Fairfax County Waste Characterization Study

JULY 2024

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COMMISSIONED BY:

Fairfax County, Virginia

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BACKGROUND AND PURPOSE

This report develops single family residential, commercial, and overall municipal solid waste (MSW) composition estimates for waste disposed within Fairfax County, Virginia, to aid in the development of a zero waste plan for Fairfax County.

Single family residential waste refers to trash collected curbside from single family detached and attached housing (such as townhomes). Commercial waste refers to trash collected from businesses and institutions including office buildings, schools, and retail establishments. Multi-family housing refers to residential units in multi-level buildings which may or may not include commercial on the ground level.

RRS/CDM Smith (the Project Team) conducted the spring 2024 sampling event at the I-66 transfer station over a 5-day period from April 8 – April 12, 2024. A total of 87 waste samples from the single family residential and commercial waste sector were hand-sorted and characterized, and an overall waste characterization of municipal solid waste collected in compaction vehicles and compactors was developed.

Additionally, estimates of segregated construction, demolition, and bulk waste delivered to the I-66 transfer station were developed utilizing 2023 I-66 transfer station scale house data. This was combined with the waste characterization data to create an overall waste characterization to include uncompacted waste.

The following sections discuss the method used to obtain representative MSW composition estimates. This includes the study parameters, the number and allocation of samples, the solid waste facilities where sampling activities were conducted, and the basis for selecting waste samples. It also details the method for estimating segregated construction, demolition, and bulk waste delivered to the I-66 transfer station for disposal.

METHODOLOGY

This section presents a summary of the data collection methods and calculation procedures used in this study.

Sample Allocation

The 2024 Fairfax County Waste Characterization Study examined waste disposed by two distinct sectors:

1. Residential (Single-family) – residential waste primarily collected in rear and side loading trucks.
2. Commercial – waste generated by businesses and institutions, including schools, office buildings, retail, and apartment buildings, primarily collected in front-end loading trucks or compactors.

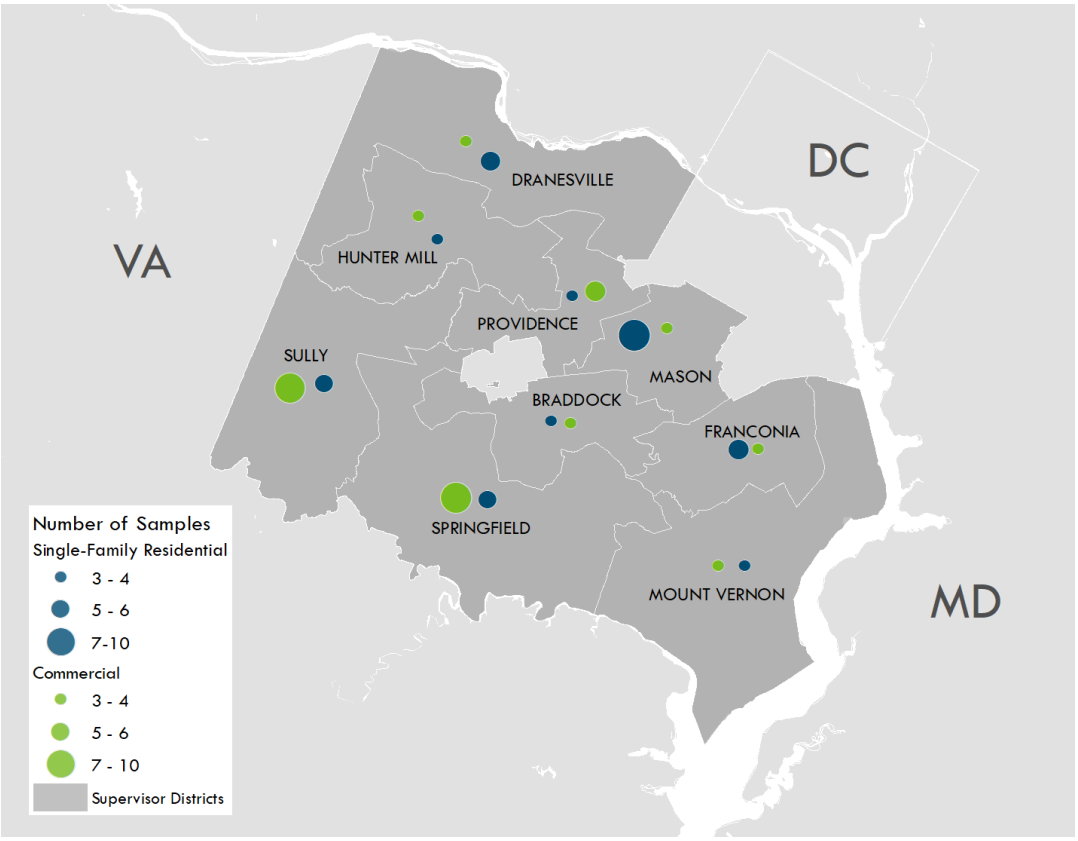
Table 1 summarizes the samples that were used to determine the composition of municipal solid waste generated by residential and commercial sectors. A total of 87 waste samples from residential and commercial waste routes that deliver waste daily to the I-66 transfer station were collected for characterization. Of the 87 samples collected, 45 were samples of commercial waste, and 42 were samples of single-family residential waste. Approximately 18,000 lbs. of waste was sorted and characterized in total. To ensure samples were representative of Fairfax County, multiple samples of residential and commercial waste were sampled from each Magisterial District, with at least 3 samples each.

Table 1 Number and Origin of Samples by Waste Sector

SAMPLING GROUP	SAMPLE COUNT		TOTAL SAMPLE WT.	MEAN SAMPLE WT.
	NO.	%	LBS.	
Single-Family Residential	**42**	**100.0%**	**8,424**	**201**
Braddock	3	7.1%	616	205
Dranesville	6	14.3%	1,226	204
Franconia	5	11.9%	1,036	207
Hunter Mill	4	9.5%	798	200
Mason	7	16.7%	1,304	186
Mt. Vernon	3	7.1%	594	198
Providence	4	9.5%	837	209
Springfield	5	11.9%	1,043	209
Sully	5	11.9%	970	194
Commercial	**45**	**100%**	**9,510**	**211**
Braddock	4	8.9%	831	208
Dranesville	4	8.9%	834	209
Franconia	3	6.7%	672	224
Hunter Mill	4	8.9%	852	213
Mason	4	8.9%	858	215
Mt. Vernon	4	8.9%	787	197
Providence	6	13.3%	1,394	232
Springfield	7	15.6%	1,449	207
Sully	9	20.0%	1,832	204
Overall Residential/Commercial	**87**	**100%**	**17,934**	**204**

Figure 1 visually depicts the origin of waste samples.

Figure 1 Number of Samples by Sector and Magisterial District



Sampling Plan

Prior to the execution of the County's Waste Characterization Study, a formal Work Plan was approved by Fairfax County's Department of Public Works and Environmental Services (DPWES) describing in detail the work required to provide a comprehensive and accurate waste composition of disposed MSW. The approved Work Plan encompassed details of the location for the waste sort, coordination with facilities, data collection methodology and quality control, sort staff, allocation of waste samples, list of equipment, contacts, and a Health and Safety Plan. The Work Plan also detailed the analysis method that would be used to determine the waste composition profiles for single family residential.

Fairfax County received permission from private haulers to conduct sampling activities on specified routes. The Project Team requested information to determine the relative mix of waste sectors that are disposed at each facility. From this information, the Project Team worked with the County staff to construct a sampling plan for the selection of vehicles at each facility. The sampling plan was developed to comply with the industry standards for conducting waste characterization studies and the American Society for Testing and Materials (ASTM) standard D5231 for samples size. All work was completed in general accordance with the approved Work Plan.

Data Collection Procedures

Fairfax County selected samples to be characterized with guidance from Project Team staff. Selected vehicles were tipped in a designated location and samples were collected from a randomly selected portion of each tipped pile. The samples consisted of approximately 200 pounds of waste and were then sorted into eight material classes (Paper, Plastics, Glass, Metals, Organics, Construction, Demolition, & Bulk (C&D), Other, and Textiles). Materials within these classes were further separated into 26 individual material categories (definitions are provided in the Appendix).

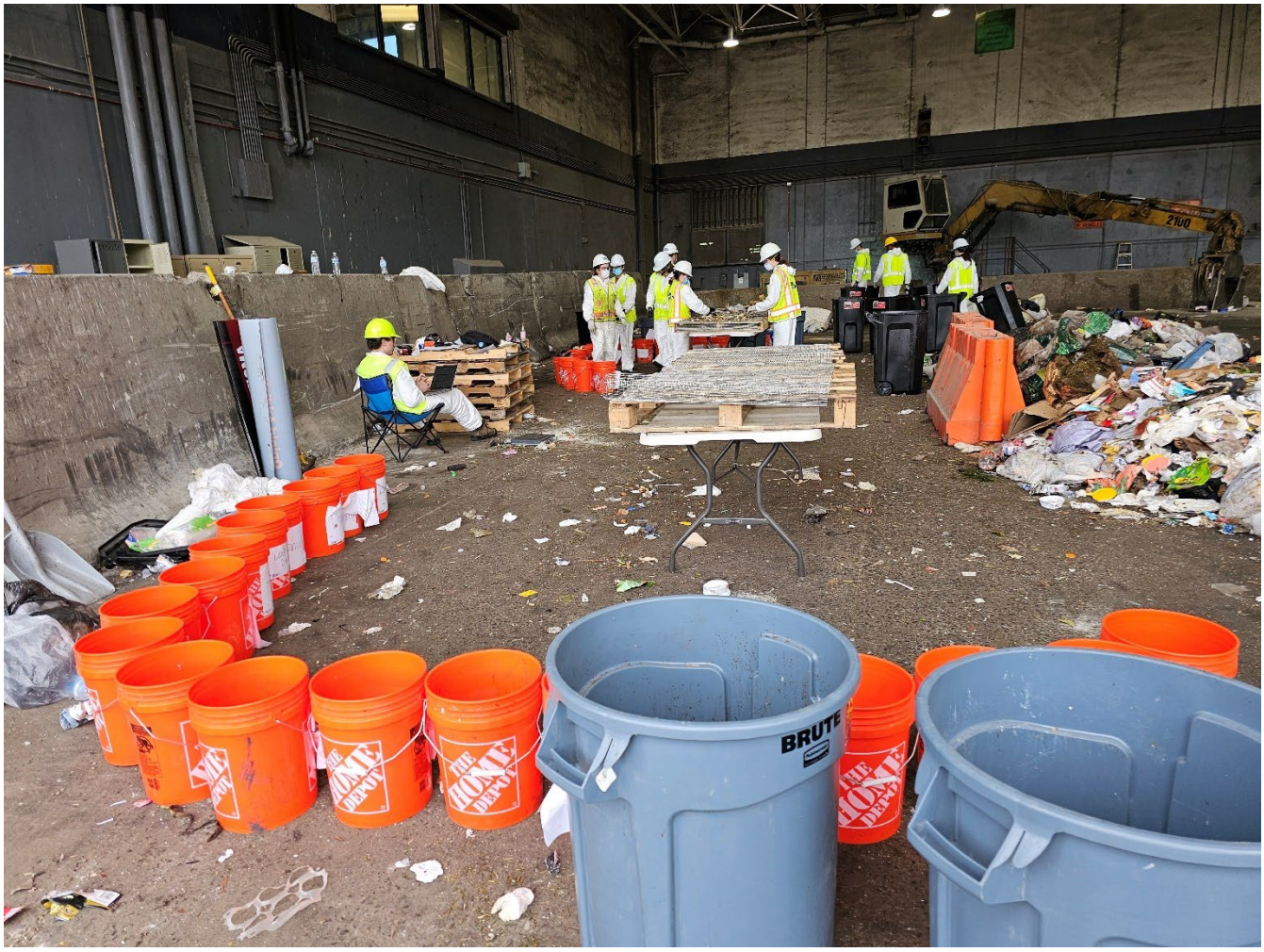
Table 2 Material Sort Categories and Examples

HIGH -LEVEL CATEGORY	SORTED CATEGORY	MATERIAL EXAMPLES[1]
PAPER	Mixed Paper	*Magazines, printer paper, cereal boxes and other paper board, discarded mail, newspaper*
	Corrugated Cardboard (OCC)	*Shipping and moving boxes, computer packaging cartons, kraft paper bags, and other kraft paper.*
	Poly coated Paper	*Aseptic packages and poly coated (gable top) cartons, coffee cups and ice cream containers.*
	Other Fiber	*Blueprints, sepia, onion skin, foiled lined fast-food wrappers, carbon paper, coated OCC, and photographs.*
PLASTIC	Polyethylene terephthalate (PET) #1 & High-Density Polyethylene (HDPE) #2 Bottles	*Soda bottles, water bottles, laundry detergent bottles, milk jugs, shampoo bottles*
	PET #1 Thermoforms	*Cups, tubs, clamshells, lids, egg cartons, berry containers*
	Polypropylene (PP) Containers #5	*Cups, tubs, lids, clamshells, takeout containers*
	Bulky Rigid Plastics	*Buckets, laundry baskets, outdoor furniture, toys*
	Other Plastics	*Polystyrene takeout containers, straws, plastic utensils, potato chip bags, candy wrappers, grain bags, shower curtains.*
	Plastic Film	*Trash bags, dry cleaning bags, bread bags, flexible food packaging, bubble wrap, Film plastic used for large-scale packaging or transport packaging, such as industrial film, wrappings and shrink wrap*
GLASS	Glass Bottles & Jars	*Whole or broken clear or colored soda, beer bottles, fruit juice bottles, peanut butter jars, mayonnaise jars, wine bottles, cosmetic jars*

[1] Full definitions of materials are in the appendix.

HIGH -LEVEL CATEGORY	SORTED CATEGORY	MATERIAL EXAMPLES
METAL	Aluminum Beverage Containers	*Aluminum soda or beer cans and some pet food cans*
	Other Aluminum	*Aluminum foil, pie plates, trays, siding, and furniture.*
	Ferrous Containers	*Canned food and beverage containers, empty metal paint cans, empty aerosol containers, and bimetal containers*
	Scrap Metal	*Metal other than items listed in other categories.* *Pots and pans, wire hangers, small appliances such as toasters and hair dryers, motors, insulated wire*
ORGANICS	Yard Waste	*Leaves, grass clippings, garden debris, pruning, shrubs, branches, woody plant material*
	Food Waste	*Discarded meat scraps, dairy products, eggshells, fruit or vegetable peels, and other food items.*
	Other Organics	*Napkins, paper towels, compostable molded fiber, fast food wrappers, animal waste, hair, sawdust*
TEXTILES	Textiles	*Carpet, carpet padding, clothing, curtains, bedding, upholstery, shoes, leather*
CONSTRUCTION, DEMOLITION & BULK (C&D)	Construction, Demolition, & Bulk	*Lumber, treated wood, concrete, brick, gypsum board, shingles, plastic or metal piping, toilets, ceramic tiles, and insulation. May also include mattresses, furniture and other bulky items not otherwise classified*
OTHER	Electronics	*Televisions, computer monitors, laptops, LCD monitors, power cords, electronic toys, speakers, keyboards, and cell phones*
	Batteries	*Non-lithium dry cell batteries and lithium batteries*
	Other/Landfill	*Air filters, garden hoses, tennis balls, disposable cleaning wipes made of fiber and plastic, used kitty litter, bags containing medical waste or bathroom waste containing feminine hygiene products*
	Bottom Fines and Dirt	Residue, sand, soil, clay, and dirt
	Diapers	Disposable baby diapers and adult protective undergarments
	Household Hazardous Waste (HHW)	Latex and oil-based paint, herbicides, pesticides, fertilizers, oil filters, automotive fluid, mercury containing items such as compact florescent light bulbs (CFLs), thermometers and thermostats, prescription medications, sharps, cleaning products, and solvents

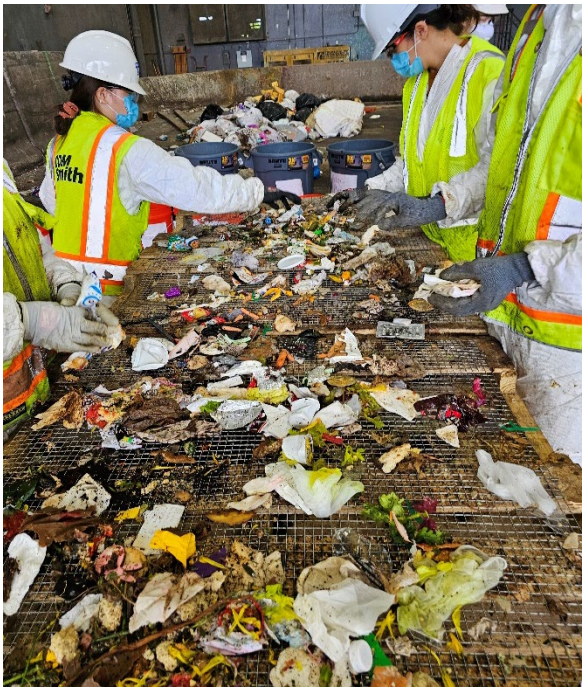
Sorting Procedure

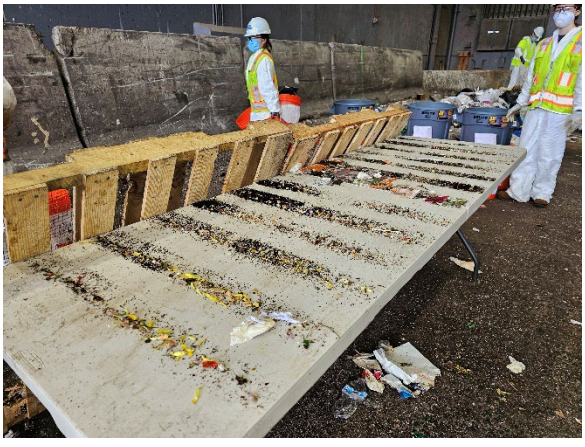


Labor

Sorting was conducted by two teams of five staff each plus two sort leadership positions. The sort team members had the following roles:

- (1) Field Manager – leads the team, communicates with County staff, selects loads for sampling, monitors quality of work, inspects sorted materials.
- (1) Crew Chief – supervises sorting, coordinates with front-end loader operator, records sample weights, monitors quality of work, inspects sorted materials.
- (10) Sorting Crew – sorting waste into designated subcategories.





The detailed sorting procedure is outlined in the approved Work Plan in the Appendix. The following section provides a high-level summary. Fairfax Department of Public Works and Environmental Services (DPWES) worked with haulers to direct selected trucks to deposit their loads for sorting. The trucks selected were based on whether they collected residential waste or commercial waste and the magisterial district where the load was collected. The County and the haulers coordinated throughout each day to identify the truck loads that would reflect the mix of samples in all districts in Fairfax County. Fairfax County staff coordinated with the I-66 scale house to identify the selected vehicles entering the facility and to record information including truck number, date and time, vehicle type, hauler name, sector, and district of origin. The driver of selected loads was instructed to tip the load onto the facility floor in an elongated pile, a loader operator then extracted a sample weighing approximately 200 pounds from the pile and moved it to the sorting area for the Project Team to sort the sample. The top photograph displays a sample being sorted on a sorting table by the project team. The middle photograph shows a container containing sorted material of just one material type being weighed from that sample. A weight was taken for each material sorted and the Crew Chief recorded the weights for each sample's material types in to matrix.

RRS provided bins and buckets to sort materials into and ensured that each was clearly labeled with the individual sort material type. Weighing all empty sort containers, the sort team obtained the empty container weight (tare weight) and recorded tare weights by container type in a data recording sheet. Samples were opened on tables with a 1/2-inch screen overlay, and items were individually sorted into their respective categories. Material was sorted properly into the correct category and placed in the corresponding container. Remaining fines and dirt which passed through the screens was collected into a separate fines container and weighed. The bottom photograph shows a picture of the fines.

Once the sample was sorted, the weight and load information associated with each sample were directly recorded into the Hand Sort Characterization Spreadsheet. One single staff person recorded all weights to maintain consistency in the record-keeping process and to ensure sorting accuracy/consistency of each bucket prior to weighing. The RRS team subtracted the weight of the empty container to derive a net weight and repeated the process for each sample.

To ensure data quality, prior to analyzing the data, a secondary review of all data recorded was conducted and checks for missing data, categories without data, suspect weights, tare weights, total sample weight, and cross-checking between RRS and FFX data for sample number, truck number, district of origin, truck type, and sector type.

Calculation Procedures

The overall approach to developing the waste composition estimates in this report was to calculate the percent composition of each material in the waste sectors as outlined in the Work Plan. Found in the appendix All composition results presented in this report were calculated at a 90% confidence interval. This means that there is a 90% probability that the material is between the mean percentage value plus or minus the confidence interval. For example, there is a 90% probability that the overall Residential/Commercial Fairfax County MSW composition of mixed paper is 7.6%, plus or minus 0.98%. Secondary checks were conducted by RRS on all calculations to ensure accuracy. Uncompacted Waste, which was not part of the sampled waste, is waste delivered to the facility as uncompacted bulky waste such as furniture, wood scrap, metals, demolition debris such as tile, framing, insulation, roofing shingles. Uncompacted Waste is counted as part of the County's total waste. When Uncompacted Waste is included in tabulated results, uncompacted waste is listed in the title of the table.

RESULTS

Results from the waste characterization study are organized into the following sections:

- Single Family Residential Waste Composition;
- Commercial Waste Composition;
- Overall Waste Composition (Residential & Commercial); and
- Overall Waste Composition, Adjusted for Uncompacted Waste.

Information for each section is presented as follows:

- Pie chart containing waste composition percent by weight by material class;
- Top ten materials in the waste stream;
- Waste composition profile with 90% confidence intervals, where applicable;
- Waste composition profile by magisterial district; and
- Waste composition profile of specific subsectors (for commercial sector only).

Single Family Residential Waste Composition

Figure 2 details the single-family residential waste composition by material class, with organics comprising ~35% of single-family residential waste.

Figure 2 Single Family Residential Waste Composition by Material Class[2]

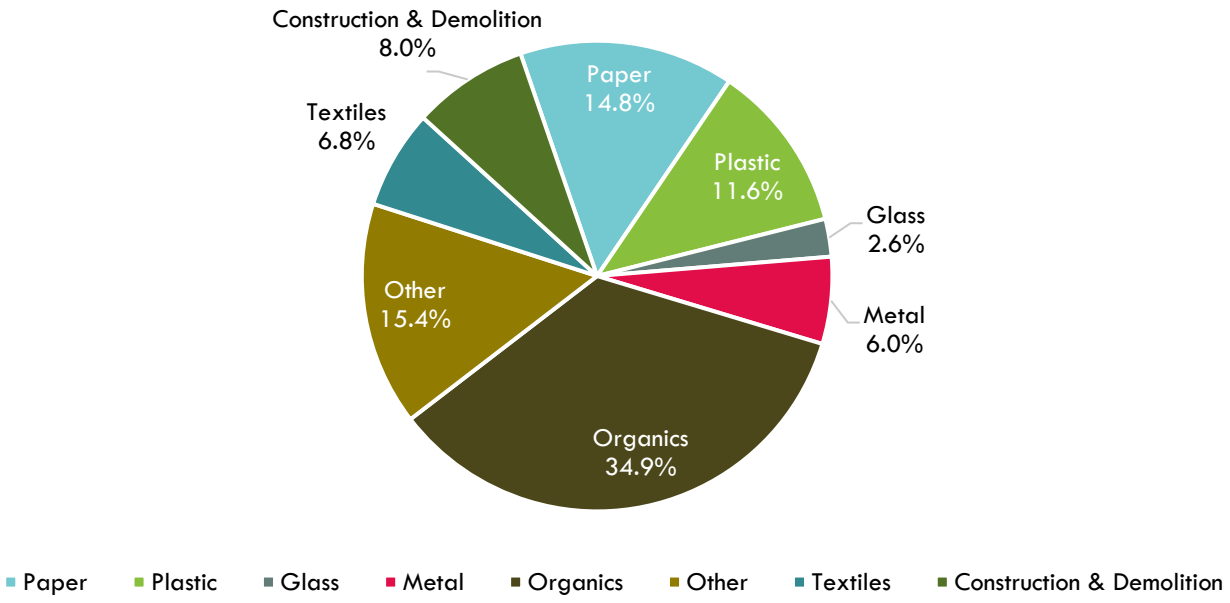


Table 3 lists the top ten material categories that were found in the residential waste sector. These ten categories account for approximately 80% of disposed single family residential waste. The top material is food waste at 17% of the single family residential disposed waste, followed by yard waste. Divertible refers to materials that can be diverted at the source and for which end markets currently exist locally. Partially divertible is used for broad material categories where some individual materials are divertible, and others are not. For example, the Plastic Film material category includes grocery carryout bags, bread bags, and dry-cleaning bags all of which can be recycled through store drop off programs. It also includes certain types of flexible food packaging, made of multiple materials, for which processing facilities are not available. And, it contains plastic trash bags which would not be feasible to recycle given their intended use.

[2] Totals may not equal 100.0% due to rounding.

Table 3 Top Ten Individual Material Categories in Single Family Residential Waste

CATEGORY	WASTE COMPOSITION %	DIVERTIBILITY
Food Waste	17.2%	Divertible
Yard Waste	13.7%	Divertible
Landfill/Other	8.1%	Not Divertible
Construction & Demolition	8.0%	Partially Divertible
Mixed Paper	7.5%	Divertible
Textiles	6.8%	Partially Divertible
Corrugated Cardboard (OCC)	5.4%	Divertible
Scrap Metal	4.7%	Divertible
Plastic Film	4.6%	Partially Divertible
Other Organics	4.0%	Partially Divertible
Total	**80.0%**[3]	

[3] 80% is the percent of the total waste composition represented by the top ten materials. The remaining ~20% is comprised of the remaining material categories. Full waste characterization can be found in other tables.

Table 4 provides a composition profile of single family residential disposed waste with percent by weight of each material item sorted and the 90% confidence interval.

Table 4 Single Family Residential Waste Composition Profile

MATERIAL CLASS	MEAN	+/-	MATERIAL CLASS	MEAN	+/-	MATERIAL CLASS	MEAN	+/-
PAPER	**14.8%**	**3.20%**	**GLASS**	**2.6%**	**0.56%**	**OTHER**	**15.4%**	**2.1%**
Mixed paper	7.5%	1.54%	Glass Containers	2.6%	0.56%	Electronics	2.1%	0.86%
Corrugated Cardboard (OCC)	5.4%	2.20%	**METAL**	**6.0%**	**1.93%**	Batteries	0.1%	0.03%
Poly coated Paper	1.5%	0.25%	Aluminum Beverage Containers	0.4%	0.10%	Other/Landfill	8.1%	1.67%
Other Fiber	0.3%	0.20%	Other Aluminum	0.5%	0.10%	Fines	1.0%	0.36%
PLASTIC	**11.6%**	**1.24%**	Ferrous Containers	0.4%	0.09%	Diapers	3.2%	0.91%
PET, HDPE Bottles & Jars	1.4%	0.21%	Scrap Metal	4.7%	1.94%	Household Hazardous Waste (HHW)	1.0%	0.43%
PET Thermoforms	0.5%	0.10%	**ORGANICS**	**34.9%**	**4.1%**	**CONSTRUCTION, DEMOLITION & BULK**	**8.0%**	**2.88%**
Polypropylene	0.6%	0.11%	Yard Waste	13.7%	3.30%	**TEXTILES**	**6.8%**	**1.67%**
Bulky Rigid Plastics	1.7%	0.60%	Food Waste	17.2%	3.55%			
Other Plastics	2.8%	0.55%	Other Organics	4.0%	0.61%			
Plastic Film	4.6%	0.67%						

SINGLE FAMILY RESIDENTIAL WASTE COMPOSITION BY MAGISTERIAL DISTRICT

Table 4 compares single family residential disposed waste composition by magisterial district of origin. This table is included to assist in the development of target education and outreach and/or increasing access to drop off locations for specific materials to address specific waste streams.

Note that while total waste data for residential and commercial sectors is statistically significant, district level data is not due to the minimal number of samples for each district. In table 5, "N" equals the number of samples characterized. Significant differences between districts could be due to demographics such as resident age, size of household, cultural practices, as well as renovation activity due to neighborhood age, etc. Comparison to peer communities by material class are in exhibit 10 of the task 2 report.

Table 5 Single Family Residential Waste Composition by Magisterial District

Material Class	County Avg. (n=42)	Braddock (n=3)	Dranesville (n=6)	Franconia (n-5)	Hunter Mill (n=4)	Mason (n=7)	Mt. Vernon (n-3)	Providence (n=4)	Spring-field (n=5)	Sully (n=5)
PAPER	**14.8%**	**15.9%**	**11.0%**	**21.8%**	**30.0%**	**10.8%**	**14.3%**	**13.7%**	**6.0%**	**14.6%**
Mixed Paper	7.5%	4.7%	6.1%	11.7%	13.5%	6.3%	7.3%	6.9%	2.3%	9.5%
Corrugated Cardboard (OCC)	5.4%	8.6%	3.1%	8.3%	14.3%	3.1%	3.9%	5.6%	2.2%	3.3%
Poly coated Paper	1.5%	2.2%	1.5%	1.7%	1.4%	1.3%	1.6%	1.2%	1.4%	1.7%
Other Fiber	0.3%	0.4%	0.2%	0.1%	0.8%	0.1%	1.5%	0.1%	0.1%	0.1%
PLASTIC	**11.6%**	**12.2%**	**12.2%**	**15.2%**	**9.3%**	**9.4%**	**14.7%**	**12.2%**	**10.9%**	**9.7%**
PET, HDPE Bottles & Jars	1.4%	1.1%	1.1%	2.3%	1.7%	1.3%	1.2%	1.2%	1.3%	1.3%
PET Thermoforms	0.5%	0.5%	0.3%	0.6%	0.9%	0.7%	0.1%	0.7%	0.5%	0.1%
Polypropylene	0.6%	0.5%	0.8%	0.8%	0.4%	0.5%	0.9%	0.7%	0.4%	0.9%
Bulky Rigid Plastics	1.7%	3.2%	1.6%	3.1%	1.1%	0.3%	0.7%	1.5%	3.2%	0.7%
Other Plastics	2.8%	2.1%	3.5%	3.4%	2.6%	2.5%	5.7%	1.3%	2.2%	2.1%
Plastic Film	4.6%	4.8%	4.9%	5.0%	2.7%	4.1%	6.1%	6.8%	3.3%	4.6%
GLASS	**2.6%**	**1.1%**	**3.5%**	**2.8%**	**3.6%**	**2.7%**	**2.9%**	**3.3%**	**1.3%**	**1.9%**
Glass Containers	2.6%	1.1%	3.5%	2.8%	3.6%	2.7%	2.9%	3.3%	1.3%	1.9%

MATERIAL CLASS	COUNTY AVG. (N=42)	BRADDOCK (N=4)	DRANESVILLE (N=4)	FRANCONIA (N-3)	HUNTER MILL (N=4)	MASON (N=4)	MT. VERNON (N-4)	PROVIDENCE (N=6)	SPRINGFIELD (N=7)	SULLY (N=9)
METAL	**6.0%**	**10.5%**	**6.3%**	**5.0%**	**4.0%**	**3.0%**	**3.7%**	**5.4%**	**15.0%**	**1.6%**
Aluminum Beverage Containers	0.4%	0.6%	0.3%	0.7%	0.6%	0.2%	0.4%	0.3%	0.3%	0.3%
Other Aluminum	0.5%	0.3%	0.4%	0.7%	0.4%	0.4%	0.8%	0.6%	0.6%	0.5%
Ferrous Containers	0.4%	0.7%	0.5%	0.5%	0.4%	0.4%	0.3%	0.4%	0.3%	0.1%
Scrap Metal	4.7%	8.8%	5.1%	3.1%	2.7%	2.0%	2.2%	4.1%	13.9%	0.7%
ORGANICS	**34.9%**	**41.9%**	**36.4%**	**28.8%**	**31.3%**	**44.8%**	**26.9%**	**33.4%**	**35.3%**	**30.7%**
Yard Waste	13.7%	22.9%	17.0%	10.1%	11.2%	13.1%	2.5%	10.8%	22.9%	9.7%
Food Waste	17.2%	15.3%	14.7%	12.9%	16.6%	27.9%	20.0%	17.9%	10.4%	17.3%
Other Organics	4.0%	3.7%	4.7%	5.7%	3.5%	3.8%	4.4%	4.7%	2.0%	3.7%

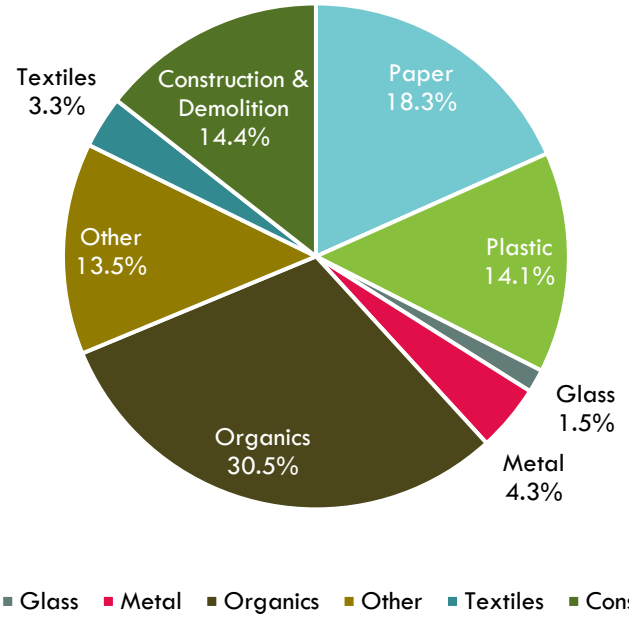
MATERIAL CLASS	COUNTY AVG. (N=42)	BRADDOCK (N=4)	DRANESVILLE (N=4)	FRANCONIA (N-3)	HUNTER MILL (N=4)	MASON (N=4)	MT. VERNON (N-4)	PROVIDENCE (N=6)	SPRINGFIELD (N=7)	SULLY (N=9)
OTHER	**15.4%**	**14.3%**	**16.6%**	**14.5%**	**13.7%**	**14.5%**	**18.9%**	**22.7%**	**12.2%**	**13.0%**
Electronics	2.1%	4.5%	0.8%	2.3%	2.9%	3.2%	1.8%	0.7%	2.5%	0.5%
Batteries	0.1%	<0.1%	0.1%	<0.1%	0.1%	<0.1%	0.1%	<0.1%	<0.1%	0.2%
Landfill/Other	8.1%	7.1%	12.0%	7.7%	3.9%	7.2%	8.8%	12.8%	6.0%	6.7%
Fines	1.0%	1.7%	0.8%	0.5%	1.9%	0.4%	2.3%	0.5%	1.1%	0.7%
Diapers	3.2%	0.5%	2.0%	1.6%	4.7%	2.7%	3.6%	8.2%	2.1%	3.7%
Household Hazardous Waste (HHW)	1.0%	0.4%	0.8%	2.3%	0.1%	1.0%	2.4%	0.4%	0.4%	1.3%
CONSTRUCTION, DEMOLITION & BULK	**8.0%**	**3.4%**	**8.3%**	**5.4%**	**4.5%**	**6.3%**	**9.8%**	**1.5%**	**8.6%**	**22.1%**
TEXTILES	**6.8%**	**0.8%**	**5.7%**	**6.5%**	**3.5%**	**8.6%**	**8.8%**	**7.8%**	**10.5%**	**6.3%**
TOTAL	*15.4%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*

Commercial Waste Composition

Commercial waste includes waste from institutional and commercial sources, such as shopping centers, office buildings, schools, restaurants, and retail. It also includes apartment buildings and all multifamily housing in buildings where four or more housing units are located.

Figure 3 shows the percentage, by weight, of each of the material classes for the commercial waste sector. The organics material class comprised ~31% of commercial waste.

Figure 3 Overall Commercial Composition by Material Class[4]



[4] Totals may not equal 100.0% due to rounding.

Table 6 shows the top ten materials in commercial waste, with food waste comprising 18% of the commercial waste stream, followed by construction and demolition at ~14%.

Divertible refers to materials that can be diverted at the source and for which end markets currently exist locally. Partially divertible is used for broad material categories where some individual materials are divertible, and others are not.

Table 6 Top Ten Materials in Commercial Waste

Material	Waste Composition %	DIVERTIBILITY
Food Waste	18.0%	Divertible
Construction & Demolition	14.4%	Partially Divertible
Corrugated Cardboard (OCC)	8.5%	Divertible
Landfill/Other	8.2%	Not Divertible
Mixed Paper	7.6%	Divertible
Other Organics	6.4%	Partially Divertible
Yard Waste	6.1%	Divertible
Plastic Film	5.7%	Partially Divertible
Textiles	3.3%	Partially Divertible
Scrap Metal	3.0%	Divertible
Total	**81.3%**[5]	

[5] 81.3% is the percent of the total waste composition represented by the top ten materials. The remaining ~20% is comprised of the remaining material categories. Full waste characterization can be found in other tables.

Table 7 provides the commercial waste composition profile with 90% confidence intervals.

Table 7 Commercial Waste Composition Profile

MATERIAL CLASS	MEAN	+/-	MATERIAL CLASS	MEAN	+/-	MATERIAL CLASS	MEAN	+/-
PAPER	**18.3%**	**2.44%**	**GLASS**	**1.5%**	**0.48%**	**OTHER**	**13.4%**	**2.56%**
Mixed paper	7.6%	1.26%	Glass Containers	1.5%	0.48%	Electronics	2.4%	0.96%
Corrugated Cardboard (OCC)	8.5%	2.04%	**METAL**	**4.3%**	**1.14%**	Batteries	<0.1%	0.01%
Poly coated Paper	1.8%	0.33%	Aluminum Beverage Containers	0.5%	0.10%	Landfill/Other	8.2%	2.18%
Other Fiber	0.4%	0.17%	Other Aluminum	0.5%	0.14%	Fines	0.6%	0.20%
PLASTIC	**14.1%**	**2.05%**	Ferrous Containers	0.3%	0.08%	Diapers	1.7%	0.73%
PET, HDPE Bottles & Jars	2.5%	0.51%	Scrap Metal	3.0%	1.12%	Household Hazardous Waste (HHW)	0.5%	0.36%
PET Thermoforms	0.5%	0.20%	**ORGANICS**	**30.5%**	**5.13%**	**CONSTRUCTION, DEMOLITION & BULK**	14.4%	5.57%
Polypropylene	0.8%	0.20%	Yard Waste	6.1%	2.83%	**TEXTILES**	**3.3%**	**1.40%**
Bulky Rigid Plastics	1.7%	0.68%	Food Waste	18.0%	5.26%	**TOTAL**	**100.0%**	
Other Plastics	3.0%	0.56%	Other Organics	6.4%	1.60%			
Plastic Film	5.7%	1.12%						

COMMERCIAL WASTE COMPOSITION BY MAGISTERIAL DISTRICT

Table 8 compares commercial disposed waste composition by magisterial district of origin. This table is included to assist in the development of target education and outreach for specific materials to address specific waste streams.

Note that while total waste data for residential and commercial sectors is statistically significant, district level data is not due to the minimal number of samples for each district. In table 5, "N" equals the number of samples characterized. Significant differences between districts could be due to demographics such as resident age, size of household, cultural practices, as well as renovation activity due to neighborhood age, etc. Comparison to peer communities by material class are in Exhibit 11 of the task 2 report.

Table 8 Commercial Waste Composition by Magisterial District

MATERIAL CLASS	COUNTY AVG. (N=45)	BRADDOCK (N=4)	DRANESVILLE (N=4)	FRANCONIA (N-3)	HUNTER MILL (N=4)	MASON (N=4)	MT. VERNON (N-4)	PROVIDENCE (N=6)	SPRINGFIELD (N=7)	SULLY (N=9)
PAPER	**18.3%**	**8.4%**	**15.5%**	**10.7%**	**16.5%**	**24.4%**	**20.6%**	**16.5%**	**25.0%**	**20.1%**
Mixed paper	7.6%	3.2%	3.9%	7.4%	5.0%	9.1%	10.3%	6.5%	10.4%	9.2%
Corrugated Cardboard (OCC)	8.5%	4.5%	9.6%	2.8%	9.0%	13.1%	7.5%	8.1%	11.6%	8.0%
Poly coated Paper	1.8%	0.6%	1.2%	0.5%	1.4%	2.1%	2.8%	1.6%	2.5%	2.3%
Other Fiber	0.4%	0.1%	0.8%	<0.1%	1.0%	0.1%	0.1%	0.3%	0.4%	0.6%
PLASTIC	**14.1%**	**6.6%**	**13.3%**	**5.7%**	**17.7%**	**11.6%**	**13.9%**	**16.3%**	**16.9%**	**16.8%**
PET, HDPE Bottles & Jars	2.5%	0.8%	1.3%	1.4%	2.6%	1.8%	3.8%	1.2%	3.3%	4.2%
PET Thermoforms	0.5%	0.1%	0.6%	0.1%	0.8%	0.3%	0.3%	0.2%	0.4%	0.8%
Polypropylene	0.8%	0.3%	1.1%	0.3%	1.1%	0.6%	0.8%	0.5%	0.8%	1.5%
Bulky Rigid Plastics	1.7%	0.4%	2.4%	0.4%	4.6%	0.9%	3.2%	1.4%	2.4%	0.5%
Other Plastics	3.0%	2.8%	2.6%	0.8%	4.2%	2.7%	1.8%	4.2%	3.6%	2.8%
Plastic Film	5.7%	2.2%	5.4%	2.7%	4.4%	5.2%	3.9%	8.8%	6.4%	7.1%

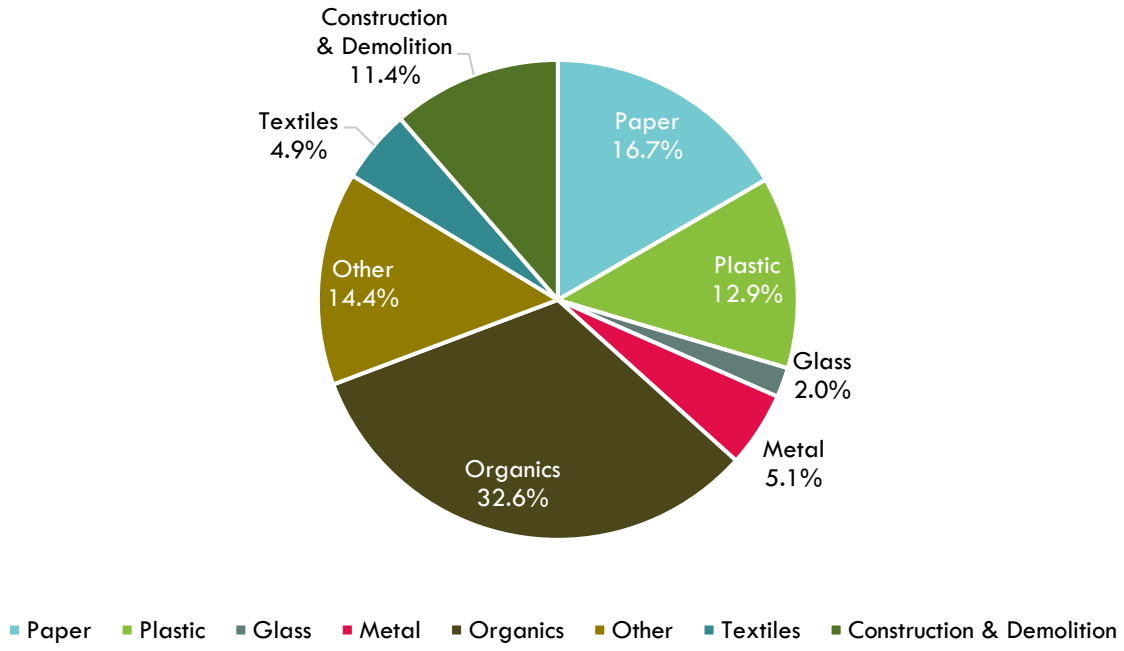
MATERIAL CLASS	COUNTY AVG. (N=45)	BRADDOCK (N=4)	DRANESVILLE (N=4)	FRANCONIA (N=3)	HUNTER MILL (N=4)	MASON (N=4)	MT. VERNON (N=4)	PROVIDENCE (N=6)	SPRINGFIELD (N=7)	SULLY (N=9)
GLASS	**1.5%**	**1.6%**	**1.1%**	**3.3%**	**0.3%**	**1.6%**	**0.7%**	**1.2%**	**1.9%**	**1.6%**
Glass Containers	1.5%	1.6%	1.1%	3.3%	0.3%	1.6%	0.7%	1.2%	1.9%	1.6%
METAL	**4.3%**	**2.5%**	**1.8%**	**12.4%**	**3.2%**	**5.8%**	**3.3%**	**5.2%**	**3.0%**	**3.7%**
Aluminum Beverage Containers	0.5%	0.2%	0.4%	0.6%	0.5%	0.4%	0.7%	0.3%	0.6%	0.6%
Other Aluminum	0.5%	0.3%	0.3%	0.4%	0.7%	0.4%	1.0%	0.6%	0.4%	0.7%
Ferrous Containers	0.3%	0.1%	0.5%	0.1%	0.1%	0.2%	0.2%	0.5%	0.4%	0.1%
Scrap Metal	3.0%	1.8%	0.6%	11.4%	2.0%	4.8%	1.4%	3.9%	1.6%	2.2%
ORGANICS	**30.5%**	**28.0%**	**38.1%**	**14.0%**	**29.5%**	**22.4%**	**36.4%**	**35.5%**	**30.8%**	**32.0%**
Yard Waste	6.1%	19.4%	22.0%	0.1%	9.5%	2.2%	5.4%	1.0%	2.8%	1.9%
Food Waste	18.0%	8.0%	12.1%	11.6%	13.9%	12.7%	17.5%	30.6%	20.7%	20.6%
Other Organics	6.4%	0.6%	4.0%	2.3%	6.1%	7.5%	13.5%	4.0%	7.2%	9.5%

MATERIAL CLASS	COUNTY AVG. (N=45)	BRADDOCK (N=4)	DRANESVILLE (N=4)	FRANCONIA (N-3)	HUNTER MILL (N=4)	MASON (N=4)	MT. VERNON (N-4)	PROVIDENCE (N=6)	SPRINGFIELD (N=7)	SULLY (N=9)
OTHER	**13.4%**	**10.1%**	**14%**	**15%**	**20%**	**24%**	**7%**	**12%**	**12%**	**11%**
Electronics	2.4%	2.4%	4.4%	4.3%	<0.1%	4.0%	1.4%	3.4%	1.3%	1.9%
Batteries	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	0.1%	<0.1%	<0.1%	<0.1%
Landfill/Other	8.2%	7.2%	6.8%	6.0%	17.1%	15.7%	4.7%	5.9%	6.7%	6.9%
Fines	0.6%	0.2%	0.7%	0.1%	1.0%	0.8%	0.4%	1.1%	0.5%	0.5%
Diapers	1.7%	0.2%	1.7%	4.4%	1.6%	1.7%	0.1%	1.1%	3.2%	1.5%
Household Hazardous Waste (HHW)	0.5%	<0.1%	0.1%	<0.1%	0.2%	2.3%	0.0%	0.4%	0.8%	0.5%
CONSTRUCTION & DEMOLITION	**14.4%**	**41.4%**	**5.2%**	**28.1%**	**11.3%**	**7.9%**	**13.9%**	**12.3%**	**8.7%**	**12.2%**
TEXTILES	**3.3%**	**1.5%**	**11.4%**	**10.9%**	**1.5%**	**1.9%**	**4.5%**	**0.9%**	**1.2%**	**2.2%**
TOTAL	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Overall Waste Composition (Residential & Commercial)

Figure 5 details the overall composition of residential and commercial waste by material class. Organics is the largest material class at ~33% followed by paper at ~17%.

Figure 4 Overall Waste Composition by Material Class (Residential & Commercial)[6]



[6] Totals may not equal 100.0% due to rounding.

Table 9 details the top ten materials in the overall waste stream (residential and commercial). Food waste comprises the largest segment at ~18%, followed by construction and demolition at ~11%.

Divertible refers to materials that can be diverted at the source and for which end markets currently exist locally. Partially divertible is used for broad material categories where some individual materials are divertible, and others are not.

Table 9 Top Ten Materials in Overall Waste Stream (Residential & Commercial)

MATERIAL	WASTE COMPOSITION %	DIVERTIBILITY
Food Waste	17.6%	Divertible
Construction & Demolition	11.4%	Partially Divertible
Yard Waste	9.7%	Divertible
Landfill/Other	8.2%	Not Divertible
Mixed Paper	7.6%	Divertible
Corrugated Cardboard (OCC)	7.1%	Divertible
Other Organics	5.3%	Partially Divertible
Plastic Film	5.2%	Partially Divertible
Scrap Metal	3.8%	Divertible
Othor Plastics	2.9%	Partially Divertible
Total	78.8%[7]	

[7] 78.8% is the percent of the total waste composition represented by the top ten materials. The remaining ~20% is comprised of the remaining material categories. Full waste characterization can be found in other tables.

Table 10 provides the overall waste composition profile for residential and commercial waste, with 90% confidence intervals.

Table 10 Overall Waste Composition Profile (Residential & Commercial)

MATERIAL CLASS	MEAN	+/-	MATERIAL CLASS	MEAN	+/-	MATERIAL CLASS	MEAN	+/-
PAPER	**16.7%**	**2.00%**	**GLASS**	**2.0%**	**0.38%**	**OTHER**	**14.4%**	**1.67%**
Mixed paper	7.6%	0.98%	Glass Containers	2.0%	0.38%	Electronics	2.3%	0.65%
Corrugated Cardboard (OCC)	7.1%	1.51%	**METAL**	**5.1%**	**1.09%**	Batteries	<0.1%	0.02%
Poly coated Paper	1.7%	0.21%	Aluminum Beverage Containers	0.4%	0.07%	Other/Landfill	8.2%	1.39%
Other Fiber	0.4%	0.13%	Other Aluminum	0.5%	0.09%	Diapers	0.8%	0.20%
PLASTIC	**12.9%**	**1.24%**	Ferrous Containers	0.3%	0.06%	Fines	2.4%	0.59%
PET, HDPE Bottles & Jars	2.0%	0.30%	Scrap Metal	3.8%	1.09%	Household Hazardous Waste (HHW)	0.7%	0.28%
PET Thermoforms	0.5%	0.11%	**ORGANICS**	**32.6%**	**3.32%**	**CONSTRUCTION, DEMOLITION & BULK**	**11.4%**	**3.28%**
Polypropylene	0.7%	0.12%	Yard Waste	9.7%	2.25%	**TEXTILES**	**4.9%**	**1.12%**
Bulky Rigid Plastics	1.7%	0.45%	Food Waste	17.6%	3.23%	**TOTAL**	**100.0%**	
Other Plastics	2.9%	0.39%	Other Organics	5.3%	0.91%			
Plastic Film	5.2%	0.67%						

Table 11 compares commercial disposed waste composition by magisterial district of origin. This table is included to assist in the development of target education and outreach for specific materials to address specific waste streams.

Note that while total waste data for residential and commercial sectors is statistically significant, district level data is not due to the minimal number of samples for each district. In table 5, "N" equals the number of samples characterized. Significant differences between districts could be due to demographics such as resident age, size of household, cultural practices, as well as renovation activity due to neighborhood age, etc. Comparison to peer communities by material class are in Exhibit 12 of the task 2 report.

Table 11 Overall Waste Composition (Residential & Commercial) by Magisterial District

MATERIAL CLASS	COUNTY AVG. (N=87)	BRADDOCK (N=7)	DRANESVILLE (N=10)	FRANCONIA (N-8)	HUNTER MILL (N=8)	MASON (N=11)	MT. VERNON (N-7)	PROVIDENCE (N=10)	SPRINGFIELD (N=12)	SULLY (N=14)
PAPER	**16.7%**	**11.6%**	**12.8%**	**17.5%**	**23.0%**	**16.2%**	**17.9%**	**15.5%**	**17.1%**	**18.2%**
Mixed Paper	4.3%	3.9%	5.2%	10.0%	9.1%	7.4%	9.0%	6.6%	7.0%	9.3%
Corrugated Cardboard (OCC)	7.1%	6.3%	5.8%	6.1%	11.5%	7.1%	5.9%	7.1%	7.7%	6.3%
Poly coated Paper	1.7%	1.3%	1.4%	1.2%	1.4%	1.6%	2.3%	1.5%	2.1%	2.1%
Other Fiber	0.4%	0.2%	0.4%	0.1%	0.9%	0.1%	0.7%	0.2%	0.3%	0.5%
PLASTIC	**12.9%**	**9.0%**	**12.7%**	**11.5%**	**13.6%**	**10.2%**	**14.2%**	**14.8%**	**14.4%**	**14.4%**
PET, HDPE Bottles & Jars	2.0%	0.9%	1.2%	2.0%	2.2%	1.5%	2.7%	1.2%	2.4%	3.2%
PET Thermoforms	0.5%	0.3%	0.4%	0.4%	0.9%	0.5%	0.2%	0.4%	0.5%	0.6%
Polypropylene	0.7%	0.4%	0.9%	0.6%	0.8%	0.6%	0.8%	0.6%	0.6%	1.3%
Bulky Rigid Plastics	1.7%	1.6%	1.9%	2.0%	2.9%	0.6%	2.1%	1.4%	2.7%	0.6%
Other Plastics	2.9%	2.5%	3.1%	2.4%	3.4%	2.6%	3.5%	3.1%	3.0%	2.5%
Plastic Film	5.2%	3.3%	5.1%	4.1%	3.6%	4.5%	4.8%	8.1%	5.1%	6.2%

MATERIAL CLASS	COUNTY AVG. (N=87)	BRADDOCK (N=7)	DRANESVILLE (N=10)	FRANCONIA (N-8)	HUNTER MILL (N=8)	MASON (N=11)	MT. VERNON (N-7)	PROVIDENCE (N=10)	SPRINGFIELD (N=12)	SULLY (N=14)
GLASS	**2.0%**	**1.3%**	**2.5%**	**3.0%**	**1.9%**	**2.2%**	**1.7%**	**2.0%**	**1.6%**	**1.7%**
Glass Containers	2.0%	1.3%	2.5%	3.0%	1.9%	2.2%	1.7%	2.0%	1.6%	1.7%
METAL	**5.1%**	**5.9%**	**4.5%**	**7.9%**	**3.6%**	**4.1%**	**3.4%**	**5.3%**	**8.0%**	**3.0%**
Aluminum Beverage Containers	0.4%	0.4%	0.4%	0.7%	0.5%	0.3%	0.6%	0.3%	0.4%	0.5%
Other Aluminum	0.5%	0.3%	0.4%	0.6%	0.5%	0.4%	0.9%	0.6%	0.5%	0.6%
Ferrous Containers	0.3%	0.4%	0.5%	0.4%	0.2%	0.3%	0.2%	0.4%	0.4%	0.1%
Scrap Metal	3.8%	4.8%	3.3%	6.3%	2.3%	3.1%	1.7%	4.0%	6.7%	1.7%
ORGANICS	**34.5%**	**33.9%**	**37.1%**	**23.0%**	**30.4%**	**35.9%**	**32.3%**	**34.7%**	**32.7%**	**31.6%**
Yard Waste	9.7%	20.9%	19.0%	6.2%	10.3%	8.8%	4.2%	4.7%	11.2%	4.6%
Food Waste	17.6%	11.1%	13.7%	12.4%	15.2%	21.9%	18.6%	25.8%	16.4%	19.5%
Other Organics	5.3%	1.9%	4.4%	4.4%	4.9%	5.3%	9.6%	4.2%	5.0%	7.5%

MATERIAL CLASS	COUNTY AVG. (N=87)	BRADDOCK (N=7)	DRANESVILLE (N=10)	FRANCONIA (N-8)	HUNTER MILL (N=8)	MASON (N=11)	MT. VERNON (N-7)	PROVIDENCE (N=10)	SPRINGFIELD (N=12)	SULLY (N=14)
OTHER	**14.4%**	**11.9%**	**15.4%**	**14.6%**	**17.0%**	**18.4%**	**12.0%**	**16.0%**	**12.4%**	**11.9%**
Electronics	2.3%	2.3%	3.3%	2.3%	3.1%	1.4%	3.5%	1.6%	2.4%	1.8%
Batteries	<0.1%	<0.0%	<0.1%	0.1%	<0.1%	0.1%	<0.1%	0.1%	<0.1%	<0.1%
Landfill/Other	8.2%	8.2%	7.2%	9.9%	7.1%	10.8%	10.6%	6.5%	8.5%	6.4%
Fines	0.8%	0.9%	0.8%	0.3%	1.4%	0.5%	1.2%	0.9%	0.7%	0.6%
Diapers	2.4%	0.3%	1.9%	2.7%	3.1%	2.3%	1.6%	3.8%	2.7%	2.2%
Household Hazardous Waste (HHW)	0.7%	0.2%	0.5%	1.4%	0.2%	1.5%	1.0%	0.4%	0.7%	0.8%
CONSTRUCTION & DEMOLITION	**11.4%**	**11.4%**	**0.9%**	**0.8%**	**0.3%**	**1.4%**	**0.5%**	**1.2%**	**0.9%**	**0.7%**
TEXTILES	**4.9%**	**4.9%**	**0.2%**	**0.5%**	**1.4%**	**0.2%**	**1.5%**	**1.0%**	**0.4%**	**0.7%**
TOTAL	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100%**	**100%**	**100%**	**100%**	**100%**

COMMERCIAL WASTE BY SUBSECTOR

Table 12 provides a snapshot of waste composition data, where available, for specific commercial sectors. Note that while total waste data for residential and commercial sectors is statistically significant, subsector level data is not due to the minimal number of samples per subsector. In the header row of the table, 'N' equals the number of samples per subsector.

The office building sample had high percentages of plastic film, ~20%, and other organics such as paper towels, 32%. These percentages are significantly higher than what would be expected for a traditional office building and are believed to be due to the type of activities present at the specific site.

The apartment building sample had higher percentages of common recyclables, such as mixed paper, aluminum beverage containers, and PET & HDPE bottles and jars than the single-family residential average. Diapers represented ~13% of the sample which likely is an outlier result. Household hazardous waste was particularly high at 5.3%.

Multi-level residential with retail are apartment buildings with retail on the first floor. These samples contained high levels of food waste, ~35%, plastic film, ~12%, and electronics, ~9%.

The school sample contained high percentages of mixed paper, ~19%, PET& HDPE bottles & jars, ~7%, food waste, ~18%, and other organics, such as paper towels, ~19%.[8]

The shopping center sample contained high percentages of food waste at ~77%. This suggests that little to no composting is occurring at the food and beverage stores at the shopping centers where the disposed waste was sampled.

Table 12 Commercial Subsector Disposed Waste Profiles

MATERIAL CLASS	APARTMENTS (N=1)	MULTILEVEL RESIDENTIAL W/RETAIL (N=3)	SCHOOL (N=1)	SHOPPING CENTER (N=2)	OFFICE BUILDING (N=1)
PAPER	**16.7%**	**13.9%**	**22.3%**	**5.0%**	**10.2%**
Mixed paper	11.5%	8.4%	19.2%	1.6%	3.3%
Corrugated Cardboard (OCC)	2.6%	4.0%	1.2%	1.4%	3.5%
Poly coated Paper	2.6%	1.4%	1.5%	1.2%	3.4%
Other Fiber	0.7%	0.1%	0.1%	0.8%	<0.1%

[8] The 2021 Fairfax County Government and Schools Zero Waste Plan also included waste results data. Results from the sorted sample for this study generally appear to be aligned; however, given different methods and small sample size, a full comparison has not been made.

MATERIAL CLASS	APARTMENTS (N=1)	MULTILEVEL RESIDENTIAL W/RETAIL (N=3)	SCHOOL (N=1)	SHOPPING CENTER (N=2)	OFFICE BUILDING (N=1)
PLASTIC	**17.8%**	**18.8%**	**19.2%**	**6.2%**	**42.6%**
PET, HDPE Bottles & Jars	4.3%	1.5%	6.7%	1.2%	6.3%
PET Thermoforms	0.1%	0.5%	0.2%	0.8%	5.8%
Polypropylene	1.0%	0.6%	1.2%	1.4%	5.4%
Bulky Rigid Plastics	5.3%	0.4%	<0.1%	0.3%	<0.1%
Other Plastics	3.3%	3.9%	3.0%	0.5%	5.4%
Plastic Film[9]	3.8%	11.9%	8.1%	1.2%	19.7%
GLASS	**3.6%**	**3.6%**	**0.2%**	**0.4%**	**2.1%**
Glass Containers	3.6%	3.6%	0.2%	0.4%	2.1%
METAL	**5.0%**	**4.7%**	**3.8%**	**5.0%**	**1.7%**
Aluminum Beverage Containers	1.2%	0.3%	0.6%	0.3%	1.3%
Other Aluminum	0.7%	1.1%	2.2%	0.1%	0.3%
Ferrous Containers	1.0%	0.7%	0.7%	0.2%	<0.1%
Scrap Metal	2.1%	2.6%	0.2%	4.4%	0.1%

[9] Plastic film in commercial settings differs from that in residential settings. Shopping centers tend to have more plastic wraps and sheeting which are readily recyclable. Both apartment buildings and office buildings contain a high percentage of trash bags. Apartment buildings also tend to have flexible film food packaging.

MATERIAL CLASS	APARTMENTS (N=1)	MULTILEVEL RESIDENTIAL W/RETAIL (N=3)	SCHOOL (N=1)	SHOPPING CENTER (N=2)	OFFICE BUILDING (N=1)
ORGANICS	**26.2%**	**40.2%**	**34.0%**	**78.9%**	**38.7%**
Yard Waste	10.5%	0.2%	<0.1%	<0.1%	<0.1%
Food Waste	12.4%	35.3%	15.3%	77.3%	6.7%
Other Organics	3.3%	4.7%	18.7%	1.6%	32.0%
OTHER	**30.8%**	**17.5%**	**20.5%**	**4.2%**	**4.1%**
Electronics	0.1%	9.0%	0.0%	0.8%	0.3%
Batteries	0.1%	<0.1%	0.1%	<0.1%	<0.1%
Landfill/Other	11.9%	5.8%	19.7%	3.3%	2.0%
Fines	0.7%	1.7%	0.5%	0.1%	0.3%
Diapers	12.7%	0.8%	0.0%	0.0%	0.0%
Household Hazardous Waste (HHW)	5.3%	0.2%	0.2%	0.0%	1.5%
CONSTRUCTION & DEMOLITION	**<0.1%**	**7.0%**	**<0.1%**	**<0.1%**	**<0.1**
TEXTILES	**4.8%**	**0.3%**	**<0.1%**	**0.4%**	**0.7%**
TOTAL	**100%**	**100%**	**100%**	**100%**	**100%**

Overall Waste Composition Adjusted to Include Segregated Construction, Demolition, & Bulk

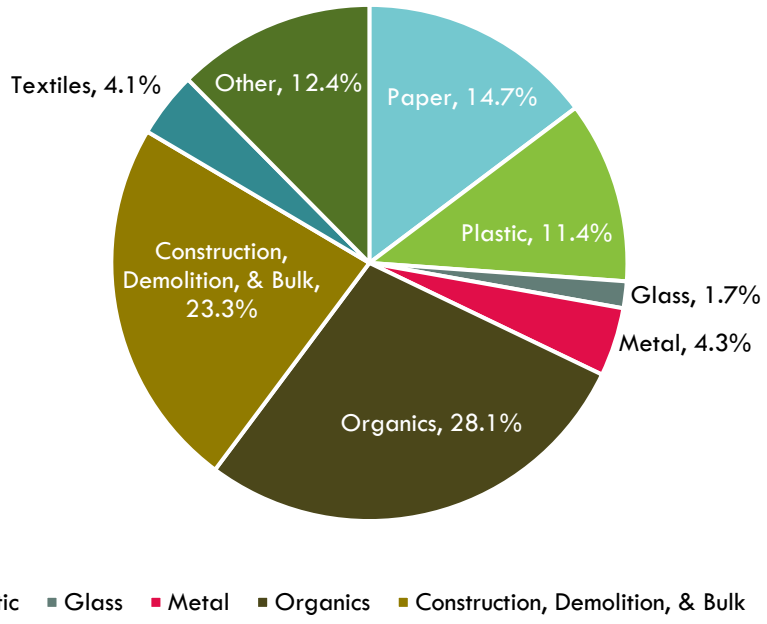
The project team reviewed 2023 transaction data for the I-66 Transfer Station & Resident Drop off Center, identifying the following vehicle types, coded as disposing of MSW, but were primarily transporting uncompacted waste primarily containing bulk items and construction and demolition waste. These vehicle types include:

- Vehicle with trailer, pickup truck <1 ton, mini-pickup, pick up with trailer, stake body, dump truck (tandem), dump truck (single), flat bed, boom crane, cube van, and van small.

Additionally, the project team identified the 2023 tonnage associated with transactions categorized by the I-66 scale house as construction and demolition waste. Combined, transactions coded as construction and demolition or as municipal solid waste and coded with the vehicle types listed above is estimated to represent 13% of the total tons of material disposed as municipal solid waste (at all County facilities). This portion of the MSW stream was not included in the waste sort conducted in April 2024 yet represents an important part of the municipal waste stream. With this in mind, the following analysis presents the overall waste stream composition adjusted to include this segregated construction, demolition, and bulk waste stream.

Figure 5 depicts the overall composition. While organics remains the greatest composition, construction, demolition, and bulk waste is the second greatest category by weight, increasing from 11% to 23%.

Figure 5 Overall Waste Composition, Adjusted for Segregated Construction, Demolition & Bulk, by Material Class[10]



[10] Totals may not equal 100.0% due to rounding.

Table 13 lists the top ten materials in the overall waste stream, adjusted for segregated construction, demolition, and bulk waste. These ten categories account for approximately 84% of the disposed overall waste stream, adjusted to include uncompacted waste. The top material is construction, demolition, and bulk waste at 23% of the disposed waste, followed by food waste. Divertible refers to materials that can be diverted at the source and for which end markets currently exist locally. Partially divertible is used for broad material categories where some individual materials are divertible, and others are not.

Table 13 Top Ten Materials in Overall Waste Stream, Adjusted for Segregated Construction, Demolition, & Bulk

MATERIAL	PERCENT	DIVERTIBILITY
Construction, Demolition and Bulk	23.3%	Partially Divertible
Food Waste	15.4%	Divertible
Yard Waste	7.9%	Divertible
Other/Landfill	7.1%	Not Divertible
Mixed Paper	6.6%	Divertible
Corrugated Cardboard (OCC)	6.3%	Divertible
Other Organics	4.8%	Partially Divertible
Plastic Film	4.6%	Partially Divertible
Textiles	4.1%	Partially Divertible
Scrap Metal	3.2%	Divertible
Total	83.5%[11]	

Figure 6 shows the estimated tonnage by sector and uncompacted waste for the top ten materials utilizing the 6-year average (2018-2023) for MSW generated and 2023 data for uncompacted waste tipped at the I-66 Transfer Station. Additionally, adjustments have been made to breakout multifamily waste from commercial by assuming the following waste generation allocation of disposed waste: 35% single-family, 13% multi-family, 39% commercial, and 13% segregated construction, demolition and bulk.

[11] 83.5% is the percent of the total waste composition represented by the top ten materials. The remaining ~16% is comprised of the remaining material categories. Full waste characterization can be found in other tables.

Figure 6 Estimated Tonnage of Top Ten Materials in Overall Waste Stream, Adjusted for Segregated Construction, Demolition, & Bulk

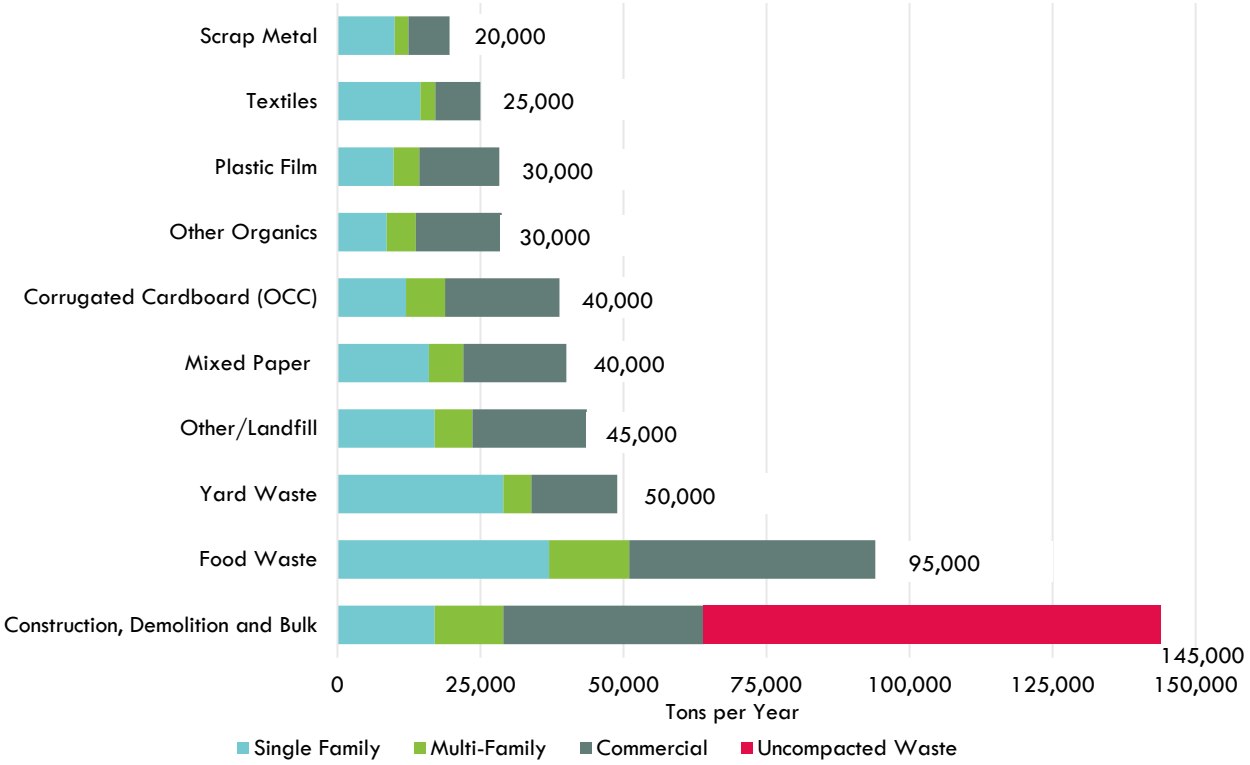


Table 14 Estimated Tonnage Values of Top Ten Materials in Overall Waste Stream, Adjusted for Segregated Construction, Demolition, & Bulk

	Single Family	%	Multi-Family	%	Commercial	%	Uncompacted Waste	%	Total
Construction, Demolition & Bulk	17,000	10%	12,000	18%	35,000	18%	80,000	100%	144,000
Food Waste	37,000	22%	14,000	22%	43,000	22%	0	0%	94,000
Yard Waste	29,000	17%	4,900	8%	15,000	8%	0	0%	48,900
Other/Landfill	17,000	10%	6,600	10%	20,000	10%	0	0%	43,600
Mixed Paper	16,000	9%	6,000	9%	18,000	9%	0	0%	40,000
Corrugated Cardboard (OCC)	12,000	7%	6,800	10%	20,000	10%	0	0%	38,800
Other Organics	8,600	5%	5,100	8%	15,000	8%	0	0%	28,700
Plastic Film	9,800	6%	4,500	7%	14,000	7%	0	0%	28,300
Textiles	14,500	8%	2,600	4%	7,900	4%	0	0%	25,000
Scrap Metal	10,000	6%	2,400	4%	7,200	4%	0	0%	19,600

Table 15 details the overall waste stream composition when adjusted for segregated construction, demolition, and bulk waste.

Table 15 Overall Waste Composition Profile, Adjusted for Segregated Construction, Demolition, & Bulk

MATERIAL CLASS	MEAN	MATERIAL CLASS	MEAN	MATERIAL CLASS	MEAN
PAPER	**14.7%**	**GLASS**	**1.7%**	**OTHER**	**12.4%**
Mixed paper	6.6%	Glass Containers	1.7%	Electronics	2.0%
Corrugated Cardboard (OCC)	6.3%	**METAL**	**4.3%**	Batteries	0.0%
Poly coated Paper	1.5%	Aluminum Beverage Containers	0.4%	Landfill/Other	7.1%
Other Fiber	0.3%	Other Aluminum	0.5%	Fines	0.7%
PLASTIC	**11.4%**	Ferrous Containers	0.3%	Diapers	2.0%
PET, HDPE Bottles & Jars	1.8%	Scrap Metal	3.2%	Household Hazardous Waste (HHW)	0.6%
PET Thermoforms	0.4%	**ORGANICS**	**28.1%**	**CONSTRUCTION & DEMOLITION AND BULK**	**23.3%**
Polypropylene	0.7%	Yard Waste	7.9%	C&D/Bulk in Compacted Waste	10.3%
Bulky Rigid Plastics	1.5%	Food Waste	15.4%	C&D/Bulk in Uncompacted waste	13.0%
Other Plastics	2.5%	Other Organics	4.8%	**TEXTILES**	**4.1%**
Plastic Film	4.6%			**TOTAL**	**100.0%**

CONCLUSIONS AND RECOMMENDATIONS

Materials of Concern

While the percentage of batteries in the waste stream was very low (< 0.1%) and were all alkaline batteries, lithium-ion batteries often are within products and therefore may have been present while still not being visible during the waste sort. Lack of observation should not deter efforts to reduce lithium-ion batteries from the waste stream as a means of enhancing safety.

8 of the 87 samples, ~10% of samples, contained medical waste. Medical waste included: syringes, sharps, medical tubing, medical vials, gauze and/or materials contaminated with blood and/or urine. In most cases, medical waste identified within a sample was in a separate enclosed trash bag within a sample. If a piece of medical waste was determined within the isolated trash bag, it was not sorted but was disposed as landfill/other. Wherever possible, this individual bag of waste was weighed and noted. Medical waste within samples where it was identified and weighed ranged from 4lbs to 33 lbs.

Similarly, individual trash bags of bathroom waste containing feminine hygiene products also were not sorted but were disposed as other/landfill.

Opportunities

Food waste and construction and demolition debris represent key opportunities to increase Fairfax County waste diversion.

Opportunity also exists to capture more of the materials for which there are existing diversion programs, specifically, yard waste, mixed paper, corrugated cardboard (OCC), and scrap metal, all materials included in the top ten materials in the waste stream.

High percentages of specific items in some samples suggests there is an opportunity to target specific materials in specific sectors. For example,

- 8 commercial samples contained ≥ 30% food waste.
- 10 samples were ≥ 30% yard waste (split between commercial and residential)
- 9 samples contained ≥ 30% C&D (majority commercial)

Recommendations regarding future waste characterization studies

The waste characterization study summarized by this report provides sufficient data to support Fairfax County in developing and beginning the implementation of its zero waste plan. At the same time, as Fairfax County seeks to implement certain aspects of its goal and makes advancements, additional waste characterization studies with different objectives, scope, and material categories may be warranted. For example:

- A four-season sort for greater understanding of material variations by seasons to support facility operational planning.
- Greater detail may be sought for future waste characterizations on specific categories of materials such as:
    - A focus on specific subsectors such as restaurants, retail, or multifamily buildings,
    - A more detailed study of construction, demolition, and bulk waste to define source and type.

- A more detailed study of food waste to determine avoidable versus unavoidable food waste (i.e., uneaten food versus banana peel)
- A more detailed study of plastic film and other plastic material categories to better project divertability of these streams.

APPENDIX

Material List & Definitions

		Material Group	Notes/Examples
PAPER	1	Mixed Paper - Recyclable	Includes newsprint, high grade office paper, magazines and catalogs, paperboard, phone books and directories, discarded mail, envelopes, brightly colored ledger paper and other dry paper, manila folders, index cards, carbonless forms, and egg cartons. Mixed Recyclable Paper may be combined with minor amounts of other materials such as wax or glues.
	2	Corrugated Cardboard (OCC)	Includes uncoated cardboard items with a wavy core, without wax coating on the inside or outside. Examples include shipping and moving boxes, computer packaging cartons, sheets and pieces of boxes and cartons, Kraft paper bags, and other Kraft paper.
	3	Poly coated paper	Includes poly coated paper. Includes aseptic packages and Poly coated (gable top) cartons, coffee cups, paper plates and ice cream containers.
	4	Other Paper	Includes items made mostly of paper but combined with large amounts of other materials such as wax, plastic, glues, foil, wire. Examples include blueprints, sepia, onion skin, foiled lined fast-food wrappers, carbon paper, coated OCC, and photographs. Not currently recyclable or compostable.
PLASTICS	5	#1 PET & #2HDPE Bottles/Jars	Includes clear or colored PET & HDPE bottles (i.e., narrow neck containers) and jars marked with a #1 or #2. May also bear the letters "PETE" or "PET." Examples include soft drink bottles, some liquor bottles, cooking oil containers, milk jugs, water jugs, some hair-care bottles, and detergent bottles.
	6	#1 Other PET Containers & Packaging	Includes PET containers and packaging marked with a #1 and potentially bearing the letters "PETE" or "PET" that are not narrow-necked containers. Includes items such as cups, tubs, clamshells, lids, egg cartons.
	7	#5 Polypropylene PP Containers & Packaging	Includes clear or colored #5 PP packaging. Examples include cups, tubs, lids, clamshells, takeout containers. Note: large PP items such as buckets and laundry baskets are categorized under bulky rigids.
	8	Bulky Rigid Plastics	Large plastic items often design for more than one use such as buckets, laundry baskets, outdoor furniture, toys, etc.
	9	Plastic film	Includes labeled grocery and merchandise, dry cleaner, and newspaper polyethylene film bags. Includes polyethylene film bags that were used to contain garbage such as black or transparent trash bags. Includes film plastic used for large-scale packaging or transport packaging, such as industrial film, wrappings, plastic strapping, other thin flexible plastic packaging, plastic sheeting, and shrink wrap. Includes flexible film food packaging.
	10	Other plastic	Expanded polystyrene items marked with a PS or a #6. Bottles, jars, and containers marked with #3, #4, #6, #7 or unmarked that are made of types of plastic. Includes film packaging not defined above, such as film that is woven together (e.g., grain bags); contains multiple layers of film or other materials that have been fused together (e.g., potato chip bags) and shower curtains. Includes plastic items not elsewhere classified, as well as items made mostly of plastic but combined with other materials. Examples include disposable razors, pens, lighters, 3-ring binders,

GLASS	11	Recyclable Glass Bottles and Jars	Includes clear, green, brown, and other colored glass bottles and jars containing beverages, food, or consumable liquids. Examples include whole or broken clear or colored soda, beer bottles, fruit juice bottles, peanut butter jars, mayonnaise jars, wine bottles, cosmetic jars, and non-prescription medical bottles.
METALS	12	Aluminum Beverage Containers	Includes any food or beverage container made mainly of aluminum, such as aluminum soda or beer cans and some pet food cans. This does not include bimetal containers with steel sides and aluminum ends.
	13	Other Aluminum	Includes items such as aluminum foil, pie plates, trays, siding, and furniture.
	14	Ferrous containers (tin cans)	Includes rigid containers made mainly of steel, such as items that will stick to a magnet and may be tin-coated. This subtype is used to store food, beverages, paint, and a variety of other household and consumer products. Examples include canned food and beverage containers, empty metal paint cans, empty spray paint and other aerosol containers, and bimetal containers with steel sides and aluminum ends.
	15	Scrap Metal	Includes metal that cannot be put in any other category. This category includes items made mostly of metal but combined with other materials and items made of both ferrous metals and non-ferrous metal combined. Examples include small non-electronic appliances such as toasters and hair dryers, motors, insulated wire, and finished products that contain a mixture of metals, or metals and other materials, whose weight is derived significantly from the metal portion of its construction.
ORGANICS	16	Yard Waste	Includes leaves, grass clippings, garden debris, pruning, shrubs, and small branches up to 2 inches in diameter from any public or private landscapes. Includes vegetative woody plant material, branches, shrubs, and stumps that exceed 2 inches in diameter from any public or private landscape.
	17	Food Scraps	Includes food material capable of being composted (including scrap animal parts). This type includes materials resulting from the processing, storage, preparation, cooking, handling or consumption of food and material from industrial, commercial, or residential sources. Examples include discarded meat scraps, dairy products, eggshells, fruit or vegetable peels, and other food items from homes, stores, and restaurants. This type includes grape pomace and other processed residues or material from canneries, wineries, or other industrial sources.
	18	Bottom Fines and Dirt	Includes fragments that pass through 1/2-inch screen. Examples include mixed residue, sand, soil, clay, dirt, coffee grounds, and glass.
	19	Diapers	Diapers made from a combination of fibers, synthetic, and/or natural, and made for the purpose of single use. This includes disposable baby diapers and adult protective undergarments.
	20	Other Organic	Includes organic material that cannot be put in any other category such as item hair, sawdust, and animal feces. Includes food soiled compostable paper such as napkins, paper towels, etc.

C&D	21	Construction, Demolition, and Bulk Waste	Clean dimensional lumber, clean engineered wood, wood pallets, painted wood, treated wood, concrete, reinforced concrete, asphalt paving, rock & other aggregates, brick, gypsum board, shingles and other roofing materials, plastic materials such as piping and windows, ceramic/porcelain such as toilets. stoneware, dishes, ceramic tiles. Also includes items such as insulation, linoleum, nails, and cabinets. May also include mattresses, furniture and other bulky items not otherwise classified
INORGANICS	22	Electronics	Includes televisions, computer monitors, laptops and LCD monitors, keyboards, printers, and modems, large and small electronic goods that have circuitry such as microwaves, stereos, VCRs, DVD players, radios, audio/visual equipment; computer related electronics such as processors, mice, keyboards, laptops, disk drives, printers, modems, and fax machines; and other small consumer goods such as personal digital assistants (PDAs), cell phones, phone systems, phone answering machines, computer games and other electronic toys, portable CD players, camcorders, and digital cameras.
	23	Household Batteries	Non-lithium dry cell batteries and lithium batteries
	24	Other/Landfill	Air filters, garden hoses, tennis balls, disposable cleaning wipes made of fiber and plastic, used kitty litter, bags containing medical waste or bathroom waste containing feminine hygiene products
HHW	25	Household Hazardous Waste	Waste which if improperly put in the solid waste stream may present handling problems or other hazards that is not included in another category, including latex and oil based paint, herbicides, pesticides, fertilizers, oil filters, automotive fluid, mercury containing items such as thermometers and thermostats, prescription medications, sharps, cleaners and corrosives (various acids and bases whose primary purpose is to clean surfaces, unclog drains, or perform other actions) and solvents.
TEXTILES	26	Textiles	Carpet, carpet padding, clothing, curtains, bedding, upholstery, shoes, leather

Glossary

Commercial Waste - Commercial waste refers to trash collected from businesses and institutions including office buildings, schools, and retail establishments. For the purposes of the waste characterization study, it includes waste generated from multifamily housing.

Divertible – A divertibility classification. Refers to materials that can be diverted at the source and for which end markets currently exist locally. Partially divertible is used for broad material categories where some individual materials are divertible and others are not.

Divertibility –A classification of the ease by which a material can be diverted at the source and the presence or absence of local end markets. Material items are classified as divertible, partially divertible, and not divertible

Multifamily housing - Multi-family housing refers to residential units in multi-level buildings, such as apartment buildings, which may or may not include commercial on the ground level.

Municipal Solid Waste (MSW) – Waste generated by residential and commercial establishments.

Not Divertible – A divertibility classification. Individual material currently cannot be diverted.

Partially Divertible – A divertibility classification. Partially divertible is used for broad material categories where some individual materials are divertible and others are not (i.e., construction, demolition and bulk, other plastics, and textiles).

Single Family Residential - Trash collected curbside from single family detached and attached housing (such as townhomes).

Fairfax County
Waste Stream Characterization Study

WORK PLAN

Contracted by:

Fairfax County Department of Public Works and Environmental Services

April 2024

Prepared by:

CDM Smith

RRS

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Section 1
Overview

1.1 Objective

This document serves as the sampling and sorting plan for the 2024 Fairfax County Waste Stream Characterization Study. It describes in detail the work required to provide a comprehensive and accurate waste composition of MSW and the state of recycling in the Fairfax County area.

To develop precise waste composition estimates, CDM Smith Inc. & RRS (the team) will collect samples at the I-66 Fairfax County Transfer Station. Five sampling days during April 2024 will be dedicated to hand-sorting and characterizing 80-100 samples of residential and industrial/commercial/institutional (ICI) waste at the Fairfax County Transfer Station.

Sampling will be approximately split 40/60 between the residential and ICI sectors.

Sampling distribution will be approximately 20% Republic-collected Residential; 20% Fairfax-collected-Residential, and 60% Republic-Collected Commercial.

Description and definitions of the waste sectors used to stratify data collection for the study are presented in the following sections. Detailed appendices follow.

1.2 Waste Sectors

This study will examine waste disposed by two distinct sectors:

1. Residential – waste generated by single and multifamily residences. This waste is primarily collected in rear and side loading trucks.

2. Industrial/Commercial/Institutional (ICI) – waste generated by fabricated manufacturing facilities, mills, and mines; businesses and institutions. This waste is primarily collected in front-end loading trucks.

1.3 Facility for Waste Sort

Sampling will be conducted at Fairfax County's transfer station. The facility address is provided in **Appendix A**.

1.4 Coordination with Facilities

The transfer station was contacted to prepare for the logistics of sampling. In addition to obtaining contact information for the staff who are able to assist in making arrangements for data collection, the following information was requested or agreed upon with the facility:

- Facility address and parking instructions; 4618 West Ox Rd, Fairfax, VA 2030

- The facility's days and hours of operation; 5:00 a.m. -5:30 p.m. (official hours for residents differ. For purposes of this project, CDM will have access to the facility as early as 5:00 a.m. and must finish sorting activity by 5:30 p.m., leaving the facility by 6:30 p.m.)
- Contact information for the owner of the facility, an employee who can provide permission to use the site, an on-site contact for logistics information, and a person who will be the point of contact on the day of sampling;

  Following are the primary contacts for access, logistics and coordinator for the County's bucket loader. By COB of each day, Annie White and Max Babits will be emailed any further information for the following day.

  Quentin Marovelli (Complex Manager): (571) 238-1393 [m], (703) 631-3746 [o]

  Dan Brooks (Assist. Complex Manager): (703) 342-6361[m], (703) 803-9614 [o]

  Robert Perly (Assist. Superintendent): 703-631-1178 [m]
- A plan or agreement about the exact location of sampling and sorting operations at the facility; The sampling location was agreed upon 4/2/24, based on a rough design layout provided by the County on 3/29.24. CDM will be provided Bays 1-3 of the transfer station facility. Bay 3 will be dedicated for loads to be dumped. Bay 1 will be dedicated for sample tables and storge. Bay 2 for sorting.
- Confirmation of the facility's willingness to make a loader available for sample collection; This has been agreed to. Loader will be available throughout the day to extract samples from each load and place in the sorting area.
- A plan for the cooperation of gatehouse personnel to obtain vehicle net weights and assist in sample identification and collection; This has been addressed. Scale house staff will advise driver(s) to proceed to Bay 3.
- The number of scale houses at the facility and the process by which vehicles are directed to the scale house (e.g., do ICI haulers use a separate gate from cash customers?); ICI haulers enter the facility via the same access as the public but proceed to a set of scales (with dedicated scale office) that is to the left of the entrance.
- Approximate daily and weekly load counts by waste sector and total for the facility; Access to this information has already been provided.
- Estimates regarding the vehicle traffic expected for each sector on each day of the week and the estimated peak time of day for each type of load; Commercial loads from all sectors will arrive throughout the day but surges will be expected early morning, mid-morning, early afternoon. Residential loads from all sectors will produce a surge mid-morning then early afternoon.
- Any rules the facility follows in recording the net weight of vehicles and for recording alternate minimum weights for small vehicles; All ICI loads are weighed by state certified scales which are maintained and inspected regularly. Both large ICI loads and small ICI

loads use the same set of scales. ICI haulers who have accounts with SWMP need only weigh full as SWMP has tare weights on file for each truck for each account. Only trucks with registered tare weights will be involved in this project.

Section 2
Data Collection

This section describes the sampling process and includes plans for the collection of data to characterize residential, ICI, and source-separated materials, as well as residential and ICI recyclables.

2.1 Sort Staff

Sorting will be conducted by two teams of five staff each plus two sort leadership positions. The sort team members will have the following roles:

- (1) Field Manager – leads the team, communicates with COUNTY staff, selects loads for sampling, monitors quality of work, inspects sorted materials.
- (1) Crew Chief – supervises sorting, coordinates with front-end loader operator, records sample weights, monitors quality of work, inspects sorted materials.
- (10) Sorting Crew – sorting waste into designated subcategories.

2.2 Allocation of Waste Samples

The team will collect samples at the Fairfax County transfer station. The team will obtain and hand-sort 80-100 samples of disposed waste, as shown below.

Table 1. Target Number of Samples

Sector	Target Number of Samples
Residential MSW (50% Fairfax Collected & 50% Republic Collected)	40-50
ICI MSW	40-50

2.3 Sampling Residential and ICI Waste

This section describes the procedures for selecting vehicles from the residential and ICI sectors, as well as the procedure for obtaining and characterizing samples from selected vehicles.

2.3.1 Obtaining Residential and ICI Waste Loads for Sampling

The samples collected will be allocated among the Fairfax County Magisterial Districts as shown in **Figure 1**. 16-20 samples will be collected per day. The samples will be split approximately as follows: 50% residential waste and 50% ICI waste.

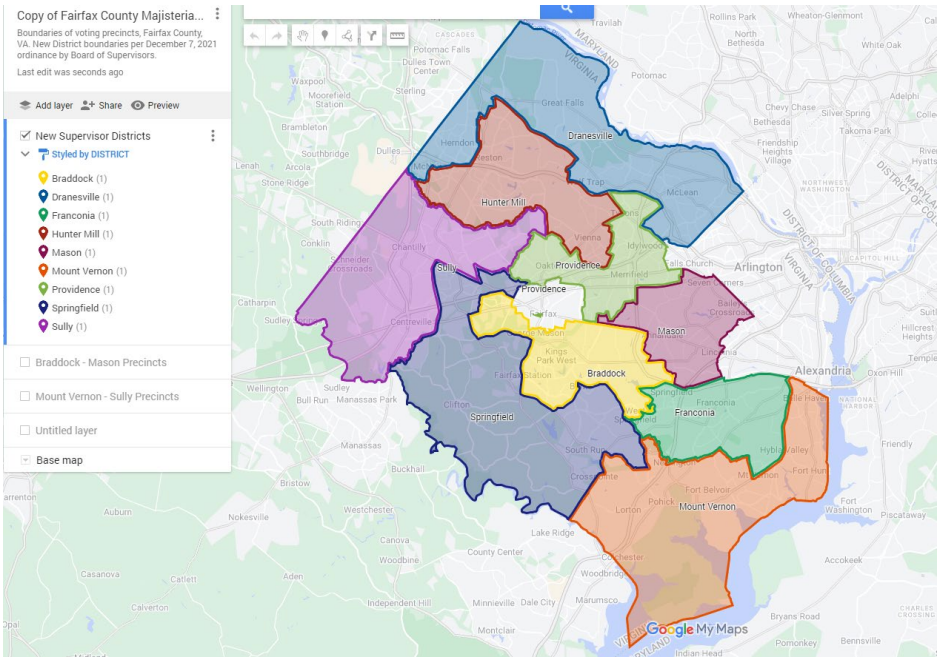

Figure 1 Fairfax County Magisterial Districts

2.3.1.1 Developing a Procedure to Select Residential and ICI Loads at Each Facility

Fairfax will work with Republic and Fairfax DPWES Collection to provide truck numbers of trucks to be sorted that reflect the mix of samples indicated above and are generated in all districts in Fairfax County. To assist with this selection, THE TEAM has developed a preferred schedule for selecting loads to sample based on previous year activity through reviewing April 2023 inbound scale tickets.

All of this information will be gathered to create a unique *Vehicle Selection List* for each sampling day.

2.3.1.2 Selection and Diversion Loads of Residential and ICI Waste for Sampling

As discussed in Section 2.2, Fairfax will work with the scale house to identify the vehicles that are entering the facility.

When a vehicle selected for sampling arrives at the gate house, the Field Manager or Scale House operator will record the following information about the vehicle on a sample placard:

- Truck Number
- Date and Time
- Vehicle type
- Hauler

- Sector
- Origin
- The Sample Placard will be placed on the vehicle's windshield or dashboard to identify it as a vehicle intended for sampling and the driver directed to the sampling area. Please see **Appendix B** for an example of a Sample Placard. County Scale Staff will provide the driver with the Placard when providing the driver with the scale ticket.

After the Field Manager identifies the designated vehicle, the facility bucket loader operator will be directed to collect a sample. The Field Manager will instruct the operator as to where to place the sample in Bay3, collect the Sample Placard and record the information from the Sample Placard onto the Sample Characterization Form. The Field Manager will also note any unusual circumstances associated with the load or the sample.

2.3.2 Obtaining and Sorting Samples from Residential and ICI Waste Loads

Samples will be obtained from selected residential and ICI loads using the same procedure, which is described below.

1. The driver of each selected load will be instructed to tip the load onto the facility floor in an elongated pile. The Sampling Coordinator will instruct the loader operator to capture material from a randomly selected location in the load. If any bulk item appears in the load once on the tip floor, the Field Manager will take a photograph of the load with the bulk item(s) visible. That information will be added to the Sample Characterization Form.
2. The loader operator will select a sample weighing at least 200 pounds from the pile. Material will be placed onto a tarpaulin.
3. Photographs of the sample when it is placed in the sampling area will be taken using a digital camera. The *Sample Placard* that identifies each sample will be positioned so it is visible in each photograph.

All samples of residential and ICI loads will be sorted according to the sorting procedures described below.

The Crew Chief will record composition weights and the information obtained from the *Sample Placard* in a waste characterization spreadsheet.

Samples from residential and ICI sectors will be sorted and weighed as outlined below. The sorting operation will proceed as follows:

- The sample will be selected as outlined in the previous sections.
- The Field Manager will provide the Crew Chief vehicle information of each sample for the sampling data form via the *Sampling Placard*. Data recorded will include the date, time, hauler name, and truck number, origin. At a later date, Fairfax DPWES will provide origin information and inbound scale tickets for each load sampled.

- The sample will be unloaded from a front-end loader bucket (or similar) onto a tarp in the sample storage area.
- Large items (e.g., corrugated cardboard, wood) and bags containing a single waste category (most often yard waste) will be removed from the sample and set aside for weighing, bypassing the sorting table.
- The remainder of the sample will be transferred by increments onto the sorting table, using broad-bladed shovels to transfer loose material.
- Sample sorting will be conducted using a sorting table/box which has a 3/8 -inch screen overlay.
- Samples will be sorted until the material particle size ranges from 3/4 to 2-inch. At that time the Crew Chief will apportion the material to the appropriate material categories. The residual fines that fall through the screen will be included in the Bottom fines and dirt material category, unless it can be visually categorized further (e.g. material is primarily food waste, etc.).
- The sample will be sorted into the containers surrounding the sorting table. The Crew Chief will check the containers periodically for accuracy of sorting.
- The containers will be brought to the scale, checked for accuracy of sorting by the Crew Chief, and weighed.
- The container number and weight of the material in each container will be recorded in the appropriate space on the data form.
- Data quality control checks will be implemented which will include a secondary review of all data recorded and checks for missing data, categories without data, suspect weights, tare weights, and total sample weight.
- Once the data form has been checked the containers will be dumped in a designated area for disposal and recycling, if available, by the facility operator.

The containers used in sorting operations have individual tare weights that typically vary no more than 2 percent from their average tare weight; therefore, a representative tare weight will be used. The tare weight will be checked if containers become coated with food or other materials. If the sorted material in a container weighs very little in proportion to the container, the waste will be removed from the container and weighed loose. The equipment used for the field activities is shown in the residential and ICI Hand Sort Equipment List provided below.

2.3.2.1 List of Equipment and Data Forms for Hand-Sorting

A list of equipment for hand-sorting is included below:

- Plastic bins/buckets
- Boots
- Safety Glasses

- Puncture Resistant Gloves
- Hard hats
- Shovels
- Broom
- Tarps/plastic sheeting
- Scales
- Sorting tables
- Clipboards
- Laptop
- Hand wipes
- Safety vests
- First aid kit
- Garbage can(s_
- Cell phone or two-way radio
- Field Forms
    - Sample Placards

2.3.3 Staffing Plan, Training, and Supervision of Hand-Sorting Crew

The Field Manager is responsible for coordinating with the facility, providing the quotas for sampling, supervising hand-sorting, reviewing data quality on-site, and will also serve as Sampling Coordinator. The field team will consist of a total of twelve personnel, a Field Manager, a Crew Chief, and 10 crew members who will serve as full-time sorters (two separate sort teams of 5 each). Fairfax is responsible for coordinating with the scale house to select the designated samples and, at the scale house, instructing them to tip in Bay 3. The Field Manager is responsible for directing vehicles where to tip in Bay 3, collection sample placards, and overall operations. The Crew Chief is responsible for supervising waste sorting, logging the sample weights, and reviewing data quality on-site. The waste sorters will consist of personnel who have experience sorting waste.

To ensure data quality, the sort team will review the work plan/ health and safety plan, be trained to identify all categories (**Appendix C**), and be trained in all data quality control measures that will be implemented in the field, prior to each period of field work. The team will have a kickoff meeting to train the sorting crew, discuss safety, and teach the proper procedures for sample collection and sorting. Daily meetings will also be held during the sort to revisit the health and safety plan and ensure quality standards are met.

2.4 Health and Safety Plan

The Health and Safety Plan for the Nashville Municipal Solid Waste (MSW) and Recycled Materials Characterization Study is provided in **Appendix D**.

Section 3
Data Management Plan

This section discusses how the sample and survey data will be stored and the analysis method that will be used to determine waste composition profiles for each subsector.

3.1 Data Entry and QA/QC

After all data has been collected and entered, THE TEAM will verify that all required data is recorded properly, that the targeted numbers of samples are obtained, and oversee data entry.

The compiled characterization data will be calculated from individual samples entered into waste characterization spreadsheet. Throughout the waste results section, confidence intervals will be calculated at a 90% level of confidence, meaning that we can be 90% sure that the population mean falls within the upper and lower confidence intervals shown.

3.1.1 Calculating Waste Composition Estimates

The following method will be used to estimate the composition of waste belonging to each waste sector or sub-sector. For a given sector (that is, for the samples belonging to the same waste sector within the same geographic subarea), the composition estimate denoted by r_j represents the ratio of the components' weight to the total weight of all the samples in the stratum. It will be derived by summing each component's weight across all of the selected samples belonging to a given stratum and dividing by the sum of the total weight of waste for all of the samples in that stratum, as shown in the following equation:

$$r_j = \frac{\sum_i c_{ij}}{\sum_i w_i}$$

where:

c = weight of particular component

w = sum of all component weights

for i = 1 to n, where n = number of selected samples

for j = 1 to m, where m = number of components

For example, the following simplified scenario involves three samples. For the purposes of this example, only the weights of the component *carpet* are shown.

	Sample 1	Sample 2	Sample 3
Weight (*c*) of carpet	5	3	4
Total Sample Weight (*w*)	80	70	90

$$r_{Carpet} = \sum \frac{5+3+4}{80+70+90} = 0.05$$

To find the composition estimate for the component *carpet*, the weights for that material are added for all selected samples and divided by the total sample weights of those samples. The resulting composition is 0.05, or 5 percent. In other words, 5 percent of the sampled material, by weight, is *carpet*. This finding is then projected onto the stratum being examined in this step of the analysis.

The confidence interval for this estimate will be derived in two steps. First, the variance around the estimate will be calculated, accounting for the fact that the ratio included two random variables (the component and total sample weights). The variance of the ratio estimator equation follows:

$$\mathrm{Var}(r_j) \approx \left(\frac{1}{n}\right)\left(\frac{1}{\overline{w}^2}\right)\left(\frac{\sum_i \left(c_{ij} - r_j w_i\right)^2}{n-1}\right)$$

where:

$$\overline{w} = \frac{\sum_i w_i}{n}$$

(For more information regarding Equation 2, please refer to Sampling Techniques, 3rd Edition by William G. Cochran [John Wiley & Sons, Inc., 1977].)

Second, precision levels at the 90 percent confidence level will be calculated for a component's mean as follows:

$$r_j \pm \left(z\sqrt{\mathrm{Var}(r_j)}\right)$$

where z = the value of the z-statistic (1.645) corresponding to a 90 percent confidence level.

Composition results for strata will then be combined, using a weighted averaging method, to estimate the composition of larger portions of the waste stream. The relative tonnages associated with each stratum serve as the weighting factors. The calculation will be performed as follows:

$$O_j = \left(p_1 * r_{j1}\right) + \left(p_2 * r_{j2}\right) + \left(p_3 * r_{j3}\right) + \ldots$$

where:

p = the proportion of tonnage contributed by the noted waste stratum (that is, the weighting factor)

r = ratio of component weight to total waste weight in the noted waste stratum (that is, the composition percent for the given material component)

for j = 1 to m, where m = number of material components

For example, the above equation is illustrated here using three waste strata.

	Stratum 1	Stratum 2	Stratum 3
Ratio (r) of carpet	5%	10%	10%
Tonnage	25,000	100,000	50,000
Proportion of tonnage (*p*)	14.3%	57.1%	28.6%

To estimate the portion of larger portions of the waste stream, the composition results for the three strata are combined as follows.

$$O_{Carpet} = (0.143 * 0.05) + (0.571 * 0.10) + (0.286 * 0.10) = 0.092 = 9.2\%$$

Therefore, 9.2 percent of this examined portion of the waste stream is *carpet*.

The variance of the weighted average will be calculated as follows:

$$\mathrm{Var}(O_j) = \left(p_1^2\ \mathrm{Var}(r_{j1})\right) + \left(p_2^2\ \mathrm{Var}(r_{j2})\right) + \left(p_3^2\ \mathrm{Var}(r_{j3})\right) + \ldots$$

Appendix A
Facility Information

Fairfax County Transfer Station – 4618 West Ox Dr, Fairfax, VA 22030

Appendix B
Sample Identification Placard

Sample Placard

Truck Number		
Date/Time	Com.; Res.; or MF	Origin
Republic or FFX	FEL RL SL Minipacker	

Appendix C
Materials List and Definitions

Proposed Material List

Material Group			Notes/Examples
PAPER	1	Mixed Paper - Recyclable	Includes newsprint, high grade office paper, magazines and catalogs, paperboard, phone books and directories, junk mail, envelopes, brightly colored ledger paper and other dry paper, manila folders, index cards, carbonless forms, and egg cartons. Mixed Recyclable Paper may be combined with minor amounts of other materials such as wax or glues.
	2	Uncoated OCC/Kraft	Includes uncoated cardboard items with a wavy core, without wax coating on the inside or outside. Examples include shipping and moving boxes, computer packaging cartons, sheets and pieces of boxes and cartons, Kraft paper bags, and other Kraft paper.
	3	Polycoated paper	Includes polycoated paper. Includes aseptic packages and polycoated (gable top) cartons, coffee cups and ice cream containers.
	4	Other Non-compostable paper	Includes items made mostly of paper but combined with large amounts of other materials such as wax, plastic, glues, foil, wire, food and moisture. Examples include blueprints, sepia, onion skin, foiled lined fast food wrappers, carbon paper, coated OCC, and photographs..
PLASTICS	5	#1 PET & #2HDPE Bottles/Jars	Includes clear or colored PET & HDPE bottles (i.e., narrow neck containers) and jars marked with a #1 or #2. May also bear the letters "PETE" or "PET." Examples include soft drink bottles, some liquor bottles, cooking oil containers, milk jugs, water jugs, some hair-care bottles and detergent bottles.
	6	#1 Other PET Containers & Packaging	Includes PET containers and packaging marked with a #1 and potentially bearing the letters "PETE" or "PET" that are not narrow-necked containers. Includes items such as cups, tubs, clamshells, lids, egg cartons.
	7	#5 PP Containers & Packaging	Includes clear or colored #5 PP packaging. Examples include cups, tubs, lids, clamshells, takeout containers. Note: large PP items such as buckets and laundry baskets are categorized under bulky rigids.
	8	Bulky Rigid Plastics	Large plastic items often design for more than one use such as buckets, laundry baskets, outdoor furniture, toys, etc.
	9	Plastic film	Includes labeled grocery and merchandise, dry cleaner, and newspaper polyethylene film bags that were not contaminated with food, liquid or grit during use. Includes polyethylene film bags that were used to contain garbage such as black or transparent trash bags .Includes film plastic used for large-scale packaging or transport packaging, such as industrial film, wrappings, plastic strapping, other thin flexible plastic packaging, plastic sheeting, and shrink wrap.
	10	Other plastic	Expanded polystyrene items marked with a PS or a #6. Bottles, jars, and containers marked with #3, #4, #6,#7 or unmarked that are made of types of plastic. Includes film packaging not defined above, such as film that is woven together (e.g., grain bags); contains multiple layers of film or other materials that have been fused together (e.g., potato chip bags) and shower curtains. Includes plastic items not elsewhere classified, as well as items made mostly of plastic but combined with other materials. Examples include disposable razors, pens, lighters, 3-ring binders,

GLASS	**11**	Recyclable Glass Bottles and Jars	Includes clear, green, brown, and other colored glass bottles and jars containing beverages, food, or consumable liquids. Examples include whole or broken clear or colored soda, beer bottles, fruit juice bottles, peanut butter jars, mayonnaise jars, wine bottles, cosmetic jars and non prescription medical bottles.
METALS	**12**	Aluminum Beverage Containers	Includes any food or beverage container made mainly of aluminum, such as aluminum soda or beer cans and some pet food cans. This does not include bimetal containers with steel sides and aluminum ends.
	13	Other Aluminum	Includes items such as aluminum foil, pie plates, trays, siding, and furniture.
	14	Ferrous containers (tin cans)	Includes rigid containers made mainly of steel, such as items that will stick to a magnet and may be tin-coated. This subtype is used to store food, beverages, paint, and a variety of other household and consumer products. Examples include canned food and beverage containers, empty metal paint cans, empty spray paint and other aerosol containers, and bimetal containers with steel sides and aluminum ends.
	15	Scrap Metal	Includes metal that cannot be put in any other category. This category includes items made mostly of metal but combined with other materials and items made of both ferrous metals and non-ferrous metal combined. Examples include small non-electronic appliances such as toasters and hair dryers, motors, insulated wire, and finished products that contain a mixture of metals, or metals and other materials, whose weight is derived significantly from the metal portion of its construction.

ORGANICS	**16**	Yard Waste	Includes leaves, grass clippings, garden debris, pruning, shrubs, and small branches up to 2 inches in diameter from any public or private landscapes. Includes vegetative woody plant material, branches, shrubs, and stumps that exceed 2 inches in diameter from any public or private landscape.
	17	Food Scraps	Includes food material capable of being composted (including scrap animal parts). This type includes materials resulting from the processing, storage, preparation, cooking, handling or consumption of food and material from industrial, commercial or residential sources. Examples include discarded meat scraps, dairy products, egg shells, fruit or vegetable peels, and other food items from homes, stores, and restaurants. This type includes grape pomace and other processed residues or material from canneries, wineries, or other industrial sources.
	18	Bottom Fines and Dirt	Includes fragments that pass through 1/4 inch screen. Examples include mixed residue, sand, soil, clay, and dirt.
	19	Diapers	Diapers made from a combination of fibers, synthetic, and/or natural, and made for the purpose of single use. This includes disposable baby diapers and adult protective undergarments.
	20	Other Organic	Includes organic material that cannot be put in any other category such as item hair, sawdust, and animal feces. Includes food soiled compostable paper such as napkins, paper towels, etc.
C&D	**21**	C&D	Clean dimensional lumber, clean engineered wood, wood pallets, painted wood, treated wood, concrete, reinforced concrete, asphalt paving, rock & other aggregates, brick, gypsum board, shingles and other roofing materials, plastic c&d materials such as piping and windows, ceramic/porcelin such as toilets. stoneware, dishes, ceramic tiles. Also includes items such as insulation, linoleum, nails, and cabinets.
INORGANICS	**22**	Electronics	Includes televisions, computer monitors, laptops and LCD monitors, keyboards, printers, and modems, arge and small electronic goods that have circuitry such as microwaves, stereos, VCRs, DVD players, radios, audio/visual equipment; computer related electronics such as processors, mice, keyboards, laptops, disk drives, printers, modems, and fax machines; and other small consumer goods such as personal digital assistants (PDAs), cell phones, phone systems, phone answering machines, computer games and other electronic toys, portable CD players, camcorders, and digital cameras.
	23	Household Batteries – Non-lithium	Includes non-lithium dry cell batteries..
	24	Lithium Batteries	Lithium batteries.
	24	Landfill - everything else	furniture, lead acid batteries, white goods, mattresses, light bulbs, air filters, garden hoses

HHW	**25**	HHW	Waste which if improperly put in the solid waste stream may present handling problems or other hazards that is not included in another category, including latex and oil based paint, herbicides, pesticides, fertilizers, oil filters, automotive fluid, mercury containing items such as thermometers and thermostats, prescription medications, sharps, cleaners and corrosives (various acids and bases whose primary purpose is to clean surfaces, unclog drains, or perform other actions) and solvents.
TEXTILES	**26**	Textiles	carpet, carpet padding, clothing, curtains, bedding, upholstery, shoes, leather

Appendix D
Health and Safety Plan

Sent Separately