City of Baltimore

RECYCLING AND SOLID WASTE MANAGEMENT MASTER PLAN

Task 3 Report

Comprehensive Description of Existing Solid Waste Management System

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Baltimore City Department of Public Works

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All appendices are provided as attachments

ABBREVIATIONS AND ACRONYMS

Formal names for offices, agencies, institutions, and programs are capitalized; technical terms are in lower case.

AD	anaerobic digestion
BCAR	Baltimore Clean Air Regulation
BCCF	Baltimore City Compost Facility
BCPSS	Baltimore City Public School System
BCRP	Baltimore City Department of Recreation and Parks
BFWRS	Baltimore Food Waste and Recovery Strategy
BPTS	Baltimore Processing and Transfer Station
BRC	Baltimore Recycling Center
BRMWF	Baltimore Regional Medical Waste Facility
BRPF	Back River Pelletech Facility
BRWWTP	Back River Wastewater Treatment Plant
BRESCO	Baltimore Refuse Energy Systems Co. (now Wheelabrator)
BSP	Baltimore Sustainability Plan
BSW	Bureau of Solid Waste (part of DPW)
BTT	Baltimore Trash Talk
CAP	Baltimore City Climate Action Plan
C&D	construction and demolition
DLLR	Maryland Department of Labor, Licensing and Regulation
DP3	Baltimore City Disaster Preparedness and Planning Project
DPW	Baltimore City Department of Public Works
HDPE	high density polyethylene (also known as no. 2 plastic)
HHC	Habitat for Humanity of the Chesapeake
HHW	household hazardous waste
L&J	L&J Waste Recycling, Inc.
LCD	land clearing debris
MDE	Maryland Department of the Environment
MDP	Maryland Department of Planning
MRA	Maryland Recycling Act
MRF	materials recovery facility
MSW	municipal solid waste
NOx	nitrogen oxides
NWTS	Northwest Transfer Station
PET/PETE	polyethylene terephthalate (also known as no. 1 plastic)
QRL	Quarantine Road Landfill
RCRA	Resource Conservation and Recovery Act
SOx	sulfur dioxides
SSR	single-stream recycling/recyclables
SWMP	Solid Waste Management Plan
U.S. EPA	United States Environmental Protection Agency
WMRA	Waste Management Recycle America
WTE	waste to energy

1. INTRODUCTION

Purpose

This Report was prepared by Geosyntec Consultants as part of a master planning effort titled the "Less Waste, Better Baltimore" Plan. The Plan is intended to outline a clear and realistic future vision for improving Baltimore City's solid waste and recycling system over both the near- and long-term, with the goal of maximizing waste reduction, reuse/repair, recycling, and sustainable management of materials in the near- and long-term. The primary goal of Task 3 is to gain an understanding of the existing waste and recycling streams in the City as well as the current systems for processing and managing these streams. This will be used to inform the ongoing planning effort. In preparing this Report, Geosyntec reviewed the multifaceted solid waste and recycling programs, services, and facilities operated by the Department of Public Works (DPW) and other municipal and private actors. Relevant regulations, population and housing projections, governance, finance, and contracts affecting solid waste management and recycling in the City are also summarized. In addition, Geosyntec reviewed private infrastructure and facilities in the local region, as defined by a 3-hour truck travel distance from the City.

Applicable Regulations and Ordinances

A comprehensive list of federal, state, and City regulations and ordinances governing municipal solid waste, special and hazardous waste, air emissions, and water pollutions is provided in Section 1.3 of the City's 10-Year Solid Waste Management Plan (SWMP) covering the period 2013 to 2023. Noteworthy regulations that have taken effect since publication of the SWMP are summarized here.

Baltimore Clean Air Regulation

The Baltimore Clean Air Regulation (BCAR), introduced as Council Bill 18-0306, was approved by the City Council on 11 February 2019 and signed by Mayor Pugh on 7 March 2019. The BCAR requires commercial solid waste incinerators to conduct continuous monitoring of the following pollutants: dioxins, furans, carbon dioxide, carbon monoxide, hydrochloric acid, hydrofluoric acid, nitrogen oxides (NOx), sulfur dioxides (SOx), particulate matter, volatile organic compounds, polycyclic aromatic hydrocarbons, arsenic, cadmium, chromium, lead, manganese, mercury, nickel, selenium, and zinc. It also establishes significantly stricter emission limits for mercury, NOx, SOx, and dioxins/furans than are currently required under Maryland regulations.

Waste Reduction & Resource Recovery Plan for Maryland

The Waste Reduction and Resource Recovery Plan for Maryland is Executive Order 01.01.2017.13 signed by Governor Hogan on 27 June 2017. The plan adopts a sustainable material management policy for Maryland aiming to minimize the lifecycle environmental impacts of material production, distribution, and consumption. The plan emphasizes environmentally and economically sustainable methods to capture and reuse resources and a stakeholder consultation process to generate goals for the complete tracking of materials management data.

Baltimore City Ordinance 18-125 (Polystyrene Ban)

The City Council passed Ordinance 18-125, which was signed by Mayor Pugh on 23 April 2018. The ordinance prohibits food service facilities from using single-use service ware made from polystyrene foam (Styrofoam). The ban goes into effect in October 2019.

2. OVERVIEW OF EXISTING PROGRAMS

The solid waste management system in Baltimore is a mix of public and private systems. The public system, overseen by DPW, is responsible per City Code for collecting mixed refuse (trash) and recyclables from single-family residences and City-owned buildings. The City also provides limited collection services to some multi-family residences and commercial/industrial establishments, but most of this waste is collected by private contractors.

Role of the Department of Public Works

DPW is responsible for fulfilling the City's solid waste management obligations. Within DPW, the Bureau of Solid Waste (BSW) is the entity that plans and implements solid waste management programs. BSW is divided into three divisions and the Quadrant System.

Structure of the Bureau of Solid Waste

Disposal Services Division

The Disposal Services Division performs the following services:

1. Operate the City's Quarantine Road Landfill (QRL);
2. Operate the Northwest Transfer Station (NWTS);
3. Manage the Small Hauler's Program at QRL and the NWTS; and
4. Maintain all closed public landfills.

Office of Waste Reduction and Support Services

The Support Services Division is responsible for the following services:

1. Review, evaluate, and analyze Solid Waste Programs to determine their efficiency and effectiveness;
2. Plan, develop, oversee, and implement the Bureau of Solid Waste's waste reduction and waste management programs;
3. Produce annual reports, including a report on the City's efforts to remediate illegal dumping;
4. Manage the City's 10 Year Solid Waste Management Plan;
5. Coordinate the Mayor's community-focused annual spring and fall litter cleanup events;
6. Manage the City's Recycling Program;
7. Manage contracts and invoices for recycling vendors;
8. Compile, review, and analyze CitiStat reports and 311 Service Request reports;
9. Perform QA/QC of Bureau services; and
10. Research and pursue industry best practices.

Citizens' Convenience Center Drop-Off Division

The City operates five convenience centers free-of-charge for City residents that have additional materials to dispose or recycle that are not typically collected during normal collection days. Besides general household refuse, the following materials are accepted: electronics, waste oil, scrap metal, scrap tires, appliances (white goods), and bulky items. This Division also manages the Mechanical Sweeper Operation and the Community Pitch-In Program.

Marine Operations Division

The Marine Operations Division oversees collection and disposal of marine debris collected from the inner harbor and surrounding

waterways. The Marine Operations Chief is also responsible for special waste collection services in the Central District (i.e. the downtown area).

Quadrant System

Solid waste collection services in the City are managed geographically using the quadrant system, which is divided into Northeast, Southeast, Northwest, and Southwest (see map on p.19). Routine Services, Special Services, and Property Management services are included within each quadrant division. Routine services provide mixed refuse and single-stream recyclables (SSR) collection from City residences and small businesses. Special Services provide dirty alley and street cleaning, graffiti removal, and bulk pick up. Property Management handles vacant properties, providing boarding, cleaning, and removal of high grass and weeds. In addition, Property Management provides rat abatement services on rights-of-ways and on private properties with the property owner's permission. Quadrant Division Chiefs report directly to the Head of the BSW. The downtown area (Central District) is not in one of the four quadrants, but is managed separately by the Chief of Marine Operations and maintained in collaboration with the Downtown Partnership.

Existing Recycling and Disposal Programs and Contracts

A brief summary of the existing solid waste stream in the City is depicted graphically in the flow diagram on Page 9, separated into residential and commercial sectors. The remainder of this section focuses DPW's solid waste programs and contracts, which are primarily concerned with the residential sector. A more detailed and comprehensive discussion of both residential and commercial waste management and recycling in the City is provided in subsequent sections of this Report.

Recycling Programs and Contracts

Mixed Recyclables

DPW contracts with the Waste Management Recycle America (WMRA) facility in Elkridge, MD for processing of SSR, hard plastic, and mixed recyclables collected curbside by DPW and at residents' drop-offs.

Other Recyclables

Targeted recyclables collected as part of the bulk collection program and at residents' drop-off locations are sent to private companies for processing:

1. Scrap metal (including appliances) and scrap tire disposal is provided by Auston Contracting (Harford County, MD);
2. Electronics recycling was, until recently, provided by UNICOR (Landover, MD) and CyclePoint by SourceAmerica (Vienna, VA) but has recently transitioned to eRevival (Columbia MD);
3. Waste oil recycling is provided by Origin Baltimore Recycling, LLC (Baltimore, MD);
4. Recycling and disposal of household hazardous waste (e.g., fluorescent lightbulbs, batteries, and mercury-containing devices) is provided by Clean Harbors (Laurel, MD); and
5. Oyster Shells are recycled by Oyster Recovery Partnership (Annapolis, MD).

Disposal Facilities and Contracts

BRESCO

DPW contracts with Wheelabrator Baltimore, the waste-to-energy (WTE) facility located at 1801 Annapolis Road, for disposal of mixed refuse. The

facility is commonly referred to as BRESCO, an acronym for the original operator Baltimore Refuse Energy Systems Company. The term BRESCO is used consistently throughout this Report. Under the contract current with BRESCO, which runs through 2021, DPW disposes of most of its acceptable waste (generally mixed refuse, excluding hazardous waste and non-burnable waste) at BRESCO. Wheelabrator recycles back-end scrap metal collected after incineration of waste.

Quarantine Road Landfill (QRL)

Mixed refuse collected by DPW but not sent to BRESCO is sent to QRL for disposal. QRL also accepts waste from other City agencies, commercial waste from large haulers as well as the City's Small Hauler Program, grit screenings from the City's wastewater treatment plants, and waste-to-energy ash from BRESCO. Soil is used for daily and intermediate cover at QRL. A residents' drop-off facility is also sited at QRL, which provides free disposal and recycling services to Baltimore City residents.

Northwest Transfer Station (NWTS)

DPW operates NWTS for transfer of mixed refuse and SSR. Mixed refuse is sent to BRESCO or QRL while SSR is sent to WMRA. NWTS also serves as a residents' drop-off location and a disposal facility for licensed small haulers, accepting waste and mixed recyclables.

Residents' Drop-off Facilities

Including QRL and NWTS, DPW operates a total of five residents' drop-off facilities throughout the City where residents may dispose of various materials, including bulk trash, mixed recycling, rigid plastics, scrap metal, scrap tires, household appliances, waste oil and antifreeze, household hazardous waste (HHW), electronics, and oyster shells. Additionally, the Department of General Services (DGS) operates three convenience centers that accept commingled recyclables Not all facilities accept all materials on a year-round basis: an up-to-date guide on the locations and operating hours of drop-off facilities, as well as a listing of materials accepted, is available here.

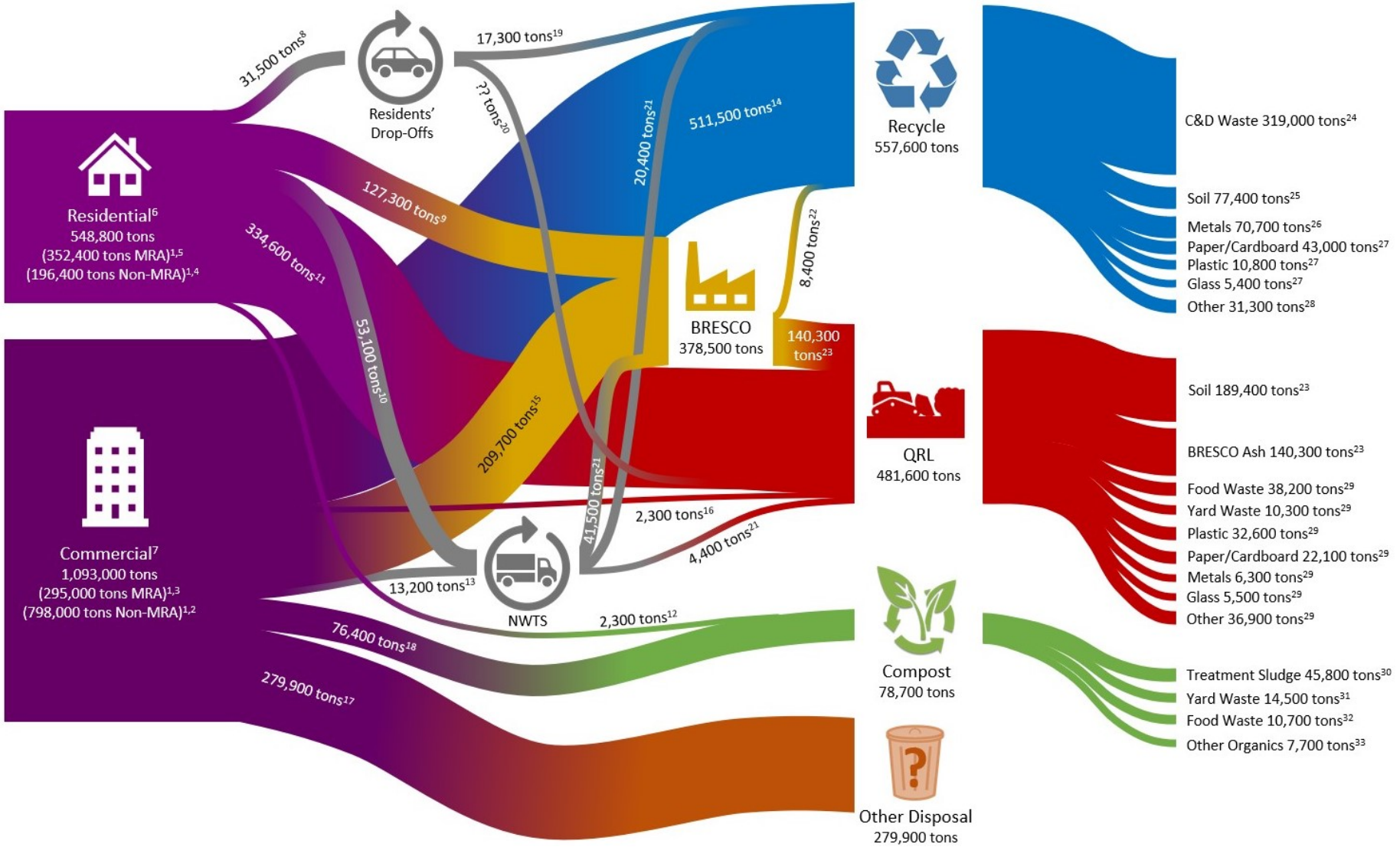
Organics Management Programs and Contracts

Sewage Treatment Plant Sludge

Sewage treatment plant sludge (biosolids) from wastewater and drinking water treatment facilities in the City are sent to the Baltimore City Composting Facility (BCCF) in Hawkins Point, the Baltimore Patapsco Pelletizer (BPP), and the Back River Pelletech Facility (BRPF) for processing. The BCCF is owned by the Mayor and City Council, but operated through a private-public partnership by Veolia Water North America. Biosolids received from the City's Back River Waste Water Treatment Plant (BRWWTP) are mixed with wood amendments to produce a Class A high organic compost product that is put to market. The BPP and BRPF are operated by Synagro, a private company that converts biosolids to granular fertilizer products through a proprietary drying and stabilizing process.

Wood Waste and Brush

Wood waste and brush collected from City parks and street right of ways are sent to the Camp Small facility for sale and reuse. The facility is operated by the Baltimore City Department of Recreation and Parks (BCRP).



Quantities and Composition of Waste Streams in Baltimore City under the Existing System

Notes for flow diagram on previous page:

1. See Section 3 of this report for a description of MRA and non-MRA waste.
2. Non-MRA Commercial waste tonnage is derived from 2017 Baltimore City MRA Report (non-MRA recyclables) and 2017 BRESCO tonnage report (commercial waste).
3. MRA Commercial waste tonnage is derived from 2017 Baltimore City MRA Report (MRA recyclables) and 2017 MDE MRA Report (total MRA waste).
4. MRA Residential waste tonnage is derived from 2017 Baltimore City MRA Report (MRA recyclables) and 2017 tonnage reports for NWTS, BRESCO, and QRL (mixed and residential waste).
5. Non-MRA Residential waste tonnage is derived from 2017 Baltimore City MRA Report (non-MRA recyclables) and includes soil, asphalt, waste oil, and millings.
6. Residential waste includes residential waste and waste from government buildings.
7. Commercial waste includes commercial, industrial, and institutional waste.
8. Waste flow to residents' drop-off locations is calculated as the difference in total MRA waste (2017 MDE MRA report) and all other residential waste streams (see also Notes 9-12).
9. Residential waste flow to BRESCO is calculated as the difference in total residential waste sent to BRESCO (2017 BRESCO tonnage report) and waste sent from NWTS to BRESCO (2017 NWTS tonnage report).
10. Residential waste flow to NWTS is calculated as the total waste flow to NWTS (2017 NWTS tonnage report) minus the total waste hauled by small haulers in 2017 (see also Note 13).
11. Residential waste flow to QRL is calculated as the sum of soil sent to QRL (presumably as daily and intermediate cover) and MSW sent to QRL (2017 QRL tonnage report) minus MSW sent from NWTS to QRL (2017 NWTS tonnage report, Note 23).
12. Residential organics tonnage includes recycled leaves as reported in 2017 Baltimore City MRA Report.
13. Commercial waste flow to NWTS is calculated from small hauler data (2017 Small Hauler Report). The small hauler program began in April 2017, so tonnages for January-March 2017 are back-calculated estimates.
14. The quantity of commercial recyclables is derived from the 2017 Baltimore City MRA Report (non-MRA recyclables, MRA recyclables) and includes all recyclables (MRA and non-MRA) not included in the organics waste stream (i.e. yard waste food waste, other organics, and treatment plant sludge). See also Note 18.
15. Commercial waste flow to BRESCO is derived from the 2017 BRESCO tonnage report.
16. Commercial waste flow to QRL is derived from the 2017 QRL tonnage report and includes Back River and Patapsco grit screenings.
17. Most commercial waste is hauled by private haulers and the City has no way to track this waste. It is assumed that many of these haulers take waste to private facilities not included in this diagram (e.g. rubble landfills outside the City).
18. Commercial organics tonnage is derived from the 2017 Baltimore City MRA Report and includes treatment sludge, yard waste, food waste, and other organics (e.g. wood waste).
19. The quantity of recyclables from residents' drop-offs is back calculated from the total recyclables included in the 2017 MDE MRA Report (557,600 tons with compostables and treatment sludge removed) and all other recyclable waste streams (see also Notes 14, 21, and 22).
20. Waste outflows from residents' drop-offs are unknown. It is assumed that DPW sends little if any of this waste to BRESCO.
21. Material outflows from NWTS to recyclables, BRESCO, and QRL are derived from the 2017 NWTS tonnage report.
22. The quantity of recyclables recovered at BRESCO is back calculated from total metals reported in 2017 MDE MRA Report and other metals reported in Baltimore City MRA Report. This value represents back-end scrap recovered from incineration of waste generated within the City.
23. The quantity of WTE ash and soil landfilled at QRL is from the 2017 QRL tonnage report.
24. Recycled C&D tonnage is from the 2017 Baltimore City MRA Report.
25. Recycled soil tonnage is from the 2017 Baltimore City MRA Report (commercial soil only, which does not include soil used as daily and intermediate cover at QRL).
26. Recycled metals tonnage is from the 2017 Baltimore City MRA Report (scrap metal and automobiles) and 2017 MDE MRA Report (all other metals, including back-end scrap from BRESCO)
27. Recycled paper/cardboard, plastic, and glass tonnages are from the 2017 MDE MRA Report.
28. Other recyclables include non-MRA recyclables (waste oil, antifreeze, oil filters, etc.) and MRA recyclables (tires, batteries, furniture, etc.) that do not fall in other recyclable categories.
29. Tonnages for MSW components are derived from the Task 0 Winter 2019 waste sort conducted by Geosyntec and the total MSW tonnage reported for QRL (2017 QRL tonnage report).
30. Treatment sludge tonnage is from the non-MRA recyclables category in the 2017 Baltimore City MRA Report.
31. Yard waste tonnage is from the compostables (yard) category in the 2017 Baltimore City MRA Report.
32. Food waste tonnage is from the 2017 Baltimore City MRA Report, and includes compostable food waste, food waste (non-mulch/compost), and food donations.
33. Other organics tonnage is from 2017 Baltimore City MRA Report and includes wood materials and other compostables.

Education and Outreach Programs

The City provides information about waste disposal and recycling programs, what materials can be recycled, locations of Residents' Drop-off facilities, disposal of household hazardous waste, and source reduction initiatives on the City's website (www.baltimorecity.gov) and on DPW's social media outlets (Facebook, Nextdoor, and Twitter). Waste reduction and reuse is promoted at City-organized spring and summer festivals and at special events throughout the year. DPW also places recycling memos and information in a monthly newsletter provided with the water bill sent to all residents. More information on specific education and outreach programs is provided below.

Source Reduction Programs

According to the 2017 Source Reduction Report published by the Maryland Department of the Environment (MDE), Baltimore participated in the following source reduction initiatives:

1. Providing an ongoing, multi-faceted public education program on grass-cycling and home composting;
2. Distributing publications to at least 30% of single-family households regarding yard waste reduction and general source reduction practices within the last three years;
3. Staffing a source reduction display;
4. Hosting a source reduction event for the general public;
5. Incorporating source reduction information into the City website;
6. Promoting source reduction in schools on an ongoing basis;
7. Creating a source reduction curriculum in schools;
8. Advertising residential source reduction success through an awards program or local media;
9. Advertising business source reduction success;
10. Integrating source reduction into an ongoing City employee training and education program;
11. Promoting source reduction through television or radio appearance or advertisement;
12. Distributing source reduction publications to at least 30% of businesses in the City within the last three years;
13. Developing or maintaining a system for providing material to a reuse center; and
14. Incorporating green building goals/requirements in City construction, remodeling, and maintenance bid specifications and contracts.

Other specific source reduction programs are detailed below.

One PLUS ONE Program

The City began the One PLUS ONE Program in July 2009. Through the program, the City reduced residential refuse collection frequency from twice weekly to once weekly and set the maximum amount of refuse collected to 96 gallons per household per week. The City simultaneously increased the collection frequency for SSR from twice monthly to weekly collections with no limit to the amount of SSR collected. As part of the program, the City also rerouted the collection schedule to account for population shifts and created a yard waste collection program (yard waste is currently collected with mixed refuse when it is bagged separately and labeled; however, yard waste collected in this way is handled with the trash stream). The One PLUS ONE Program greatly improved efficiency of collection, reduced the amount of trash generated in the City, and increased recycling participation. Since the inception of One PLUS ONE, curbside recycling tonnages have doubled.

Municipal Can Program

In 2016, the City provided every household subject to trash collection by DPW with a 65-gal. wheeled trash can specifically for mixed refuse. By providing all households with a trash can with a tight-fitting lid, DPW aimed to reduce wind-blown litter, prevent rats and other animals from foraging in trash cans, and standardize trash collection in the city to reduce the strain on trash collection workers. The program was also launched with the intent of reducing total trash generation in the City by providing all residents with a standardized bin size that is considerably smaller than the maximum collection volume of 96 gallons mandated under the One PLUS ONE program.

Polystyrene Ban

Under Ordinance 18-125, food service facilities in Baltimore will be prohibited from using disposable food service ware made from polystyrene (Styrofoam) in October 2019. According to the City's SWMP, the ban is intended to force businesses in the City to replace polystyrene containers with recyclable or compostable alternatives. The City is working with a coalition of environmental non-profits to provide educational material to local businesses and residents about alternatives to polystyrene and the best way to dispose of carry-out containers.

Recycling Programs

Recycle Coach

DPW partnered with Recycle Coach, a mobile application from Municipal Media, to make recycling information readily available to Baltimore residents. The application allows residents to keep track of trash and recycle collection days and receive weekly reminders for trash and recycle pickup. The application launched for Baltimore residents on 14 January 2019.

recycle coach

Initiatives in City Schools

DPW participates in multiple school initiatives to encourage and promote recycling. These include:

1. Conducting recycling presentations in schools that discuss waste reduction and reuse, what is and is not recyclable, and recycling at home;
2. Providing schools that recycle properly and consistently with 65-gallon recycle bins (this program is planned and has not yet been implemented).
3. Working with Baltimore City Public Schools to design school specific recycling posters; and
4. Piloting gravity locks for two schools with dumpsters to reduce contamination.

Recycling Website and Newsletters

The City has published an online recycling guide available at DPW's website (https://publicworks.baltimorecity.gov/recycling-services).

Subsidized Recycling Bins

DPW sells subsidized 18-gal. or 25-gal. recycling bins at DPW's Kane Street Yard and at four hardware stores year-round. Additional recycling bins sales are held at least six times per year at a heavily discounted price. These bin sales are also available at other DPW events by request. Subsidized bins are available to all City residents. Information on recycling and source reduction is passed out during sales.

The City's 65-gal. Trash Can (left) and 25-gal./18-gal. Recycle Bins (right)

Other Recycling Programs

To promote paper recycling with residents and businesses in the City, DPW holds shredding events three to four times per year, plastic bag take-back events two to three times per year, and an annual "Clean Your Files Day." During these and all other DPW events, educational materials on recycling and source reduction are provided to participants.

Composting and Organics Management Programs

A pilot curbside composting program is reportedly underway in the City. A compost bin pilot study is being planned, in which three different types of bins will be testing for their utility and serviceability for collecting source separated organics.

The Baltimore Office of Sustainability has also implemented a small-scale food scrap drop-off service at the Baltimore Farmers' Market and Bazaar held beneath the Jones Falls Expressway at Holliday and Saratoga Streets. Collected food scraps are used by a tenant farmer to feed pigs.

3. WASTE GENERATION

Sources of Solid Waste

Solid waste generation in Baltimore can be broken down into two primary categories of generator: residential and commercial. Commercial waste includes waste generated by City businesses, industries, and institutions such as hospitals and schools. Available data related to the generation and composition of waste are provided along with source information in Appendix 1; these generally originated from DPW or MDE. Published sources of data are also referenced in Section 10 of this Report. The most recent calendar year for which complete records are available is 2017. All waste tonnage values reported herein are rounded to the nearest hundred tons.

Residential Waste

Residential waste includes household trash, recyclables, and compostables generated by Baltimore residents. In Baltimore, DPW collects residential waste alongside waste generated at City-owned or City-leased properties. As such, residential waste is reported as "mixed waste" by the City. The total amount of mixed waste generated in the City in 2017 was approximately 548,800 tons. This value includes recycled residential material as well as mixed or residential material disposed at QRL and BRESCO.

Commercial Waste

Commercial waste includes all recyclables, compostables, and trash generated by the private sector in Baltimore. This waste is almost exclusively collected by private haulers rather than DPW, so precise information on tonnages generated are not available. However, information on the amount of commercial waste recycled/composted and the amount of commercial waste disposed at BRESCO is available. Based on this, an estimated total of 1,093,000 tons of commercial material was generated in the City in 2017. However, as commercial waste is part of the private system and is not tracked by the City, it should be noted that this value is a "best guess" estimate on the part of DPW and MDE in many aspects and may underestimate the true amount of commercial waste generated in the City.

Industrial Waste

Industrial waste includes all non-hazardous waste generated by industrial and manufacturing facilities in the City that are not regulated under Subtitle C of the Federal Resource Conservation and Recovery Act (RCRA). As with waste from businesses, industrial waste is collected by private haulers in the City. As such, the exact quantity of industrial waste generated within the City is not well known. For the purposes of this Report, industrial waste tonnages are included as part of commercial waste.

Institutional Waste

Institutional waste includes all waste generated by institutions (e.g. schools, hospitals, and government buildings) in Baltimore. Most of this waste is collected by private haulers in the City (except for waste generated at government buildings, which is collected by DPW alongside residential waste). As such, exact tonnages are not well quantified. For the purposes of this Report, institutional waste tonnages are included as part of commercial waste.

Solid Waste Composition

Under Maryland law, solid waste generated in Baltimore is broken down into different categories by type based on classification under the Maryland Recycling Act. Quantities of waste reported and discussed in this section were depicted graphically on the flow diagram provided on Page 9.

Waste Classification under the Maryland Recycling Act

The Maryland Recycling Act (MRA) requires each jurisdiction in Maryland to develop and implement recycling programs. Since December 2015, Baltimore City and all counties with a population greater than 150,000 are required to attain a 35% recycling rate, which is calculated by dividing the tons of material recycled by the tons of materials generated, which in turn is defined as the tons of material recycled plus the tons of material disposed. Counties with a population less than 150,000 are required to attain a 20% recycling rate.

To allow fair comparison between different jurisdictions, only certain materials can be included when calculating a county's MRA recycling rate, which must be reported to MDE each year. These include paper, plastic, glass, metal, compostables, and a broad category of miscellaneous materials (in 2017, the miscellaneous materials reported by Baltimore city as part of its recycling rate included vehicle tires, textiles, wood and pallets, and batteries). Specific materials that are excluded from the calculation of the recycling rate include antifreeze, asphalt and concrete, coal ash, construction and demolition (C&D) debris, land clearing debris, scrap automobiles, scrap metal, sewage sludge, soils, waste oil, and a host of other materials. Although the tons of these materials recycled are not counted when calculating the county's MRA recycling rate, they are still reported to MDE each year. This division of waste and recyclables into MRA and non-MRA materials is important in the context of understanding reported recycling and waste diversion rates for counties in Maryland versus local jurisdictions in other states or countries, which may include non-MRA materials in their reported recycling rates.

The MRA also allows counties to take up to a 5% recycling credit for recovering energy from waste (considered resource recovery) if the county "achieves a reduction of at least 5% in the volume of its waste through the utilization of one or more resource recovery facilities in operation as of January 1, 1988." Baltimore City recovers energy from waste and thus takes up this credit.

In addition to the MRA recycling rate, the City reports a waste diversion rate to MDE on an annual basis. The waste diversion rate includes the calculated MRA recycling rate plus up to 5% credit for specific source reduction activities (the City's source reduction activities were discussed in Section 2). In 2017, the City earned a 4% credit in recognition of its source reduction efforts.

MRA Waste

MRA waste includes municipal solid waste (MSW) plus industrial waste from non-private, industrial waste landfills. It does not include recycled or disposed MSW ash or backend scrap metal (i.e. metal recovered at WTE facilities post-incineration). A total of approximately 647,400 tons of MRA waste was generated in Baltimore in 2017. Of this, approximately 122,700 tons of material was recovered (see discussion on MRA recyclables below) while 524,700 tons was sent for disposal.

MRA Recycling and Waste Diversion Rates

Based on the MRA waste values reported above, the City's unadjusted MRA recycling rate in 2017 was 19%, although the City's reported MRA recycling rate for 2017 was 24% after adding the additional resource recovery credit. The City's reported waste diversion rate for 2017 was 28% after applying the 4% source reduction credit. These figures compare to the statewide average MRA recycling rate of 45% and waste diversion rate of 49.2%.

MRA recyclables include compostables (yard waste and other organics), paper, plastic, metal, glass, and other materials recovered or diverted from the waste stream prior to disposal (see graphical breakdown on Page 17).

Paper and Cardboard

Recycled paper includes corrugated cardboard, newspaper, mixed paper, magazines, and office/computer paper diverted from the waste stream. Of the approximately 43,100 tons of paper diverted in Baltimore in 2017, roughly 34% came from residential sources, while 66% came from commercial sources.

Plastic

Recycled plastic includes high density polyethylene (HDPE) and polyethylene terephthalate (PET/PETE) bottles and containers, film plastics, and other mixed plastics diverted from the waste stream. Note that PET/PETE and HDPE are classified as No. 1 and 2 plastics, respectively, in many recycling programs. Of the approximately 10,800 tons of plastic diverted in Baltimore in 2017, roughly 94% came from residential sources, while 6% came from commercial sources.

Metal and Glass

Recycled metal includes aluminum cans, tin/steel cans, and metal household appliances (e.g., washers, dryers, refrigerators, etc.) diverted from the waste stream. Of the approximately 10,200 tons of metals diverted in Baltimore in 2017, roughly 91% was from residential sources, while 9% was from commercial sources.

Recycled glass includes mixed glass and fluorescent light tubes diverted from the waste stream. Of the approximately 5,400 tons of glass diverted in Baltimore in 2017, roughly 68% came from residential sources, while 32% came from commercial sources.

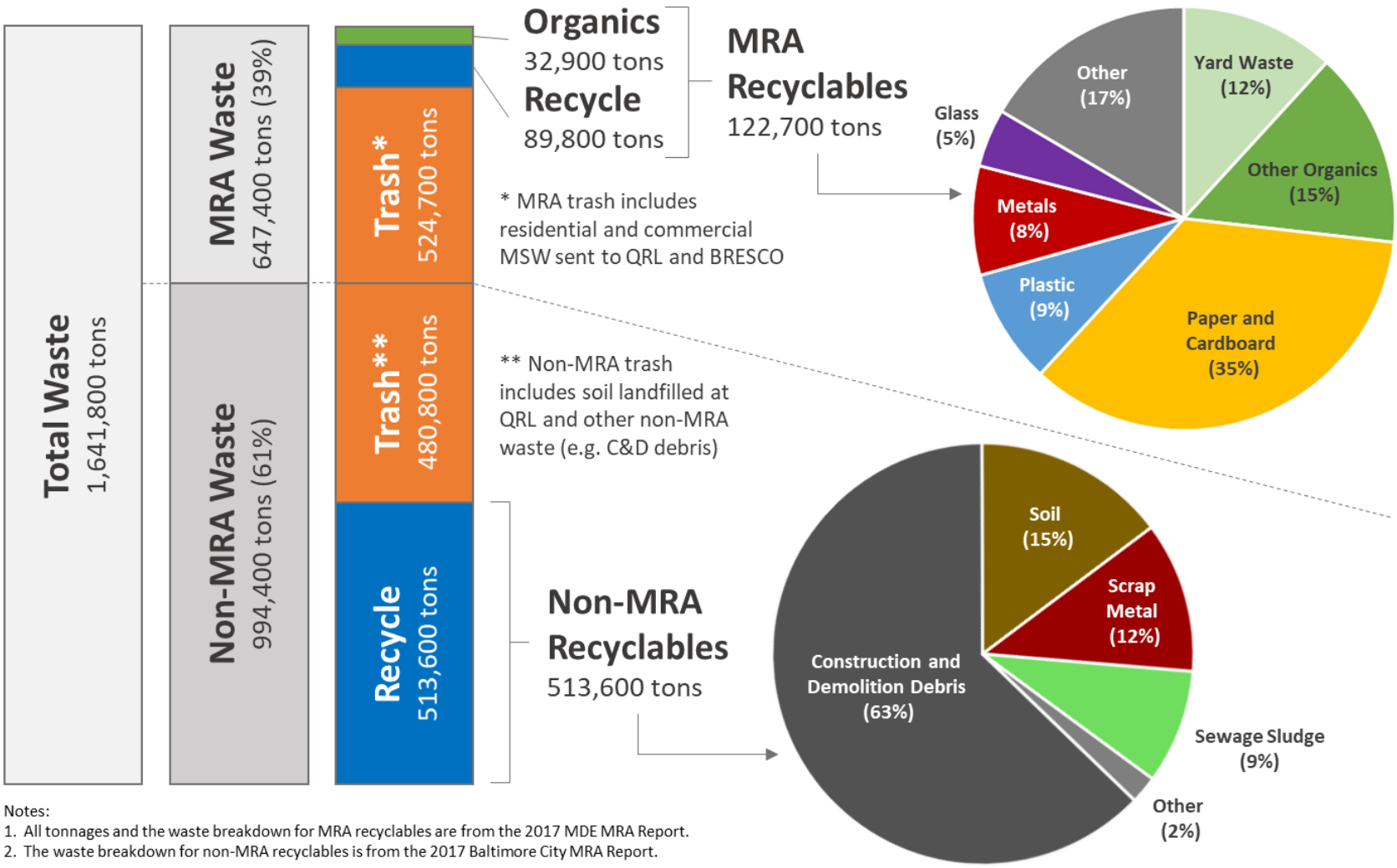
Yard Waste and Other Organics

Yard waste includes brush, branches, grass, and leaves diverted from the waste stream and composted. Of the approximately 14,500 tons of yard waste diverted in Baltimore in 2017, roughly 16% was from residential sources, while 84% was from commercial sources.

Other organics diverted from the waste stream mainly include food waste, wood materials, and donated food. This material may be composted, donated, or recycled by other means (e.g. anaerobic digestion, mulching, etc.). All of the approximately 18,400 tons of other organics diverted in Baltimore in 2017 were from commercial sources.

Other

This is a broad category of materials that count towards MRA recycling, including animal proteins/fats, electronics, textiles, tires, toner cartridges, batteries, and furniture. In 2017, about 20,300 tons of material that falls into this category was collected in Baltimore, split roughly 50/50 between residential and commercial sources.



Notes:
1. All tonnages and the waste breakdown for MRA recyclables are from the 2017 MDE MRA Report.
2. The waste breakdown for non-MRA recyclables is from the 2017 Baltimore City MRA Report.

Waste Generation by Type and Composition of Existing Recycling in Baltimore City

Non-MRA Waste

Non-MRA waste includes all categories of waste disposed in Baltimore that do not classify as MRA waste as defined above. These include MSW collected from commercial sources as well as C&D debris, soil, and a wide range of other materials that are ultimately diverted for recycling.

The vast majority of non-MRA waste in Baltimore is collected by private haulers. As such, limited information is available for generation of this material. The quantities of non-MRA waste listed below and shown in the accompanying diagrams on Pages 9 and 17 of this Report include recycled non-MRA waste reported in the 2017 MRA report for the city (including non-MRA recyclables as well as soil disposed at QRL) as well as other non-MRA waste generated in the city (e.g. C&D waste). A total of 944,400 tons of non-MRA material was generated in Baltimore in 2017, of which about 480,800 tons was sent for disposal at BRESCO or QRL.

Non-MRA Recyclables

Approximately 513,600 tons of the 994,400 tons of non-MRA materials generated in the City in 2017 were reported to be recycled. The predominant categories of non-MRA recyclables include C&D debris, soil, sewage sludge, and scrap metal.

Construction and Demolition Debris

This category of materials includes asphalt, concrete, bricks, sheetrock, plaster, siding, wood pieces, and roofing, as well as general land clearing debris generated in Baltimore. Of the approximately 327,500 tons of C&D waste recycled in the city in 2017, roughly 1% was classified as residential, with 99% coming from commercial sources.

Soil

Recycled soil includes soil that has been put to beneficial reuse by DPW (i.e. as fill material in City projects). For this Report, however, soil used as daily and intermediate cover material at QRL is not included in this category. All of the approximately 77,000 tons of soil recycled in Baltimore in 2017 came from commercial sources.

Scrap Metal

Recycled scrap metal includes materials left over from product manufacturing and consumption such as vehicle parts, building supplies, and surplus metals. DPW provides scrap metal recycling at five of the residents' drop off facilities. However, most of the approximately 60,400 tons of scrap metal recycled in Baltimore in 2017 came from commercial sources.

Sewage Sludge

Sewage sludge is the semi-liquid waste obtained from the processing of municipal wastewater sewage. In Baltimore, this material is composted or converted into a pelletized soil amendment or fertilizer by two private companies, Veolia and Synagro. As such, all of the approximately 45,800 tons of sewage sludge recycled in Baltimore in 2017 came from commercial sources.

Other

Other types of recycled non-MRA waste in Baltimore include antifreeze, waste oil, oil filters, industrial fluids, millings, and a host of miscellaneous materials. Of the approximately 11,000 tons of this material recycled in Baltimore in 2017, roughly 32% came from residential sources, while 68% came from commercial sources.

4. WASTE COLLECTION

Waste collection in Baltimore is conducted by a mixed public/private system. The public system, operated by DPW, serves single-family residences and City-operated buildings in the City, while the private system primarily serves multi-family residences, businesses, institutions, and industries.

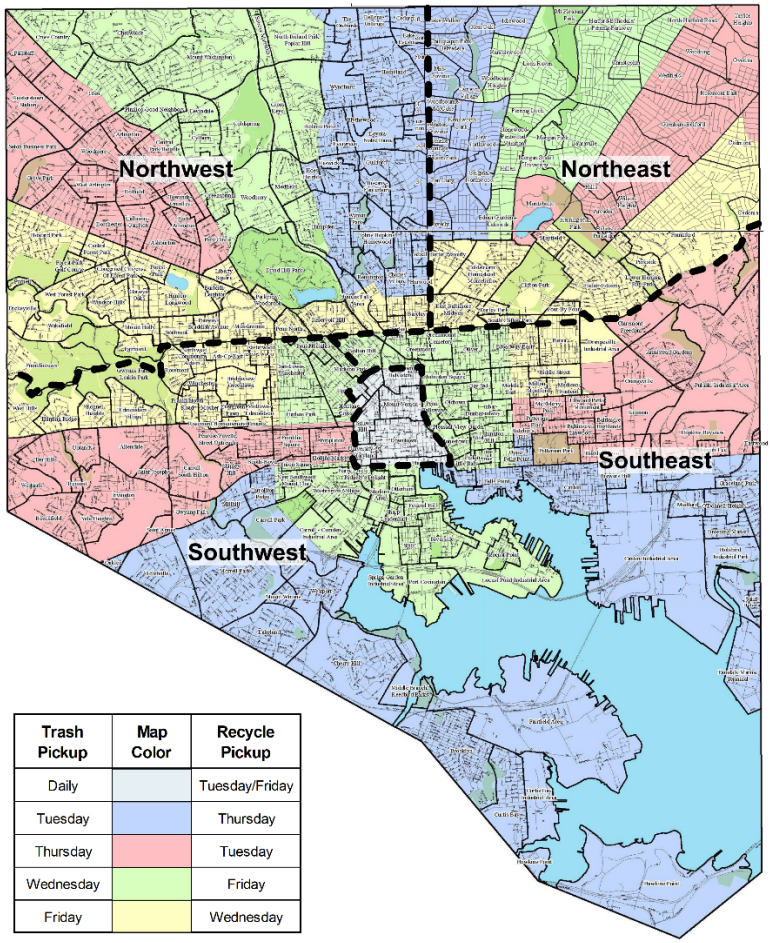
Residential Waste Collection

Residential waste collection services are offered to over 210,000 homes in Baltimore. These services include curbside collection as well as access to eight residents' drop-off centers.

Mixed Refuse Collection

Curbside collection of mixed refuse is provided to single-family homes in Baltimore once per week, Tuesday through Friday, under the One PLUS ONE program. The downtown district is serviced daily. Saturdays are used to make-up for missed holiday collections. The One PLUS ONE program, established in 2009, stipulates that a maximum of 96 gallons of waste may be collected once per week from any serviced location.

Collection of mixed waste is divided into four geographical quadrants: Northeast, Northwest, Southeast, and Southwest covering the 14 Council Districts in the City. Three-person crews and two different sized vehicles (16 and 20 cubic yard rear load packers) are used to collect most residential waste in the City. Mixed refuse collection for multi-family residences served by the City is conducted using front-end loader trucks.



Trash Pickup	Map Color	Recycle Pickup
Daily		Tuesday/Friday
Tuesday		Thursday
Thursday		Tuesday
Wednesday		Friday
Friday		Wednesday

Map of DPW's Collection Quadrants

Single-Stream Recycling (SSR) Collection

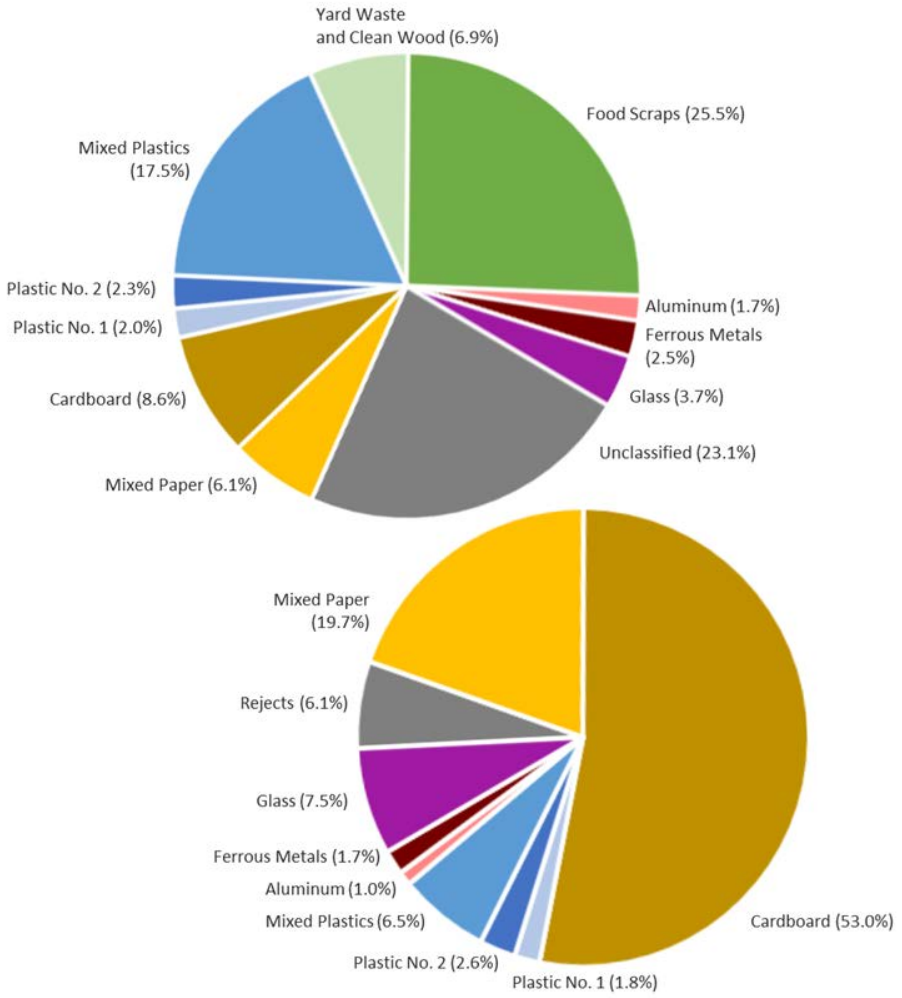
DPW provides curbside SSR collection once per week, Tuesday through Friday, under the One PLUS ONE program to each single-family residence located in Baltimore. Under the One PLUS ONE program, there is no maximum amount of recyclable material that can be collected from each residence. Materials accepted in the SSR collection program include aluminum and steel/tin cans, cardboard, glass containers, mixed paper, and plastic bottles and jars. A full listing of acceptable and unacceptable materials is available here.

Bulk Trash Collection

Bulk trash collection in Baltimore is coordinated via the quadrant system and occurs once per month at all serviced residential locations. To arrange for bulk trash collection, residents must make a service request to 311 two to three months prior to their desired bulk trash collection date. Pickup may not be available on the requested date depending on the backlog of pickup requests. Materials accepted for bulk collection include furniture, appliances, and tires (without rims). C&D debris (e.g. sheetrock, concrete, siding, wood pieces, and roofing) is not eligible for bulk trash collection.

Collection of Yard Waste and Leaves

Residential yard waste is collected by load packers along with mixed refuse on trash collection days throughout the City. Residents may place as many as five bags of leaves per household for curbside collection each week. Additionally, from October through January, residents may make a service request to 311 for special Monday pickups of as many as 20 bags of yard waste. Yard waste is disposed at BRESCO. Leaves on City streets



Composition of MSW (top) and SSR (bottom) in Residential Curbside Collection

(Data from Task 0 Winter 2019 Waste Sort conducted by Geosyntec)

and other lots are collected using mechanical sweepers and load packers (although the sweepers are not specifically designed for this purpose) and disposed of at BRESCO or QRL.

Residents' Drop-off Centers

City residents may drop off waste and recycling for free at the Residents' Drop-off Centers located at QRL or NWTS as well as three other full-service convenience centers – Western Sanitation Yard (Reedbird Ave), Eastern Sanitation Yard (Bowleys Lane), and NW Citizens Convenience Center (Sisson St). These facilities provide additional disposal capabilities to city residents and accept bulk trash, commingled recycling, rigid plastics, scrap metal, scrap tires, appliances, waste oil and antifreeze, electronics, and oyster shells on a year-round basis. In addition, DGS operates three convenience centers that only accept commingled recyclables – York Road Substation, Calverton Road Substation, and Lewin Substation. A listing of acceptable materials at each drop-off facility is available here.

Commercial Waste Collection

Commercial waste (including most institutional and non-hazardous industrial waste) in Baltimore is collected by the private sector. However, a small amount of commercial recycling in the City is handled by DPW.

Mixed Refuse Collection

DPW will only collect waste from addresses that generate less than 96-gal. weekly. As a result, commercial mixed refuse is predominantly collected via the private system, with individual waste haulers contracting directly with businesses and institutions in the City.

Solid Waste and Recycling Drop-Off Facilities in the City

(1)	Quarantine Road Landfill	(5)	Northwest Transfer Station
(2)	Reedbird Ave. Conv. Center	(6)	York Road Substation*
(3)	Bowleys Lane Conv. Center	(7)	Calverton Road Substation*
(4)	Sisson St. Conv. Center	(8)	Lewin Ave. Substation*

* Recyclable items only

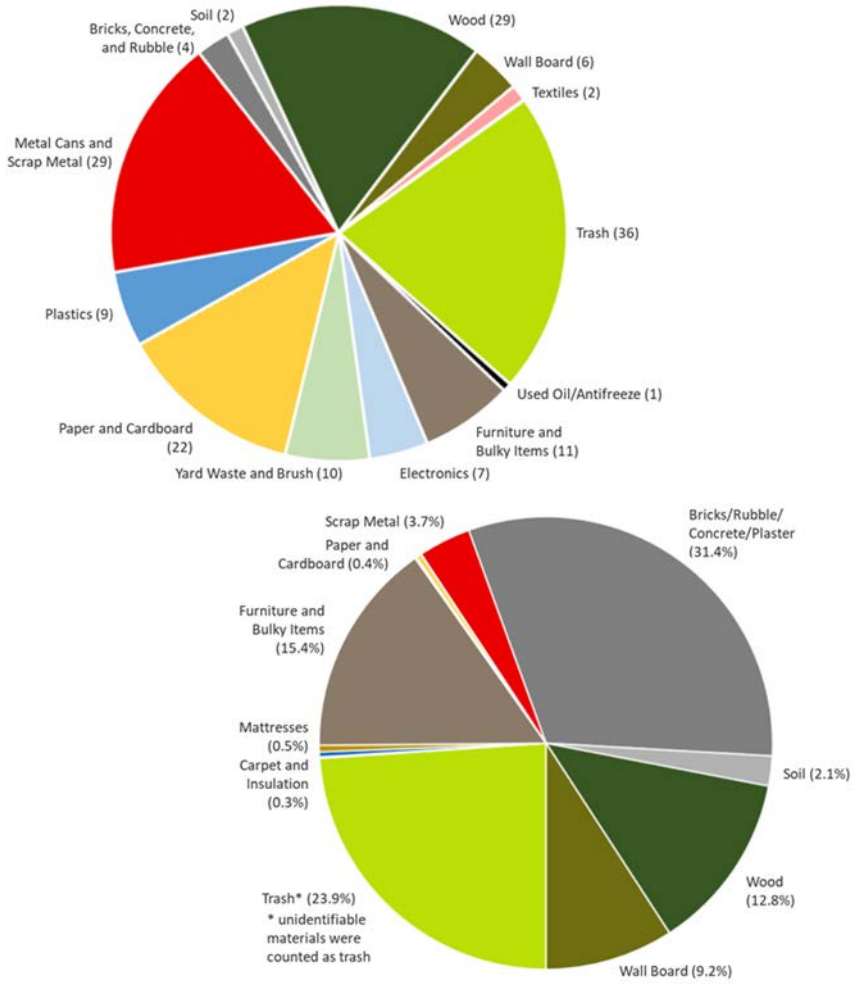
DPW and MDE have few means of determining the exact types, quantities, and disposal fate of all mixed refuse collected in the private system. However, it is estimated that roughly half of commercial mixed refuse collected in the City is disposed at BRESCO.

Small Hauler Program

In April 2017, the City extended the successful Small Hauler Program at QRL to allow small haulers to also use NWTS. Small commercial waste haulers include those who contract with others for collection, transportation, or disposal of solid waste; or engage in the collection, transportation, or disposal of solid waste. The program was designed to encourage small haulers to apply for a City permit, reduce instances of illegal dumping, and allow for more efficient disposal of commercial waste. Small haulers may dispose of their loads at NWTS and QRL for a disposal fee of $20 per load up to 7,000 pounds and $3.38 per 100 pounds above 7,000 pounds. In 2018, approximately 19,400 pounds of waste was delivered to NWTS under the small hauler program.

Recycling Collection

Most commercial recycling occurs through the private system, however, DPW collects SSR material from some Baltimore businesses. Most participating businesses set out recyclables for once-a-week pickup. As of 2018, 150 businesses are on the SSR collection route in the City. However, the exact number of businesses that participate in the City's recycling program is unknown as many simply place their recycling out with residential SSR for curbside pickup.



Composition of Small Hauler Loads at QRL by Vehicle Count (Top) and at NWTS by Weight (Bottom)
(Data from Task 0 Winter 2019 Waste Sort conducted by Geosyntec)

Recycling at City Schools

Under Maryland Law, Baltimore City is required to prepare a plan to address the collection, processing, marketing, and disposition of recyclable materials from City public schools (Citation for Environmental Article of the Maryland Annotated Code §9-1703). It is the responsibility of the Baltimore City Public School System (BCPSS) to ensure the implementation of the Public Schools' Recycling Plan, as outlined in Section 3.3.3 of the SWMP. Under the plan, publics schools must recycle mixed paper and cardboard, and are encouraged to recycle glass bottles, plastic bottles, ferrous and non-ferrous metals and cans, light bulbs, and electronics. All Baltimore City Public Schools are eligible for recycling services by DPW or a BCPSS designated vendor.

Special Waste Management Programs

The city operates multiple special waste collection programs to collect special types of waste and to clean and collect waste from City waterways and public areas (e.g. street sweeping and marine debris).

Rat Eradication

DPW has operated the Rat Rubout Program in Baltimore since 2010. The goal of the program is to reduce the rat population in the City to prevent property damage and to limit the spread of disease. Under the program, City pest control workers inspect and bait active rat burrows at residential properties as a result of either a citizen complaint (via a service request to 311) or as a proactive blitz. In 2018, the City performed approximately 167,000 proactive inspections and 4,500 inspections as a result of citizen complaints. In addition to inspecting and baiting active rat burrows, City pest control workers in the program educate residents on how to keep their properties free of the trash and debris that attract rats.

Christmas Trees

The City allows residents to drop off Christmas trees at multiple locations throughout the City where residents are given the option to mulch their trees and collect the mulch. Any mulch not taken by residents is disposed at QRL or BRESCO. The City also collects trees in curbside collection of mixed refuse and allows trees to be left at residents' drop-off locations. Trees collected via curbside or residents' drop-off are sent to QRL or BRESCO for disposal.

Waste from City Parks

DPW services the trash cans from 262 parks and 43 recreation centers on a weekly basis. Parks and recreation centers are also able to schedule bulk trash pickup by request. Waste from the parks and recreation centers is included in the residential waste stream.

Animal Manure and Carcasses

The main producer of animal manure is the Maryland Zoo in Baltimore. The City collects manure from the zoo multiple times each week. Approximately 850 tons of manure is removed from the zoo annually and sent to QRL for disposal. Most animal carcasses collected in the City are those of stray cats and dogs. The Health Department collects animal carcasses and sends them to Valley Pet Crematory in Williamsport, Maryland for incineration.

Cleanup of Illegal Dumping

Illegally dumped waste remains a persistent issue in the City with an estimated 10,000 tons of waste illegally dumped annually. DPW responds to 311 service requests to investigate and clean up illegal dumping. However, dedicated alley and lot cleaning crews have recently been able to address illegal dumping "hot spots" without relying solely on 311 complaints. According to a December 2018 report by DPW, the City's cyclical response to illegal dumping incurred costs of over $22.6 million in FY2016 on right-of-way cleaning services, which includes street and alley cleaning, mechanical street sweeping, marine operations, and cleaning of business districts. DPW's Office of Communications and Community Affairs is actively engaged in educational outreach to engage residents in preventing and reporting illegal dumping.

Source: https://www.chesapeakebay.net/state/litter

Marine Debris

The City provides cleaning services for the inner harbor and surrounding waterways via DPW's Marine Operations Unit, which operates seven days a week. The Marine Operations Unit uses four skimmer boats and five bass boats to remove debris from harborways. Skimmer boats are designed to skim the waterways for debris and store the debris on-board while bass boats are smaller boats that are used by operators to remove debris using a net. As a side note, Baltimore City is the first City in the nation to use skimmer boats for debris removal.

The City also receives assistance from Waterfront Partnership and their trash wheels (e.g. "Mr. Trash Wheel") to collect marine debris. Trash wheels are solar-powered watercraft that intercept trash at the end of a river, stream, or other outfall. There are currently three trash wheels

installed in the inner harbor, Harris Creek, and Masonville Cove. Collectively, they have removed approximately 850 tons of trash from the inner harbor since their installation.

Street and Sidewalk Sweeping

The City operates a fleet of mechanical street sweepers in addition to human sidewalk sweepers to collect litter and dirt from the main streets and sidewalks in Baltimore. Mechanical sweepers operate 74 routes on a weekly basis while sidewalk sweepers and ATLVs operate on a daily basis primarily within the business district and gateway areas. A total of over 7,000 tons of dirt and debris is collected by street and sidewalk sweepers annually.

Treatment Plant Sludge

Treatment plant sludge from wastewater treatment facilities (i.e. Back River Wastewater Treatment Plant and Patapsco Wastewater Treatment Plant is collected by three private facilities for disposal (The Baltimore City Compost Facility, the Baltimore Patapsco Pelletizer, and the Back River Pelletech Facility) where it is converted to horticultural compost and pelletized fertilizer for use as a soil amendment.

Community Programs

DPW supports two notable community programs aimed at improving waste collection and reducing litter in the City. The Community Pitch-In Program empowers residents to tackle the trash problems in their neighborhoods. Community associations can request up to four roll-off dumpsters yearly to aid in such cleanup efforts. The Mayor's Annual Spring and Fall Cleanups are multi-agency, citywide events that encourage residents to clean up their communities. DPW offers bags, roll-off dumpsters, and same-day bag collection to participating community organizations and business organizations.

The BMORE Beautiful Program, introduced as the Clean Corps program in 2015, is a collaboration between the Mayor's Office, Office of Sustainability, DPW, Department of Housing and Community Development, the Environmental Control Board, and non-profit partners including Baltimore Green Works and the Waterfront Partnership. It utilizes the core principles of community-based social marketing and peer-to-peer networking to engage, educate, and motivate residents, businesses, schools, and neighborhood associations to change their behavior toward litter, trash, and proper waste disposal. The goal of the pilot program is to not only change behaviors and attitudes toward the beautification of the City, but to also encourage residents, businesses and organizations to become directly involved in activities and projects that will keep their neighborhoods clean. To meet this goal, the City works closely with neighborhoods on their unique beautification projects and cleanliness challenges, and provides educational literature, outreach materials and other resources. A resident in each piloted neighborhood volunteers to be the block captain, following the ROLE model of engagement. They are responsible for RECRUTING neighbors to sign the pledge and participate in the program, ORGANIZING ongoing beautification and cleaning activities, LEADING others to change their negative behaviors regarding neighborhood cleanliness, and EDUCATING their neighbors on how to comply with City Code requirements and how they can keep their neighborhoods beautiful through simple, easy-to-follow behaviors.

Additionally, BMORE Beautiful supports community beautification goals by offering small and innovative grant programs that address an array of

neighborhood beautification and engagement needs. Current grant opportunities include: Love Your Block, Say YES! (Youth Environment Stewardship) Program, and Care-A-Lot Grant.

Smart Cans

Solar powered trash compactors fitted with sensors and communications devices that let DPW know when they need to be emptied have been deployed in the City. Bigbelly cans, sponsored by Waste Management and Under Armour, have been in service in the Inner Harbor for several years. In 2018, 64 ECUBE Smart Cans were deployed in South Baltimore in conjunction with attached recycling cans. Installation of these smart cans was funded by grants from the Casino Local Development Council and the Maryland Port Administration.

Inmate Cleaning

Inmates clean the wooded shoulders (i.e. the tree lined areas along streets in the City) of tossed trash and debris from cars and pedestrians within all four City Quadrants on Monday, Wednesdays, and Fridays each week.

Special Events

Per Maryland Code, Environment Article 9-1712, all special event organizers are required to provide recycling at special events that meet three main criteria: includes temporary or periodic use of a public street, publicly owned site or facility, or public park; serves food or drink; and is expected to have 200 or more persons in attendance.

DPW will provide cleaning services, trash removal, and recycling services to any special events meeting these criteria in the City that request solid waste services. If the event organizer does not request solid waste services from DPW, they will need to contract with a private hauler.

BMORE Beautiful Smart Cans in Federal Hill

Encampments

While residents remain at a homeless encampment, DPW will remove trash from the site until the Department of Health can provide residents with temporary housing. DPW also provides cleanup services to areas used as homeless encampments after residents have been provided alternative housing.

5. WASTE PROCESSING AND DISPOSAL

Recycling Facilities

The City contracts exclusively with private recycling facilities for processing of collected recyclables. Commercial recycling, while also prevalent in the City, is provided by private haulers contracted directly with local businesses, industries, and institutions. As such, it is unknown where commercial recyclables are processed and disposed; however, all facilities under contract with the City also accept recyclables from commercial clients. It is noted that all facilities that DPW currently has a recycling contract with are located outside of the City and thus are discussed here in the context of being service providers to DPW rather than as City-based facilities.

Recycling Facilities under Contract with the City

Waste Management Recycle America (WMRA) Facility

WMRA is a materials recovery facility (MRF) located in Elkridge, Maryland that serves the greater Baltimore and Washington D.C. area. Using a combination of manual labor and automated sorting technologies, the MRF separates single-source recyclables into base components of recyclable paper, cardboard, plastic, glass, aluminum, and steel. Separated materials are then baled and shipped worldwide (although plastics are shipped only within the United States). The facility processes approximately 20,000 tons of SSR every month and primarily serves clients in Baltimore City as well as Anne Arundel, Baltimore, Carroll, Frederick, and Howard Counties.

DPW currently sends all recyclables collected in the City's residential curbside recycling program as well as all mixed recyclables and hard plastic collected at residents' drop-off facilities to WMRA. In 2017, DPW sent a total of 21,550 tons to WMRA.

Auston Contracting, Inc.

DPW currently sends all the scrap metal (including appliances) and scrap tires recovered at QRL and the residents' drop-off facilities to Auston Contracting, Inc., a recycling facility located in Joppa, Maryland. In 2017, DPW sent approximately 100 tons of scrap tires and 400 tons of appliances and scrap metal to the facility.

CyclePoint from SourceAmerica

In 2017, DPW sent nearly 40 tons of electronics collected at residents' drop-off facilities to CyclePoint, a non-profit e-cycling facility in Vienna, Virginia. However, this facility no longer offers e-cycling.

UNICOR Federal Prison Industries, Inc.

In 2017, DPW sent approximately 46 tons of electronics to the National Capital Electronics Recycling Center operated by UNICOR in Landover, Maryland. However, DPW no longer utilizes this service.

Other Recycling Facilities and Programs in Baltimore

MDE does not require recycling facilities in Maryland to be permitted as waste acceptance facilities. As such, it is difficult to determine exactly how many recycling facilities exist in Baltimore City. A list of City-based recycling facilities and programs is included in Appendix D of the City's SWMP; however, this list is not intended to be comprehensive.

Polystyrene Recycling

Until May of 2018, the City of Baltimore worked with Dart Services to provide recycling services for polystyrene collected at the Sisson Street Residents' drop-off location. In 2017, roughly 9.6 tons of polystyrene were recycled. The polystyrene recycling service was discontinued by Dart in response to the ban on polystyrene food containers enacted by the City in April 2018 that goes into effect in October 2019.

Baltimore Recycling Center, LLC

The Baltimore Recycling Center (BRC) is a private MRF and transfer station that accepts wood, cardboard, aggregates, metals, plastics, and concrete for recycling and recovery. In 2016, BRC accepted approximately 195,200 tons of material. The current posted gate fee for this facility is $75.00 per ton with a one ton minimum.

L&J Waste Recycling, LLC

L&J Waste Recycling (L&J) is a private MRF permitted to accept solid and medical waste. L&J accepts aggregates, metals, wood, SSR, and gypsum/drywall for recycling and reuse. In 2016, L&J accepted and processed approximately 30,100 tons of material.

Disposal and Transfer Facilities

DPW operates one disposal facility in the City (QRL) and contracts with BRESCO for the disposal of the remainder of its residential solid waste. Commercial waste in the city is almost entirely processed by the private system. Although it is not directly tracked by DPW, it is assumed that most of Baltimore's commercial waste is sent for incineration at BRESCO with small quantities exported from the City.

Quarantine Road Landfill (QRL)

QRL is located on a 153-acre site (of which the landfill occupies 126 acres) at 6100 Quarantine Road in Hawkins Point. The facility was initially constructed in 1985 and has a permitted capacity of approximately 18.3 million cubic yards, of which about 3.6 million cubic yards remains. Based on current projections, QRL is expected to reach its permitted capacity around 2026. For this reason, DPW is currently undergoing an expansion design to significantly increase the future disposal capacity at QRL.

QRL accepts mixed refuse, rubble, WTE ash from BRESCO, and grit screenings from the Back River and Patapsco wastewater treatment plants. In 2017, QRL accepted approximately 189,400 tons of soil (which was predominantly used for daily and intermediate cover), 140,300 tons of WTE ash from BRESCO, 2,300 tons of grit screenings, and 149,600 tons of mixed refuse.

BRESCO

The BRESCO facility, officially the Wheelabrator Baltimore Waste-to-Energy Facility, is located on a 15-acre parcel at 1801 Annapolis Road. The facility was constructed in 1984 and became fully operational in 1985 with a capacity of 725,000 tons of waste annually, or 2,250 tons per day. The roughly 500,000 pounds of steam generated by the facility each hour is used to generate 64 MW of electricity and feed a steam loop that provides district heating to many businesses and residences in downtown Baltimore.

In 2017, BRESCO accepted approximately 705,800 tons of waste, including 156,900 tons of residential waste and 221,700 tons of commercial waste generated within the City. The remaining 327,200 tons

of waste accepted at the facility came from out-of-city sources, primarily in Anne Arundel and Baltimore Counties.

Northwest Transfer Station (NWTS)

NWTS is operated by DPW as a transfer station to consolidate mixed refuse and SSR loads collected curbside by DPW's load-packer trucks into larger truckloads for transfer. It also serves as a drop-off point for the small hauler program and operates a residents' drop-off center. NWTS has a permitted capacity of 150,000 tons per year. In 2017, about 20,400 tons of recyclables and 45,900 tons of mixed refuse were handled at NWTS. Recyclables are sent to WMRA. Of the mixed refuse handled at NWTS for disposal, roughly 41,500 tons was sent to BRESCO while the remaining 4,400 tons was sent to QRL. NWTS is currently closed while undergoing a comprehensive renovation; as such, a larger proportion of the City's waste has been sent to QRL in 2019 than is typical.

Other Disposal and Transfer Facilities in Baltimore

Waste Management Quad Avenue Transfer Station

The Quad Avenue Transfer Station operated by Waste Management is a transfer facility for recyclables collected in Baltimore. The facility serves as a primary drop off location for mixed recycling collected in northeastern areas of the City.

Daniels Sharpsmart

The Daniels Sharpsmart facility is permitted as a private MRF and transfer station. It processes medical waste (specifically sharps) and accepted approximately 1,800 tons of material in 2016.

Baltimore Processing and Transfer Station

The Baltimore Processing and Transfer Station (BPTS) is permitted as a private MRF and waste transfer station. The facility accepted roughly 74,300 tons of material in 2011 but has not accepted any material since 2014. Its operating permit expires in 2019 and the owner's plans for this facility are not known.

Stericycle, Inc.

Stericycle is a private autoclave facility and MRF that processes medical waste (specifically chemotherapeutic, pharmaceutical, and pathological waste). Processed waste is shipped to Haw River, North Carolina where it is incinerated. In 2016, the facility accepted approximately 21,200 tons of waste.

Baltimore Regional Medical Waste Facility

The Baltimore Regional Medical Waste Facility (BRMWF) is a privately-owned medical waste incinerator (the nation's largest) located in Hawkins Point. The facility has a capacity of 62,050 tons of waste per year and accepted approximately 24,800 tons of material in 2016. Ash generated at BRMWF is shipped to North Carolina for landfill disposal.

Hawkins Point Plant Industrial Waste Landfill

The Hawkins Point Plant Industrial Waste Landfill consists of two parcels. The first parcel contains a 28-acre industrial waste landfill which accepted 240 tons of material in 2016. The second parcel is permitted for industrial waste, but no landfill has yet been constructed. Constellation Energy has plans to develop 29 acres of this undeveloped parcel for use as a landfill for coal combustion residuals (ash) from its Brandon Shores, H.A. Wagner, and C.O. Crane coal power plants.

Fort Armistead Road – Lot 15 Landfill

The Fort Armistead Road – Lot 15 Landfill is permitted as an industrial waste landfill and currently accepts coal ash and other residues from the Brandon Shores, H.A. Wagner, and C.O. Crane coal power plants. In 2016, Lot 15 accepted approximately 165,500 tons of material.

W.R. Grace and Co. – Davison Chemical Division

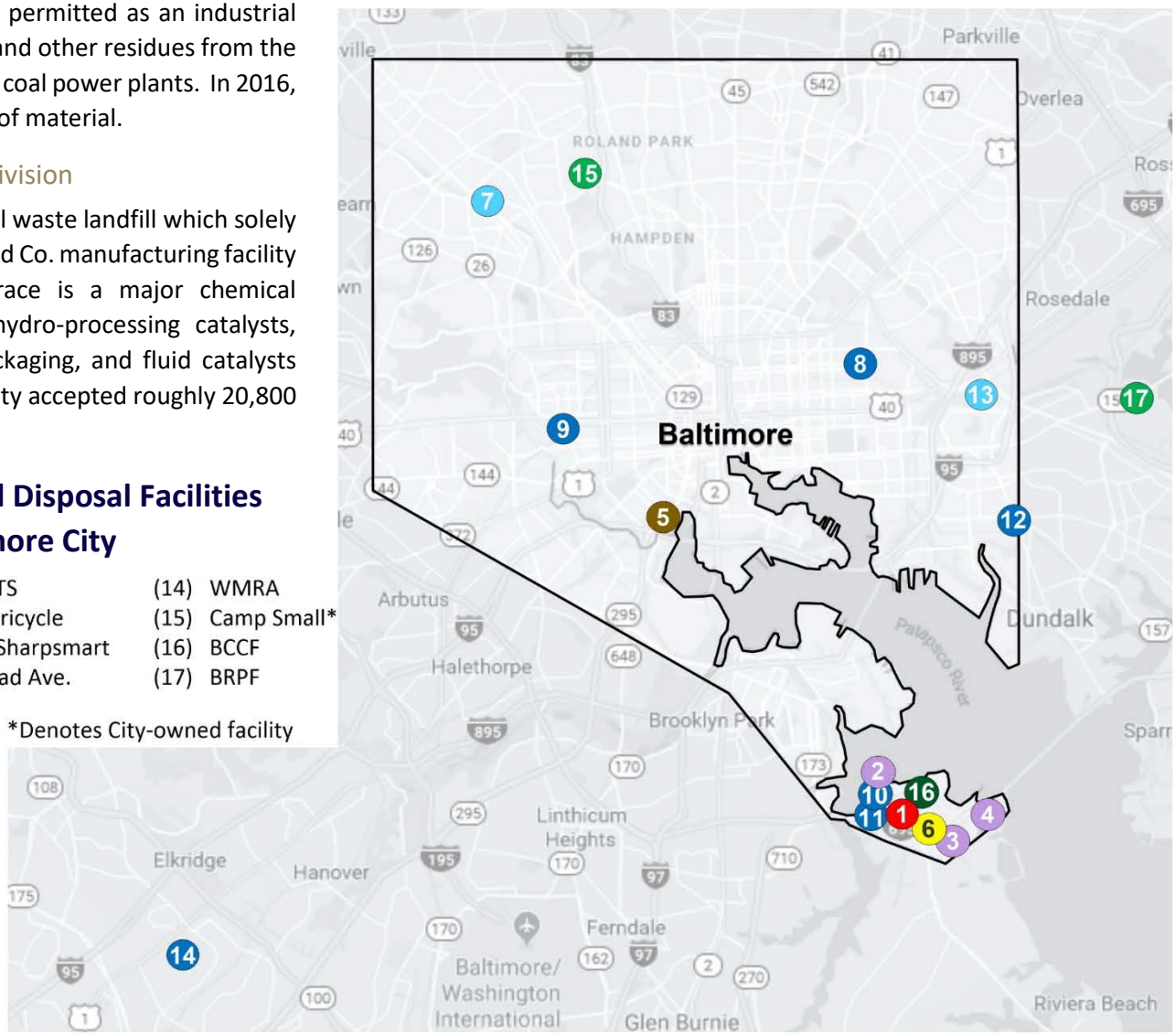
The W.R. Grace and Co. landfill is an industrial waste landfill which solely accepts waste generated at the W.R. Grace and Co. manufacturing facility located on the same property. W.R. Grace is a major chemical manufacturer of silica-based absorbents, hydro-processing catalysts, polyolefin catalysts used in plastics and packaging, and fluid catalysts used in petroleum refining. In 2016, the facility accepted roughly 20,800 tons of material.

Local Solid Waste Processing and Disposal Facilities Directly Serving Baltimore City

(1)	QRL*	(6)	BRMWF	(10)	BPTS	(14)	WMRA
(2)	W.R. Grace	(7)	NWTS*	(11)	Stericycle	(15)	Camp Small*
(3)	Lot 15	(8)	BRC	(12)	D. Sharpsmart	(16)	BCCF
(4)	HPP	(9)	L&J	(13)	Quad Ave.	(17)	BRPF
(5)	BRESCO						

*Denotes City-owned facility

- ***MSW Landfill***
- ***Transfer Station***
- ***MRF***
- ***WTE Incinerator***
- ***Med. Waste Incinerator***
- ***Industrial Landfill***
- ***Compost Facility***
- ***Other Organics Facility***



Composting and Organics Management Facilities

The City operates one wood waste processing facility (Camp Small) and partners with private industries for the processing of wastewater treatment sludge. However, most residential yard and food waste in the City currently ends up being sent for disposal at BRESCO or QRL. Commercial organics recycling is handled by the private system and is not directly tracked by DPW; as such, specific tonnage estimates per facility are difficult to obtain.

Camp Small

Camp Small is a wood waste collection and recycling yard located in the Jones Falls valley just north of Spring Lane and operated by BCRP. All logs, branches, wood chips, leaves, and brush collected from City parks and street right of ways are brought to Camp Small for processing. Under the Camp Small Zero Waste Initiative, prime logs, wood chips and brush are sorted and made available for purchase by City residents and businesses. Approximately 7,700 tons of wood waste was processed at Camp Small in 2017.

Baltimore City Compost Facility

The Baltimore City Compost Facility (BCCF), operated as a partnership between the Northeast Maryland Waste Disposal Authority, the City of Baltimore, and Veolia Water North America and located at the QRL site, processes approximately 30% of the sewage treatment sludge (biosolids) generated at the Back River Wastewater Treatment Plant (BRWWTP) on a dry weight basis. The biosolids composted using an in-vessel process to produce high-quality horticultural compost that is marketed to landscapers, nurseries, contractors, topsoil manufacturers, golf courses, and commercial growers. According to the City's SWMP, BCCF accepts about 30,000 wet tons of treatment sludge annually from which it generates approximately 30,000 to 35,000 cubic yards of compost.

Back River Pelletech Facility

Synagro operates the Back River Pelletech Facility (BRPF) at BRWWTP for processing sewage treatment sludge generated at BRWWTP. BRPF is a heat drying and palletization facility that processes liquid and semi-liquid treatment sludge into a pelletized product that is marketed as a fertilizer and soil conditioner. BRPF processes roughly 70% of the treatment sludge generated at BRWWTP on a dry weight basis.

Baltimore Patapsco Pelletizer

Synagro operates the Baltimore Patapsco Pelletizer (BPP) at the Patapsco Wastewater Treatment Plant (PWWTP) for processing sewage treatment sludge generated at PWWTP. BPP is a heat drying and pelletization facility that processes liquid and semi-liquid treatment sludge into a pelletized product that is marketed as a fertilizer and soil conditioner. BPP processes all of the treatment sludge generated at PWWTP on a wet and dry weight basis.

Other Organics Management Facilities

According to the 2017 MRA report for Baltimore City, roughly 12,200 tons of commercial yard waste, and 12,300 tons of commercial food waste were recycled in the City. However, as all commercial recycling is conducted via the private system in Baltimore, it is unknown exactly how and where this material was recycled, and whether the facilities were located within the City.

Community Composting Programs

Although not directly affiliated with the City, a few community farms and composting services are available for City residents to divert food scraps. Examples include Charm City Farms and Whitelock Community Farm, where local residents can bring food scraps. More proactively, the Baltimore Compost Collective, a youth entrepreneurship program, provides weekly food scrap collection from homes in South Baltimore and composts the material at the Filbert St. Community Garden in Curtis Bay.

Reuse and Repurposing of Waste Materials

Although they are generally not part of the City's formal waste management system, several reuse and repurposing facilities in the City provide residents and businesses with opportunities to reduce the amount of material sent into the solid waste system.

Reuse and Repurposing of C&D Waste

Second Chance

Second Chance, Inc. is a non-profit deconstruction and building material reuse center in Baltimore that employs displaced or unemployed members of the community and trains them in deconstruction methods. Second Chance focuses on deconstructing and salvaging valuable building materials from homes and other structures that are to be demolished. These materials are then sold for reuse or repurposing. The center also accepts donations of building materials and household fixtures and appliances. Through March 2019, Second Chances reports having diverted over 2.2 million lbs. of waste from landfill disposal.

Disclosure: Second Chance is a partner with Geosyntec as a member of the Consultant Team on this master planning effort.

The Loading Dock

The Loading Dock, Inc., a non-profit building materials reuse center, reports to have diverted approximately 12,000 truckloads of materials from landfill disposal since 1984. The center accepts paint, lumber, plumbing fixtures, appliances, doors, cabinets, windows, caulks, moldings, and other reusable materials from the home building industry. Donated materials can be dropped off at the center.

Habitat for Humanity of the Chesapeake

Habitat for Humanity of the Chesapeake (HHC) is a non-profit organization focused on bringing investment to underserved communities in the Baltimore area through the construction and renovation of homes. In addition to constructing/renovating homes, HHC also operates six ReStores which sell new and gently used furniture, building materials, and appliances at discount prices. ReStore locations accept donations of furniture, appliances, cabinets, building materials, houseware, hardware, lighting/electrical, flooring, plumbing, doors and windows.

Reuse and Repurposing of Clothing and Textiles

Goodwill and the Salvation Army operate multiple locations within Baltimore for the donation and resale of clothing, shoes, and household items. Additionally, Donation Town, an online resource, will help to connect Baltimore residents with local charities that will pick up donations from residents' homes.

Food Donation Programs

Food donation programs in Baltimore include the Maryland Food Bank and Food Rescue Baltimore, where residents and businesses may donate unwanted or excess food to reduce food waste in the City. Reducing food waste in the City is a major priority for the Baltimore Office of Sustainability, which recently launched the Baltimore Food Waste and Recovery Strategy. Food waste reduction is discussed in more detail in Section 8 of this Report.

Source: http://www.catalystkitchens.org/

Other Reuse Facilities

In addition to those listed above, multiple other reuse organizations exist within Baltimore. For example, the Lions Club in Baltimore will accept donations of old eyeglasses for distribution to others in the City. Vehicles may be donated at Vehicles for Veterans or St. Vincent de Paul in Baltimore. Other facilities exist for donation of books, furniture, electronics, musical instruments, sports equipment, and other items.

Import and Export of Solid Waste

Some waste disposal facilities within the City process out-of-City waste (imported waste) while some waste generated within Baltimore is processed outside of the City (exported waste). To fully characterize the Baltimore City waste stream, both imported and exported waste are included in this analysis. While imported waste is well characterized, DPW has limited information on the quantity and composition of waste exports.

Imported Waste

Mixed Refuse

In 2017, BRESCO imported residential and commercial refuse from Baltimore County as well as commercial waste from several Maryland counties, including Anne Arundel County, Howard County, Prince George's County, Montgomery County, and St. Mary's County, as well as North Carolina, Pennsylvania, West Virginia, Virginia, New York, New Jersey, Delaware, and Ohio. In total, out-of-City waste totaled approximately 327,200 tons of the 705,700 tons of waste accepted at BRESCO. Most of the ash generated at BRESCO is disposed at QRL

(approximately 140,300 tons in 2017) while the remainder is sent to Baltimore County's Eastern Landfill for disposal.

Scrap Tires

The Emanuel Tire Company is the major tire recycler in Baltimore, with the ability to process six million tires annually. Approximately half of the scrap tires that the facility processes are not from Maryland, while an unknown (but presumably large) number of tires are from out-of-City sources within the state. Tires at this facility are shredded and recycled as landscape material, playground surfaces, and rubber matting.

Scrap Metal and Scrapped Automobiles

Eleven licensed automobile scrap processers and recyclers operate within the City. These facilities accept scrapped automobiles from wrecking yards throughout the Baltimore metropolitan area and recycle the scrap metal salvaged from the vehicles. In addition to the recycled scrap metal, these facilities generate approximately 600 lbs. of non-recycled material per automobile (fluff) that must be disposed. QRL does not accept automobile fluff for disposal.

Special Medical Waste

BRMWF imports approximately 9,000 tons of special medical waste and mixed refuse from out-of-city medical facilities for incineration. The ash generated is exported to North Carolina for disposal.

Household Hazardous Waste (HHW)

HHW collected by the City is sent to Clean Harbors Environmental Services, Inc. for processing and disposal. In addition to processing in-city waste, Clean Harbors also serves as a treatment facility for industrial wastewater and as a transfer facility for other industrial waste including flammables, oxidizers, poisons, etc.

Exported Waste

Residential Recyclables

As discussed previously, single stream recyclables collected by DPW are exported to the Waste Management Recycle America (WMRA) facility in Elkridge, Maryland. In 2017, DPW exported approximately 21,550 tons of recyclables to WMRA. All recyclables collected by private haulers in the city are also exported, although not exclusively to WMRA. Precise data on the flow of privately collected recyclables are lacking.

Mixed Refuse

A portion of the mixed refuse generated by the city (particularly commercial waste) is hauled by private haulers. It is assumed that some of these haulers bring waste generated within Baltimore to out-of-City facilities for disposal.

Scrap Tires and Scrap Metal

Scrap tires and scrap metal collected at residents' drop-offs in the City are exported to Auston Contracting in Harford County for recycling and disposal. Tires sent to this facility are shredded and sold to other permitted sites, including tire recyclers (shredded tires are recycled as landscape material, playground matting, etc.) and waste to energy facilities. Auston Contracting plans to build a pyrolysis plant on their property to break down tires into saleable products such as heavy oil and carbon black residue.

Electronics

Electronics collected by DPW are currently exported to eRevival in Columbia, MD for recycling.

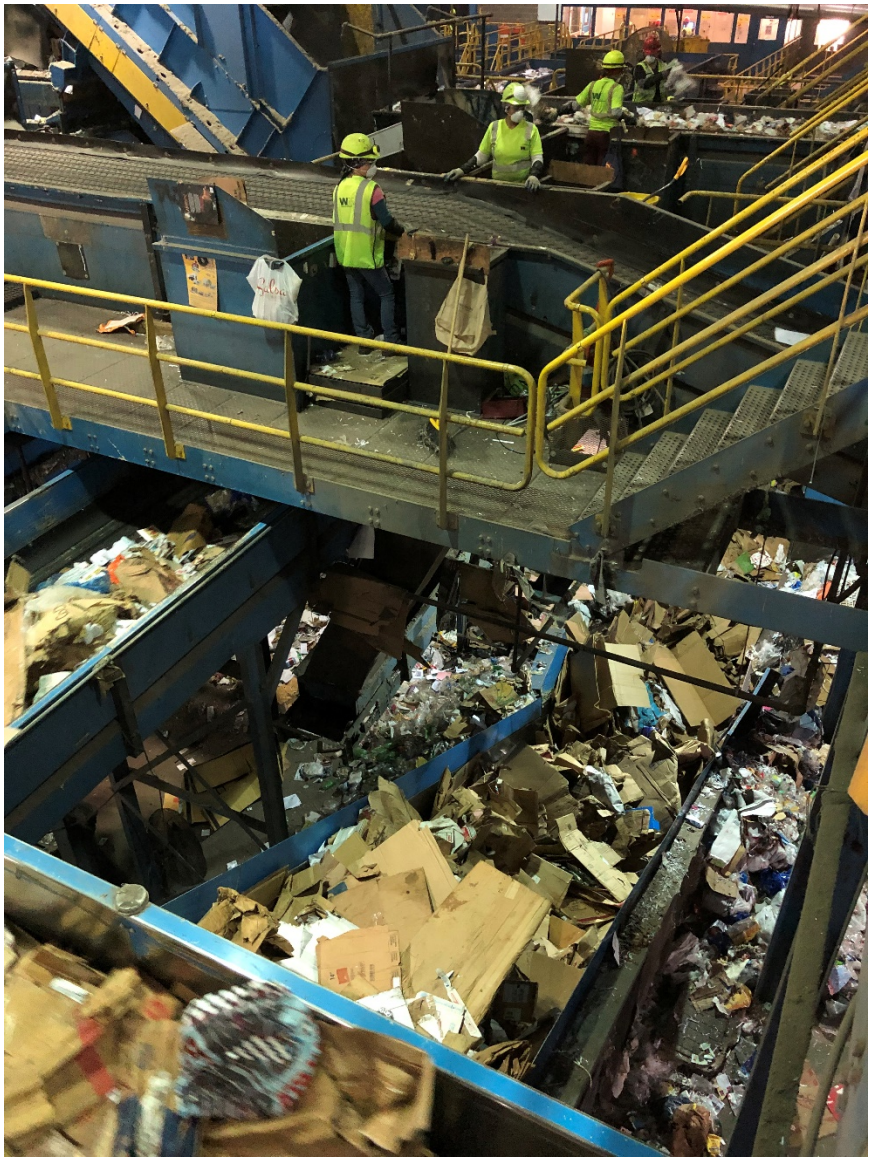
Special Medical Waste and Controlled Hazardous Substances

The ash from special medical waste incineration at BRMWF is exported to North Carolina for disposal. Stericycle exports processed special medical waste to its facility in North Carolina for incineration.

Controlled hazardous substances generated within the City are exported for treatment and disposal.

Animal Carcasses

Animal carcasses collected in Baltimore are exported to Valley Pet Crematory in Williamsport, Maryland for incineration.



The Waste Management Recycle America materials recovery facility in Elkridge (right) annually processes over 20,000 tons of curbside single-stream recycling from Baltimore City

6. EQUIPMENT, COSTS, AND REVENUES FOR EXISTING SYSTEM

Collection Services

Equipment

Active equipment owned and operated by BSW for collection purposes is categorized below by its storage location or use.

200 North Holliday Street

Equipment stored at the Holliday Street facility includes:

- One loadpacker truck with a capacity of 9 cubic yards (CY)
- One dump truck with a capacity of 3-5 CY
- Seven pickup trucks/SUVs
- One flat non-driven trailer

NW Sisson Street

Equipment stored at the Sisson Street facility includes:

- 25 loadpacker trucks with a capacity of 16-20 CY
- Four roll-off container trucks
- Five pickup trucks

Bowleys Lane

Equipment stored at the Bowleys Lane facility includes:

- 33 loadpacker trucks with a capacity of 16-20 CY
- Four pickup trucks

SW Reedbird Avenue

Equipment stored at the Reedbird Avenue facility includes:

- 28 loadpacker trucks with a capacity of 16-20 CY
- One roll-off container truck
- Six pickup trucks

SE Bowleys Lane

Equipment stored at the Bowleys Lane facility includes:

- 31 loadpacker trucks with a capacity of 16-20 CY
- Three roll-off container trucks
- Four pickup trucks

111 Kane Street

Equipment stored at the Kane Street facility includes:

- Ten front loadpacker trucks
- 17 loadpacker trucks with a capacity of 16-20 CY
- Eight loadpacker trucks with a capacity of 9 CY
- 30 ATLVs
- Two heavy truck dumpster carriers
- 40 street sweeper trucks
- 22 dump trucks with a capacity of 6-9 CY
- Two roll-off container trucks
- 12 pickup trucks/SUVs
- One flatbed trailer
- Four skid steer loaders
- One industrial forklift

S Hanover Street

Equipment stored at the Hanover Street facility includes:

- Six roll-off container trucks

IH Wells Street

Equipment stored at the Wells Street facility includes:

- Two loadpacker trucks with a capacity of 16-20 CY
- Four pickup trucks

Marine Operations

Equipment stored for marine operations includes:

- Two pickup trucks
- Seven boat trailers
- One flatbed trailer
- Two pier conveyors
- Seven boats (ranging from 14-ft to 17-ft)
- Four marine skimmers

Cleaning and Boarding

Equipment stored for cleaning and boarding operations includes:

- Two heavy dump trucks
- One Heavy hook lift truck
- One large farm tractor
- Eight trash pickup trucks
- 42 dump trucks
- Two roll-off container trucks
- 38 pickup trucks/SUVs
- 19 non-driven two-axle flat trailers
- Three flatbed trailers
- Nine non-driven tilt trailers (ranging from 20-ft to 24-ft)
- 16 skid steer loaders
- One 2-3 CY backhoe
- One industrial forklift
- Five tractors
- One walk-behind mower
- 32 deck mowers
- One brush cutter
- Two portable wood/brush chippers

Costs

The City reported spending $29,071,708 on solid waste collection in Fiscal Year (FY) 2018. This includes costs associated with curbside collection of trash and recycling ($24,607,698), bulk trash collection ($1,009,303), collection from condominiums ($1,525,571), and the municipal can program ($1,929,136).

In FY 2018, the City reported spending $23,691,934 on public right-of-way cleaning. This includes costs associated with marine operations ($1,308,027), cleaning of business districts ($2,932,009), street and alley cleaning ($12,724,304), mechanical sweeping ($4,476,356), graffiti removal ($789,778), rat control ($1,028,237), and casino support and sanitation services ($433,223).

Revenue

The City does not currently charge a separate collection fee for curbside trash or recyclables. Instead, the solid waste program (including

collection) is funded through the City's general fund. As such, there are no revenues directly associated with collection of waste or recyclables in the City.

Recycling Operations

Equipment

There is no equipment specific to recycling operations in the City. All equipment used for recycling is listed under collection and disposal and transfer operations.

Costs

The City currently pays WMRA to accept SSR recyclables from DPW's curbside collection and residents' drop-offs. In 2017, the City paid a total of $561,702 for recycling at WMRA for an average effective tip fee of $26.07 per ton. From January through May of 2018, the City paid $579,669 to WMRA for recycling of SSR for an effective tip fee of $60.59. This dramatic increase in the effective tip fee is the result of the crash in the U.S. recycling market caused by China's implementation of its National Sword policy to limit acceptance of secondary material imports to loads with very low levels of contamination.

The City currently pays eRevival $0.27 per pound ($540 per ton) to recycle all electronic equipment collected in the City. In 2017, DPW exported about 86 tons of electronics for recycling under its former contracts with UNICOR and CyclePoint.

In FY 2018, the City spent approximately $107,000 to operate Camp Small ($72,000 for labor, $35,000 for a removal contract). During the same time period, revenues from Camp Small included $8,200 in sales to residents, $2,900 in donations, and $122,000 in direct savings to the City via donations of finished lumber from Camp Small to City projects.

In FY 2018, the City paid $465,056 for administration of Baltimore's recycling programs.

Revenue

The City did not report receiving any revenue from its recycling programs in FY 2017 or FY 2018.

Disposal and Transfer Operations

Equipment

A list of equipment used at QRL and NWTS is provided below:

- One tracked front-end loader
- One fuel tanker
- One off-road dump truck with capacity of 26-30 tons
- One seeder truck
- Three dump trucks with capacity of 12-14 CY
- 17 tractors
- One tanker truck
- Six pickup trucks/SUVs
- Two non-driven flat one-axle trailers
- Ten flatbed trailers
- 15 waste trailers
- Three tracked loaders
- Three rubber tire loaders
- One skid steer loader
- Two tracked bulldozers

Category	Cost	Revenue
Collection Services		
Curbside collection	$24,607,698	
Bulk trash collection	$1,009,303	
Collection from multi-family homes	$1,525,571	
Public right-of-way cleaning	$20,327,831	
Subtotal	**$47,470,403**	
Recycling Operations		
SSR recyclables*	$561,702	
Electronics	$90,365	
Wood waste (Camp Small)	$107,000	$133,100
Administration	$465,056	
Subtotal	**$1,224,123**	**$133,100**
Disposal and Transfer Operations		
Disposal at BRESCO	$8,541,613	
Tip fees for BRESCO ash*		$1,685,977
QRL operations	$4,972,702	
QRL closure/post-closure fund	$884,562	
QRL capital projects	$1,594,933	
QRL tip fees*		$374,482
NWTS operations	$1,715,269	
Disposal of HHW	$171,976	
Small hauler program fees*		$1,278,613
Subtotal	**$17,881,055**	**$3,339,072**
TOTAL	**$66,378,216**	**$3,339,072**

Note: This cost summary does not include revenues or costs incurred by the City for recycling waste oil, scrap metal, or tires, for which data were not available.

Summary of Direct Costs and Revenues for Solid Waste Management

(2018 data, except where marked with an asterisk *2017 Data)

- One 2-3 CY backhoe with loader
- Two trash compactors
- One farm tractor
- One light tower

Costs

In FY 2018, the City reported spending $16,996,493 for solid waste disposal. This includes disposal of mixed refuse at BRESCO ($8,541,613); QRL operations ($4,972,702), capital projects ($1,594,933), and closure/post-closure fund ($884,562); operations at NWTS ($1,715,269); and household hazardous waste (HHW) disposal ($171,976).

Revenue

QRL Tip Fees

In FY 2017, the City reported approximately $374,482 in tip-fee revenue from QRL. It is assumed this is for large private haulers only and excludes fees from the small hauler program, which are tabulated separately.

Small Hauler Program Fees

In 2017, the City reported approximately $1,278,613 in revenue from the small haulers program. This includes $846,392 from small haulers at QRL and $432,221 collected from small haulers at NWTS.

Revenues from BRESCO

In 2017, the City received $1,685,977 in tip fees at QRL for disposal of incineration ash generated at BRESCO. Additionally, the City received a number of other payments from BRESCO in 2017, including $1,802,435 in property taxes, $1,630,150 for site lease payments, and $2,415,385 in host fees (community fee and city surcharge).

7. ALTERNATIVE SYSTEMS AVAILABLE TO THE CITY

Multiple waste disposal and processing facilities within the City and in nearby jurisdictions are potentially available for use by the City's solid waste management system (both the private and public systems).

Processing and Disposal Facilities within the City

A summary description of the active processing and disposal facilities within the City was provided in Section 5. Many of these facilities are owned and operated by the City (e.g., QRL, NWTS, Camp Small, and the residents' drop-offs), or are already employed by the City for waste processing or disposal (e.g., BRESCO, BCCF, and BRPF). The remaining private facilities (e.g., Lot 15, BRC, and L&J) are likely already used by commercial entities in the City. These facilities could potentially be used by DPW for waste processing and/or disposal subject to addressing potential permitting restrictions, costs, and other issues.

Processing and Disposal Facilities within a Three-Hour Truckshed

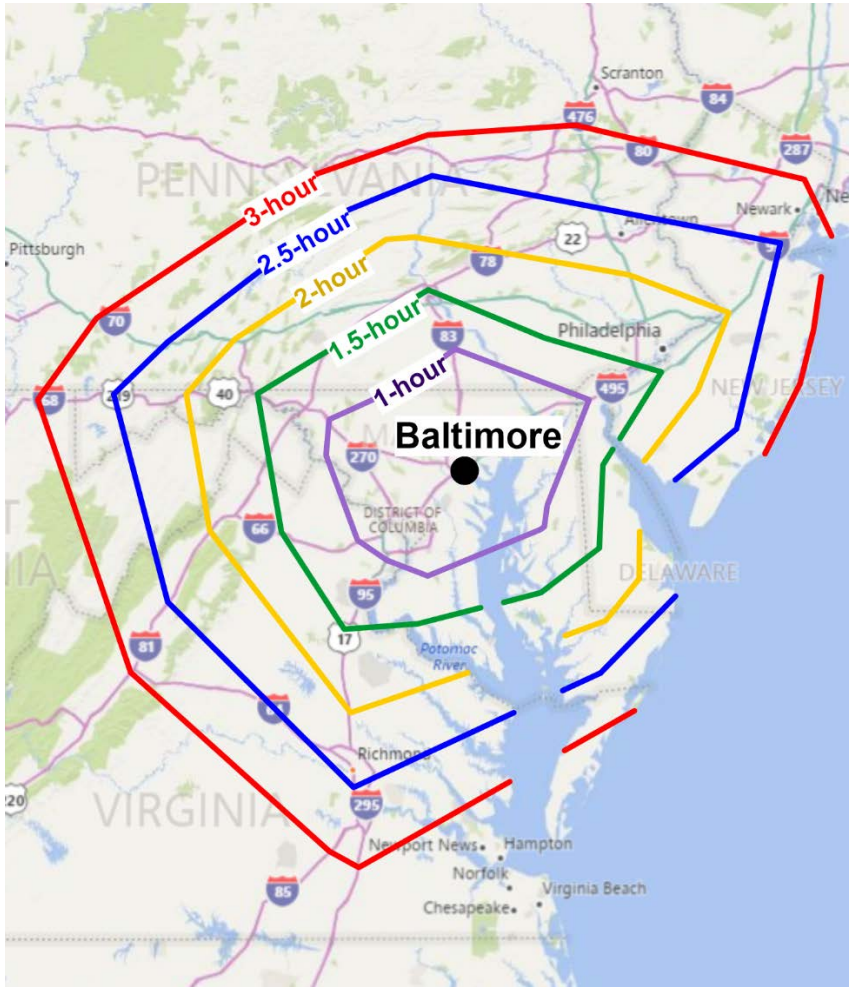
The scope of work for Task 3 includes identifying waste processing and disposal facilities located within a three-hour truckshed of Baltimore City. To address this, Geosyntec began by developing drive time polygons around the City. Then, the average driving speed of a fully loaded truck was used to choose the drive time polygon most closely representing a three-hour truckshed from the City. Finally, research was conducted (predominantly through state agencies and the EPA) to identify the waste disposal facilities located within the three-hour truckshed. Specific data for each facility (e.g. capacity, expected closure year, waste types accepted, etc.) were recorded for each facility (where available) and uploaded into a Microsoft Excel spreadsheet database. The 3-D Map tool feature in Excel was used to create an interactive online map from the database (available as Appendix 2).

Development of Drive-Time Polygons

Drive-time polygons were developed using the software package Maptive, an online program used to develop custom Google Maps using spreadsheet data. The drive-time polygon tool in Maptive generates polygons of constant drive time from an input origin point using Google Maps drive time data. This tool was used to generate drive-time polygons corresponding to 1-hour, 1.5-hour, 2-hour, 2.5-hour, and 3-hour driving distances from Baltimore. BRESCO was used as the point of origin for this analysis because it is currently the location at which the majority of Baltimore's waste is disposed.

Selection of Drive-Time Polygons Corresponding to Expected Truck Travel Speeds

According to a 2017 report by the Federal Highway Administration, the average operating truck speed on U.S. interstates in the mid-Atlantic region (i.e., between Washington, D.C., Philadelphia, and New York) was 54.9 miles per hour. Drive-time polygons were generated by Maptive using the current posted speed limit of 65 mph on Interstate Highways and 55 mph on state or national highways. Therefore, the drive-time polygons are conservative in terms of ensuring capture of facilities within the designated truckshed (i.e., it may take a truck slightly longer than three hours to reach a facility at the edge of the three-hour polygon).



Drive-Time Polygons Representing Trucksheds around Baltimore City

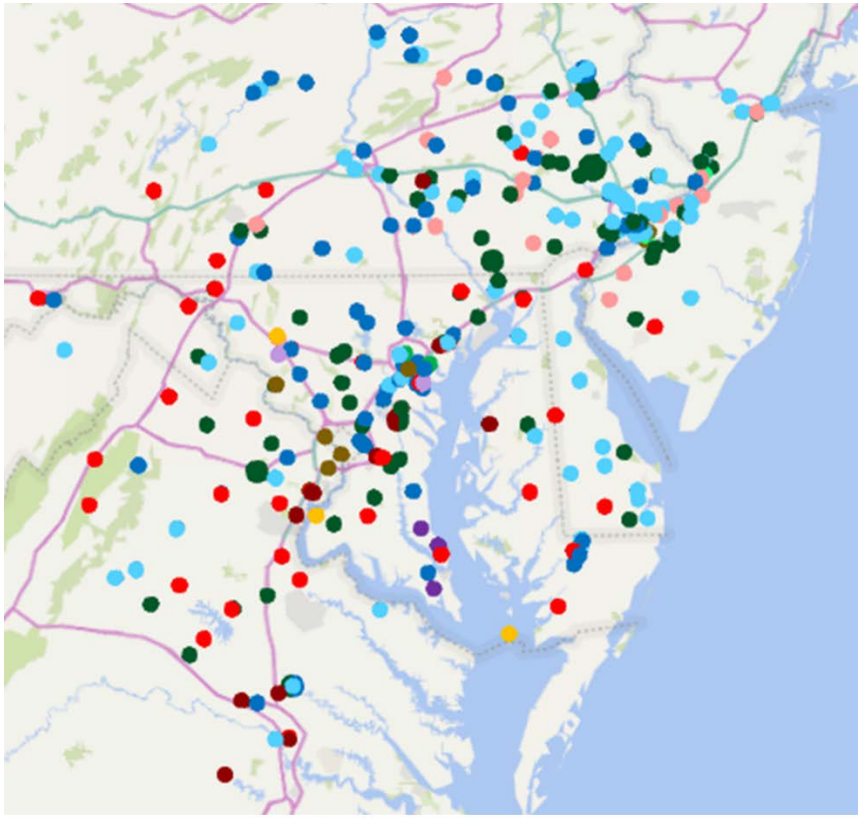
Development of a Processing and Disposal Facility Database Tool

Portions of Maryland, Virginia, Washington D.C., West Virginia, Pennsylvania, Delaware, and New Jersey fall within the three-hour truckshed from Baltimore. Information from these states' environmental agencies as well as data from the U.S. EPA was used to develop an Excel database of solid waste processing and disposal facilities that fall within the three-hour truckshed. Each facility was assigned metadata reflecting:

1. Latitude and longitude;
2. Type (e.g. landfill, transfer station, compost facility, etc.);
3. Ownership type (e.g. municipal, state, federal, private);
4. Status (e.g. open, closed, planned); and
5. Designation as to whether it falls within each of the drive-time polygons identified (i.e. 1-hour, 1.5-hour, etc.).

The size, capacity, expected closure date, and material types accepted at each facility were added for those facilities where this information was available. **The database tool is included as Appendix 2.** Sources of data are listed in tool, along with instructions on how to use the tool to access an interactive map of the facilities within the truckshed. Users may customize the map to show facilities of interest (e.g., all private facilities, all landfills within a 2.5-hour drive, all composting facilities, etc.).

In total, 352 facilities were identified within the three-hour truckshed. Of these, 215 are privately owned, while 137 are owned by a government or government-affiliated agency. The list of facilities includes a total of 12 incinerators, 93 landfills, 85 transfer stations, 79 MRFs, and 81 organics processing facilities (including 77 compost facilities and 2 anaerobic digestors). Available details on materials processed vary by state.

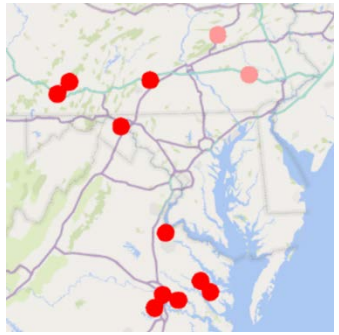


Waste Disposal and Processing Facilities within a Three-Hour Truckshed of Baltimore City

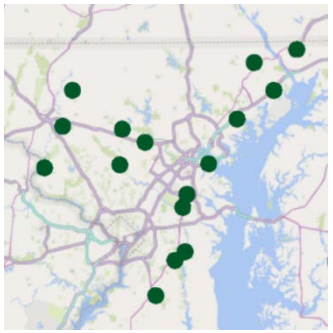
Abbreviations shown on the map include municipal solid waste (MSW), construction and demolition debris (C&D), land clearing debris (LCD), waste to energy (WTE), and anaerobic digestion (AD).

As examples of the tool's utility:

1. Setting the filters to show only MSW and MSW+C&D landfills within a three-hour truckshed that are privately operated and have at least five million tons or cubic yards of remaining capacity yields 12 landfills, including five in Pennsylvania (Commonwealth Env. Systems, Conestoga, Cumberland County, Mostoller, and Shade); six in Virginia (Charles County, King and Queen, King George County, Middle Peninsula, Old Dominion, and Shoosmith); and one in West Virginia (LCS Service).



2. Setting the filters to show all operating and planned organics composting facilities within a one-hour truckshed with annual capacity in excess of 10,000 tons or cubic yards yields 16 facilities, including Veteran Compost, Aberdeen (20,000 tons/year), Veteran Compost, Lothian (20,000 tons/year); and Prince George's County Organics Compost Facility (69,000 tons/year).



8. PLANNED AND FUTURE PROGRAMS

Source Reduction and Recycling Plans

The City has multiple planned source reduction, recycling, and waste diversion programs. Many of these programs are outlined in the Baltimore Food Waste and Recovery Strategy and the Baltimore Sustainability Plan, which were prepared by the Baltimore Office of Sustainability.

Baltimore Food Waste and Recovery Strategy

The Baltimore Food Waste and Recovery Strategy (BFWRS) was published in 2018 by the Baltimore Office of Sustainability in partnership with the Institute for Local Self-Reliance. In addition to presenting the reasons to reuse edible food and compost non-edible food waste, the BFWRS highlights seven local case studies and sets goals and strategies for recovering food waste in the City. The ten major goals outlined in BFWRS are as follows, with a target date of 2040 in each case:

1. Reduce commercial food waste in the City by 50%;
2. Eliminate all food waste from higher education institutions;
3. Divert 90% of food and organic waste generated by Baltimore City Government agencies from landfill or incineration;
4. Reduce household food waste in Baltimore by 80%;
5. Ensure all Baltimore City residents have access to organic waste collection at home or in their neighborhoods;
6. Divert 80% of residential food and organic waste from landfill or incineration;
7. Create composting and anaerobic digestion facilities capable of processing all the City's organic waste;
8. Support the food waste diversion market by ensuring an adequate supply of organic waste is being diverted to compost and anaerobic digestion facilities;
9. Attain 90% food and recyclable waste diversion in City K-12 schools; and
10. Create a supportive culture for food waste reduction and diversion in K-12 students, faculty, and staff.

To meet the above goals, BFWRS outlines over 60 short, medium, and long-term strategies to be implemented by the City, many of which will require significant funding to be approved by the City Council.

Baltimore Sustainability Plan

The Baltimore Sustainability Plan (BSP) was published in 2019 by the Baltimore Office of Sustainability. The BSP outlines a zero-waste strategy for the City and presents three major goals, with associated action items:

1. Increase the amount of trash that is diverted from QRL and BRESCO to recycling programs. Specific action items include providing free recycling bins to all City residents, launching an anti-litter, pro-recycling campaign, and creating and implementing a zero-waste plan.
2. Expand the City's Waste to Wealth Initiative (see below). Specific action items include implementing the BFWRS, siting a local compost facility, and revising codes/creating ordinances to eliminate waste and encourage reuse of deconstructed building materials.

3. Pursue legislative and policy changes to reduce the waste stream. Specific action items include imposing a fee for plastic bags, creating a city government procurement committee to incentivize source reduction, and developing a plan for a "Save as You Throw" program.

Meeting the above goals will require funding to be approved by the City Council as well as deviation from DPW's current funding mechanisms (e.g., provision of collection services from the City's general fund).

Waste to Wealth Initiative

The Waste-To-Wealth Initiative was developed by the Baltimore Office of Sustainability to help grow businesses in Baltimore City while reducing overall waste generation. The initiative seeks ways to support local businesses that are using waste (secondary materials) to make products rather than primary (virgin) materials. The vision is for these businesses to support creation of the stable middle-class jobs needed for the City to grow by 10,000 families in accordance with the goal established by then-Mayor Rawlings-Blake in 2012 and maintained by Mayor Pugh.

The initiative acknowledges that while several businesses in Baltimore have already engaged in innovative reuse and repurposing strategies for a wide variety of secondary materials, they need support from the City. By fostering businesses that seek to capture value from secondary materials before they enter the waste stream, it is hoped the City can stimulate job creation, combat blight, and encourage resident-led greening efforts revitalize City neighborhoods. The initiative is designed to do this by targeting three high-value, primarily non-residential wastes that comprise a significant portion of waste generated in the City:

1. Food waste, of which it is estimated that the City generates nearly 100,000 tons annually;
2. C&D debris, which makes up over 40% of the City's overall waste stream; and
3. Wood waste, which makes up only 6% of the City's overall waste stream but offers significant potential for high value reuse.

Climate Change Adaptation and Resilience

To mitigate the severity of future impacts due to climate change, and to adapt to known risks facing a low-lying coastal region, the City is working to instill resilience into vulnerable systems and infrastructure. In addition to a multitude of ongoing projects and initiatives, two plans have been created that focus on mitigation and adaption strategies:

1. Climate Action Plan (CAP). The CAP was developed by the Office of Sustainability in 2012 to reduce the City's greenhouse gas emissions through a range of strategies targeted at reducing consumption of fossil fuels.
2. Disaster Preparedness and Planning Project (DP3). The DP3 was created in 2013 by the Department of Planning as an effort to address existing hazards while simultaneously preparing for predicted hazards due to climate change. An update to the DP3 was conducted in 2018.

In both cases, public services such as solid waste management are vulnerable to changing climate patterns but also offer solutions.

Future Regulations and Ordinances

As of May 2019, no new regulations or ordinances directly affecting or regulating solid waste management in Baltimore City are planned.

9. GROWTH PROJECTIONS

While historical trends in solid waste management in the City can help set expectations for future growth (or contraction) in the waste generation rate, demographics data related to population, businesses, and housing can often provide contrasting projections of future waste streams. However, it is important to note that such projections cannot account for potential changes in consumer behavior and waste composition that may result from increased education and outreach efforts targeted at source reduction and improved recycling, or changes in the solid waste management system (e.g., implementation of a program to require households to separate food scraps and organics for composting). The potential effects of such behavioral and programmatic changes will be considered in later stages of this master planning effort.

Projected Population, Business, and Housing Growth in the City

Population, business, and housing growth projections presented in this section are based on data from the U.S. Census Bureau as well as the Maryland Department of Planning (MDP) and the Maryland Department of Labor, Licensing, and Regulations (DLLR). The data and worksheets used in the analyses presented here are provided in Appendix 3. Published sources of data are also listed in Section 10 of this Report.

Population Growth Projections

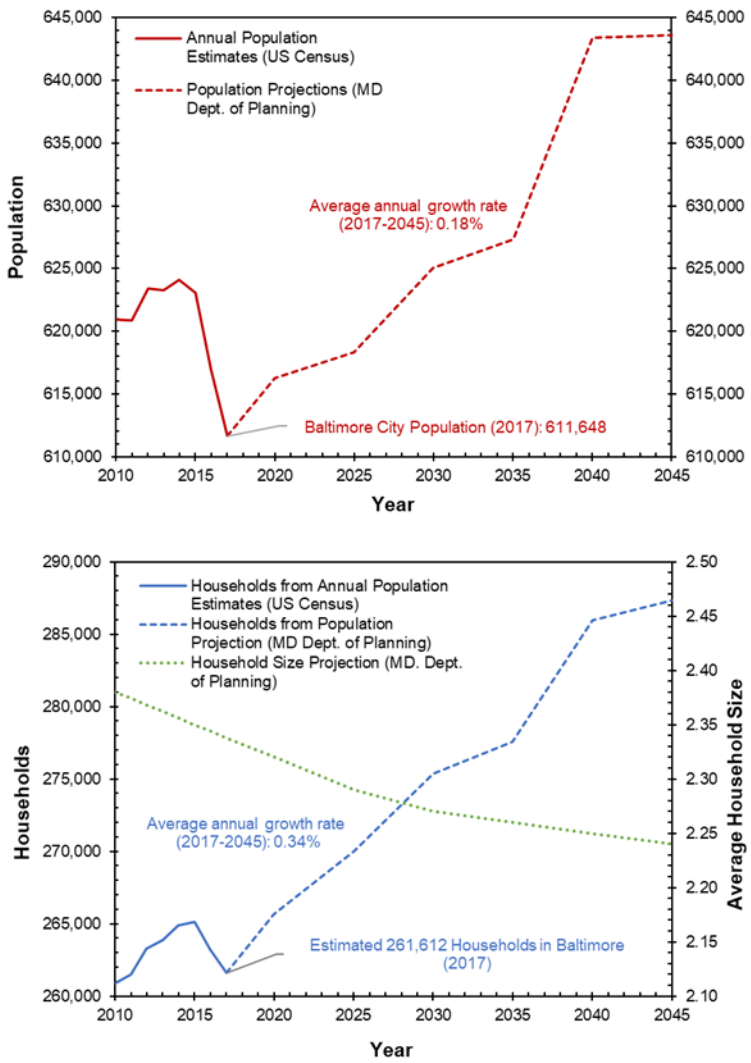
City population estimates were obtained from the U.S. Census Bureau for the period 2010 through 2017. Population projections from MDP were used to estimate growth. The City population in 2017 was estimated at about 611,600 people. Although the City has experienced a sharp decline in population since 2015, based on MDP projections it is anticipated that the population will grow reasonably steadily at an average annual rate of 0.18% through 2045, as shown in the chart overleaf.

Housing Growth Projections

Housing growth in Baltimore is estimated using the population estimates obtained from the U.S. Census Bureau coupled with population and household size projections from MDP. As of 2017, there were an estimated 261,600 households in the City, down from a recent peak of about 265,000 households in 2015. Based on MDP projects, it is anticipated that the number of households in the City will grow reasonably steadily at an average annual rate of 0.34% through 2045, as shown in the chart overleaf. Note that the data do not differentiate between type of homes (e.g., single family homes versus condominiums/apartments or rowhomes/duplexes). However, the average household size is projected to fall steadily to below 2.25 people/household in 2045.

Business Growth Projections

Business growth projections were obtained from DLLR. In the most recent analysis available, which was published in 2014, it was estimated that 27,459 new jobs would be added in Baltimore City between 2014 and 2024, for an average annual increase of 0.77%. Most job growth was expected to occur in healthcare, educational services, government, and transportation and warehousing. The only industries expected to experience declines in the number of people employed were manufacturing and other services (excluding government).



Baltimore Population and Housing Projections

Industry	Persons Employed (2014)	Average Annual Growth
Agricultural, Forestry, Fishing and Hunting	4	0.00%
Manufacturing	11,437	-0.50%
Wholesale Trade	7,781	0.51%
Retail Trade	16,919	0.29%
Transportation and Warehousing	14,266	1.73%
Information	4,258	0.26%
Finance and Insurance	11,274	1.03%
Real Estate and Rental and Leasing	4,866	0.51%
Professional, Scientific, and Technical Services	19,992	1.20%
Management of Companies and Enterprises	2,150	2.92%
Administrative and Support Services	21,647	1.07%
Waste Management and Remediation Services	1,092	0.51%
Educational Services	46,131	0.74%
Healthcare and Social Assistance	74,671	1.29%
Arts, Entertainment and Recreation	6,320	0.37%
Accommodation and Food Services	22,753	0.57%
Other Services (Except Government)	10,731	-0.71%
Postal Service	2,172	-3.91%
Government	66,038	0.49%
TOTAL	**344,502**	**0.77%**

Projected Employment Growth in Baltimore by Industry

Projected Waste Stream Growth

Waste stream growth projections are based on expected population growth, business growth, coupled with historical trends in solid waste generation observed over the past ten years (i.e., 2008 to 2017, the last year for which compete waste records are available). Historical waste tonnages were obtained from the MDE Solid Waste Management and Diversion Reports (see list of references in Section 10). Data worksheets used in this analysis are provided in Appendix 1.

Total Waste

Historical data from 2008 through 2017 show that total waste generation (i.e., MRA and non-MRA waste) has grown at an average annual rate of 0.68% over this ten-year period. This is higher than the projected long-term growth in City population (0.18%) and households (0.34%), but slightly lower than expected job growth through 2024 (0.77%). In the interests of conservatism, it is therefore anticipated that total waste growth will continue to grow at 0.68% in the future. This more closely reflects expected growth in the business rather than residential sector.

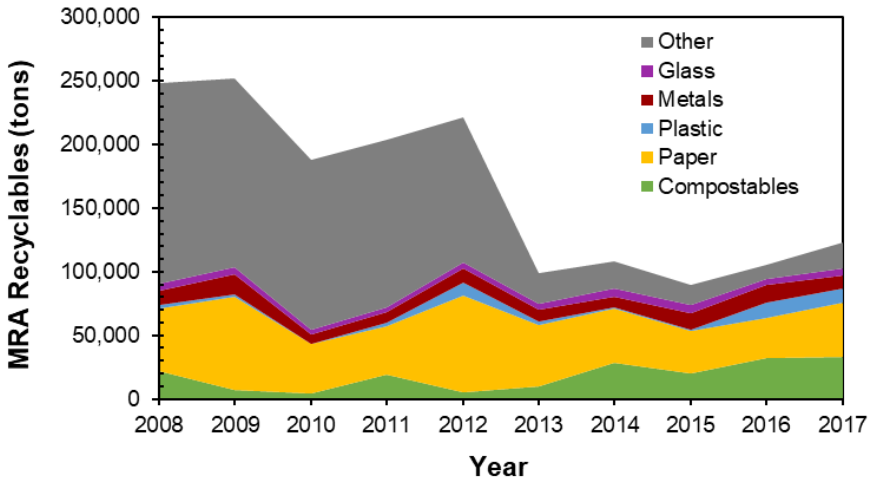
MRA Waste

Over the past ten years, MRA waste tonnages have been relatively stagnant and have even declined slightly in the last 10 years. This is most likely due to the relatively stagnant growth in the City's population through 2015 and a decline thereafter. Because of the nature of MRA waste (predominantly residential and commercial refuse), it is likely that tonnages will mirror growth in population and businesses in the City. Projected population growth is expected to be 0.18% annually, while business growth is expected to grow at approximately 0.77% annually.

Assuming that half of MRA waste is commercial and half is residential, it is estimated that MRA waste tonnage will grow at approximately 0.48% annually (average of population and business growth).

MRA Recyclables

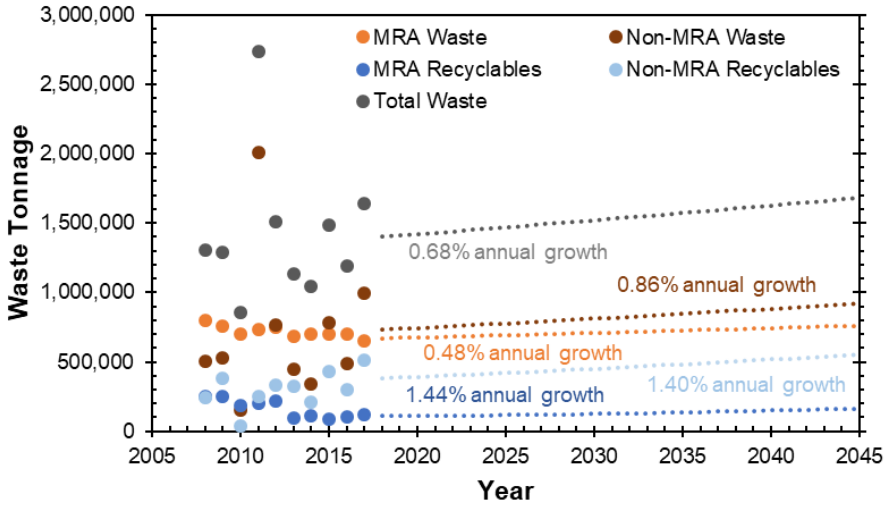
Based on historical averages, collection of MRA recyclables is expected to grow at roughly 1.44% annually. Trends observed over the past ten years of data (see chart below) include roughly stagnant growth in glass and metals, slightly declining mixed paper, and increased collection of compostables. It is anticipated that these trends will continue, particularly the increase in compostables as the BFWRS is implemented. Collection of other MRA recyclables has also remained relatively constant since 2013 (prior to 2013, MDE allowed a larger range of materials to be counted within this category).



Historical Trends in MRA Recyclables in Baltimore

Non-MRA Waste

Growth of non-MRA waste is estimated based on the projected growth in total waste excluding MRA waste. Based on this, it is estimated that non-MRA waste will grow at 0.86%. A higher growth rate is expected for non-MRA waste than for MRA waste mainly because of the expected increase in C&D waste generation in the City. Baltimore currently has nearly 17,000 vacant properties that will require demolition, deconstruction, or significant renovation to accommodate expected population and business growth. This work has already started in some neighborhoods, as is evident in the City's waste stream data. Ongoing demolition and renovation activities are thus expected generate a significant amount of C&D waste in the short and medium term.



Waste Tonnage Projections in Baltimore (above)

Non-MRA Recycling

Over the past ten years, the recycling rate for non-MRA waste fluctuated significantly from a low of 12.6% in 2011 to a high of 72.5% in 2013. However, the overall trend is a slight increase in the non-MRA recycling rate with time. It is expected that this trend will continue in the future, with non-MRA recyclable tonnages increasing at approximately 1.40% per year annually.

Drop-Off Container at NWTS in January 2019 (right)

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