1 - High 2 - Moderate 3 - Limited	
Material Recovery	5	Can the material be extracted with current equipment or is new equipment needed?	1 – New Equipment 3 – Yes with minor adjustments 5 – Current equipment		1 - High 2 - Moderate 3 - Limited	
	6	Will the material recovery require additional maintenance work or supervision?	1 - Yes 3 – Potential additional work but no additional staff 5 - No		1 - High 2 - Moderate 3 - Limited	

Category	Question Number	Question	Scoring Criteria	Individual Score	Overall Risk to R&E Board	Final Score
	7	Will the material recovery increase safety risk for R&E Center staff?	1 - Yes 3 – Potential mitigation needed 5 - No		1 - High 2 - Moderate 3 - Limited	
County/ R&E Board Goals	8	Will recovery assist the counties in reaching its 75% diversion goal?	1 - No 3 – Slightly 5 – Yes		1 - High 2 - Moderate 3 - Limited	
	9	Are there strong factors for extracting this material (such as problem material or impact on RDF quality)	1 - No 3 – Slightly 5 – Yes		1 - High 2 - Moderate 3 - Limited	
Financial Risk	10	Is there a current stable market for the material?	1 - No/Low 3 - Medium 5 – High		1 - High 2 - Moderate 3 - Limited	
	11	Does the potential recycling commodity value exceed costs considering any new capital investments?	1 - Cost 3 - Net 5 – Profit		1 - High 2 - Moderate 3 - Limited	
	12	How large is the R&E Board's financial risk to extract this material? (i.e. magnitude of overall risk)	1 - No/Low 3 - Medium 5 – High		1 - High 2 - Moderate 3 - Limited	
					Total Score	

End Notes

[i] SWANA has developed a webpage dedicated to tracking changes in China's Waste Import Restrictions: https://swana.org/Resources/ChinaWasteImportRestrictions.aspx.

[ii] Foth Infrastructure & Environment, *Summary of 2016-2017 Seasonal Waste Characterizations*, December 18, 2017.

[iii] Foth Infrastructure & Environment, *Summary of 2016-2017 Seasonal Waste Characterizations*, December 18, 2017.

[iv] Paden, Jared. Resource Recycling, *China enacts tariffs on U.S. scrap aluminum*, Posted April 3, 2018. https://resource-recycling.com/recycling/2018/04/03/china-enacts-tariffs-on-u-s-scrap-aluminum/.

[v] Foth Infrastructure & Environment, *Summary of 2016-2017 Seasonal Waste Characterizations*, December 18, 2017.

[vi] Foth Infrastructure & Environment, *History of Residential Recyclables Prices*, March 14, 2018.

[vii] For more discussion about the factors influencing the normal commodity cycles (both up and down), see additional discussion on the SRMG web page: http://zerowaste.com/recycling-markets/

[viii] Foth Infrastructure & Environment, Pre-Processing: End Market Analysis for Process Residue, March 30, 2018