

Final Memorandum

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Project: City of Alexandria, Virginia, Resource Recovery Division Strategic Plan Review

To: Michael Clem, Recycling Program Analyst

From: Christopher Koehler, Susan Raila, Wendy Mifflin and Annette Scotto, HDR

Subject: Task 5 – Recycling Market Analysis

Introduction

The City of Alexandria (City) is examining how it currently manages its solid waste and recyclable materials as part of their short and long-term strategic planning efforts.

Solid waste trends over the past 5 to 10 years have been focused on diverting waste away from landfills and waste-to-energy facilities:

- 1) Organics/Food Waste Management programs (Separation, Collection and Processing)
- 2) Zero-Waste to Landfill initiatives (Product Stewardship; Education; Reuse, Reduce, Recycling; Organics Management)
- 3) Advanced Processing/Separation of Traditional Recyclables (Mixed Waste Processing Facilities); or by
- 4) Developing alternative disposal technologies (Gasification, Arc Plasma, Pyrolysis, Depolymerization, Hydrolysis, etc.)

To help these efforts, many states have enacted and promoted diversion goals. In 1989, Virginia adopted a 25% recycling goal for most of its communities. By calendar year (CY) 2015 the average recycling rate in Virginia for the 17 reporting planning units was 44.2%⁽¹⁾.

Other states have adopted similar goals. For example, Maryland requires all counties with populations under 150,000 to recycle 20% of the waste stream, and counties with populations over 150,000 to recycle 35% of the waste stream. Maryland also established a voluntary waste diversion goal of 60%, and a voluntary recycling rate of 55% by 2020.

Recycling has been a cornerstone of the City's waste management strategy for decades. Currently, the City is meeting the Virginia goal. In 2016, the City's recycling rate was 49.3%, just 0.7% off the Environmental Action Plan (EAP) goal of reaching a 50% recycling rate by 2020.

However, in order to maintain these high levels of diversion and recycling, there must be a market for post-consumer recycled materials. If not, despite all efforts, these materials may end up being disposed of in a landfill or a WTE facility. Recent global events exacerbate the economic viability of recycling. Task 5 provides a review of the recycling markets in the Mid-Atlantic States as they pertain to Alexandria.

Recycling Market Industry Trends

China

We cannot begin an evaluation of recycling markets without first mentioning that China's 'National Sword' program began implementation in September of 2017, and took full effect in March 2018. China is the world's largest purchaser of processed recyclable materials⁽²⁾. The U.S exported about two thirds of its recycled paper fiber and over 40% of its recyclable plastics to China in 2016⁽³⁾.

The new National Sword program has banned 24 materials from "contaminating" the post-consumer recyclables stream while simultaneously dropping the acceptable contamination rate from 1.5% to 0.5%. The likely result of the program is that China will purchase much less material from the United States and only purchase the highest quality recyclables. This new policy has had an immediate negative impact on commodity prices in the U.S., especially prices for post-consumer paper.

While not fully understood at this time, a few probable impacts of the program are described below:

- The program will have an immediate impact on mixed paper and, to a lesser extent, plastics.
- Supply of paper and plastic commodities will grow in the U.S. as less material is exported.
- Quality standards for sorting and processing facilities will increase.
- Because of these pressures, prices of processed commodities will likely drop and costs to produce suitable materials will rise.
- Mixed paper, especially from mixed waste processing facilities (MWPFS) and material recovery facilities (MRFs) that may have higher contamination rates, will become difficult to market. At some point, mixed paper may not have any market value.
- HDPE and PET, which are two of the materials subject to the Chinese ban, are likely to find alternate domestic markets. While supply is likely to increase nationally, only a slight price drop is predicted because of good domestic demand and capacity, especially for higher quality baled product.

Unfortunately, if alternate markets are not found for paper and other plastics, most of this material will end up being disposed of in landfills or burned in mass burn facilities. As recently as February 2018, the Massachusetts Department of Environmental Protection issued waivers to their disposal bans allowing recyclable materials to be landfilled or disposed of at WTE facilities.

Single Stream Recycling

Single stream recycling (SSR) is available in about 73% of residential curbside collection routes in the United States⁽⁴⁾. Single stream recycling is attractive to communities because it has been found to decrease cost of collection, as only one truck is needed for collection of recyclables. It also increases recycling rates due to the convenience of having one large container to throw all recyclables into. However, contamination of the recyclable materials stream with non-recyclables has also increased. Contamination of the recyclable stream typically occurs in SSR systems when residents, not familiar with recycling rules, place non-recyclable materials such as plastic bags, plastic (film) wrap, and greasy pizza boxes in with their recyclables. Contamination in the recycling

stream degrades materials, which lessens its market value, creates more residue, can break processing machinery, and can harm workers along the collection routes and at the recycling facility.

Education and enforcement make a big difference in the success of any recycling program, but especially for single stream programs. Residents frequently put just about everything into their single stream pick-up containers. This is what some people call “wishful recycling” or “the halo effect.” People want to “do the right thing”, but end up putting things like plastic wrap, styro-foam, soiled food containers, garden hoses, fishing nets, and other non-recyclable materials into their recycle bins. It should be noted that what recyclables are accepted is specific to the single-stream program; each varies depending on the specifics of the end processing/disposal facility. For example, some programs do not accept pizza boxes as any grease absorbed is considered contamination by recycling processors. However, if the cardboard is going to a compost facility, a greasy pizza box is an acceptable material.

To combat high contamination rates within the recyclables stream, communities are turning to education and enforcement procedures. Some communities have developed programs that send employees along collection routes to check recycling containers and place stickers or tags on containers that hold non-recyclables. In an effort to educate residents, these tags often explain what materials the residents should not have included in their recycling bins ⁽⁵⁾.

The City of Des Moines, Iowa began “curbside audits,” where recycling bins filled with non-recyclable items are not picked up. While Des Moines had two years of record quantities of recyclables collected, they also had record levels of contamination⁽⁵⁾.

Recycling companies such as Sonoco Recycling may begin charging for contaminated recycling loads they receive. This all is a result of China’s contamination restrictions and their efforts to slow their importation of recycled materials⁽²⁾.

In Ocala FL, high contamination rates caused the value of recovered commodities to drop, and to offset this drop, an increase to the residential collection fee was approved. Sioux Falls, SD raised hauling fees largely to cover the cost of handling the problematic issues related to glass, and Pendleton, OR also raised its trash fees in part because recycling revenues have dropped⁽⁵⁾.

Dual Stream Recycling

On the other hand, dual stream recycling (DSR) provides customers with two collection bins: one for paper products and another for metal, glass and plastics. This separation results in lower inbound contamination rates when compared to SSR. Based on a Florida study, the mean contamination rates were 18.54% for SSR and 3.89% for DSR⁽⁶⁾.

The City may wish to allow for alternative bids for DSR in the next Request for Proposals (RFP) for curbside collection of recyclables. This would allow for real-time comparison of costs of SSR and DSR.

Recycled Material Markets

Once collected and processed, the market for end users needs to be available to purchase the materials. Overall, the recyclables markets have been sluggish over the past 5 years, even aside from the issues with the Chinese markets. A study by the State Recycling Program in the North Carolina Department of Environmental Quality (NCDEQ) estimated that the average market value of

a ton of mixed recyclable material arriving at a recovery facility in the state dropped from just over \$180/ton in early 2011 to less than \$80/ton at the end of 2015. In 2016, that value has since rebounded to a little over \$100/ton.

Some reasons for the previous decline in the recycling markets include:

- 1) Fears surrounding China's "National Sword" program.
- 2) A general decrease in demand as foreign growth rates have leveled off.
- 3) Low oil prices making plastics cheaper to make out of raw materials.

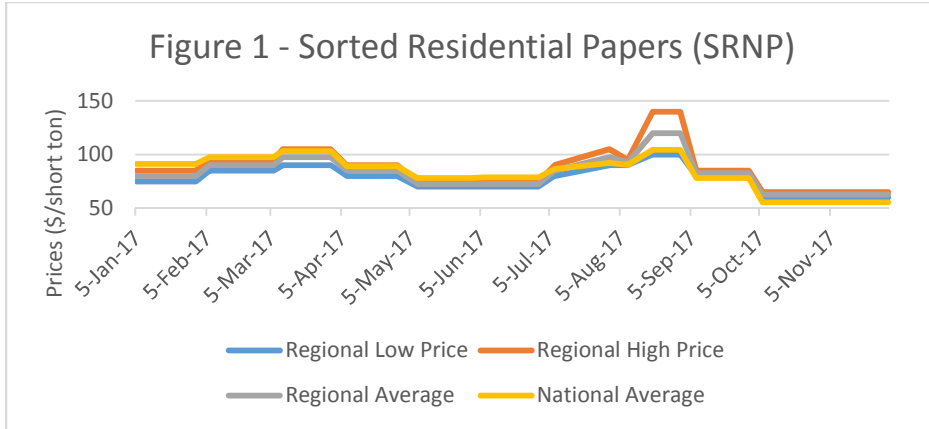
The uncertainties around the recycling markets are presenting themselves at an unfortunate time for the City. The City's contract with Bates was extended to January 31, 2019 and, depending on the execution of one-year options, the Waste Management Inc. (WMI) contract for processing and marketing recyclables will also be up for renewal in December 2019.

The current contract with WMI allows the City to drop off recyclables (via Bates) at a cost of \$72/ton. WMI processes and markets the materials and shares the revenues (or costs) with the City based on the market rates and according to a "rebate" formula within the agreement. The rebate varies from month to month based on the market prices of the recycled commodities. As recently as June 2016, the net rebate was negative (i.e. the City was paying WMI an additional fee, as revenues were not covering processing costs). As an example of the variability of the rebate, in January 2016, the net rebate was -\$14.14/ton and in March 2017 net revenue peaked at \$33.27/ton. More recently, in April 2017 the net rebate was \$28.58/ton, but by October 2017 the net rebate dropped to \$1.90/ton. HDR expects this turbulence in the markets to continue. The City should be prepared for negative rebate values in the short term.

Since the previous collapse of the recycling markets in 2008, most processing/recycling agreements typically include shared costs and shared profit clauses that allow for an equal assumption of risk and a shared shouldering of market swings. The City currently has such an agreement with WMI.

Sorted Residential Paper

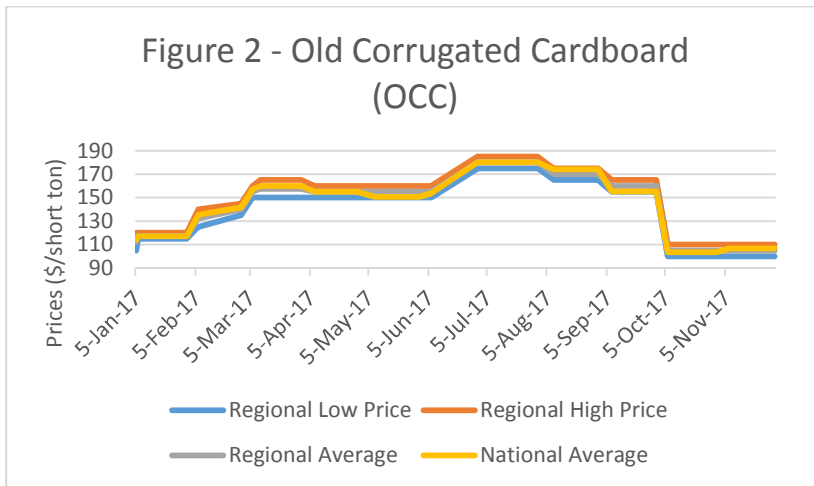
Sorted residential paper is a commodity that will likely be impacted by China's National Sword program. According to www.recyclingmarkets.net, since August 2017, the NY/mid-Atlantic price for sorted residential paper has dropped from approximately \$140/ton to about \$85/ton. This is most likely in response to the new China policy. This trend has continued and the average regional price for sorted residential paper in June 2018 was \$10/ton.



Source: www.recyclingmaterials.net – NY/mid-Atlantic Region

Old Corrugated Cardboard

OCC is another commodity that will likely be impacted by the new China policy. Over the past year, the price for a ton of baled OCC peaked in July 2017 at \$185, but dropped to \$110 in October after the China’s National Sword program was announced. The regional average price in June 2018 was \$82.50/Ton.



Source: www.recyclingmaterials.net– NY/mid-Atlantic Region

Glass

Glass is currently a liability from a recycling perspective. One major issue with glass collected in single stream recycling programs is contamination. Since glass breaks during collection and processing, it is difficult to keep other small particles such as metal lids, ceramics, porcelain, rocks, and other fines from being processed along with the glass. This contamination is enough to prevent container and fiberglass recyclers from purchasing the processed glass material. As such, most processors currently view glass as a contaminant, not a resource. In addition, broken glass is a danger to the workers on the collection routes and at the processing facilities.

Glass impacts the entire single stream recycling program. Glass contamination is problematic to the recovered paper industry as it damages paper mill equipment causing a higher rate of shutdown for



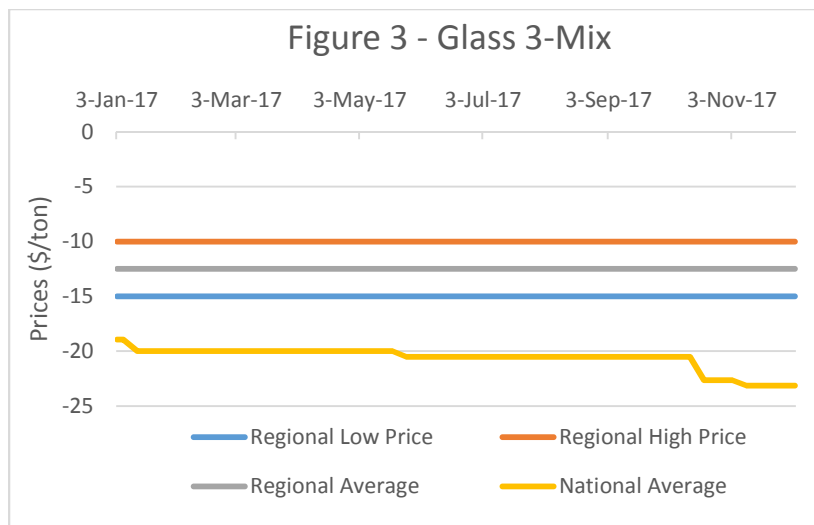
repairs and replacement. One paper mill averaged 37 tons of glass contamination per month over a 6-month period in 2009⁽⁷⁾.

There is a limited market for mixed glass as an aggregate. Reusing crushed mixed glass for a beneficial use such as pipe bedding and backfill is viable in some markets. Virginia regulation 9VAC20-81-95(C)6(n) allows for glass to be used as a substitute for conventional aggregate and clean fill. Virginia also allows crushed glass to be used as a landfill “alternate daily cover.” Even with these policies, there is no positive market for mixed glass.

The current NY/mid-Atlantic market for mixed glass is negative (meaning you pay to get rid of it). That said, in many municipalities it is still cost-effective to pay a processor only \$10-15/ton to recycle glass, in lieu of paying \$35 or more/ton to dispose of glass.

Based on the City’s agreement with WMI, the City pays WMI \$72/ton for processing recyclables, including glass. However, within that agreement, glass is not included in the formula to calculate the monthly per ton rebate amount. In other words, the City pays \$72/ton to process glass but gets back nothing for glass in the monthly rebate. Based on the Falls Church waste characterization study, 22.5% of the recyclables stream is glass.

Based on the April 2018 recycling numbers provided by the City, had the City not collected glass the recycling tonnage would have been 129.64 tons less (576.19 tons x 22.5% Glass = 129.64 tons of glass). Fees paid to WMI for processing would have been \$9,334.28 less (446.55 tons x \$72/ton = \$32,151.40). Based on WMI’s contractual rebate equation, the per ton payment from WMI would have increased from (\$19.80)/ton to (\$4.65)/ton as the percentage of valuable materials would increase as a portion of the total recycling stream. Had the City not collected glass in April 2018, it is estimated that the City would have saved \$18,668.55 from the recycling program. However, the city would have paid for the glass to be disposed of at the Covanta A/A Facility at \$43.16/ton or an additional \$5,595.38 (129.64 tons x \$43.16/ton = \$5,595.38). In total the net savings for not collecting and processing glass in April 2018 would have been \$13,073.17 (see attached spreadsheets for calculations).



Source: www.recyclingmaterials.net– NY/mid-Atlantic Region

In response to the lack of a positive market for glass, some municipalities have simply stopped collecting glass in their curbside recycling programs. Santa Fe, NM overhauled its recycling program and will no longer collect glass from households. Residents are being asked to take their glass to four drop-off centers around the city⁽⁵⁾.

In Cobb County, Georgia, a waste collector told customers, *“Effective July 1, 2016 WestRock will grade and inspect individual loads of single stream recyclables. Loads that contain mixed glass are subject to rejection and/or additional fees including costs to remove non-acceptable material from our facility.”*⁽⁶⁾

In Decatur, Georgia, when a hauling contract expired at the end of June 2016, the new recycling hauling contract did not require glass pick-up. Glass is now disposed of with the trash, and constituted about 20% of the recyclables stream⁽⁶⁾. Unfortunately, the quoted article, **“Recycling companies: Glass is no longer green”** by Rebecca Lindstrom (April 5, 2016) did not evaluate the reaction of the public to these changes.

Similar to Decatur, the Falls Church’s waste characterization study of 2015 indicates that 22.5% of the recyclables stream is glass. If glass is eliminated from the City’s recycling stream the recycling rate will likely drop by approximately 10-12%; the current rate of 49.3% may fall to under 40%.

Based on economics alone, it may be tempting to simply stop collecting glass in the single stream program and re-educate residents to “put glass in the trash.” However, from an environmental point of view, recycling glass does make sense, specifically from the energy and emissions perspective. It does take about 33% less energy to produce a ton of glass from recycled cullet than from virgin materials⁽⁷⁾. However, the glass cullet must be clean, non-contaminated, and separated by color; these requirements are difficult to meet within a single stream program that mixes all glass together where collection, hauling and processing typically breaks the glass.

One compromise may be to stop collecting glass in the single stream program, and instead encourage residents to use the four drop-off facilities to recycle glass. The drop-off facilities could set up a bin program where glass is separated by color by the residents and delivered to WM as separated glass.

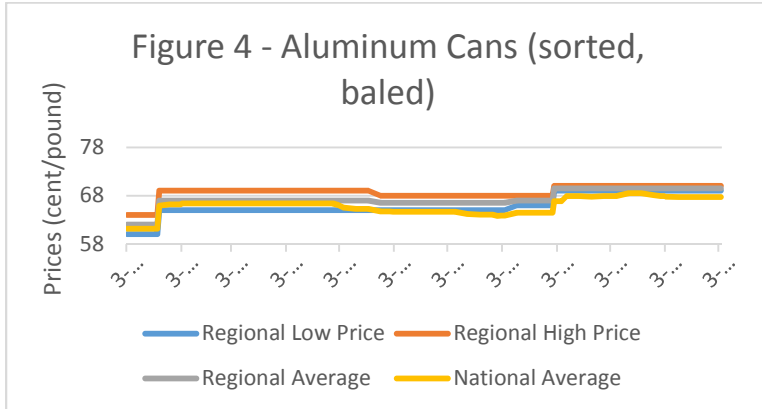
Another way to continue to recycle some glass containers is to support a statewide bottle bill. One major difference between Virginia and northeast states is that five of the ten northeast states have enacted beverage container deposit systems (ME, VT, CT, NY, & MA). In addition, two mid-west states (MI & IA) and three western states (CA, OR & HI) also have container deposit laws. These states are typically called “bottle bill states.” No southern states have deposit programs.

Bottle bill states have control of containers and can keep plastics, aluminum, and glass containers separated from the waste stream and separated by material type. This creates a recyclable stream that requires little additional processing as it contains virtually no contamination. As explained above, separation of glass by color is critical for glass recycling.

Aluminum

Aluminum is one of the cornerstones of the recycling commodity market. The current price for a ton of baled aluminum is approximately \$1,400. Because Virginia is not a “bottle bill” state, most aluminum ends up in the recycling bin producing more revenue for the local recycling program.

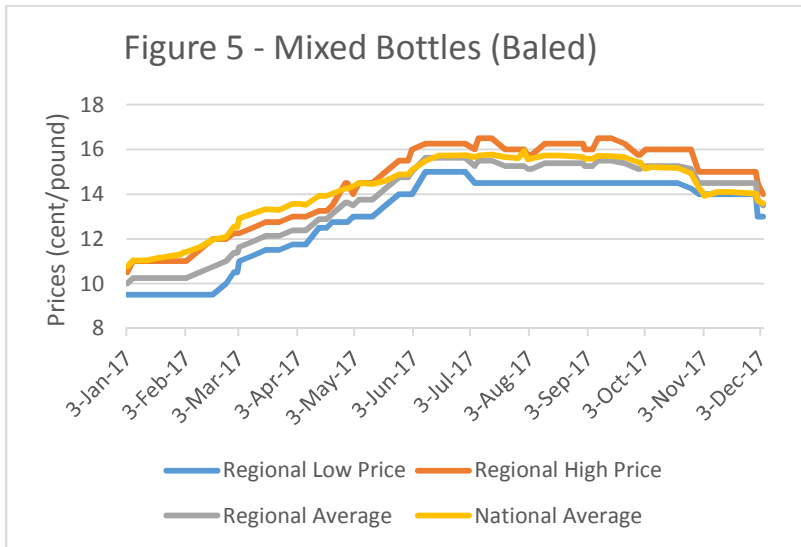
Because of the high price for aluminum, other, not as profitable materials can be recycled. However, aluminum only makes up 1.1% of the recyclables stream by weight.



Source: www.recyclingmaterials.net– NY/mid-Atlantic Region

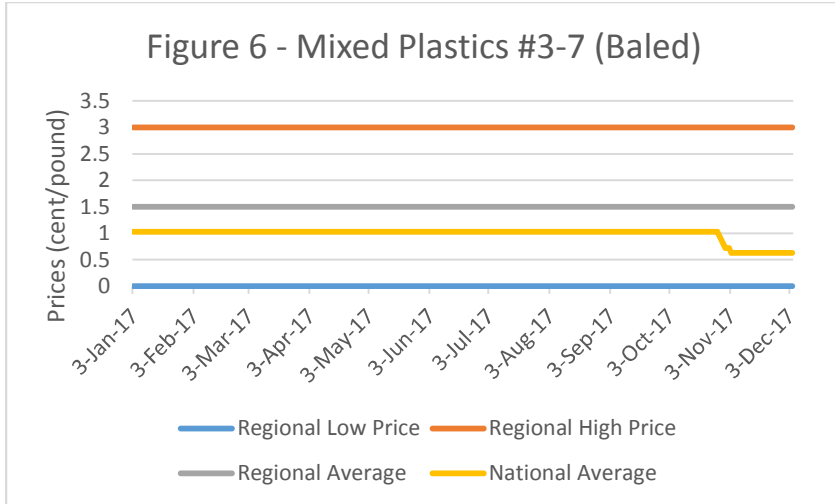
Plastics

Plastics #1 - 2 are typically your clear and colored beverage bottles (mixed PET bottles, natural HDPE, and colored HDPE). Since August 2017, the price for baled mixed PET bottles has fluctuated between \$0.14/lb to \$0.20/lb. Overall the market for Plastics # 1-2 (mixed PET bottles, natural HDPE, and colored HDPE) has not fallen as much as paper since there is a relatively robust domestic market for these plastics.



Source: www.recyclingmaterials.net– NY/mid-Atlantic Region

The low market for mixed unsorted Plastics #1-7; mixed unsorted Plastics #3-7; and mixed rigid plastics is illustrated in Figure 6 below. Due to the low prices and global changes these types of mixed unsorted plastics are no longer being collected in several communities such as Lane County, OR and Madison, WI. Haulers in Oregon and Washington are beginning to landfill these plastics.



Source: www.recyclingmaterials.net– NY/mid-Atlantic Region

Drop-off Facilities

The City operates four drop-off recycling centers, which are unmanned and operate 24 hours a day, 7 days a week. The drop-off centers are used by single and multi-family residents, as well as some small businesses. The City picks up the recyclable materials at the drop-off centers twice a week using a front loader. Materials are delivered to Waste Management’s Merrifield Transfer Station where they are managed as part of the overall recycling processing contract. In 2016, a total of 508 tons of recyclable material was collected at the four drop-off centers at an estimated cost of \$43,000 annually or \$85/ton (\$43,000 divided by 508 tons).

To put this in perspective, the drop-off facility’s cost per ton is similar to that of the residential single stream recyclables curbside collection program and the schools and government facilities recyclables collection. In 2016, the City delivered a total of 7,580 tons of recyclables to the Merrifield Transfer Station which included 6,622 tons collected from residential properties by Bates, 508 tons collected by the City at the drop-off centers, and 450 tons collected by the City from schools and government facilities. The cost for residential curbside collection (not including processing fees or revenues) is estimated at \$98/ton. The \$98/ton is calculated by dividing the contractor costs by the tons of recyclables collected by Bates curbside ($\$2.67/\text{month} \times 20,200 \text{ households} \times 12 \text{ months/year}$ divided by 6,622 tons = \$98/ton). In 2016, the City collected 450 tons of recyclables from 65 schools and government facilities at an estimated cost of \$38,000/year (or \$85/ton), compared to an estimated curbside collection cost of \$150/ton for trash collection and disposal.

Given these values, the facilities are relatively cost effective. These facilities typically provide additional recycling outlets for residents who miss their curbside collection or have additional items due to events such as garage clean-outs and holiday celebrations where they gather additional recyclable materials. Based on experience, these facilities are typically appreciated by residents and, if they are not excessively expensive, they do provide a valuable service to the community.

If done in concert with eliminating glass collection from the single stream collection program, the drop-off facilities could provide an outlet for residents and small businesses who wish to continue

recycling glass. Irrespective of eliminated glass collection curbside, the City may wish to explore expanding the glass receptacles to provide separation of glass by color (clear, amber and green). This could be accomplished by providing separate containers for each color or providing one large container with internal dividers. Separating the glass into colors would help improve the re-sale value of the commodity.

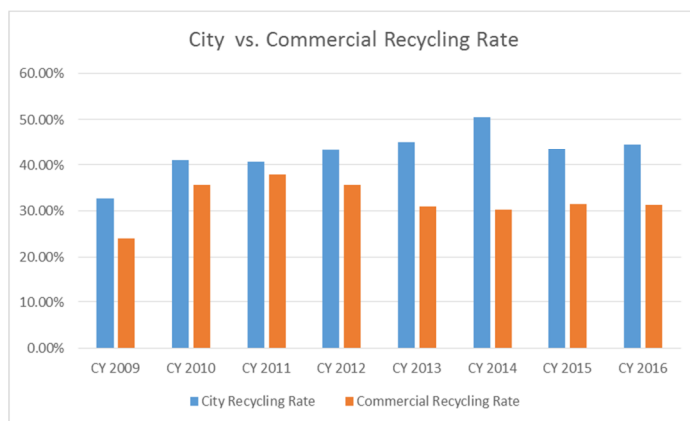
Commercial Recycling

The commercial and multi-family sectors account for more than 70% of the City’s solid waste stream. In general, the responsible party within commercial properties, condominiums, multi-family buildings, and Homeowners Associations are required to provide recycling to residents. The responsible party must provide the City with a Recycling Implementation Plan (RIP) that describes their recycling systems for the two recyclable materials that comprise the largest portion of their waste stream. Typically, mixed paper and newsprint.

The City provides several resources to help assist commercial and multi-family properties with finding recycling haulers. Site visits by City recycling personnel are offered to help determine what materials are recyclable as well as suggesting different strategies for reducing waste and educating multi-family residents about recycling. Strict review and enforcement of each RIP could lead to commercial entities paying more attention to recycling and assisting commercial entities to realize the goals in their RIP. However there is no active monitoring or enforcement of the commercial collection contractors unless a complaint is made.

Based on data submitted by the commercial sector, the commercial recycling rate is lagging behind the City’s residential recycling rate. Overall, commercial haulers are meeting the Virginia goal of 30%, but fall short of the EAP’s future goal of 50% by 2020. Note that the figure below includes commercial C&D waste; the actual commercial rate for non-C&D recycling is likely significantly lower than those shown.

Figure 7 – Alexandria’s Recycling Rates



One potential explanation for commercial entities lagging recycling rates is that they may only be focusing on collecting recyclables that are profitable and ignoring those that are unprofitable or difficult to manage (such as glass and certain plastics).

Recommendations

Based on HDR review of the City's residential curbside collection program, the commercial recycling haulers, and the current markets for recyclable commodities, the following is recommended:

- 1) The City should conduct a waste characterization study for both their waste stream and their recyclable stream. This study should take place over at least four consecutive quarters to capture the seasonality of waste and recyclables generation. The waste characterization should be updated annually.
- 2) Knowing the composition of these two streams is a critical factor when developing long-term plans. It will also serve as a check of the rebate formula in the WMI agreement. Once the waste characterization is complete, the City may wish to have a discussion with Waste Management to discuss the fate of glass within the waste stream.
- 3) Ask WMI to provide a list of recycling end users to whom they sell the recyclable commodities.
- 4) The City should also consider eliminating Plastic #3-7 (keeping in mind that that material only makes up about 0.5% of the recyclable stream – about 40 tons/year). The City should decide if they wish to continue with glass and/or plastics #3-7 recycling prior to issuing a new RFP for processing and, if possible, prior to issuing an RFP for curbside collection of recyclables.
- 5) Should the City decide to eliminate glass from the curbside program, The City should retain and possibly expand glass collection at the drop-off facilities and implement the collection and separation of glass by color. This will allow residents who still wish to recycle glass to do so while increasing the marketability of the glass product.
- 6) The City should take a more active role in monitoring and enforcing the private haulers recycling processes. The commercial recycling rate is hovering at around 30% (including C&D) while the City's rate is closer to 50% (without C&D). This effort may require an expanded education campaign for people living in apartment buildings and/or spot inspections of commercial haulers to determine if the Recycling Implementation Plans are being followed.
- 7) Consider supporting a state-wide bottle bill that will require a nominal (typically \$0.05) deposit for plastic, aluminum and glass beverage containers (Maine has a \$0.15/bottle deposit for wine bottles). This would help remove a large percentage of the glass, aluminum, and plastic from the single stream recycling program, and may also create a market for glass, if separated by color.
- 8) When preparing the next curbside collection RFP and the recyclables processing and marketing RFP, the City should include several alternate prices to determine costs:
 - a. With and without glass collection
 - b. With and without Plastics #3-7
 - c. With and without glass processing and marketing
 - d. With and without Plastics #3-7 processing and marketing
 - e. With single stream recycling collection
 - f. With dual stream recycling collection

Recent Prices

Based on the City contract with WMI for recycling processing, the difference in commodity pricing between July 2017 and April 2018 is summarized in the table below.

Table 1 – Summary of Changing Commodities Markets
(July 2017 – April 2018)

COMMODITY	% of Material Stream	July 2017		April 2017	
		Market Price Per Ton July 2017	Weighted Price July 2017	Market Price Per Ton April 2017	Weighted Price April 2017
Mixed Paper (#2)	25.00%	\$85.00	\$21.25	\$10.00	\$2.50
Old News Print (ONP #8)	25.00%	\$85.00	\$21.25	\$35.00	\$8.75
Old Corrugated Containers (OCC #11)	14.60%	\$185.00	\$27.01	\$85.00	\$12.41
Steel Cans	1.20%	\$40.00	\$0.48	\$40.00	\$0.48
Aluminum Cans	1.10%	\$1,360.00	\$14.96	\$1,500.00	\$16.50
Natural HDPE	0.50%	\$580.00	\$2.90	\$760.00	\$3.80
Colored HDPE	0.50%	\$340.00	\$1.70	\$400.00	\$2.00
PET	1.80%	\$330.00	\$5.94	\$320.00	\$5.76
Mixed Glass	22.50%	-\$10.00	\$0.00	-\$10.00	\$0.00
Commingled Plastic (#3-7)	0.50%	\$60.00	\$0.00	\$60.00	\$0.00
Mixed Bulky Rigid Plastic	0.30%	\$100.00	\$0.00	\$60.00	\$0.00
Residual	7.00%		\$0.00		\$0.00
	100.00%		\$95.49		\$52.20
Processing Fee			\$72.00		\$72.00
Rebate			\$23.49		(\$19.80)

Table 2 - Summary of Potential Markets in Mid-Atlantic States

Material	Primary Market(s)	Comments
<i>Paper</i>		
Cardboard	Pratt, Georgia Pacific, International Paper, WestRock and export markets	The markets for cardboard (used in packaging) were rebounding; however the impacts of China's National Sword program have already begun to take effect as prices have dropped July 2017. From July 2017 to October 2017, prices dropped by about 27%.
Mixed Waste Paper and Newspaper	Pratt, Georgia Pacific, International Paper, WestRock and export markets	The markets are likely to become volatile in the short term. As demands from China decreases and costs for processing increase to meet the new lower contamination rates, the prices have already begun to fall since July 2017 and could drop substantially, especially for inferior product.
<i>Plastics</i>		
Plastics	KW, Custom Polymers, and export markets	The markets for Mixed Bottles PET and separated Natural and Colored HDPE are currently stable; Mixed Plastics 1-7; Mixed Plastics 3-7; and Rigid Plastics are weak.
Other Plastics	Primarily export	Markets are volatile and sometimes unreliable. No market for styrofoam and limited market for rigid plastics.
<i>Metals</i>		
Aluminum	David Joseph, Sims, regional markets	Aluminum prices are strong and currently about \$1,400/ton.
Tin cans, appliances, and ferrous and non-ferrous scrap	David Joseph, Sims, regional markets	Steel/metals have fluctuated and the market is currently low for steel cans.
<i>Glass</i>		
Clear Glass	None	Currently, processor's are paying approximately \$5 - \$15/ton to recycle mixed glass; there is a market for high quality separated glass.
Brown and Green Glass	None	Currently, processor's are paying approximately \$5 - \$15/ton to recycle mixed glass; there is a market for high quality separated glass.
<i>Organics</i>		
Wood	Brought to municipal facility for tub grinding and mulching	Market for mulch end product or municipal use.
Yard Debris	Brought to local composting facility for a fee	Finished Grade A compost is \$25-35 per yard marketed to local residents https://www.improvenet.com/r/costs-and-prices/composting

Endnotes

- 1) **Virginia Department of Environmental Quality – Recycling Website**
www.deq.virginia.gov/Programs/LandProtectionRevitalization/RecyclingandLitterPreventionPrograms/Recycling.aspx
- 2) **China bans foreign waste – but what will happen to the world’s recycling?** Christine Cole
Wednesday 25 October 2017; www.theconversation.com
- 3) **Trash Talk: Price of Recyclables Sinks After China Bans U.S. Scrap** U.S. companies that use recycled materials are taking advantage of price drop, Erica E. Phillips Oct. 20, 2017, Wall Street Journal <https://www.wsj.com/articles/less-cash-to-buy-trash-after-chinas-ban-1508493603>
- 4) **Assessment of the Impact of Single Stream Recycling on Paper Contamination in Recovery Facilities and Paper Mills**, Duygu Yasar, Haluk Damgacioglu, Mehrad Bastani, and Nurcin Celik (PI), University of Miami, Coral Gables, FL, USA Department of Industrial Engineering, February 28, 2017. <http://www.coe.miami.edu/simlab/documents/Final-2016.pdf>
- 5) **“Recycling is in trouble — and it might be your fault”**, Paul Singer, USA
TODAY Published 2:22 p.m. ET April 20, 2017 | Updated 2:34 p.m. ET April 28, 2017
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