PRINCE GEORGE'S COUNTY

RESOURCE RECOVERY MASTER PLAN

2018

Draft

PRINCE GEORGE'S COUNTY RESOURCE RECOVERY MASTER PLAN

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Executive Summary

Prince George's County has asked the Maryland Environmental Service (MES), in consultation with the County's Department of the Environment (DoE), to assist in the preparation of their Resource Recovery Master Plan (RRMP or Plan) outlining the long-term strategy for the county-managed waste and recycling streams.

The RRMP is the continuation of the planning process begun by Prince George's County in April 2018 when the County published its Zero Waste Initiatives. Specifically, the RRMP outlines policies, programs and services that can reduce the quantity of waste generated, and/or divert waste away from landfill disposal toward reuse, recycling, and composting opportunities. These opportunities are identified in the Plan.

Prince George's County generates approximately 1.6 million tons of waste annually, including - municipal solid waste or MSW (trash and garbage consisting of everyday items discarded by the public); construction and demolition debris; controlled hazardous waste; and sewage. Through the Department of the Environment, the County directly manages approximately 422,000 tons of waste, or 25% of the total. This volume includes the 300,000 +/- tons of MSW disposed of at the Brown Station Road Sanitary Landfill (Landfill), 72,000 tons of recyclables processed at the Materials Recycling Facility, and 50,000 tons of yard trim and food scraps composted at the Western Branch Organics Composting Facility. To divert material away from the landfill, the County first needed to understand what materials were currently being disposed at the County-owned and operated Brown Station Road Sanitary Landfill. In 2014-15, the DoE conducted a Waste Characterization Study (WCS) of the Landfill to determine the types and amount of MSW that may be recycled or diverted to other uses. The WCS determined of the 304,000 tons placed in the landfill annually, approximately 234,000 tons can be composed, recycled or diverted. This volume represents the County's resource recovery opportunities. In addition, the WCS also sorted recyclable, compostable, divertible, and other waste by: (a) specific type, (b) where applicable, by commodity value, and (c) source (residential, commercial, schools). The type and value of the recoverable materials, together with the material sources, lead to varying alternatives for resource recovery. Recommendations for doing so are discussed below. At the same time, the County needs to continue its source reduction efforts and plan for disposal of non-recyclable, non-divertible waste beyond 2026.

The **Goals of this RRMP are:**

1. **Increase Recycling – Value and Volume**
2. **Increase Food Waste Diversion**
3. **Increase Reuse of Divertible Materials**
4. **Increase Source Reduction**
5. **Efficiently and Effectively Manage Waste Disposal**

Goal I - Increase Recycling – Value and Volume

Prince George's County currently processes recyclable materials at its Materials Recycling Facility (MRF) located at 1000 Ritchie Road, Capitol Heights, Maryland. The MRF has a design capacity of 30 tons per hour. Maximum operating capacity for the site is two, 10-hour shifts; this also provides time for maintenance and cleaning. Currently, the MRF operates one shift per day, and receives an average of 315 tons daily. Annually, the MRF processes approximately 40,000 tons of recyclables received from residents and 32,000 tons received from a combination of local merchants, St. Mary's County, Charles County, and the City of Takoma Park.

Increase Recycling Value

The revenues from commercial tipping fees and out-of-county local governments together with the sale of recyclables offset the cost of recycling operations. In fiscal year 2017, the revenue generated from tipping fees and commodity sales exceeded the day-to-day operating expenses by approximately $700,000.

However, there has been a recent decline in commodity pricing due to policy changes put in place by the Chinese Government, i.e. banning the import of certain recyclable commodities, including mixed paper. These changes have resulted in little material being shipped to China, which previously had been the largest importer of recyclable materials from the United States. The absence of this demand has caused mixed paper and cardboard prices to fall dramatically. As a result, for fiscal year 2018 the MRF will experience a projected net loss of $1.4 million and for fiscal year 2019, a projected net loss of $2.4 million.

Based on this downturn, the RRMP recommends that the County upgrade the MRF to improve the quality of commodity revenues least impacted by the current downturn, namely plastics. The County currently only produces a mixed plastics commodity at the MRF. Since the County last upgraded the MRF, optical sorting equipment has been developed to separate plastics by type, garnering much higher sales prices in the market. Current commodity pricing for mixed plastics is $27/ton. However, when separated, these commodities have an average price of $326 per ton.

Recommendation

Purchase and install optical sorting equipment for $5.1 million to increase the value of recycling revenue by $1.475 million annually.

Increase Recycling Volume

According to the WCS, of the 99,000 total tons of recyclables of MSW, 62,000 tons are from residential sources, 32,000 tons from the commercial sector, and approximately 4,000 tons from schools. The commercial, residential and school sectors vary in the total recyclables available for diversion. Though specific recommendations to increase diversion in each sector are discussed below, most recommendations could be applied to all types of recycling.

Commercial Recycling

Annually, 32,000 tons of commercial and industrial recyclables are disposed of at the Landfill rather than being recycled. A modest 25% increase in commercial recycling could result in an estimated additional annual revenue of $504K. At 35%, additional annual net revenue is increased by $706K.

Recommendation

The RRMP recommends that the County may increase the volume of commercial recycling by:

- Increasing the county inspection staff to provide outreach to county businesses and enforce commercial recycling regulations; and
- Instituting a commercial ban on recyclable material at the Landfill.

Residential Recycling

According the WCS, County residents are disposing of 62,000 tons of recyclables at the Landfill annually. A 25% increase in residential recycling results in estimated additional annual revenue of $712K. At 35%, additional annual revenue is estimated at $997K.

Recommendation

The RRMP recommends that the County may increase the volume of residential recycling by:

- Conducting a countywide residential sampling survey to determine residential recycling participation rates and targeting underperforming recycling areas with specifically tailored educational materials
- Enhancing ongoing educational efforts to encourage both increased recycling through the curbside collection program, and improved quality of the material collected
- Requiring mandatory residential recycling by implementing a residential disposal ban on recyclable materials with targeted enforcement through additional county inspectors

Prince George's County Public Schools

According to the WCS, there are 4,200 tons of recyclables from 220 elementary, middle, and high schools in Prince George's County currently being landfilled. While a 25% increase in school recycling results in modest additional annual net revenue of $45K, additional benefits are far greater over the long term: educating students on recycling practices that will have life-long impacts.

Recommendations

In conjunction with the strategies on school organics diversion discussed later, increase the volume of school recycling by:

- Establishing a zero-waste goal for county public school systems
- Conducting a recycling audit of each school to determine if it has appropriate recycling bins placed in areas visible and convenient for recycling
- Providing recycling containers to schools that do not have them
- Providing exterior recycling receptacles for bottles and cans on school grounds and at athletic fields
- Continuing to work closely with the public-school system to include recycling in the environmental education curriculum

Goal II – Increase Food Waste Diversion

According to the WCS, of the 88,000 tons of compostable materials, 21,000 tons are from commercial sources and 64,000 tons are from residential sources. This represents approximately 30% of the total Landfill waste stream and is a significant opportunity for waste diversion. Schools generate approximately 3,000 tons of this material type.

The Prince George's County Organics Composting Facility (OCF) over 50,000 tons of yard and food scraps annually. Using 52 acres of the 200-acre site, organic waste is processed into two compost products, Leafgro™ and Leafgro Gold™, which are then marketed to retailers. Over $430,000 in sales revenue from Leafgro™ and Leafgro Gold™ is returned to the County.

The facility is utilized by private and contract haulers providing service over 165,000 households in the County. The current tip fee generates revenue in excess of $1.5 million annually which, along with the sales revenue, generates just under $2.0 million used to offset the cost to operate the facility. In fiscal year 2017, the County composted 5,492 tons of food scraps and 41,224 tons of yard trim at a net cost of $9.78 per ton.

The OCF has composted yard trim since 1991. Yard trim collected at the curb from county residences is ground and placed into long narrow piles known as windrows. The final product generated from the open windrow process is Leafgro™, a soil amendment marketed by MES to a network of retailers.

Recognizing the need to address food waste recycling, in 2013, the County began food scrap composting as a pilot program using the Gore cover technology. The project recently expanded to a 12 Mega Bunker Wall heap system capable of processing 32,000 tons of food scraps and 32,000 tons of yard trim annually. The expansion has taken the project from a net cost of $9.78 per ton to a net gain of $8.64 per ton.

Commercial Food Waste Diversion

There are 11,300 tons of vegetative and non-vegetative food from commercial establishments being landfilled rather than composted. The new 12 heap mega GORE system coming on line in August 2018 can process all 11,300 tons. Strategies to bring in this additional tonnage include targeting in-county businesses, establishing flexible collections programs, using "put or pay" agreements, and enacting legislation banning commercial food waste in the Landfill.

Recommendations

Increase commercial organic waste diversion by:

- Targeting large, in-county generators of food waste to establish pilot collection programs, e.g. FedEx Field, Bowie Baysox Stadium and Joint Base Andrews;
- Establishing put or pay agreements with participating in-county food waste generators to guarantee reserved capacity;
- Working with licensed haulers and commercial businesses to create flexible collection programs; and
- Banning commercial food waste from the Landfill, phased in over time.

Residential Organic Waste Diversion

According to the WCS, 35,000 tons of vegetative and non-vegetative food materials from county residences are being Landfilled rather than composted. The challenge is developing a collection program that diverts this material from the Landfill to the County's OCS.

Recommendations

Increase residential organic diversion by:

- Assess the data from the residential household pilot program and determine how the program shall be expanded, whether to additional areas or county-wide, and/or on a voluntary (opt-in) or mandatory (full participation) basis

School Food Waste Diversion

According to the WCS, 1,700 tons of vegetative and non-vegetative food scraps from county schools are being landfilled rather than composted. At the time of the WCS, in 2015, the County had not yet banned Styrofoam trays. The trays are now compostable. If the WCS were conducted today the composting rate would be closer to 4 – 5,000 tons.

The first challenge in school organic waste diversion is to establish a food collection program within the schools and the second is to collect and transport the food for composting.

The second challenge – taking food scraps to the OCF - is easier. Food scrap collection services could be incorporated into the scope of work for the County's next procurement for solid waste collection services from county schools.

Recommendations

Implement a school food waste diversion program by:

- Establishing a zero-waste recycling goal for public school systems
- Offering schools with the highest recycling rate of participation the opportunity to participate in pilot food waste diversion programs
- Providing appropriate infrastructure and education to schools in the pilot program
- Requiring food waste collection in the next county procurement for solid waste collection services.

Goal III – Increase Recycling of Divertible Materials

According to the WCS, of the 47,000 tons of divertible materials being landfilled, 30,000 tons are from residential sources and 16,000 tons are from commercial sources. Divertible materials include items such as textiles, scrap metal, pallets, and other materials not processed through the MRF or OCF.

Residential Diversion

The 30,000 tons of residential divertible materials represents roughly 10% of the overall annual material in the Landfill and approximately 14.7% of the total annual residential materials. Aside from plastic shopping bags, which can be brought to nearby grocery stories, the majority (69%) consists of:

- Textiles (36%)
- Pallets/lumber/other wood (20%)
- Scrap metal (7%)
- Electronics (6%)

Out of the original 30,000 tons, 20,800 tons consist of easily divertible materials such as those above. At $52/ton, the annual cost of processing these materials at the Landfill is $1.1 million. Successful reuse and recycling efforts pursued by the County should focus on diversion of these items from the Landfill while acknowledging some level of difficulty in marketing various products.

Recommendations

Increase diversion of residential materials by:

- Designing and constructing a new recycling convenience center on Brown Station Road
- Consolidating into the new convenience center current recycling opportunities within the Landfill complex and on Brown Station Road, and recycling materials currently disposed of in the Landfill, including textiles, pallets/lumber/other wood, and other materials
- Designing and constructing a new recycling convenience center in North County on county-owned land or on private property through a public-private partnership for managing divertible materials.

Commercial Diversion

Per the WCS, there are 16,300 tons of divertible material entering the Landfill annually. This constitutes approximately 18% of the total annual commercial materials delivered to the Landfill. Commercial divertibles represent roughly 5% of the overall annual material landfilled. Approximately 75%, or 12,500 tons, of all divertible materials from the commercial sector consists of three groups, textiles (24%), carpet/carpet padding (21%) and pallets/lumber/other wood (20%). Potential diversion opportunities are discussed below.

Recommendations

Increase commercial diversion of textiles, pallets and other wood, and carpets and padding by:

- Requiring businesses, as part of their recycling plans, to submit information on disposal of these items as MSW, through recycling and sale, or otherwise
- Analyzing the information submitted to determine if a ban on acceptance of these materials at the Landfill is commercially reasonable.

Goal IV – Increase Source Reduction

It is a common misunderstanding that recycling paper, aluminum cans, and glass bottles is the primary strategy to reduce waste when in fact, recycling is third in the waste management hierarchy. The highest priority is waste prevention through source reduction because of its overall impact on waste management. Reduction in physical waste corresponds with a reduction in use of other materials, such as fossil fuels, raw materials, and mining waste used in the manufacturing, shipping, and handling of the material. A complete discussion of source reduction measures is including in the County ZWI.

Recommendations

Implement source reduction measures discussed in the ZWI, including

- Supporting a ban or a fee on single use disposable plastic bags
- Supporting extended producer responsibility programs requiring a product producer to take back the used product or fund a recycling/recovery program
- Continuing multifaceted public outreach and education campaigns that have earned the County the full 5% source reduction credit awarded by MDE.

Goal V – Efficiently and Effectively Manage Waste Disposal

The purpose of Goal V is to identify strategies to address the portion of the waste stream that cannot be recycled, composted or diverted, now or into the future. If 25% of the material in the Landfill were recycled, diverted or composted, that would still leave 228,000 tons of MSW to manage. If 35% were recycled, composted or diverted, then 197,000 tons would be left to manage. Even if all 75% of the materials in the Landfill that could potentially be recycled, composted or diverted were recycled, composted or diverted, the remaining waste would equal 76,000 tons and require management.

The Landfill Complex

The Landfill began operations in 1968. It consists of Area A, Area B, a landfill gas collection system, leachate pretreatment plant, recycling facilities and a soil borrow area. Area A is a 150-acre unlined Landfill that was closed in 1992. Area B consists of a fill area of 134 acres with a design capacity of approximately 12 million tons. As of the end of 2017, the remaining capacity at the Landfill is approximately 2.8 million tons

Landfill Operations

MES examined daily operations to determine if the County was making efficient and effective use of this asset. Through operational controls and the use of the CAES equipment, the operations crew has been seeing compaction rates of 0.7 to 0.8 tons per cubic yard of constructed Landfill airspace. This is an excellent compaction ratio for a Landfill of this size and number of staff working on waste placement and cover efforts. This compaction rate exceeds the Solid Waste Association of North America average "industry standard" for landfilled waste density of 0.6 tons per cubic yard.

The industry standard cost per ton for Landfill site operations, closure and post closure is approximately $48/ton. By way of comparison, for $52/ton, the County Landfill currently processes 800-900 tons per day – more than 1.5 times the amount used in the industry average – while managing both LFG and leachate pretreatment systems. The Landfill operational costs compare favorably and well to the industry standard.

MES considered on-site alternatives to reduce the volume of MSW, including shredding and Landfill mining. Shredding involves processing the incoming waste to gain volume reduction and increase compaction when placed in the cell. The practice has both significant capital and operational costs, requires significant space to process the waste, and increases the potential for worker injury and increased downtime. For these reasons, MES does not recommend shredding.

Landfill mining is the excavation and separation of landfilled MSW to recycle soil, metals, plastics and other recyclable material. In theory, the cost of landfill mining is offset by the amount of soil to be reused, recovery of recyclables that can be processed and sold, and the air space reclaimed. In practice however, issues including the significant capital investment required to undertake landfill mining, the substantial space required for the operations, odors, actual quality of recyclable product for sale, and the cost of recycling soil compared to the cost of soil available to cover the disturbed area have cast doubt on the feasibility of landfill mining. For these reasons and based on the Landfill's location to the community and the current availability of cover soil, this option is not recommended.

Landfill Capacity and Waste Management Options

With its overall compaction rates and effective operational management, the County is maximizing use of the Landfill. Given this, at a fill rate of 290,000 +/- tons per year, the Landfill may reach capacity by mid to late 2020s.

Over the years, the County has contemplated several options it could take when the Landfill finally reaches capacity. In 2004, the County retained MES to prepare a study to construct a Solid Waste Transfer Facility in the County. A transfer station receives all incoming MSW at a central location and then transfers it to other sites within or outside the County. MES looked at three sites within the County borders and assumed an 1,800 ton per day facility, which is twice the current tonnage. The County took no action as a result of the MES study.

In 2011-12 an outside engineering consultant prepared a draft plan presenting several alternatives for disposing the County's solid waste on a long-term basis:

1. Direct haul to nearby disposal options
2. Construct a waste derived fuel facility
3. Construct a transfer station at the Organics Processing Facility for transfer to out-of-state disposal facilities, primarily landfills in the neighboring State of Virginia.
4. Maximize airspace potential within the footprint of the existing Landfill without increasing the Landfill footprint.

In 2014 the County issued an RFP for construction of a facility to manage waste after the Landfill reach capacity, including a mixed waste pre-processing facility co-located at the Organics Composting Facility that would provide for presorting disposed items from a common tipping floor. Once a promising technology, mixed waste preprocessing would have separated recyclable materials from MSW, which could then be converted to energy via aerobic or anaerobic digestion, or combustion, potentially producing refuse-derived fuel or other products for sale. Remaining residue would be taken to the Landfill. The County cancelled the RFP in 2017.

In the meantime, in 2015-16, the County explored possible airspace potential without expanding the Landfill footprint. Based upon the analysis as provided by an engineering consultant, the use of available airspace potential will offer extended life.

Recommendations

Manage waste disposal over the long term by:

- Increase diversion while maximizing waste compaction.
- Explore uses of available potential airspace within the existing footprint of the permitted Landfill.

Introduction

Prince George's County annually generates approximately 1.6 million tons of waste, including municipal solid waste or MSW (trash and garbage consisting of everyday items discarded by the public); construction and demolition debris; and controlled hazardous waste, and sewage. Through the Department of the Environment, the County directly manages approximately 422,000 tons of waste, or 25% of the total, including: 300,000 +/- tons of MSW at the Brown Station Road Sanitary Landfill (Landfill), 72,000 tons of recyclables at the Materials Recycling Facility, and 50,000 tons of yard trim and food scraps at the Organics Composting Facility. Overall waste management in the County is described in the County's Ten Year Solid Waste Plan (TYSWP), a requirement of the Department of the Environment (MDE). The current TYSWP covers the period 2017 – 2026 and is scheduled to be updated in 2020.

In 2014-15, DoE conducted a Waste Characterization Study[1] (WCS) of the Landfill to determine the types and amount of MSW that may be recycled or diverted to other uses. Recyclable materials are sold in the marketplace, including paper, cardboard, bottles, cans and plastics. Even with the decline in the value of recyclables (discussed later), recycling is less expensive than landfilling. Recyclable materials may also be repurposed as in conversion of wood or food waste to soil amendments. Divertible materials, not processed, are sold to specialty buyers. Examples include scrap metal, rigid plastics, and textiles. The study concluded that 60% of the MSW in the Landfill may be recycled and 15% diverted for recovery and reuse.

In 2016, after a series of public informational meetings, the County adopted a Zero Waste Initiatives (ZWI) plan[2]. "Zero Waste" is an ambitious long-term goal aimed at eliminating the need for waste disposal. It is a continuum that begins with reducing the source of waste. Source reduction refers to any change in the design, manufacture, transport, purchase, or use of materials or products which reduces the amount that must be recycled, composted or landfilled at all stages of the process. An example of source reduction is replacing disposable dishware and utensils with reusable ones or using refillable water bottles rather than disposable ones. Source

[1] https://www.princegeorgescountymd.gov/2584/Waste-Characterization-Study

[2] https://www.princegeorgescountymd.gov/DocumentCenter/View/21910/Zero-Waste-Initiative-Final-April-5-2018a?bidId=

reduction measures also can include bans on environmentally unacceptable materials. In 2015, the Council banned the sale of expanded polystyrene products, an action resulting in elimination of 5,700 tons of polystyrene within the environment and at the Landfill annually.

Education is a component of source reduction. County source reduction activities recognized by Maryland Department of Environment (MDE) include ongoing, multifaceted public outreach campaigns focused on home composting, recycling, and source reduction; surveys of residents and businesses about source reduction; and various educational activities. Since 2014, the County has achieved the full 5% source reduction credit from MDE.

Next on the zero-waste continuum is product reuse. Being able to reuse goods eliminates the demand for new goods to be made and reduces the energy needed to recycle them. As discussed in the ZWI, Community Forklift in Edmonston is a good example of a reuse system. This non-profit reuse center collects unwanted home improvement building materials throughout the DC Metro Region and make these materials available to the public at low-cost. Community Forklift has recovered over $12 million of building materials from the DC Metro Region and has provided supplies to 20,000 homeowners, non-profits, businesses, and artisans.

After source reduction and reuse comes resource recovery. Resource recovery is the selective extraction of disposed materials for a specific next use. It includes recycling, composting, and diverting materials from disposal. It also includes energy recovery. The County has been operating a landfill gas recapture program at the Landfill for more than twenty years. The gas creates steam and electricity for the County Correctional Facility and sells additional electricity to Potomac Electric Power Company.

Finally, at the other end of the continuum is waste disposal. As the ZWI notes, “Zero waste is not a literal goal; we will always have some materials that cannot be recycled and cannot be designed out of the system.” That material finds its resting place at the Landfill. As later explained, based upon updated remaining air space calculations and current fill rates, projections reveal that the Landfill may reach capacity in mid to late 2020s.

The zero-waste continuum is frequently displayed as a waste hierarchy (Exhibit 1).

Exhibit 1.
Maryland Department of Environment Waste Hierarchy

This RRMP works in conjunction with the TYSWP, WCS and ZWI plan by providing the County with strategic and implementable alternatives for the waste it manages, including recycling, composting, and diversion, as well as recommendations for managing non-reusable, non-recyclable waste for the future.

Background

Prince George's County is located on the southern and eastern border of Washington, D.C. in south-central Maryland. It has 27 incorporated municipalities and the county seat is Upper Marlboro. According to the U.S. Census Bureau[3], Prince George's County has a current population of 906,000 people. The median income is $76,741 and the median age of the County is 36. The County has a total area of 499 square miles (1,290 km^2), of which 483 square miles (1,250 km^2) is land, and 16 square miles (41 km^2) is water.

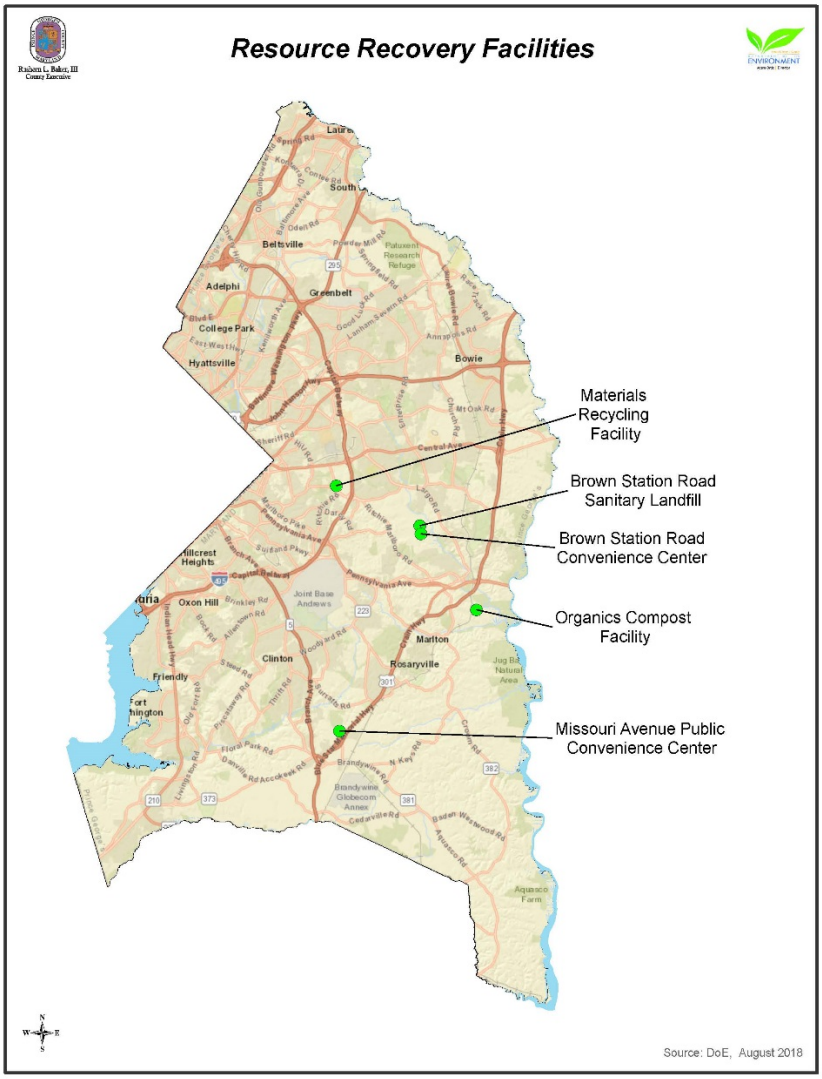
Prince George's County was granted a charter form of government in 1970 with the County Executive elected as the head of the executive branch. Within the executive branch, DoE is the agency responsible for managing the County's environmental programs. DoE performs the following services through its Resource Recovery Division:

- Provides residential curbside collections of trash, yard trim and bulky trash to 165,000 county residences and recycling to 174,000 residences
- Provides recycling collection services to residents in nine municipalities
- Enforces mandatory multifamily and business recycling laws

[3] "2010 Census Gazetteer Files". United States Census Bureau. August 22, 2012.

- Operates the Landfill
- Operates two homeowner recycling and disposal convenience centers
- Manages the Prince George's County Materials Recycling Facility
- Manages the Prince George's County Organics Composting Facility
- Develops and updates the County's TYSWP as required by State law and MDE
- Manages disposal of household hazardous waste, electronics, scrap tires and scrap metal

Exhibit 2.
Map of County Resource Recovery Facilities



Recycling and Waste Diversion

The State of Maryland and the County have established recycling, waste diversion and source reduction goals. The State's recycling policy is guided by the Maryland Recycling Act (MRA) established by Chapter 536 in 1988. In 2012, the MRA set a mandatory recycling rate of 35% for local jurisdictions and a voluntary goal of 55% by 2020. During the same year, the County Council enacted a comprehensive ordinance establishing requirements for voluntary residential recycling; mandatory recycling and reporting in the multifamily and commercial sectors; and implementation of a pilot food waste composting program. The same law set a mandatory recycling goal of 55% by year 2018, and 60% by year 2020, exceeding the state's voluntary goal by 5%.

In 2016, the County's recycling rate was 55.61%, highest in the State. This means that the County exceeded both the County-mandated recycling goal of 55% by 2018 and the statewide voluntary recycling goal of 55% two years earlier than 2020. The County's waste diversion rate, which is the recycling rate plus the full 5% source reduction credit, is the highest of all counties at 60.61%.

Prince George's County continues to work towards the county goal of a 60% recycling rate by 2020. This RRMP identifies opportunities provides alternative recommendations that can be used to meet and/or exceed this goal, including shifts in behavior, policy, infrastructure and end markets.

The Economics of Resource Recovery

The estimated cost of Landfill disposal is $52/ton. This cost includes not only disposal but also management of toxic byproducts – landfill gas and leachate. It also includes the costs of closing the landfill and maintenance thereafter for 30 years. There is no recovery and reuse of materials placed in a landfill.

Recycling produces commodities that have value and are sold in the marketplace. The value received offsets in whole or in part the costs of disposal. Based upon commodity sales over the past three years, if 25% of recyclable materials currently being landfilled were instead recycled, the County would realize additional estimated annual revenue of $3.6 million. If 35% of recyclable materials currently being landfilled were instead recycled, the estimated annual return is $5 million.

If 25% of recyclable materials currently being landfilled were instead recycled, the County would realize additional estimated annual revenue of $1.26 million.

The ZWI identified potential commodity revenues by source. MES has updated the ZWI data and calculated the return on investment from increased residential, commercial and school recycling at various levels.

Exhibit 3.
Potential Commodity Revenue from Currently Landfilled Recyclable Material

Summary By Source Category						
Source	*Annual Recyclable Tons	**Market Pricing Per Ton	***Net Revenue Per Ton	Recovery Rate 25%	Recovery Rate 35%	Recovery Rate 50%
Residential	62,100	$ 130.86	$ 45.86	$711,977	$996,767	$1,423,953
Commercial	32,300	$ 147.41	$ 62.41	$503,961	$705,545	$1,007,922
Schools	4,200	$ 127.74	$ 42.74	$44,877	$62,828	$89,754
TOTAL - All Sources	**98,600**	**$ 136.15**	**$ 51.15**	**$1,260,814**	**$1,765,140**	**$2,521,629**

* Represents the recyclable material currently being landfilled as identified in the County's Waste Characterization Study.
** Market Pricing Per Ton is based on the 3-year average pricing per ton from 2015 - 2017 for all non-fiber materials, and the 3-year average pricing for the period of 2015 - 2017 including the first 6 months of 2018 for all fiber materials.
*** Net Revenue Per Ton is the average market price per ton for each Source Category less the estimated operating costs per ton of $85 = Net Revenue Per Ton.

Composting yard trim and food scraps produces soil amendments that are marketed to retailers and sold to the public as Leafgro™ and Leafgro Gold™. The sales offset the cost of managing these materials. In FY '17, the cost to the County for managing 50,000 tons of yard trim and food scraps was $9.78/ton as compared to the Landfill cost of $52/ton. With the expansion of the organics composting facility in FY '19, composting operations realize a net revenue of $8.64/ton. Additional composting opportunities are discussed below.

Diverting materials, such as clothing and other textiles, pallets and other wood, furniture and appliances from the Landfill is cost-effective. Based on the WCS, county residents landfill over 20,800 tons of valuable and potentially divertible materials annually. At $52/ton, the annual cost of managing these materials is $1.1 million. The estimated annual cost of operating an expanded recycling convenience center using existing employees at the Landfill and a new recycling convenience center in north County for repurposing or reusing these materials is estimated at $528,000.

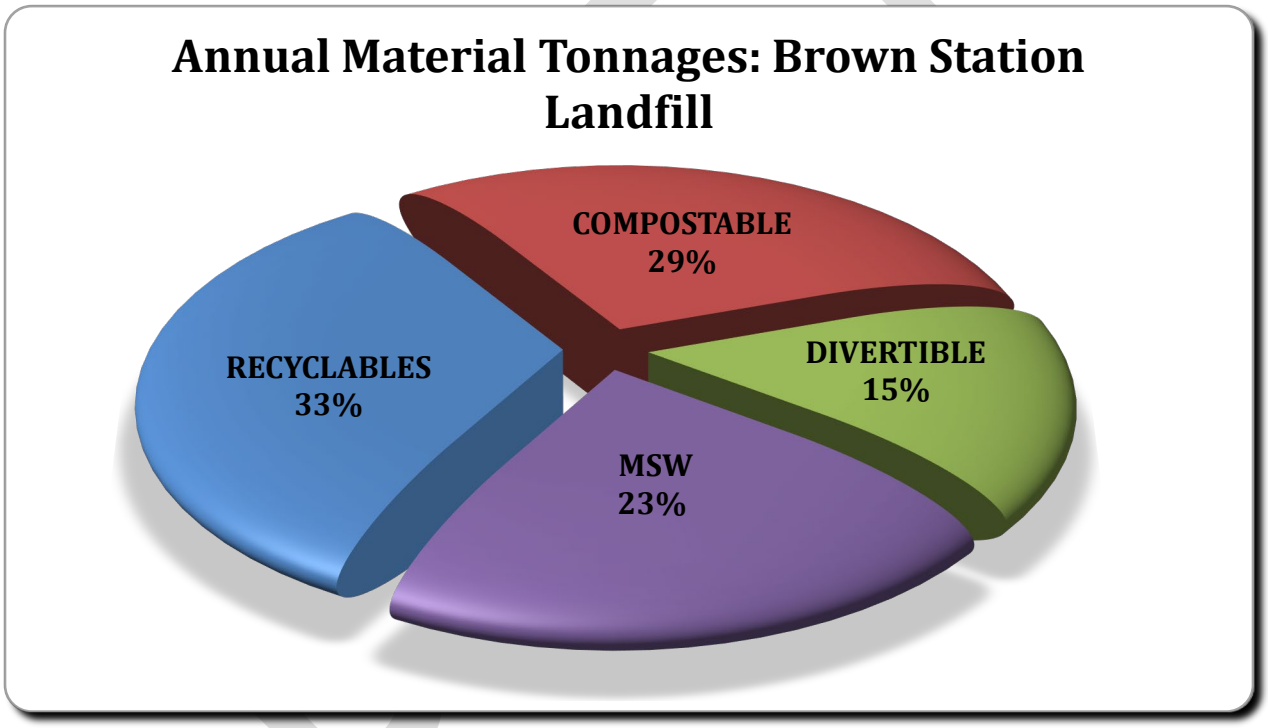
Opportunities for Resource Recovery

According to the WCS, of the 304,000 tons of MSW annually placed at the Landfill,[4] approximately 234,000 tons can be composed, recycled or diverted.

- 99,000 tons - Recyclable
- 88,000 tons - Compostable
- 47,000 tons - Divertible
- 70,000 tons - Municipal Solid Waste (MSW)

Exhibit 4.

Distribution of the 304,000 tons landfilled at Brown Station Road



[4] The WCS consisted of a four-season waste sort from November 2014 to September 2015. For consistency, the report uses the WCS tonnage totals. MSW placement at the Landfill from July 1, 2017 to June 30, 2018 totaled 295,442 tons.

This volume represents the County's resource recovery opportunities. In addition to volume, the WCS also sorted recyclable, compostable, divertible, and other waste by: (a) specific type, (b) where applicable, by commodity value, and (c) source (residential, commercial, schools). Alternatives for resource recovery vary depending on the source, type, and value of materials and are discussed in detail below. At the same time, the County needs both to continue its source reduction efforts and to plan for disposal of non-recyclable, non-divertible waste beyond 2026. Accordingly, the goals of this RRMP are:

1. Increase Recycling – Value and Volume
2. Increase Food Waste Diversion
3. Increase Reuse of Divertible Materials
4. Increase Source Reduction
5. Efficiently and Effectively Manage Waste Disposal

The County is well-positioned to achieve these goals through an existing and expanded system of interconnected facilities comprising a Resource Recovery system. For purposes of implementation, the County should establish goals to increase recycling, food waste diversion and reuse by 25% by 2022 and by 35% by 2026. This will provide the County with the time to increase staffing and resources and develop additional facilities, e.g., recycling convenience centers. Estimated RRMP implementation costs and potential revenue sources follows discussion of the goals and recommendations.

The County should establish goals to increase recycling, food waste diversion and reuse by 25% by 2022 and by 35% by 2026.

Goal I - Increase Recycling – Value and Volume

Background

The Prince George's County Materials Recycling Facility (MRF) is located at 1000 Ritchie Road, Capitol Heights, Maryland, and is operated under contract by MES. The MRF opened in 1993 and was upgraded to a single stream facility in 2007. The MRF receives and processes commingled single-stream recyclables (e.g., plastics, corrugated cardboard, paper, aluminum, ferrous and steel food and beverage containers, and glass) collected curbside from approximately 174,000 County residences. Private collection contractors serving commercial and multifamily complex customers also tip material at the facility. The MRF has a design capacity of 30 tons per hour. Maximum operating capacity for the site is two, 10-hour shifts; this also provides time for

maintenance and cleaning. Currently, the MRF operates one shift per day, and receives an average of 315 tons daily. Annually, the MRF processes approximately 40,000 tons of recyclables received from residents and 32,000 tons received from local merchants, St. Mary's County, Charles County, and the City of Takoma Park.

Increase Recycling Value

The revenues from commercial tipping fees and out-of-county local governments together with the sale of recyclables offset the cost of recycling operations. MES provides a revenue forecast for each fiscal year which is based on the following four factors: 1) estimated incoming volume, 2) proposed tip fees; and the sale of marketable material based on 3) commodity mix, and 4) the projected market pricing for the upcoming year. In the first full fiscal year MES operated the facility, fiscal year 2017, the revenue generated from tipping fees and commodity sales exceeded the day-to-day operating expenses by approximately $700,000.

However, there has been a recent decline in commodity pricing due to policy changes put in place by the Chinese Government banning the import of certain recyclable commodities, including mixed paper. The Chinese Government has implemented the "National Sword" campaign focusing on contamination and limiting any imported recycled material to 0.5% contamination. This includes cardboard, higher grades of paper and plastics. In addition, import licenses have been significantly restricted, further tightening the market. These changes have resulted in little material being shipped to China, which had been the largest importer of recyclable materials from the United States. The absence of this demand has caused mixed paper and cardboard prices to fall dramatically. As a result, for fiscal year 2018 the MRF will experience a projected net loss of $1.4 million and for fiscal year 2019, a projected net loss of $2.4 million.

Considering this economic downturn, MES recommends that the County increase the value of its recyclable commodities. Since the County last upgraded the MRF, optical sorting equipment has been developed to separate plastics by type, garnering much higher sales prices in the market. Plastic commodities include #1 PET bales (e.g. water and soda bottles), #2 HDPE natural (e.g. milk jugs), HDPE color (e.g. laundry detergent bottles), and #5 PP tubs and lids (e.g. yogurt containers). Current commodity pricing is $27/ton. However, when separated, these commodities have an average price of $326 per ton. The additional value results in an approximate annual revenue increase of $1,475,716. The cost of the equipment upgrade is approximately $5.1 million and will pay for itself in about 5 years.

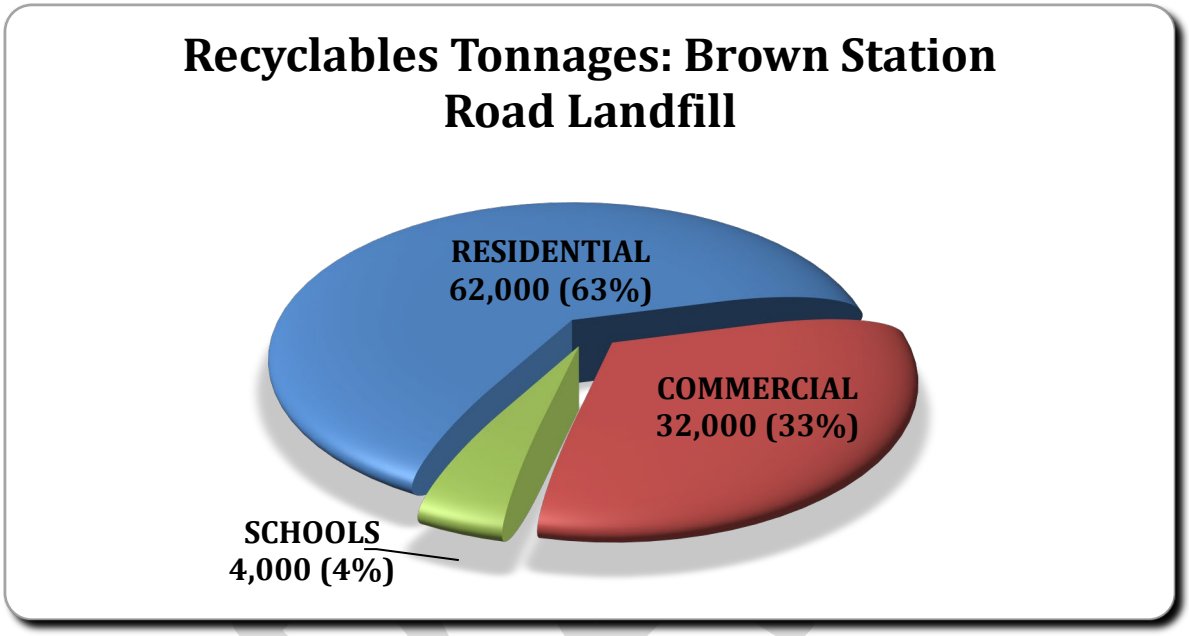
Recommendation

Purchase and install optical sorting equipment for $5.1 million to increase the value of recycling revenue by $1.475 million annually.

Increase Recycling Volume

According to the WCS, of the 99,000 total tons of recyclables of MSW, 62,000 tons are from residential sources, 32,000 tons from the commercial sector, and approximately 4,000 tons from schools.

Exhibit 5. Recyclable Material Landfilled at Brown Station Road



Increasing the amount of recycling increases revenue as shown in Exhibit 6.

Exhibit 6

Potential Commodity Revenue from Currently Landfilled Recyclable Materials

Summary By Source Category						
Source	*Annual Recyclable Tons	**Market Pricing Per Ton	***Net Revenue Per Ton	Recovery Rate 25%	Recovery Rate 35%	Recovery Rate 50%
Residential	62,100	$ 130.86	$ 45.86	$711,977	$996,767	$1,423,953
Commercial	32,300	$ 147.41	$ 62.41	$503,961	$705,545	$1,007,922
Schools	4,200	$ 127.74	$ 42.74	$44,877	$62,828	$89,754
TOTAL - All Sources	**98,600**	**$ 136.15**	**$ 51.15**	**$1,260,814**	**$1,765,140**	**$2,521,629**

* Represents the recyclable material currently being landfilled as identified in the County's Waste Characterization Study.
** Market Pricing Per Ton is based on the 3-year average pricing per ton from 2015 - 2017 for all non-fiber materials, and the 3-year average pricing for the period of 2015 - 2017 including the first 6 months of 2018 for all fiber materials.
*** Net Revenue Per Ton is the average market price per ton for each Source Category less the estimated operating costs per ton of $85 = Net Revenue Per Ton.

As shown in Exhibit 6, the commercial, residential and school sectors vary in the total recyclables available for diversion. Though specific recommendations to increase diversion in each sector are discussed below, most recommendations are applicable to multiple sectors.

Commercial Recycling

Annually, 32,000 tons of commercial and industrial recyclables are disposed of at the Landfill rather than being recycled. County law requires owners of commercial and industrial property to provide opportunities for tenants to recycle. DoE has inspected 7% of the 48,000 business in the County and reports a 99% compliance rate.

Annually, 32,000 tons of commercial and industrial recyclables are disposed of at the Landfill, rather than being recycled.

However, up until recently, county law did not require owners or tenants to provide the opportunity for customers to recycle. A convenience store could recycle its own used paper or bottles in the back room or office but had no obligation to provide interior recycling receptacles for customers to use. Nor was there any requirement to provide exterior recycling receptacles along storefronts or sidewalks. This changed upon County Council passage of CB-12-2018, effective September 24, 2018. The law now requires commercial property owners, by July 1, 2019, to provide recycling containers alongside exterior trash receptacles and interior recycling receptacles wherever trash receptacles are provided for public use.

The following examples highlight some of the different strategies that encourage commercial recycling. One approach is to require mandatory business recycling practices. In 2012, the City of Austin's Universal Recycling Ordinance (URO) went into effect. Initially, commercial properties such as office buildings, medical facilities, religious buildings, and private education facilities were required to recycle according to the following phased in approach:

- 2012 - Properties with >100,000 square feet;
- 2013 - Properties with >75,000 square feet;
- 2014 - Properties with >50,000 square feet; and
- 2015 - Properties with >25,000 square feet

The ordinance specifies five steps to compliance. These steps include: 1) providing recycling, 2) ensuring convenience (recycling containers should be within 25 feet of trash containers), 3) posting bilingual signage, 4) providing annual education, and 5) submitting an annual diversion plan. This program does not require specific diversion amounts. This ordinance covers both

multifamily residential properties and commercial non-residential properties.[5] It does not require specific diversion amounts.

Another approach is to set diversion requirements. Neighboring Montgomery County requires business of all sizes to practice waste reduction and provide recycling services. Through these two practices, all businesses in the county are required to achieve a 70% waste reduction rate, calculated by weight. Businesses with more than 101 employees are required to file a waste reduction plan with the County while businesses with less than 100 employees are only required to file a plan upon request. Montgomery County provides significant support to businesses by hosting an annual business recycling seminar; webinars on annual reporting; and provide literature, handbooks, and other education materials to businesses to facilitate waste reduction and recycling. Supported by 11 county business inspectors (DoE has 5), Montgomery County's program allows businesses to customize their approach through source reduction and recycling and avoids burdening small businesses with reporting requirements unless necessary[6].

A third approach is to focus on collection services. In Oregon, the City of Portland, mandates commercial haulers offer trash, recycling, food scrap, multifamily, and dumpster collection to provide service to commercial businesses (though the service may be subcontracted). Through this requirement, commercial businesses can increase their divertible tonnage by easily adding new collection streams. In addition, Portland updates the rules governing trash and recycling collection annually, which provides flexibility for changing market conditions.[7]

As shown in Exhibit 6, a 25% increase in commercial recycling results in estimated additional annual revenue of $504K. At 35%, additional annual net revenue is $706K.

Recommendations

Increase the volume of commercial recycling by:

- Increasing the county inspection staff to provide outreach to county businesses and enforce commercial recycling regulations; and
- Institute a commercial ban on recyclable material at the Landfill.

Residential Recycling

As shown in Exhibit 6, county residents are disposing 62,000 tons of recyclables at the Landfill annually. There are two approaches to increase residential recycling. The first is through education and outreach. In the U.S. Chamber of Commerce Foundation's 2018 report "Beyond 34 – Recycling and Recovery for a new Economy", the Chamber concludes that improved

[5] http://www.austintexas.gov/uro
[6] https://www2.montgomerycountymd.gov/depwebstore/items.aspx?subcatalog_id=41
[7] https://www.oregon.gov/deq/mm/Pages/Oregon-Recycling-Laws.aspx

recycling education leads to better recycling. Continuing education is needed to counteract the tendency for the public to engage in "wishcycling" – the practice of placing questionable items in the recycling bin (e.g., plastic bags, electronics, fast food contaminated plastic/wrap), with the hope that they can be somehow recycled.

The Chamber recommends allotting $1 per household to a recycling education program's annual budget. In its report the Chamber further recommends that if there are changes to be made to the program, e.g., to mandate residential recycling, this spending allocation should be increased to $3-$4 per household[8].

Residential recycling rates can vary substantially within a County based on access to programs, educational efforts, housing type, and other factors – especially a county as large as Prince George's with nearly 500 square miles. The County could assess recycling participation in order to reduce contamination and provide feedback to residents. Using existing collection routes, the County can randomly select a cross section of homes to determine participation and material quality. This information can then be used to deploy educational resources to areas of low participation and/or quality.

Nevertheless, while education and outreach can make improvements to the recycling rate, these alone are often not enough to see significant impacts. One study on curbside recycling found that when voluntary programs instituted mandatory requirements, they saw collection increases of over 150% for certain commodities when compared to continued voluntary participation.[9]

Legislative mandates can include disposal bans on recyclable commodities and mandated participation in recycling programs. Pairing disposal bans with mandatory recycling participation allows for curbside enforcement through collections, which encourages proper participation. Recycling mandates can come in many forms. Some local governments focus on mandatory recycling participation while others mandate high levels of recycling education and outreach.

San Francisco, California is an excellent example of successful of mandatory recycling. In 2009, the City began enforcing mandatory recycling and composting for residents and businesses. After one year, San Francisco observed a 45% increase in composting collection and a 72% increase in Landfill diversion over the previous year. In addition, the program created 118 new employees to sort recyclables and monitor collection routes[10]. The program continues to be successful, with San Francisco achieving a recycling rate close to 80% in 2012[11].

[8] https://www.uschamberfoundation.org/beyond-34-recycling-and-recovery-new-economy
[9] Everett, J.W. 1993. Curbside Recycling in the U.S.A.: Convenience and Mandatory Participation
[10] SF Attains 77 Percent Recycling. 2010. Sfenvironment.org
[11] Layzer, J.A. et al. 2014. Municipal Curbside Compostable Collection : What works and why ?

Sacramento County, California conducts a curbside enforcement program in which county staff conducts inspections of county provided trash carts for recyclable materials for 150,000 households. The program costs are estimated to be $500,000 for inspections and $20,000 to $30,000 for outreach and education. This program is flexible and can be easily adjusted to changing market conditions but is very labor intensive. The program recently began in April 2018 and is expected to reduce contamination and increase recycling participation.[12]

As shown in Exhibit 6, a 25% increase in residential recycling results in estimated additional annual revenue of $712K. At 35%, additional annual revenue is estimated at $997K.

Recommendations

Increase the volume of residential recycling by:

- Conducting a countywide residential sampling survey to determine residential recycling participation rates and targeting underperforming recycling areas with specifically tailored educational materials
- Enhancing ongoing educational efforts to encourage both increased recycling through the curbside collection program, and improved quality of the material collected
- Requiring mandatory residential recycling by implementing a residential disposal ban on recyclable materials with enforcement by additional county inspectors

Prince George's County Public Schools

According to the WCS, there are 4,200 tons of recyclables from 220 elementary, middle, and high schools in Prince George's County currently being landfilled. The County is working closely with the public-school system to develop recycling curriculum for students in all grades that can be taught both with and without the assistance of DoE staff. This is being done by Keep Prince George's County Beautiful and the County's Public Schools System Recycling Coordinator. Through these actions, County residents will continue to increase participation in recycling programs.

Research demonstrates that education and understanding of recycling programs is particularly important to a school-based recycling system. School based programs are often different from curbside collection at home. This can lead to confusion among the students and reduce recycling participation. Also, many students do not believe the recycling is collected separately from the regular trash or transported for recycling[13]. Collection containers should be convenient for students and both clearly and consistently labeled to improve recovery rates. School systems in

[12] https://www.wastedive.com/news/sacramento-county-california-recycling-without-raising-rates/521142/

[13] Flanagan, S. 2017. How Can Education Improve the Recycling Behaviors and Attitudes of Middle School Students? Digital Commons, Hamline University http://digitalcommons.hamline.edu/hse_all

Harford County and the District of Columbia are examples of jurisdictions that have squarely addressed these issues by setting goals and providing infrastructure.

Harford County Public Schools

In 2013, the public schools in Harford County, Maryland partnered with the Harford County Department of Parks and Recreation to place over 400 recycling cans at sports fields throughout the County. Since implementation in 2013, this program has provided single stream recycling collection for all fields, parks, playgrounds, and other exterior locations.[14] In 2017, The Harford County Department of Parks and Recreation collected approximately 30 tons of single stream recycling material.

The Maryland National Capital Park and Planning Commission (MNCPPC) provides for single stream recycling and collection at all MNCPPC facilities with the County, and strictly adheres to County legislation that requires Recycling and Food Waste Collection at Special Events occurring on their properties (CB-008-2017). In 2017, MNCPPC collected approximately 200 tons of single stream recycling material.

District of Columbia Public Schools

The District of Columbia Public School (DCPS) system, comprised of 112 schools (not including charter schools) has a target of zero waste by 2032. To meet that goal, all schools are required to collect paper and mixed recyclables. The Department of General Services (DGS) in the D.C. government oversees these efforts and provides feedback through awards and recognition programs. These include programs on recycling and composting, energy reduction, drinking water testing, indoor air quality, and integrated pest management. The DCPS Recycles! program is designed to fulfill legal requirements; improve building operations; reduce waste of money and natural resources; achieve the Sustainable DC target of zero waste by 2032; and teach DCPS students values and skills for a sustainable 21st century. DGS maintains an interactive map online which provides information on each school's participation in recycling and organics programs.[15]

All DCPS schools are expected to sort and collect paper recyclables, mixed recyclables, and non-recyclable trash in accordance with the city-wide hauling contract managed by DGS. In schools that voluntarily opt-in, schools also sort organics (food scraps and soiled paper). DGS provides pick up services, standardized supplies, and on-site support.

[14] http://www.baltimoresun.com/ph-ag-school-recycling-20130827-story.html
[15] https://dgs.dc.gov/page/dgs-healthy-schools

Everyone is expected to participate. All staff and students are to sort waste into bins according to labels and instructions provided. Most schools have the following containers and a pick-up schedule:

- 8 cubic yard dumpster for paper recyclables, 2 times per week.
- (2) 96-gallon toters for mixed recyclables* (bottles and cans), 2 times per week
- (3) 96-gallon toters for organics, 3 times per week
- 8 cubic yard dumpster for non-recyclable trash, 3 times per week
- *DGS considering converting to single stream for their next collection contract

Schools use the following organization:

- BLUE bins (paper or mixed recycling)
- YELLOW bins (organics recycling)
- BLACK bins (trash)
- Compostable bags

Classrooms and Offices - One (1) blue recycling bin and 1 trash bin per classroom/office. The recycling bin is placed next to teacher's desk to allow for active monitoring and labeled for paper only. Blue recycling bins do not need to be lined if used properly.

Common areas and teacher's lounges - rooms that generate paper and bottles/cans should have a "sorting station", which constitutes one blue recycling bin for paper only, one blue recycling bin for bottles/cans only, and one trash can. The blue bins are labeled for either paper or bottles/cans only.

Cafeteria and Kitchen - schools make one or more sorting "stations" out of appropriately colored bins along with a table for stacking trays. The stations are in the same place every day and some placed against a wall with signs identifying acceptable contents. Schools use a Cafeteria Sorting Cheat Sheet to remind staff what goes in each bin.

Of the 112 public schools in the District of Columbia, approximately 50% are meeting the minimum recycling program requirements, and of these 56 schools, 30 of programs are performing well.

As showing in Exhibit 6, while a 25% increase in school recycling results in modest additional annual net revenue of $45K, additional benefits are far greater over the long term: educating students on recycling practices that will have life-long impacts.

Recommendations

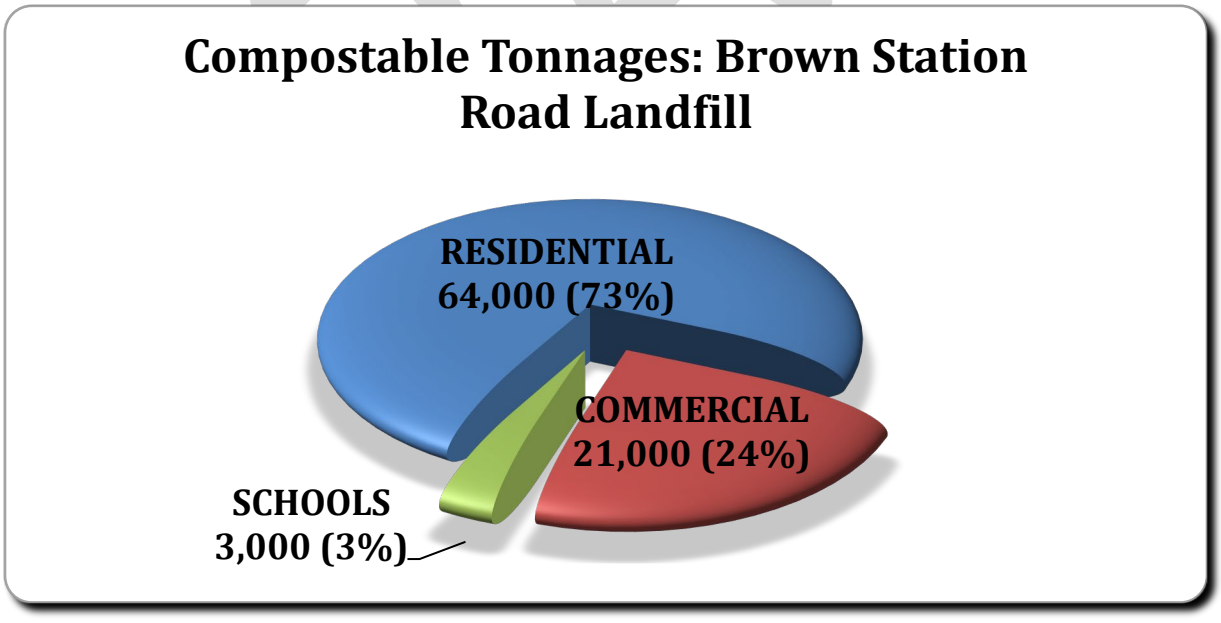
In conjunction with the strategies on school organics diversion discussed later, increase the volume of school recycling by:

- Establishing a zero-waste goal for county public school systems
- Conducting a recycling audit of each school to determine if it has appropriate recycling bins placed in areas visible and convenient for recycling
- Providing recycling containers to schools that do not have them
- Providing exterior recycling receptacles for bottles and cans on school grounds and at athletic fields
- Continuing to work closely with the public-school system to include recycling in the environmental education curriculum

Goal II – Increase Food Waste Diversion

According to the WCS, of the 88,000 tons of compostable materials, 21,000 tons are from commercial sources, 64,000 tons are from residential sources, and 3,000 tons are from schools. This represents approximately 30% of the total Landfill waste stream and is a significant opportunity for waste diversion.

Exhibit 7.
Compostable Materials Landfilled at Brown Station Road



There are various categories of compostable materials from three different sources.

Exhibit 8.
Categories and Sources of Compostable Materials

	Residential	Commercial	Schools	Total
Vegetative Food	24,300	8,300	1,500	34,100
Non-Vegetative Food (meat, dairy)	10,700	3,000	200	13,900
Compostable Paper	14,600	6,600	700	21,900
Leaves	5,700	700	300	6,700
Grass	3,00	1,100	<100	4,600
Shrubs	5,100	1,200	<100	6,400
Total	**63,800**	**20,800**	**2,800**	**87,500**

The primary opportunities lie in diverting vegetative and non-vegetative food: 11,300 tons from commercial sources, 35,000 tons from residences and, to a lesser extent, 1,700 tons from schools.

Background

The Prince George's County Organics Composting Facility (OCF) receives over 50,000 tons of yard and food scraps annually. Using 52 acres of the 200-acre site, organic waste is processed into two compost products, Leafgro™ and Leafgro Gold™ which is then marketed to retailers. Over $430,000 in sales revenue from Leafgro™ and Leafgro Gold™ is returned to the County.

The facility is utilized by private and contract haulers providing service to over 165,000 households in the County. The current tip fee generates revenue of over $1.5 million annually which, along with the sales revenue, generates just under $2.0 million used to offset the cost of operating the facility. In fiscal year 2017, the County composted 5,492 tons of food scraps and 41,224 tons of yard trim at a net cost of $9.78 per ton.

The OCF has composted yard trim since 1991. Yard trim collected at the curb from county residences is ground and placed into long narrow piles known as windrows. The feedstock varies seasonally, primarily leaves in the fall and grass in the spring. The active composting phase requires both leaves and grass and takes approximately nine months. The final product generated from the open windrow process is Leafgro™, a soil amendment marketed by MES to a network of retailers.

Recognizing the need to address food scrap recycling, in 2013, the County began food scrap composting as a pilot program using the Gore cover technology. The Gore system is an in-vessel, aerated pile system with oxygen and temperature monitoring devices. This system processes yard trim and food scraps combined, on a smaller footprint of area than required by windrowing and with little energy consumption, while creating a finished compost product within 8 weeks. Using the Gore cover system enables the County to efficiently divert food scraps from the Landfill, thus increasing the overall recycling rate within the County. The final product is Leafgro Gold™ and is sold through the same network of retailers.

During 2014, the County expanded the Gore cover system from a three-heap pilot project to a four-heap continuous process. Further expansion to an eight-heap system occurred in 2016. Customers include grocery stores, museums, DC public schools, three local universities and three municipalities.

The project recently expanded to a 12 Mega Bunker Wall heap system capable of processing 32,000 tons of food scraps and 32,000 tons of yard trim annually. The expansion is the result of increased commercial interest in food composting. Since the inception of food waste composting, MES and the County have worked closely with local haulers to communicate the site's available capacity and the acceptable and unacceptable feedstocks. In addition, MES and the County actively promote the food waste composting program through area trade shows, conferences, environmental symposiums, and direct presentations at local institutions, i.e. universities, municipal offices, hospitals, etc. This outreach has generated significant demand for both food waste collection service and the capability to process food waste into compost. MES has a current customer waiting list of over 40 customers representing over 25,000 tons of food waste material per year, including 5,700 tons generated within the County.

The expansion has taken the project from a net cost of $9.78 per ton to a net gain of $8.64 per ton. The growth of the food scrap processing system is displayed in the following table:

Exhibit 9

Western Branch – Organics Composting

Fiscal Year	# of Heaps	Tons of Food Scraps	Food Scraps Tipping Fee Revenue	Leafgro™ Gold Sales Revenue
FY 2013	3	288	$12,960	$0*
FY 2014	4	1,509	$67,905	$0*
FY 2015	4	4,400	$198,000	$46,200
FY 2016	4	5,096	$229,320	$53,508
FY 2017	4	5,492	$247,140	$60,900
FY 2018	8	9,785	$440,325	$106,167
FY 2019	20**	25,943	$1,167,450	$281,485
FY 2020	**20**	**32,000**	**$1,440,000**	**$347,200**

* Initially all material was sold as Leafgro™ until the Leafgro Gold™ product registration was approved.

** System conversion from 8 heaps to 8 heaps + 12 bunkers. The FY2019 food scrap tons, tipping fees and revenue are per the FY2019 budget.

Commercial Food Waste Diversion

There are 11,300 tons of vegetative and non-vegetative food from commercial establishments being landfilled rather than composted. The new 12 heap mega GORE system coming on line in August 2018 can process all 11,300 tons. Strategies to bring in this additional tonnage include targeting in-county businesses, establishing flexible collections programs, using "put or pay" agreements, and enacting legislation banning commercial food waste in the Landfill.

BWI Food Waste Commercial Collection Pilot Program

MES is currently operating a pilot program to collect food scraps from eight volunteer restaurants located inside of the Baltimore Washington International Thurgood Marshall Airport. Participants collect food scraps and deliver them to centralized locations for storage in 35-gallon carts, which are provided by the Maryland Aviation Administration. MES staff provides ongoing personalized education and trainings for each location. The food scraps are collected twice per week and transported to the Prince George's County Organic Composting Facility. This allows individual restaurants to participate in food scrap collection programs that otherwise may be cost prohibitive. During the first month of collection, the program has collected more than 900 pounds of food scraps. The projected diversion rate for the pilot program is over nine tons during the first year. The program is well received with very limited contamination and high rates of participation.

City of Orlando, Florida

In September 2017, the City of Orlando was selected by the US Chamber of Commerce Foundation to be the home for its *"Beyond 34: Recycling and Recovery for a New Economy"* pilot project. This project aims to increase the 34 percent recycling rate that was current in 2017 in the United States by providing a scalable model for improving recycling and recovery rates. The City provides businesses with a 65-gallon carts at no charge. They also provide participating businesses with front-end education aimed at teaching business staff on how the program works. The program costs businesses $14.25 per cart per month per pickup and the City offers up to three pickups per month.

Put or Pay Agreements

The County could implement "put-or-pay" agreements with both local haulers and/or directly with in-county food scrap generators. With a "put-of-pay" contract, the County is setting aside food waste capacity for a customer at the OCF. In exchange for this guaranteed space, the customer is charged the contract tipping fee for the agreed upon number of tons whether the material is delivered to the site or not. The proposed tipping fees in the "put-of-pay" agreements will be based on the current rates. The spot market pricing will be higher for customers who have not entered into a contract. This will provide an incentive to local haulers to establish collection programs at County office buildings, farmers markets, grocery stores, restaurant chains, etc., and direct in-county food scrap material to OCF.

Organics Ban Legislation

Currently the State of Maryland has a ban on separately collected yard trim at landfills. However, this ban does not include food waste and other compostable materials. These materials can be captured through "compost recovery legislation". This style of mandatory organics collection has been successful in counties and jurisdictions in New York City, the State of Massachusetts, and the City of Vancouver. These locations are seeing a 300+% increase in waste diversion.

New York City's legislation prohibits contamination and mandates that generators of compostable or recyclable material have three collection services: trash, recycling and composting. Mandating organics diversion resulted in a volume increase from 450 tons a day to 650 tons a day within six months.

Effective January 2015, Metro Vancouver initiated banning organic materials from area landfills. In 2017, nearly 450,000 tons of organic waste was turned into compost, an increase of nearly 30 per cent from when new rules banning organic waste from landfills were implemented. The ban is part of a strategy to divert 80% of the region's garbage from landfills by 2020. Metro Vancouver's 2017 overall diversion rate is 63%. Beginning in January 2015, Metro Vancouver

reduced the amount of organic waste which it permits at landfill sites to 25%. This was done to phase-in the organics ban. In 2018, the percentage was dropped to 5% — a move the region hopes will spur those who aren't yet composting to do so.

The Massachusetts Department of Environmental Protection (MassDEP) Organics Study and Action Plan outlines the obstacles involved when attempting to divert organics from landfills, along with the solutions to be put in place to achieve their removal. Over the next decade, annual landfill capacity in Massachusetts is expected to decline by as much as 1.5 million tons of airspace. With an organic waste ban they outline steps to increase business and institutional composting, require waste haulers to provide full service organics collection services, utilize a Pay-As-You-Throw Programs, increase incentives through producer responsibility legislation (E-waste bill) and enforce waste ban compliance by waste generators and haulers to name a few.

If a County-wide organics ban is implemented, this type of ban should be phased-in over time. This is a tactic Metro Vancouver took by slowly increasing to allowable amount of food residuals to be collected in each MSW load. The County has experience with this type approach – the successful plastics ban at the Organics Compost Facility was phased in over time.

Recommendations

Increase commercial organic waste diversion by:

- Targeting large, in-county generators of food waste to establish pilot collection programs, e.g. FedEx Field, Bowie Baysox Stadium and Joint Base Andrews;
- Establishing put or pay agreements with participating in-county food waste generators to guarantee reserved capacity;
- Working with licensed haulers and commercial businesses to create flexible collection programs; and
- Banning commercial food waste from the Landfill, phased in over time.
- Investing in de-packaging sorting equipment.

Residential Organic Waste Diversion

According to the WCS, 35,000 tons of vegetative and non-vegetative food materials from county residences that are being Landfilled rather than composted. The challenge is developing a collection program that diverts this material from the Landfill to the County's OCS. Nationally curbside food waste collection programs have increased by 65% since 2014 – from 198 to 326 communities (Biocycle 2017). Over 60% of are classified as standard, meaning they are offered alongside trash and recycling. In Maryland, there are three jurisdictions with varying voluntary participation rates, collection practices and costs. In addition, the County recently implemented a pilot food scrap collection program.

Howard County is currently operating three collection routes in their residential food scrap collection program. Per the County, 6,500 households out of the 15,000 eligible households, or 43%, are actively participating in the program. There is limited processing capacity at the Alpha Ridge Landfill composting site at the current time. Howard County offers three different sizes of collection containers - 12, 35, or 65-gallon carts. The initial container is free of charge. Accepted items include vegetative food scraps, soiled paper and yard trimmings. First-time registrants receive a welcome kit which includes a box of compostable liners, a kitchen container, and a curbside collection container in the size of their choosing. Registrants also receive a sample bag of compost. Outreach is primarily done through the County website, social media, direct mailings, and HOA meetings. The most prevalent contaminant is plastic sandwich bags. The bags are ground with the feedstock material and screened out at the end of the process. The program is funded through a designated line item on the County's property tax bills for those households participating in the program - approximately $15 per household per year.

Takoma Park currently has approximately 50% of its 3,200 residents participating in its curbside food scrap collection program. This is an increase of roughly 300 households since 2015. Social media, the city's website and direct mail are utilized to engage and enroll participants. Each participant is provided a 5-gallon bucket with a lid. Replacement and additional containers are provided free of charge. No interior containers are provided. All food scraps are accepted including meat and dairy products along with soiled paper. Takoma Park has reached their allotted capacity at the Western Branch. They have a 70% weekly set out rate with an average weight of 8 lbs. per bucket. This is a drop from the initial average weight of 12-13 pounds in 2011. Takoma Park has one full time staff person to facilitate the program at an annual cost of $52,000 and is currently paying $45 per ton to dispose of 200 tons of food scraps per year at the Prince George's County Organics Composting Facility. Approximately $1,000 is spent for the transportation of the food scraps and $10,000 was spent for purchase of 5-gallon buckets. The expansion of their program is contingent upon expansions at the Prince George's County composting facility.

University Park began providing food scrap collection in 2013 to approximately 211 households of the 900 households in the town. They have experienced a small increase of 20 households since 2015 for a participation rate of 25%. The overall weight of food scraps collected has decreased, even though the number of participating households has increased. Weekly participation is declining, possibly due to the novelty wearing off and residents losing interest. Residents who choosing to participate are provided a kitchen pail, a supply of compostable bags and a 5-gallon bucket. Each household receives 125 compostable liners per year. They are using compostable liners made by BIO Bag. Outreach, limited due to staffing, is generally word of mouth, town's website, and a weekly email reminder. University Park is exploring ideas to maintain interest and increase participation. Food scraps, excluding meat and dairy, are collected

on trash day. Should meat and dairy be added in the future; food scrap collection would be changed to the same day as yard waste collection. A larger collection container would be required to accommodate the additional volume. The most prevalent contaminant is small plastic sandwich bags.

Prince George's County began a one year, **175**-home pilot food waste collection program in the Pepper Mill/Carmody Hills, Wilburn & Fort Washington areas in December 2017 and January 2018. In June 2018, 35 participants were added in West Laurel area. Each participating household was provided a 1.5-gallon kitchen pail for food waste, soiled paper towels, napkins, uncoated paper plates, coffee grounds and filters in addition to a 32-gallon `wheeled organic cart for commingled food and yard waste. The kitchen pail is used for daily collection in the home and emptied into the cart at the homeowner's convenience. Carts are collected by the County contracted hauler once a week and delivered to the OCF.

The County considered using 5-gallon buckets but was discouraged from doing so as they disappear frequently due to passersby or blow away when the weather is bad. In addition, five-gallon buckets are too small to combine food scraps with yard trim for processing compost. The cost of the 1.5-gallon kitchen pail was $ 4.35 per unit. The 32-gallon wheeled cart was $42.55. Labels added an additional $1.25 per cart. Total cost per residence: $48.15.

For the first six months of the pilot the County asked residents to place food scraps in separately provided containers to allow the County to determine the average per household food scrap tonnage. (As noted, Takoma Park averages eight pounds per five-gallon bucket). In August, the West Laurel collection area will commingle yard trim and food in the 32-gallon organic carts to provide staff at OCF the opportunity to begin testing mixed commingled material.

Results of the voluntary pilot program are being tabulated at this time. Presently, participating households are averaging 5.5 pounds of food waste per week. At this average, if the pilot were expanded county-wide to 165,000 households with 100% participation, the County collection is

an estimated 23,595 tons/year. While the 175-household sample size is small, this compares favorably to the estimated 35,000 tons of residential food scraps currently being landfilled.

As noted, however, 100% participation is not the norm in Maryland jurisdictions, with Takoma Park at 50%, University Park at 25%, and a part of Howard County at 43%. On the other hand, both Takoma Park and Howard County have limited additional processing capacity, unlike OCF.

Recommendations

Increase residential organic diversion by:

- Assess the data from the residential household pilot program and determine how the program shall be expanded, whether to additional areas or county- wide, and/or on a voluntary (opt-in) or mandatory (full participation) basis

Schools Food Waste Diversion

According to the WCS, 1,700 tons of vegetative and non-vegetative food scraps from county schools are being Landfilled rather than composted. At the time of the WCS, in 2015, the County had not yet banned Styrofoam trays. The trays are now compostable. If the WCS were conducted today the composting rate would be closer to 4 – 5,000 tons.

The first challenge in school organic waste diversion is establishing a food collection program within the schools and the second is collecting and composting the food. Other jurisdictions have implemented practices for school food diversion, including lessons learned.

District of Columbia

As noted, the District of Columbia has established a zero-waste goal for the DCPS. Further to this goal, schools can voluntarily opt-in for organics collection. As described in the school recycling section, most participating schools have 96-gallon toters for organics with collection services three times a week. In fiscal year 2015, more than 30 schools diverted 252 tons of organics. In the 2016-2017 school year, the participation rate increased to 61 schools throughout the District. On-campus composting bins and vermiculture classroom bins are also encouraged at the individual school level.

Boulder Valley, Colorado

Another good example of a school district with a successful organics program is the Boulder Valley School District (BVSD). These schools meet their overall waste reduction goals by implementing composting school-wide, through education by hosting special events focusing on measurable waste reduction, and with increased attention to overall waste education in every

aspect of school life. In addition to food scraps being collected in cafeterias, major efforts are made to encourage recycling and composting of items used every day in class. BVSD's vision for sustainability includes recognizing and understanding the dynamic interconnections of composting and the ecological, economic, and social systems and teaching students to be able to critically evaluate the potential positive and negative consequences of personal and collective actions. By focusing on student education and staff development in each school, diversion numbers have increased and over all waste had decreased

Sustainable Urban Solutions, Texas

Sustainable Urban Solutions, located in Texas, provided research into increasing offsite composting in schools for grades K-12. The research is based on lessons learned from a 100+ schools in four districts in Central Texas. They identified the 5 "people" needed to have a successful program:

- Leadership (Head Custodian, Cafeteria Manager)
- Student Participation (Stewards who monitor bins, classrooms and hallways)
- Custodians (someone to move and transfer full bins to the compost compactor)
- Teachers and Administrative Staff (Continuous education from educators)
- Parents (adults who volunteer their time and knowledge to the school)

All receptacles throughout the school or even the school district should be color coded with abundant signage. This includes compost bins in the cafeteria, kitchen, classrooms and hallways, bathrooms, and outside of the building for any yard trimming waste. Schools interested in starting a compost program should first start with a waste audit. Tonnages, volume and compostable materials vary from school to school. Next is to increase the infrastructure of the school (compost collections bins and compostable linings). Third is sourcing a contract hauler and compost facility that will accept the CLEAN sorted compostable scraps. The final step is to train staff and teachers and incorporate composting into the student's daily routine. It is important to track progress and material management throughout the school year.

Collection Services

The second challenge – taking food scraps to the OCF - is easier. Food scrap collection services could be incorporated into the scope of work for the County's next procurement for solid waste collection services from county schools.

Recommendations

Implement a school food waste diversion program by:

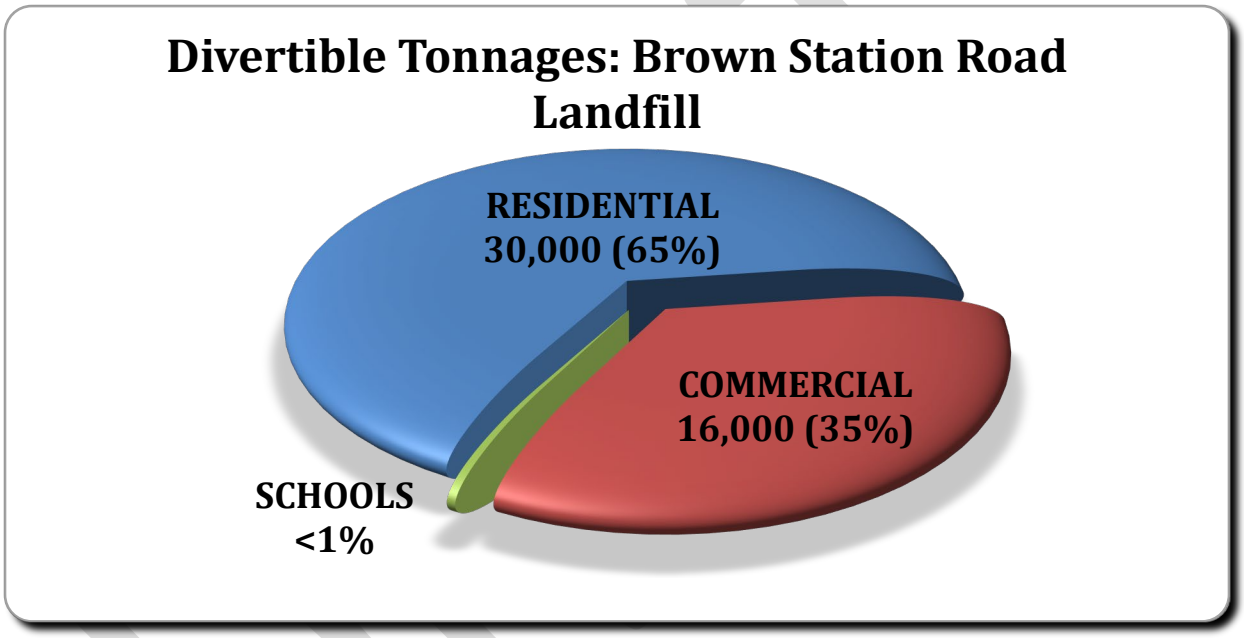
- Establishing a zero-waste recycling goal for public school systems
- Offer schools with the highest recycling rate of participation the opportunity to participate in pilot food waste diversion programs

- Providing appropriate infrastructure and education to schools in the pilot program
- Requiring food waste collection in the next county procurement for solid waste collection services.

Goal III – Increase Recycling of Divertible Materials

According to the WCS, there are 47,000 tons of divertible materials being landfilled: 30,000 tons are from residential sources and 16,000 tons are from commercial sources.

Exhibit 10.
Divertible Materials Landfilled at Brown Station Road



Residential Diversion

The 30,000 tons of residential divertible materials consist of the following components

Exhibit 11

Residential Divertible Tonnage		
Material Component	Tons	Approx. %
Textiles	10,900	36
*Other wood	4,200	14
Plastic shopping bags	3,100	10
Scrap metal	2,100	7
Electronics	1,900	6
Pallets/Lumber	1,700	6
Sheet Rock	1,600	5
Dirt	1,500	5
Carpet/Carpet Padding	1,400	5
Concrete/Brick/Rock	700	2
Shingles	700	2
Paint	300	1
CRTs	<100	0
Total Divertible	**30,100**	**100**

*Tree stumps, wooden chairs, misc. wooden items

Residential divertible material represents roughly 10% of the overall annual material in the Landfill and approximately 14.7% of the total annual residential materials. Aside from plastic shopping bags, which can be brought to nearby grocery stories, the majority (69%) consists of:

- Textiles (36%),
- Pallets/lumber/other wood (20%)
- Scrap metal (7%); and
- Electronics (6%).

Total potential diverted materials: 20,800 tons. At $52/ton, the annual cost of processing these materials at the Landfill is $1.1 million. Successful reuse and recycling efforts pursued by the County should focus on diversion of these items from the Landfill.

The County currently provides an opportunity for recycling scrap metal and electronics recycling, but not textiles or pallets, lumber and other wood. Electronics may be recycled in an area within the Landfill complex that also accepts household hazardous waste, scrap tires and used

appliances. Scrap metal is accepted at a residential recycling convenience center on Brown Station Road across the street. Both the Landfill and the Brown Station Road Convenience Center are in the central part of the county. A separate convenience center is in Brandywine, in South County. There is no recycling convenience center in North County although construction of one has been in planning discussions for years. Materials accepted at all three facilities and FY '18 tonnages are listed in Exhibit 6.

Exhibit 12
FY 2018 Recycling Centers(Tons)

	Brown Station Road	Brandywine	Landfill Complex	Total
Single stream recyclables	454	210		664
Trash	700	458		1158
Yard trim	757			757
Rigid plastics	160	109		269
Used oil and antifreeze				69
Scrap metal	1484			1484
Electronics			199	199
Household hazardous waste			131	131
Scrap tires			356	356

While the County does not currently except textiles and wood for recycling, other jurisdictions have implemented collection efforts to support textile and pallet and other wood products management at their homeowner convenience centers. Textiles are managed by independent vendors who manage the material. Pallets and other wood products are either ground for mulch or returned to suppliers, vendors or residents. The County can engage vendors to provide similar services at existing and future homeowner recycling convenience centers, as discussed below.

Textile Recycling

Anne Arundel County collects clothing and textiles at their recycling centers using bins provided by an independent vendor. Anne Arundel County[16] operates three drop-off centers with two small bins and one with three large bins. These items are separated into two types: usable clothing and textiles and non-reusable (worn out, torn, stained, and unmatched shoes and socks). Citizens are required to bag the usable items separately from the worn items and place the bagged material in the appropriately labeled bin. Bagging the items ensures that they will stay

[16] Anne Arundel County, Department of Public Works, Bureau of Waste Management Services. https://www.aacounty.org/departments/public-works/waste-management/Materials_Accepted/clothing

clean, dry and can be properly reused or recycled. Anne Arundel County contracts with Mid-Atlantic Clothing Recycling LLC (MAC) to collect, sort, and dispose of the items. MAC operates on a rotating scheduling, visiting each collection site approximately once a week. MAC pays Anne Arundel County approximately $100/ton ($0.05/lb.) for reusable material and $10/ton ($0.005/lb.) for non-reusable items. According to Anne Arundel County, the textile collection effort was implemented in FY 2016 and yielded roughly 9,000 pounds of reusable items in its first year. FY 2017 yielded 18,000 pounds of reusable items and less than 2,000 pounds of non-reusables. Clothing and textiles placed at the curb for curbside collection are accepted as trash, not recyclables

Similarly, Harford County[17] provides clothing and textile collection at the Harford Waste Disposal Center and manage the material like Anne Arundel County. They contract with Turnkey Enterprises LLC who pays the County pounds collected.

Other jurisdictions in Maryland, including Montgomery County and St. Mary's County, also provide textile collection services for homeowner drop-off through an independent vendor. Montgomery County[18] does so at its Shady Grove Processing Facility and Transfer Station. St. Mary's County[19] provides this service at their six convenience centers through PlanetAid Inc.

Typically, the vendor will include the following as part of the service at no cost to the County:

- Purchase the shed/bins (collection station) and all related materials
- Obtain all necessary permits
- Perform all necessary site work
- Maintain the appearance of the collection station
- Maintain the appropriate insurance

There are several sized bins. The most commonly used textile drop off bins have a 4'x4' footprint and are roughly 7' tall, similar to the size of a soda machine. To accommodate three bins, an area of approximately 50 square feet, and a height clearance of at least 7 feet is needed.

Outside of Maryland, a 2014 waste characterization study found that City of Austin, Texas curbside customers send approximately 3,322 tons of textiles to Austin Landfills each year[20]. As a result, the City of Austin launched a free curbside clothing and housewares recycling collection

[17] Harford County, Office of Recycling. https://www.harfordcountymd.gov/261/Clothing-Textile-Recycling
[18] Montgomery County, Department of Environmental Protection. https://www2.montgomerycountymd.gov/DepHowDoI/material.aspx?tag=clothing-textiles&key=466
[19] St. Mary's County, Department of Public Works and Transportation, Recycling & Solid Waste Services. https://www.stmarysmd.com/dpw/recycleprogramslist.asp#Clothing%20and%20Textile%20Recovery
[20] Austin Resource Recovery Master Plan. City of Austin. 15 December 2011.

service for its curbside customers in December 2016[21]. The City partnered with an independent company (Simple Recycling) to provide the service, which occurs on customers' regular recycling collection day. Many types of clothing and housewares are recycled, including shoes, accessories, fabrics scraps, stuffed toys, linens, tools, toys, hats, purses, kitchenware and books.

As part of the program, customers use green bags provided by Simple Recycling to collect their items and leave them on the curb next to their recycling bin on their scheduled recycling collection day. When Simple Recycling collects a bag, they leave a new bag in its place for the resident. The plastic bags are recycled after the items are collected. This new service is provided free of charge. Simple Recycling pays the City of Austin $20 per ton of material collected and keep the remaining profits from the sale of the collected items.

Partnering with an independent vendor and piloting a textile collection program at the existing centers could add value to the existing operation without significant financial risk to the County. As indicated above, several jurisdictions already provide this type of service at residential drop off centers with very little burden to existing operations and operate as a revenue generating program. Adding textile collection services at the existing centers would align with the short-term objectives of the County's Zero Waste Plan for the expansion of reuse programs.

Pallets, Lumber and Other Wood Recycling

Anne Arundel County collects pallets/lumber and other wood at their recycling centers. They mix it with homeowner brush, grind it, and use the material as mulch. St. Mary's County does not provide a service for pallet/lumber collection at their convenience centers due to concerns with nails and damage to grinding equipment. However, St. Mary's County accepts wood pallets at the St. Andrew's Landfill and those in good or fair condition are reused directly or with minor repair by suppliers who may want them for reuse.

The County could explore collecting wooden pallets and other untreated wood materials and giving them away to facilities that chip wood products for use as fuel, mulch, compost, or animal bedding. Alternatively, the County could collect and sell the material to local manufactures in need of pallets or pallet brokers. These companies would be willing to repair, reuse, and resell the material.

Below is a selected list of companies offering wood pallet recycling services in Maryland as listed in the recycling directory maintained by mdrecycles.org[22]. These are also listed in MDE's Recycling Processor Mailing List 2017.

[21] New Curbside Recycling Service Collects Clothing and Housewares. City of Austin. 10 November 2016. http://www.austintexas.gov/news/new-curbside-recycling-service-collects-clothing-and-housewares

[22] MD Recycles.org https://www.mdrecycles.org/recycling-directory/

Exhibit 13.
Sample Recycling Processors

Company	Materials Accepted	Other Information
Edrich Lumber Company, Inc. www.mulchbaltimore.com 9700 Old Court Road Baltimore, MD 21244 Phone: (410) 922-5959	Wood Pallets, Clean Wood Scrap, Yard Waste, Log Stumps, Brush, Leaves.	Must unload your own materials. Edrich also operates lumber mill and manufacture furniture & related products. Items not accepted include paper products, trash bags, grass/sod/bed edgings, Styrofoam products, treated wood, brick/concrete, metals of any kind.
Franks Pallet Services www.frankspallets.com 6201 Pulaski Highway Baltimore, MD 21205 Phone: (410) 631-7199	Wood Pallets	Accept only certain sizes of wood pallets.
Mid-Atlantic Pallet Company 7407 Sparr Drive Kingsville, MD 21087 Phone: (410) 8791700	Remanufactured pallets.	No painted or treated wood
Valleywood Pallet www.valleywoodpallet.com 6517 Landay Avenue Baltimore, MD 21237 Phone: (410) 488-5500	New and reconditioned wood pallets and wood chips for mulch	Trailer pick-up service.

Recycling Convenience Centers

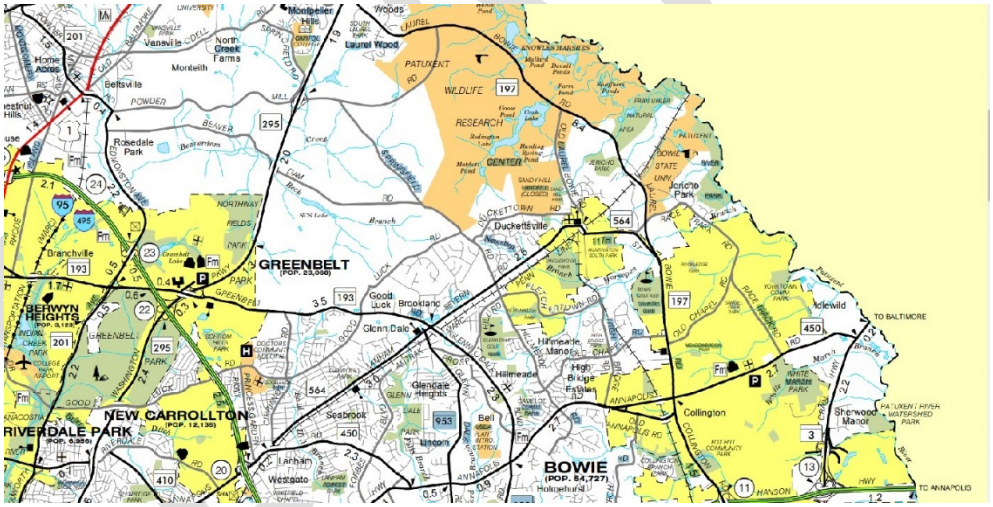
In the TYSWP, the County expressed interest in adding one or two convenience centers by 2026. The goal is to reduce the amount of divertible residential waste currently going to the Landfill. There are two locations that make the most sense.

The first location, in the south part of the County, is in an undeveloped area on Brown Station Road across from the Landfill. Years ago, the County developed a plan to improve and expand the existing convenience center at this location. Moving forward with this plan would accomplish three objectives. First, it would consolidate recycling services in one location rather than separate areas as is now the case - inside the Landfill complex and the other across the street.

Second, it will make recycling easier for residents. Residential traffic arriving at the Landfill complex - where electronics household hazardous waste, scrap tires and used appliances- can be recycled - must sit in the traffic line along with the heavy truck traffic of commercial and contractors; drive onto a truck scale; leave their vehicles to walk to the Scalehouse greeter's window; and transact business and be directed to separate areas for each recycled item. The experience is not "convenient." Finally, the new footprint will provide space for textile and pallet, wood and lumber recycling and could include a Sorting and Re-Use Center for acceptance of furniture, window-air conditioners, paints, and working appliances in addition to materials currently being recycled.

The second location for a recycling convenience center is in North County. Based on the location of the current convenience centers, population density, accessibility to major routes, and an ideal travel distance for residents of five miles, a convenience center could be located in the northern portion of the County to supplement the current curbside service provided to County residents. The site could be constructed in the general area east of Greenbelt and west of Bowie.

North County Convenience Center Recommended Location



This location could capture divertible tonnages from dense population centers that are not readily handled by curbside collection programs.

Total costs for the construction of a new recycling convenience center would depend on several financial factors including necessary capital expenditures (staff facilities, construction materials, and equipment) and expected operational expenses (staffing, equipment, and operating hours). To minimize upfront costs, the location could either be county owned or co-located on private property as part of a public-private partnership to manage divertible materials, e.g., textiles and

wood. It is estimated that planning, design, permitting and construction of a new convenience center would cost up to $1,500,000; for two convenience centers, $3 million.

Recommendations

Increase diversion of residential materials by:

- Designing and constructing a new recycling convenience center on Brown Station Road
- Consolidating into the new convenience center current recycling opportunities within the Landfill complex and on Brown Station Road, and recycling materials currently disposed of in the Landfill, including textiles, pallets/lumber/other wood, and other materials.
- Designing and constructing a new recycling convenience center in North County on county-owned land or on private property through a public-private partnership for managing divertible materials.

Commercial Diversion

Per the WCS, there are 16,300 tons in commercial divertibles, constituting approximately 18% of the total annual commercial materials delivered to the Landfill. Commercial divertibles represent roughly 5% of the overall annual material landfilled.

Exhibit 14
Annual Commercial Divertible Tonnage

Material Component	Tons	Approx. %
Electronics	500	3%
CRTS	600	4%
Paint	<100	0%
Scrap Metal	1,100	7%
Pallets/Lumber	2,800	17%
Other wood	2,200	13%
Concrete/Brick/Rock	100	1%
Dirt	300	2%
Sheet Rock	200	1%
Carpet/Carpet Padding	3,400	21%
Shingles	500	3%
Textiles	3,900	24%
Shopping bags	700	4%
Total Divertible	**16,300**	**100**

Specifically, textiles (24%), carpet/carpet padding (21%) and pallets/lumber/other wood (20%), represent approximately 75% of all commercial divertible components – a total of 12,500 tons. Potential diversion opportunities are discussed below.

Textile Recycling

Diverting commercial textiles from Landfills, which have a recognized commercial value as discussed in the residential section above, remains a challenge for the recycling and waste management sectors. A 2017 *Waste Management World* article presents a commercial textile model in the United Kingdom that is being regarded as an industry best practice[23]. The UK textile recycling firm BIU Group collects and recycles unwanted clothes, shoes and household textiles, then sells the items to raise money for its partner charities. BIU forges long-term relationships with charities, waste management companies, supermarkets and local authorities, collecting then selling reusable garments to customers across the UK, Europe, the Middle East and Asia. The company places collection bins at various sites including supermarket parking lots, council-owned land, and at commercial waste management sites. Since its formation in 2005, the firm has generated over $10 million for good causes.

Quality control takes place at collection and at depots, ensuring unsuitable donations are removed at the source. Reusable and recyclable garments are sold to customers in the UK and overseas, with an agreed rate from the sale of every ton paid to charity partners. There is no cost to the charities as BIU provides all equipment and transport. The company also provides services to local councils, waste management firms and other organizations needing a partner to collect used textiles at banks and recycling centers.

This model is consistent with the model employed by vendors currently partnered with Maryland jurisdictions to collect residential textiles. The Maryland Recycles program, found on the www.mdrecycles.org website, provides a wealth of general information on recycling, including a recycling guide, a recycling contract manual, a list of government and private recycling organizations and a comprehensive directory of recycling businesses serving the State of Maryland.

Pallets and Other Wood Recycling

Pallets and other wood waste have a commercial value. Some wood is appropriate for composting with a variety of landscape and soil amendment applications. Other wood waste can be chipped and used for biomass fuel, manufacturing feedstock, composite wood products, animal bedding, and pulp and paper products. Pallets in good or fair condition can be reused directly or with minor repair, while pallets too damaged for reuse can be recycled in several ways.

[23] Messenger, Ben. Success for Charitable Textile Reuse & Recycling Business Model. Waste Management World. 20 October 2017. https://waste-management-world.com/a/success-for-charitable-textile-reuse-recycling-business-model

These pallets can be ground into landscaping mulch, fireplace logs, or wood pellet fuel. In addition, some wood pallet recycling companies accepting used pallets are willing to purchase those in reusable condition. A select list of these companies is found in the discussion of residential wood waste.

Carpet and Padding Recycling

Carpets and padding can be recycled into a variety of products. Not accepting these items at the Landfill would encourage local businesses and carpet retailers to develop reuse or recycle plans for these items. Some jurisdictions work with the recycling companies to arrange to have separate containers available for carpet and padding and charge a tipping fee that would cover the cost of having these companies recycle the materials.

Opportunities for Commercial Diversion

There are opportunities for businesses to divert textiles, pallets and other wood, and carpet and padding from the landfill; however, it is unlikely that businesses will take advantage of these opportunities without being required to do so. While a commercial ban on receipt of these materials at the Landfill could be imposed, businesses pay a solid waste fee in part for the ability to dispose of such waste at the Landfill. Moreover, the 12,500 tons of materials represent only 4% of the waste at the Landfill. For these reasons, in the short-term the County is likely be better served by collecting information on the recycling of these items as part of its efforts to increase commercial recycling, as discussed under Goal 1.

Recommendations

Increase commercial diversion of textiles, pallets and other wood, and carpets and padding by:

- Requiring businesses, as part of their recycling plans, to submit information on disposal of these items as MSW, through recycling and sale, or otherwise;
- Analyzing the information submitted to determine if a ban on acceptance of these materials at the Landfill is commercially reasonable.

Goal IV – Increase Source Reduction

It is a common misunderstanding that recycling paper, aluminum cans, and glass bottles is the primary strategy to reduce waste when in fact, recycling/composting is third in the waste management hierarchy, as shown in Exhibit 2. The highest priority is waste prevention through source reduction because of its overall impact on waste management. Reduction in physical waste corresponds with a reduction in use of other materials, such as fossil fuels, raw materials, and mining waste used in the manufacturing, shipping, and handling of the material. A complete

discussion of source reduction measures is including in the County ZWI. Two of those measures – disposal bans and extended producer responsibility – are highlighted below. The words are taken from the ZWI.

Support Disposal Bans

One of the most effective ways to control or eliminate disposal of certain materials is to utilize "disposal bans." Disposal bans are typically implemented to reduce the quantity of material in the landfill and to create markets for the recycling and/or composting of the material. These include materials for which there is already adequate recycling capacity or for which disposal produces environmental harm, including:

- Electronics
- Latex paint
- Carpet
- Metal
- White goods
- Mattresses/Box Springs
- Gypsum wallboard
- Wood
- Asphalt and concrete
- Batteries
- Mercury dental amalgam and mercury-containing products

For example, a ban or fee on single use disposal bags has shown to be effective in reducing bag waste in other jurisdictions. The Prince George's Sierra Club conducted a survey in early 2014 that observed about 17,000 shoppers leaving the stores of five major grocery store chains in Prince George's and Montgomery counties. Volunteers recorded the number of shoppers using reusable bags, disposable bags, and a mix of reusable and disposable, or unbagged merchandise. The shoppers in Montgomery County (which has a five-cent fee on bags, as does D.C.) were six times more likely to use reusable bags than shoppers in Prince George's County. There are 3,900 tons of shopping bags annually disposed of at the County's landfill. A ban or fee on bag disposal would eliminate or considerably reduce these bags from the waste stream, much as the ban on polystyrene has resulted in the reduction of 5,700 tons of this material from the Landfill.

Support and Implement Extended Producer Responsibility (EPR) Programs

EPR aims to internalize the environmental costs of goods into the market price of the product. This model places a shared responsibility on the end-of-life management of goods to product

manufacturers and all parties involved in the product supply chain. It also focuses on redesigning products to minimize the negative impact a product might have during its life cycle. This "upstream" initiative shifts the responsibility from consumers and local governments to product manufacturers to produce products that can more easily be recycled or reused and secondarily to retailers.

There are several products in the County's waste stream that EPR programs can be applied to, including:

- Electronics – 0.7 percent (2,400 tons disposed at the Landfill annually)
- Paint – 0.1 percent (400 tons disposed at the Landfill annually)
- CRTs – 0.2 percent (600 tons disposed at the Landfill annually)
- Carpet/carpet padding – 1.7 percent (4,800 tons disposed at the Landfill annually)

Other products entering the waste stream that can be covered by EPR initiatives include pharmaceuticals, medical sharps, tires, computers, toner cartridges, and mattresses.

The County could take an active role in advocating for legislation that requires product manufacturers, retail establishments, wholesale distributors and other appropriate entities to take back certain products or packaging that currently are difficult to recycle, contain toxics or otherwise pose problems when they are discarded as waste. As part of internal procurement requirements, the County can preferentially support product manufacturers and businesses that have implemented EPR for their products.

Recommendations

Implement source reduction measures discussed in the ZWI, including

- Supporting a ban or a fee on single use disposable plastic bags
- Supporting extended producer responsibility programs requiring a product producer to take back the used product
- Continuing multifaceted public outreach and education campaigns that have earned the County the full 5% source reduction credit awarded by MDE

Goal V – Efficiently and Effectively Manage Waste Disposal

The purpose of Goal V is to identify strategies to address the portion of the waste stream that cannot be recycled, composted or diverted, now or into the future. If 25% of the material in the Landfill were recycled, diverted or composted, that would still leave 228,000 tons of MSW to manage. If 35% were recycled, composted or diverted, then 197,000 tons would be left to manage. Even if all 75% of the materials in the Landfill that could potentially be recycled, composted or diverted were recycled, composted or diverted, the remaining waste would equal 76,000 tons and require management.

Pilot Programs

In addition to the strategies discussed in this RRMP, the County should continue to explore and pilot innovative programs to reduce Landfill waste. DoE provided examples of two current efforts, one relating to mattresses and the other to bulky trash collection. During a two-month study period, DoE calculated that 85 tons of mattresses and box springs from commercial companies were being disposed of at the Landfill, representing over 500 tons/year. According to the Maryland Recycles program, three mattress recycling companies operate in the Baltimore region, potentially creating the opportunity for mattress landfill diversion.

DoE annually collects over 4,000 tons of bulky trash. Based upon a recent, separate day audit of two bulky trucks, 25% of the materials collected were scrap metal, 25% rigid plastics, and 25% furniture and other household items. These materials could potentially be sorted on a warehouse tipping floor and recycled. DoE advises that it continue investigating these and other opportunities to reduce the amount of Landfill waste.

The Landfill Complex

The Landfill began operations in 1968. It consists of Area A, Area B, a landfill gas collection system, leachate pretreatment plant, recycling facilities and a soil borrow area. Area A is a 150-acre unlined Landfill that was closed in 1992. Area B consists of a fill area of 134 acres with a design capacity of approximately 12 million tons. As of the end of 2017, the remaining capacity at the Landfill is approximately 2.8 million tons

The closed Area A Landfill and major portions of the active Area B Landfill has a landfill gas (LFG) system that collects LFG and supplies it to multiple end users including the nearby County Correctional Center complex, an onsite electrical generation facility and a separate LFG flaring facility to ensure total gas control. Area B is equipped with a leachate collection system consisting of collection and conveyance piping and storage and pretreatment systems. The County has a

permit to discharge a maximum of 115,000 gallons per day to the Washington Suburban Sanitary Commission.

Landfill Operations

MES examined daily operations to determine if the County was making efficient and effective use of this asset. The facility accepts 800 to 900 tons per day of MSW/day. Landfill operations use Caterpillar Computer Aided Earthmoving System (CAES) on its compactor to aid in lift thickness, number of passes of the Landfill compactor, and data logging. Through operational controls and the use of the CAES equipment, the operations crew has been seeing compaction rates of 0.7 to 0.8 tons per cubic yard of constructed Landfill airspace. This is an excellent compaction ratio for a Landfill of this size and number of staff working on waste placement and cover efforts. This compaction rate exceeds the Solid Waste Association of North America average "industry standard" for landfilled waste density of 0.6 tons per cubic yard.

The industry standard cost per ton for Landfill site operations, closure and post closure is approximately $48/ton. This is based on an average 500 ton per day facility with offsite disposal of leachate, no leachate pretreatment, and no landfill gas production equipment. By way of comparison, for $52/ton, the County Landfill currently processes 800-900 tons per day – more than 1.5 times the amount used in the industry average – while managing both LFG and leachate pretreatment systems. The Landfill operational costs compare favorably and well to the industry standard.

MES considered on-site alternatives to reduce the volume of MSW, including shredding and Landfill mining. Shredding involves processing the incoming waste to gain volume reduction and increase compaction when placed in the cell. The practice has both significant capital and operational costs, requires significant space to process the waste, and increases the potential for worker injury and increased downtime. For these reasons, MES does not recommend shredding.

Landfill mining is the excavation and separation of landfilled MSW in order to recycle soil, metals, plastics and other recyclable material. In theory, the cost of landfill mining is offset by the amount of soil to be reused, recovery of recyclables that can be processed and sold, and the air space reclaimed. In practice however, Issues including the significant capital investment required to undertake landfill mining, the substantial space required for the operations, odors, actual quality of recyclable product for sale, and the cost of recycling soil compared to the cost of soil available to cover the disturbed area have cast doubt on the feasibility of landfill mining. Recently, the City of Denton, Texas canceled a landfill mining program before it even began because of problems that arose in implementing the plan that hadn't otherwise been considered when the original funding was approved. In short, the cost of the proposed plan skyrocketed as City

Planners dug into the details. [24] In the initial planning, the cost of recyclable materials and the value of the recovered space were overestimated, this led the City of Denton to conclude that if the program were to continue they could expect a loss of $14 million. There was also the concern that there wasn't a means to capture methane released during the mining operation. In addition to odor problems associated Methane, there also is the problem of greenhouse gas emissions. Methane is a greenhouse gas that is second only to carbon dioxide in greenhouse gas impacts. A 2016 article published in the journal, *Chemical and Engineering News*[25] concluded that the climate benefits of landfill mining are not clear-cut and that looking just at climate impact, it would likely be better to install a state of the art landfill gas management system, (something that the County has already done) than to mine the landfill. For these reasons and based on the Landfill's location to the community and the current availability of cover soil, this option is not recommended. Landfill Capacity and Waste Management Options

With its excellent compaction rate and effective operational management, the County is maximizing use of the Landfill. Given this, at a fill rate of 290,000 +/- tons per year, the Landfill may reach capacity by the mid to late 2020s. MES bases this conclusion upon a volume calculation comparing the aerial topographic survey of Area B flown on February 21, 2018 to the design waste placement elevations. This calculation shows roughly 3,710,000 CY of air space available. This is 1.5 years earlier than the previous estimate based upon the 2015 aerial survey along with a lower fill rate of 275,000 TPY.

Over the years, the County has contemplated several options it could take when the Landfill finally reaches capacity. In 2004, the County retained MES to prepare a study to construct a Solid Waste Transfer Facility in the County. A transfer station receives all incoming MSW at a central location and then transfers it to other sites within or outside the County. MES looked at three sites within the County borders and assumed an 1800 ton per day facility, which is twice the current tonnage. The County took no action as a result of the MES study.

In 2011-12 an outside engineering consultant prepared a draft plan presenting several alternatives for disposing the County's solid waste on a long-term basis:

- Direct haul to nearby disposal options
- Construct a waste derived fuel facility
- Construct a transfer station at the Organics Processing Facility for transfer to out-of-state disposal facilities, primarily landfills in the neighboring State of Virginia.

[24] Goode, Kayla. "Denton ends landfill mining program before it begins." *The North Texas Daily*, October 4, 2017

[25] Lockwood, Deirdre. "Mining Landfills for Resources doesn't always benefit client." *Chemical and Engineering News*, (ISSN) 0009-2347

- Maximize available airspace potential without altering the current footprint of the Landfill.

In 2014 the County issued an RFP for construction of a facility to manage waste after the Landfill reach capacity, including a mixed waste pre-processing facility co-located at the Organics Composting Facility that would provide for presorting disposed items from a common tipping floor. Once a promising technology, mixed waste preprocessing would have separated recyclable materials from MSW, which could then be converted to energy via aerobic or anaerobic digestion, or combustion, potentially producing refuse-derived fuel or other products for sale. Remaining residue would be taken to the Landfill. The County cancelled the RFP in 2017.

The County is currently receiving 295,000 tons of MSW per year. At this fill rate and as noted, absent any increase in recycling, composting or diversion, the Landfill may reach capacity in the mid to late 2020s. Therefore, it is essential that the County have a waste management plan that maximizes use of available and potential airspace within the existing Landfill. Construction of another County landfill is not realistic; mixed waste preprocessing and a transfer station places the County in an unenviable position of relying on out-of-county vendors for performing the essential government function of waste management; and mixed waste processing, energy conversion and sale of derivative products is unproven in the marketplace.

Recommendations

Manage waste disposal over the long term by:

- Maximizing available airspace within the Landfill.
- Beginning the processes of planning and required collaborations with State in CY2019.

Plan Implementation

Implementing this RRMP requires additional capital and operating expenditures for recycling, diversion and source reduction, and for managing remaining waste.

Recycling, Diversion and Source Reduction

As stated earlier, MES recommends that the County establish goals to increase recycling, food waste diversion and reuse by 25% by 2022 and by 35% by 2026. Achieving these goals will require additional capital and operating expenditures:

- Installing optical equipment at the MRF at a cost of $5.1 million will increase the market price of recyclable commodities and provide a return on investment of $1.47 million per year.
- Constructing an expanded recycling convenience center at the Landfill to accept textiles, pallets and other wood and another center in North County on county land or on private land through a public-private partnership, at an estimated total cost of $3 million, will potentially divert nearly 20,000 tons of materials now being landfilled at an annual cost of $1.1 million. The estimated annual cost of operating the convenience centers is $528,000.
- Increasing the volume of recycling, providing opportunities for waste diversion, and enhancing outreach and education for source reduction is a function of increasing program staff. As noted, a 25% increase in recycling results in an additional $1.26 million in net revenue; a 35% increase results in an additional $1.76 million in net revenue.
- Expanding organics infrastructure to an additional 12 mega heaps per current direction (FY21).

The County can initially fund expansion of staffing resources by adjusting tipping fees at the Landfill and/or by increasing solid waste benefit charges for businesses, municipal customers and residents. Tipping fees at the Landfill were last raised in 2010. The current fee is $59/ton. Eight (8) surrounding jurisdictions all have higher fees; the average is a little over $73/ton. Increasing the commercial tipping fee to $73/ton for businesses and municipal customers equates to increased revenue of approximately $1.2 million. For comparison purposes, the gate rate tipping fee at the Waste Management-owned Annapolis Junction Transfer Station located in Anne Arundel County is $90.41 per ton.

Solid waste benefit charges were last raised on July 1, 2012 on residences and commercial property owners. The increase was 2.7%. On residents, the typical total solid waste charge for single family and town homes increased $346.96 to $356.32. A similar 2.7% increase on residential properties would result in additional annual revenue of $1.6 million. The commercial solid waste fee is determined based on the size of the facility and would need to be separately calculated. Either or both revenue sources could be used to invest in source reduction, recycling and diversion, offsetting landfill costs and realizing the return on investment through sale of recyclable commodities.

Waste Management

The chief expenditure for managing remaining waste is on the capital side. As of 2015, the estimated cost for increasing the capacity of the Landfill to 2045 was $50 million. A capital expenditure financed through general obligation bonds or other revenue sources will be necessary to pay for this cost, amortized over the twenty (20) years added to the Landfill lifecycle.

Conclusion

MES appreciates the opportunity to have worked with the County Department of the Environment in Development of this Resource Recovery Master Plan. A summary of the goal and recommendations is provided in the chart below.

[To be added by County after draft plan review and approval]

Appendix

Can add WCS, ZWI and any other applicable reports to the Appendix per County direction.

Appendix 1.
Potential Commodity Impact from Currently Landfilled Recyclable Material

By Source Category								
				Estimated Percentage of Material Recovered				
Residential Material	*Annual Recyclable Tons	**Market Pricing Per Ton	***Net Revenue Per Ton	Annual Impact 25%	Annual Impact 35%	Annual Impact 50%	Annual Impact 75%	Annual Impact 100%
Newspaper/Print	6,200	$52	-$33	-$51,150	-$71,610	-$102,300	-$153,450	-$204,600
Corrugated Cardboard	7,000	$110	$25	$43,750	$61,250	$87,500	$131,250	$175,000
Magazines/Catalogs/Other Books	2,200	$52	-$33	-$18,150	-$25,410	-$36,300	-$54,450	-$72,600
Kraft Paper/Paperboard	6,800	$52	-$33	-$56,100	-$78,540	-$112,200	-$168,300	-$224,400
Office Paper/Junk Mail/Misc Paper	11,200	$52	-$33	-$92,400	-$129,360	-$184,800	-$277,200	-$369,600
Aseptic/Wax Coated Paper	3,600	$52	-$33	-$29,700	-$41,580	-$59,400	-$89,100	-$118,800
PET (#1) Bottles	4,000	$230	$145	$145,000	$203,000	$290,000	$435,000	$580,000
HDPE (#2) Bottles	2,300	$493	$408	$234,600	$328,440	$469,200	$703,800	$938,400
Other (PET #3 thru #7) Bottles	100	$27	-$58	-$1,450	-$2,030	-$2,900	-$4,350	-$5,800
Jars/Jugs/Tubs/Trays	2,700	$236	$151	$101,925	$142,695	$203,850	$305,775	$407,700
Flower Pots	200	$0	-$85	-$4,250	-$5,950	-$8,500	-$12,750	-$17,000
Other Rigid Plastic	4,500	$64	-$21	-$23,625	-$33,075	-$47,250	-$70,875	-$94,500
Ferrous Cans	2,300	$122	$37	$21,275	$29,785	$42,550	$63,825	$85,100
Aluminum Cans/Foil	2,000	$1,267	$1,182	$591,000	$827,400	$1,182,000	$1,773,000	$2,364,000
Glass Bottles/Jars	7,000	$0	-$85	-$148,750	-$208,250	-$297,500	-$446,250	-$595,000
TOTAL - Residential	62,100	$130.86	$45.86	$711,975	$996,765	$1,423,950	$2,135,925	$2,847,900

				Estimated Percentage of Material Recovered				
Commercial Material	*Annual Recyclable Tons	**Market Pricing Per Ton	***Net Revenue Per Ton	Annual Impact 25%	Annual Impact 35%	Annual Impact 50%	Annual Impact 75%	Annual Impact 100%
Newspaper/Print	1,000	$57	-$28	-$7,000	-$9,800	-$14,000	-$21,000	-$28,000
Corrugated Cardboard	10,600	$110	$25	$66,250	$92,750	$132,500	$198,750	$265,000
Magazines/Catalogs/Other Books	1,500	$103	$18	$6,750	$9,450	$13,500	$20,250	$27,000
Kraft Paper/Paperboard	1,900	$49	-$36	-$17,100	-$23,940	-$34,200	-$51,300	-$68,400
Office Paper/Junk Mail/Misc Paper	5,900	$160	$75	$110,625	$154,875	$221,250	$331,875	$442,500
Aseptic/Wax Coated Paper	1,500	$97	$12	$4,500	$6,300	$9,000	$13,500	$18,000
PET (#1) Bottles	1,900	$230	$145	$68,875	$96,425	$137,750	$206,625	$275,500
HDPE (#2) Bottles	600	$493	$408	$61,200	$85,680	$122,400	$183,600	$244,800
Other (PET #3 thru #7) Bottles		$27	-$58	$0	$0	$0	$0	$0
Jars/Jugs/Tubs/Trays	1,500	$236	$151	$56,625	$79,275	$113,250	$169,875	$226,500
Flower Pots			-$85	$0	$0	$0	$0	$0
Other Rigid Plastic	2,600	$64	-$21	-$13,650	-$19,110	-$27,300	-$40,950	-$54,600
Ferrous Cans	500	$122	$37	$4,625	$6,475	$9,250	$13,875	$18,500
Aluminum Cans/Foil	700	$1,267	$1,182	$206,850	$289,590	$413,700	$620,550	$827,400
Glass Bottles/Jars	2,100	$0	-$85	-$44,625	-$62,475	-$89,250	-$133,875	-$178,500
TOTAL - Commercial	32,300	$147.41	$62.41	$503,925	$705,495	$1,007,850	$1,511,775	$2,015,700

School Material	*Annual Recyclable Tons	**Market Pricing Per Ton	***Net Revenue Per Ton	Estimated Percentage of Material Recovered: Annual Impact 25%	Annual Impact 35%	Annual Impact 50%	Annual Impact 75%	Annual Impact 100%
Newspaper/Print	-	$57	-$28	$0	$0	$0	$0	$0
Corrugated Cardboard	1,000	$110	$25	$6,250	$8,750	$12,500	$18,750	$25,000
Magazines/Catalogs/Other Books	100	$103	$18	$450	$630	$900	$1,350	$1,800
Kraft Paper/Paperboard	200	$49	-$36	-$1,800	-$2,520	-$3,600	-$5,400	-$7,200
Office Paper/Junk Mail/Misc Paper	1,000	$160	$75	$18,750	$26,250	$37,500	$56,250	$75,000
Aseptic/Wax Coated Paper	200	$97	$12	$600	$840	$1,200	$1,800	$2,400
PET (#1) Bottles	400	$230	$145	$14,500	$20,300	$29,000	$43,500	$58,000
HDPE (#2) Bottles	200	$493	$408	$20,400	$28,560	$40,800	$61,200	$81,600
Other (PET #3 thru #7) Bottles		$27	-$58	$0	$0	$0	$0	$0
Jars/Jugs/Tubs/Trays	100	$236	$151	$3,775	$5,285	$7,550	$11,325	$15,100
Flower Pots			-$85	$0	$0	$0	$0	$0
Other Rigid Plastic	200	$64	-$21	-$1,050	-$1,470	-$2,100	-$3,150	-$4,200
Ferrous Cans		$122	$37	$0	$0	$0	$0	$0
Aluminum Cans/Foil		$1,267	$1,182	$0	$0	$0	$0	$0
Glass Bottles/Jars	800	$0	-$85	-$17,000	-$23,800	-$34,000	-$51,000	-$68,000
TOTAL - Schools	4,200	$127.74	$42.74	$44,875	$62,825	$89,751	$134,626	$179,501
TOTAL - All Source Categories	**98,600**			**$1,260,775**	**$1,765,085**	**$2,521,551**	**$3,782,326**	**$5,043,101**

Summary By Source Category

Source	*Annual Recyclable Tons	**Market Pricing Per Ton	***Net Revenue Per Ton	Recovery Rate 25%	Recovery Rate 35%	Recovery Rate 50%	Recovery Rate 75%	Recovery Rate 100%
Residential	62,100	$130.86	$45.86	$711,977	$996,767	$1,423,953	$2,135,925	$2,847,900
Commercial	32,300	$147.41	$62.41	$503,961	$705,545	$1,007,922	$1,511,775	$2,015,700
Schools	4,200	$127.74	$42.74	$44,877	$62,828	$89,754	$134,626	$179,501
TOTAL - All Sources	**98,600**	**$ 136.15**	**$ 51.15**	**$1,260,814**	**$1,765,140**	**$2,521,629**	**$3,782,326**	**$5,043,101**

* Represents the recyclable material currently being landfilled as identified in the County's Waste Characterization Study.

** Market Pricing Per Ton is based on the 3-year average pricing per ton from 2015 - 2017 for all non-fiber materials, and the 3-year average pricing for the period of 2015 - 2017 including the first 6 months of 2018 for all fiber materials.

*** Net Revenue Per Ton is the average market price per ton for each Source Category less the estimated operating costs per ton of $85 = Net Revenue Per Ton.