2019 King County Waste Characterization and Customer Survey Report

King County Waste Monitoring Program

King County
Department of
Natural Resources and Parks
Solid Waste Division

Waste **Prevention** | *Resource* **Recovery** | *Waste* **Disposal**

www.kingcounty.gov/solidwaste

June 2020

Acknowledgments

This study would not have been possible without the support of the King County Solid Waste Division and the cooperation and assistance of the management and operators of the County's solid waste management facilities. Studies of this nature take time and facility space, and staff cooperation is greatly appreciated. Cascadia Consulting Group gratefully acknowledges the management and staff of the following disposal facilities who allowed our team into their sites and enabled us to conduct the fieldwork that made this study possible.

Algona Transfer Station

Bow Lake Recycling & Transfer Station

Cedar Falls Drop Box

Enumclaw Recycling & Transfer Station

Factoria Recycling & Transfer Station

Houghton Recycling & Transfer Station

Renton Recycling & Transfer Station

Shoreline Recycling & Transfer Station

Skykomish Drop Box

Vashon Recycling & Transfer Station

Support for this study was provided in part by the Washington State Department of Ecology.

Table of Contents

Tables and Figures

Executive Summary

Project Purpose and Background

In 2019, residents and businesses in King County disposed 868,532 tons of garbage, also known as municipal solid waste (MSW). To better understand the composition of King County's disposed waste and how it is managed, the King County Solid Waste Division has conducted its Waste Monitoring Program since the 1990s. The Waste Monitoring Program includes waste characterization studies, customer surveys, and other research to present an accurate picture of waste as it moves through the region, from residents and businesses to disposal. This recurring study helps King County provide efficient and effective services to residents and businesses, track progress toward recycling goals, and plan for future needs as they evolve over time. The 2019 study design ensured that the results were comparable to previous studies to track progress toward waste diversion goals.

In 2019, King County conducted a year-long waste characterization study and customer surveys at its disposal facilities as part of the Waste Monitoring Program. This research included data collection across all four seasons across throughout county and was designed to meet these objectives:

- **Waste characterization studies** provide robust composition data for King County's disposed waste. Collecting and sorting material delivered to each of King County's ten disposal facilities produces representative composition estimates for the residential, nonresidential, and self-haul substreams. These studies combine substream compositions to calculate statistically reliable estimates of waste disposed overall and for the total residential and nonresidential disposed waste streams in King County (excluding Seattle).
- **Customer surveys** track how customer-use profiles and related data change over time. Information gathered from customers through surveys supports analysis of trends in waste disposal and provides King County with information to help shape transfer station infrastructure and policies. Additionally, surveys help the County better understand its customers and continue to improve service.

Both studies categorized data into different substreams to provide detailed insight into King County's MSW stream and waste facility users. Substreams pertain to where the waste came from and who brought it to the facility. Disposed waste loads were divided into substreams according to the source, or generator, of the waste: residential or nonresidential. Disposed waste was then categorized further according to how materials were delivered to disposal facilities: commercially collected by waste-hauling companies or self-hauled by residents or other businesses that bring loads to disposal facilities.[1] This

[1] Commercial haulers are firms that contract with local governments to operate a garbage collection company or operate under a state franchise in a particular geographic area. The City of Enumclaw and the Town of Skykomish operate their own waste collection systems, rather than contracting with commercial haulers. Loads hauled by the City of Enumclaw and Town of Skykomish are categorized with commercially collected loads in this study. Self-haul loads are categorized as residential or nonresidential according to the source of the load, not the type of hauler. Some companies collect waste from homes or businesses, but they are not franchised haulers (1-800-GOT-JUNK, for example). These loads were categorized as self-haul residential if the waste is produced from homes, even though a company, not the residents, delivers the material to a waste facility.

study provides King County with information needed for effective materials management planning and to plan public programs designed to reach target customers.

In 2019, the project team hand-sorted 451 waste samples into 105 material types (listed in *Appendix B. Material Definitions*) and completed 5,563 customer surveys at the County's eight transfer stations and two drop box facilities (Skykomish was excluded from surveying due to its low traffic volume and remote location). This report presents the findings of those waste sorts and customer surveys.

Summary of Findings

This section summarizes key findings of the waste characterization and customer surveys. Waste characterization results are included in *Chapter 3. Waste Characterization Findings* and *Appendix D. Detailed Waste Composition Results*. Customer survey results are included in *Chapter 4. Transfer Station Customer Survey Findings* and *Appendix E. Detailed Customer Survey Results*. Throughout the report, waste quantity figures are presented in annual tonnages unless noted otherwise. Table 1 illustrates the annual disposed quantity (in tons) of waste in 2019 from each of the various substreams: residential and nonresidential, commercially collected and self-haul.

Table 1. Municipal Solid Waste Tonnage by Substream, 2019[2]

	Commercially Collected	Self-haul	Total
Residential tons	310,640	172,622	**483,262**
Nonresidential tons	369,478	15,792	**385,270**
Total	**680,118**	**188,414**	**868,532**

Key Waste Characterization Findings

As with previous Waste Monitoring Program studies, the study's material types were classified into three recoverability groups to help identify additional diversion opportunities: Readily Recyclable, Limited Recyclability, and Not Recyclable, as defined by King County. Material types included in each of these recoverability groups and the factors that affect recoverability are described in *Chapter 3. Waste Characterization Findings*. As shown in Figure 1, the waste composition results show 62.3% (541,166 tons) of the county's overall waste was Readily Recyclable, and 9.3% (81,104 tons) was considered to be of Limited Recyclability; the remainder was Not Recyclable. Figure 2 presents the overall waste composition by material class. **Paper** (17.7%) and **Food** (15.6%) were the most prevalent materials, followed by **Wood/Yard** (14.8%), **Other Organics** (14.8%), and **Plastic** (14.0%).

[2] King County provided these estimated quantities of commercially collected residential and nonresidential disposal and self-haul residential and nonresidential waste. In 2019, King County disposed 27,654 tons of other and special waste at Cedar Hills Regional Landfill; this waste was not sampled and is not included in the study results.

Figure 1. Disposed Waste Recoverability, Overall, 2019

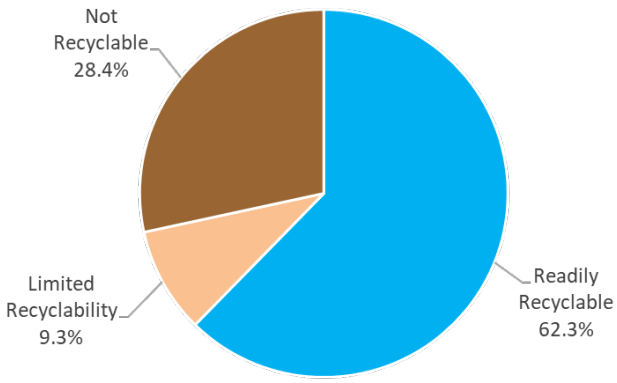


Figure 2. Composition by Material Class, Overall, 2019

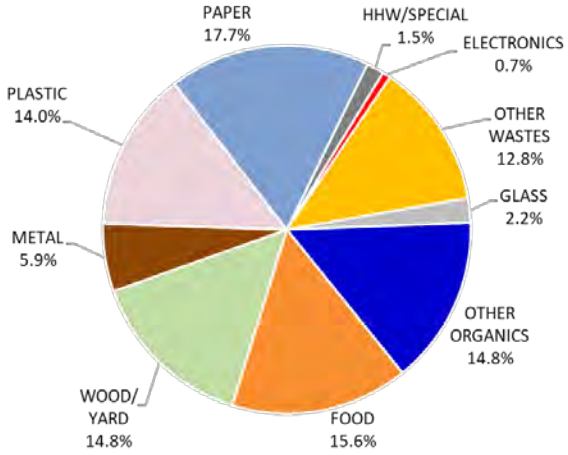


Table 2 summarizes the material types that represented more than 5% of each substream. *Dimensional lumber/engineered wood* was the largest portion of the overall disposed waste stream (7.0%), and it was the most prevalent material in the residential self-haul (17.0%) and nonresidential self-haul (12.7%) substreams. For nonresidential self-haul wastes, the seven most-common materials together represent 65 percent of the substream: *dimensional lumber/engineered wood*, *furniture*, *carpet*, *other wood*, *C&D wastes (except wood)*, *mattresses*, and *contaminated wood*. In commercially collected substreams, *low-grade recyclable paper* and *other compostable paper* were commonly found. The most common single material in the commercially collected residential substream was *disposable diapers*, followed by *animal feces*. The Food category was divided into "edible" and "non-edible" material types; if combined, "Fruits & Vegetables" represented 8.4% of commercially collected residential waste.

Table 2. Materials Contributing More than 5% of Disposed Waste by Substream, 2019

	Overall	Residential		Nonresidential	
		Commercially Collected	Self-haul	Commercially Collected	Self-haul
Dimensional Lumber/Engr. Wood	7.0%		17.0%	5.0%	12.7%
Low-Grade Recyclable Paper	5.9%	6.4%		7.6%	
Disposable Diapers	5.3%	9.6%			
Other Compostable Paper		5.6%		5.7%	
Mixed/Other Food Waste, Non-edible				5.3%	
Mixed/Other Food Waste, Edible		5.4%			
C&D Wastes (except wood)			8.9%		8.4%
Animal Feces		7.8%			
Furniture			5.3%		12.2%
Carpet					9.2%
Other Wood			7.0%		8.5%
Mattresses					8.4%
Contaminated Wood					5.6%
Total	**18.2%**	**34.8%**	**38.1%**	**23.6%**	**65.0%**

Estimates are presented to the nearest 0.1 percent and, when summed, may not equal the total shown due to rounding.

Comparisons Between Study Years (2015 to 2019)

This section presents findings from statistical comparisons between the 2019 waste composition data and the previous study period in 2015. The analysis examines statistical differences, using *t*-tests, between the 2019 and the 2015 studies. These comparisons are meant to determine if changes in the composition of King County's disposed waste stream are statistically significant (with a *p*-value less than or equal to 0.0125) or indicate a strong trend (defined as a *p*-value greater than 0.0125 but less than or equal to 0.02). The year-to-year comparisons were made by examining the changes in the composition percentages for selected material groupings. Key findings, summarized in Table 3, include the following:

- Overall, Newspaper decreased by about 82 percent. This decrease was about 79 percent in the single-family residential sector, 79 percent in multifamily residential, 83 percent in nonresidential, and 78 percent in the self-haul sector. The decrease was statistically significant in all these sectors.
- Overall, Organics decreased by about 30 percent, which was statistically significant. This decrease was 27 percent in the nonresidential sector and 46 percent in self-haul; these decreases were also statistically significant.
- A 25 percent increase in disposed Other Curbside Paper shows a strong trend compared to 2015 but did not meet the definition for statistical significance. This material type, which includes high-grade and low-grade paper, increased by 39 percent and 54 percent in the single-family and multifamily residential sectors, respectively; the increases for these sectors were statistically significant.

Table 3. Waste Composition Changes and Trends, 2015 vs. 2019

	Material Grouping	Composition† 2015	Composition† 2019	Relative Change in Composition	t-Statistic	p-Value	Strength of Results
Overall							
Overall	Newspaper	1.4%	0.3%	-81.6% ▼	10.6696	0.0000 *	stat. significant
Overall	Other Curbside Paper	4.3%	5.3%	24.8% ▲	2.4220	0.0156	strong trend
Overall	Organics	27.3%	19.2%	-29.6% ▼	5.4020	0.0000 *	stat. significant
Commercially Collected							
Single Family	Newspaper	2.1%	0.4%	-78.8% ▼	6.0636	0.0000 *	stat. significant
Single Family	Other Curbside Paper	4.3%	6.0%	38.7% ▲	3.0343	0.0028 *	stat. significant
Single Family	Curbside Containers	5.8%	7.5%	30.0% ▲	2.8379	0.0052 *	stat. significant
Multifamily	Newspaper	2.0%	0.4%	-79.3% ▼	5.7134	0.0000 *	stat. significant
Multifamily	Other Curbside Paper	5.4%	8.2%	53.8% ▲	2.9341	0.0046 *	stat. significant
Nonresidential	Newspaper	1.6%	0.3%	-83.1% ▼	7.2402	0.0000 *	stat. significant
Nonresidential	Other Curbside Paper	6.0%	8.4%	40.2% ▲	3.1083	0.0021 *	stat. significant
Nonresidential	Organics	37.3%	27.2%	-27.2% ▼	3.9994	0.0001 *	stat. significant
Self-haul							
Self-haul	Newspaper	0.6%	0.1%	-77.7% ▼	3.3816	0.0008 *	stat. significant
Self-haul	Organics	10.9%	5.9%	-46.3% ▼	2.6359	0.0088 *	stat. significant

†*Composition data was unweighted for the t-test.*

**Differences with a p-value of 0.0125 or less were considered statistically significant (abbreviated as "stat. significant" in table); "strong trend" was defined as a p-value greater than 0.0125 but less than or equal to 0.02.*

Key Customer Survey Findings

From March through December 2019, the research team completed 5,563 customer surveys at the County's disposal facilities. Key findings are as follows (percentages are based on the number of survey respondents):

- 80 percent of facility users surveyed were self-haul customers. These self-haul customers primarily delivered waste from residences (72%).
- Passenger vehicles represented 87 percent of the self-haul traffic surveyed.[3]
- Approximately half (51%) of commercially collected loads originated from nonresidential sources.
- Survey respondents reported that residential self-haul loads came from single-family homes, not multifamily residences.
- MSW/Mixed Garbage accounted for 72 percent of all loads surveyed. Construction and Demolition Debris represented 13 percent, and Yard Waste accounted for 9 percent. (These figures are as a percentage of customers surveyed, not tonnage disposed.)
- Most residential self-haul customers subscribed to curbside garbage service (57%); subscribers made, on average, less than half as many trips per year as non-subscribing self-haul customers.
- "Large amount of garbage" was the top reason for customers to self-haul waste for both residential (47%) and nonresidential customers (32%).

Organization of the Report

The remainder of this report provides the project purpose and background (Chapter 1), describes the study methodology (Chapter 2), and presents the findings for the waste characterization study (Chapter 3) and transfer station customer surveys (Chapter 4). Appendices follow the main body of the report detailing the study methodology (Appendix A), material definitions (B), composition calculations (C), detailed waste composition (D) and survey results (E), comparisons with previous studies (F), project plans and field forms (G, H, and I), and estimates of potential greenhouse gas emission savings through increased diversion of materials (J).

[3] Passenger vehicles include cars, pick-up trucks, vans, and sport-utility vehicles.

1. Project Purpose and Background

In 2019, residents and businesses in King County disposed 868,532 tons of garbage, also known as municipal solid waste (MSW).[4] To better understand the composition of King County's disposed waste and how it is managed throughout the county, the King County Solid Waste Division has conducted its Waste Monitoring Program for the past three decades. The Waste Monitoring Program includes waste characterization studies, customer surveys, and other components to present an accurate picture of waste and material flows through the region, from residents and businesses to disposal.[5]

King County's Waste Monitoring Program

This recurring study helps King County provide efficient and effective services to residents and businesses, track progress toward recycling goals, and plan for future needs. In 2019, King County conducted a year-long waste characterization study and customer survey at its ten disposal facilities as part of the Waste Monitoring Program. Data collection occurred across all four seasons throughout the county. The key objectives of the two studies are summarized below:

- **Waste characterization studies** provide robust composition data for King County's disposed waste. Collecting and sorting material delivered to each of King County's ten disposal facilities produces representative composition estimates for the residential, nonresidential, and self-haul substreams. These studies combine substream compositions to calculate statistically reliable estimates of waste disposed overall and for the residential and nonresidential disposed waste streams in King County (excluding Seattle).
- **Customer surveys** track how customer-use profiles and related data change over time. Information gathered from customers through surveys supports analysis of trends in waste disposal and provides King County with information to help shape transfer station infrastructure and policies. Additionally, surveys help the County better understand its customers and continue to improve service. Surveying took place at nine of the County's ten waste facilities; as in the prior study, Skykomish was excluded due to its low traffic volume and remote location.

Waste Characterization Studies

From March to December 2019, the project team hand-sorted 451 samples of disposed waste into 105 material types (defined in *Appendix B. Material Definitions*). Table 4 shows the number of samples sorted through King County's Waste Monitoring Program since 1991. Analysis by substream is useful because the different substreams often have different waste types, user profiles, and public programs

[4] This tonnage figure excludes wastes originating within the City of Seattle, which manages its solid waste separately from the rest of King County, and the City of Milton, which is serviced by Pierce County. The figure includes waste from Bothell (partly in Snohomish County) as well as Auburn and Pacific (partly in Pierce County).
[5] All fieldwork was conducted prior to the COVID-19 pandemic reaching the United States and is representative of the disposed waste stream in 2019.

for reaching customers. The total disposed waste was organized into the following categories, defined below, for the purposes of analysis:

1. Generators of waste:
    a. Residential (homes)
    b. Nonresidential waste (e.g., businesses, offices)
2. Mechanisms for delivering the waste to the facilities:
    a. Commercially collected
    b. Self-hauled (referred to as "self-haul")

Substreams were divided according to the source, or generator, of the disposed waste (residential or nonresidential) and by how materials were delivered to disposal facilities (commercially collected or self-haul) using these definitions, as summarized in Table 5 below:

Table 4. Number of Samples by Study

Study Period	# of Samples
2019	451
2015	421
2011	420
2007	421
2002-2003	369
1999-2000	412
1995-1996	630
1993-1994	568
1991	569
Total	**4,261**

- **Residential waste** is material disposed from single-family or multifamily dwellings.
- **Nonresidential waste** is material disposed from businesses, schools, government offices, and other institutions that are not residences.
- **Commercially collected** material is hauled by a firm under contract with local governments to operate a garbage collection company or operate under a state franchise in a particular area.[6]
- **Self-haul** material is disposed from and hauled by a resident or a business.[7]

Table 5. Definitions of Disposed Waste Streams and Substreams

Waste Stream	Commercially Collected Substream	Self-haul Substream
Residential Waste	Commercially collected waste from residential sources	Self-haul waste from residential sources
Nonresidential Waste	Commercially collected waste from nonresidential sources	Self-haul waste from nonresidential sources
Mixed Residential and Nonresidential Waste	Commercially collected waste from residential and nonresidential sources	Self-haul waste from residential and nonresidential sources

Waste loads coming into the facilities were first categorized into loads brought in by commercially operated garbage companies and loads that were self-hauled by residents or businesses. Then those loads were divided further by generator type into "residential" or "nonresidential" sources. A small portion of loads contained a mixture of disposed waste from residential and nonresidential sources; commercial waste haulers typically classify these mixed loads as nonresidential. To be consistent with

[6] The City of Enumclaw and the Town of Skykomish operate their own waste collection systems, rather than contracting with commercial haulers. Beginning with the 2002-2003 study, King County has included these waste deliveries with the commercially hauled loads.

[7] Self-haul loads were categorized as residential or nonresidential according to the source of the load, not the type of hauler. Although some companies that are not franchised commercial waste haulers remove waste from homes or businesses, these loads were considered self-haul residential if the waste was produced from homes, even though a "junk removal" service delivered the load to a waste facility.

previous studies, quantities from mixed loads were included in the nonresidential substream tonnage. Regional direct waste was classified as commercially collected nonresidential waste.[8]

Customer Surveys

In 2019, the project team completed 5,563 customer surveys at nine of King County's ten disposal facilities; as in 2015, Skykomish was excluded due to its low traffic volume and remote location. Table 6 shows counts of customer surveys completed as part of the Waste Monitoring Program since 1993.

Table 6. Number of Surveys by Study

Study Period	# of Surveys
2019	5,563
2015	6,034
2011	5,556
2008	5,086
2006	5,665
2002-2003	6,381
2001	7,050
1999-2000	7,809
1998	22,645
1997	12,610
1995-1996	11,132
1993-1994	12,523
Total	**102,491**

Customer survey data was segmented by generator type and how materials were brought to the transfer station, as with the waste characterization studies. For customer surveys, results from mixed residential and nonresidential loads were reported as nonresidential waste. Additionally, customer survey results were further divided by the type of material brought to the transfer station for disposal. These materials were classified into one of these four waste categories:

- **Yard Waste** is organic matter consisting of plant material, including grass, leaves, and prunings.
- **Construction and Demolition Debris** is waste created by construction and/or demolition activities such as roofing or remodeling.
- **Special Waste** is petroleum-contaminated soil, sludge, or asbestos.
- **MSW/Mixed Garbage** is waste that does not fit into the above categories or is a mix of types.

An overview of King County's waste management system is provided in the following section.

[8]*Regional direct waste* refers to any solid waste generated and collected in King County and transported to the Cedar Hills landfill by conventional long-haul transfer vehicles from solid waste transfer stations or intermediate processing facilities permitted by Public Health – Seattle & King County as provided for in KCC 10.08.090 and the Board of Health's regulation. Both definitions originate from the *King County Comprehensive Solid Waste Management Plan, Glossary.* These are primarily residual materials from materials recovery facilities (MRFs).

Waste Management in King County

Private waste management companies collect much of the waste from King County's homes and businesses. Some individuals and companies also choose to haul their own waste, either occasionally or on a regular basis. After collection, most of the county's solid waste destined for disposal arrives at one of ten County-owned facilities: eight transfer stations and two drop boxes. The transfer stations include Algona, Bow Lake, Enumclaw, Factoria, Houghton, Renton, Shoreline, and Vashon. The two drop boxes are located at Cedar Falls and in Skykomish. From these facilities, trucks haul King County's waste to the Cedar Hills Regional Landfill for disposal. Some MSW is disposed of directly at Cedar Hills and does not pass through the transfer stations; this material includes regional direct waste, special waste, and some direct deliveries from collection trucks that operate in the vicinity of the landfill. King County's overall disposed waste totaled 868,532 tons in 2019.

Table 7 below shows the tons and percentage of MSW delivered to each of King County's ten facilities, and directly to Cedar Hills landfill in 2019. Residents and businesses disposed of over 848,000 tons of MSW at these facilities. Bow Lake transfer station received the most waste: 266,623 tons and 31 percent of the total. Waste taken to the Skykomish drop box represented the smallest share of the total, with slightly more than 1,650 tons, or less than 1 percent of the county's MSW waste stream. Table 8 shows the total number of annual transactions by facility. Bow Lake also receives the most customers, with approximately 24 percent (198,762) of more than 818,000 transactions. Skykomish receives the fewest visitors, with approximately 1 percent of transactions.

Table 7. Annual Tons by Facility, 2019 [9]

Site	Annual Tons	Percent of Total
Algona	154,195	18%
Bow Lake	266,623	31%
Cedar Falls Drop Box	3,556	0%
Enumclaw	22,355	3%
Factoria	139,617	16%
Houghton	137,361	16%
Renton	59,156	7%
Shoreline	48,549	6%
Skykomish Drop Box	1,651	0%
Vashon	7,815	1%
Subtotal	***840,878***	***99%***
Regional Direct Waste	7,542	1%
Total	**848,420**	**100%**

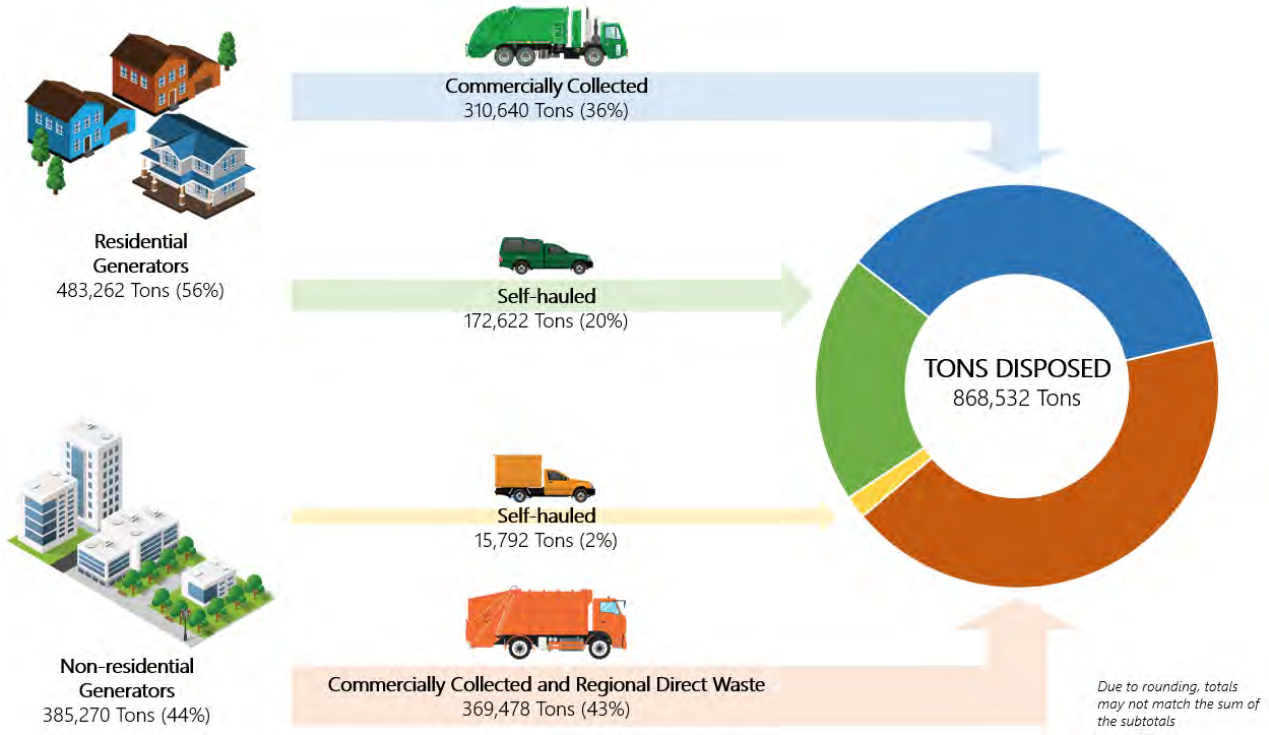
Table 8. Annual Transactions by Facility, 2019

Site	Annual Transactions	Percent of Total
Algona	140,627	17%
Bow Lake	198,762	24%
Cedar Falls Drop Box	20,226	2%
Enumclaw	55,958	7%
Factoria	108,082	13%
Houghton	108,591	13%
Renton	77,263	9%
Shoreline	84,825	10%
Skykomish Drop Box	4,111	1%
Vashon	19,551	2%
Subtotal	***817,996***	***100%***
Regional Direct Waste	512	0%
Total	**818,508**	**100%**

[9] Special and other waste that is delivered directly to Cedar Hills Regional Landfill without passing through a County facility is not included. The Skykomish drop box is typically hauled to the Houghton transfer station where it is weighed and reported as Skykomish tonnage. In the table, the Skykomish drop box tonnage is separated from the total tonnage received at Houghton. For logistical reasons, the drop box was sampled at Bow Lake in 2019.

Figure 3 depicts the material flows associated with the two primary generators of waste (residential and nonresidential) and the two methods of transporting waste to disposal facilities (commercially-collected and self-haul).

Figure 3. Waste Tonnage by Substream, 2019



2. Summary of Methodology

The following section summarizes the four main elements of the study methodology: 1) develop sampling plan, 2) survey incoming vehicles, 3) collect and sort samples, and 4) analyze data and prepare reports. The 2019 methodology follows that of the 2015 waste characterization study for comparability.

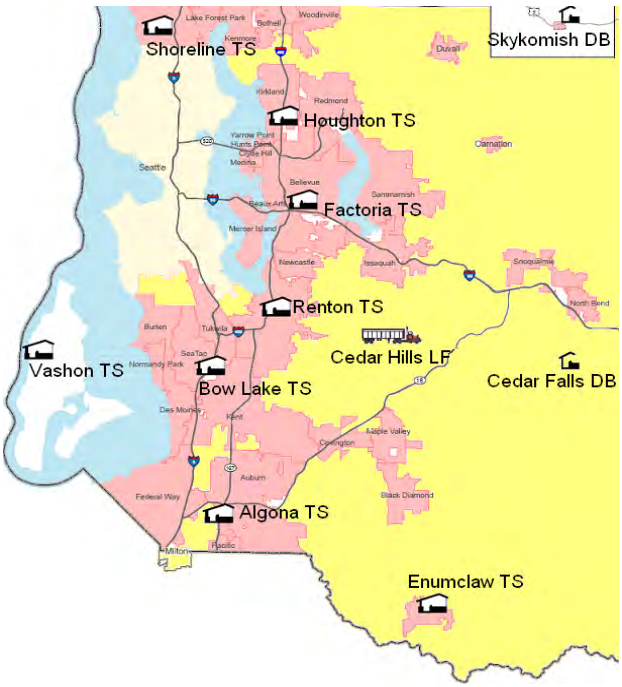
Develop Sampling Plan

Samples were allocated by source or generator (residential or nonresidential) and then by collection type (commercially collected or self-haul) and vehicle type. The vehicle types for commercially collected loads were packers or drop boxes. For self-haul loads, the vehicle types were passenger vehicles or other large vehicles. Examples of the vehicle types can be found in *Appendix I. Example Field Forms*.

A sampling schedule was constructed for the study period of March through December 2019, allocating sampling days across transfer stations throughout the year. Sampling days were randomly assigned to ensure a representative distribution across seasons, days of the week, and site locations while maximizing sample size and reliability. More survey days were allocated to higher-traffic sites. Figure 4 shows the location of the eight transfer stations and two drop boxes in King County.

In the 2019 study, 31 of the 44 customer survey shifts were concurrent with vehicle selection for waste sampling. Surveying took place at nine of the County's ten waste facilities; the Skykomish drop box was excluded due to its extremely low traffic volume and remote location. The survey shifts included evening (4 p.m. to midnight) and night (midnight to 8 a.m.) shifts at Bow Lake transfer station and weekend days at all surveyed facilities.

Figure 4. Map of Transfer Station Locations



Survey Incoming Vehicles

The Gatekeeper gathered information from the driver of every vehicle about the hauler type (commercially collected or self-haul), vehicle type (packer truck, passenger vehicle, etc.), waste type (mixed garbage, yard waste, construction and demolition, and special waste), and generator (residential or nonresidential) of the load. When a surveyed vehicle met the daily sampling criteria, the Gatekeeper affixed a *Sample Placard* to the vehicle's windshield and directed the driver to the sample collection area. Figure 5 shows a vehicle being surveyed. Table 9 shows the number of surveys completed each month at each facility; surveying began in March, and no surveys were conducted in April. Methods for surveying, vehicle selection, and sampling are detailed in *Appendix A. Sample and Survey Methodology*.

Figure 5. Vehicle Surveyor at Renton Transfer Station

Table 9. Surveys Completed by Facility and Month, 2019

Site	Mar	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Algona	156	0	0	220	0	240	140	125	0	**881**
Bow Lake	124	363	114	109	0	54	269	138	225	**1,396**
Cedar Falls Drop Box	0	81	0	0	0	0	0	1	50	**132**
Enumclaw	0	105	77	0	0	0	75	71	0	**328**
Factoria	155	0	114	187	0	74	0	193	0	**723**
Houghton	146	0	0	172	185	172	74	0	0	**749**
Renton	0	86	0	0	0	0	86	91	139	**402**
Shoreline	130	0	0	210	0	143	77	0	0	**560**
Skykomish Drop Box	0	0	0	0	0	0	0	1	0	**1**
Vashon	86	69	0	73	0	52	0	63	48	**391**
Total	**797**	**704**	**305**	**971**	**185**	**735**	**721**	**683**	**462**	**5,563**

Collect and Sort Samples

Cascadia planned to complete 30 days of sampling, with an average of 15 samples per day. The number of sampling days allocated to each facility was roughly proportional to the annual tonnage handled by that facility. No sampling days were allocated to the Cedar Falls or Skykomish drop box sites; instead, Cascadia worked with the County and the appropriate hauler to ensure that at least one drop box from each site was delivered to Factoria or Houghton, respectively, during sampling days at those sites. In 2019, the Skykomish drop box was sampled at Bow Lake instead of Houghton for logistical reasons.

Table 10 shows the number of planned and actual samples collected for each facility. In some cases, the target number of loads from a specific sector did not arrive at the facility. This could have a result of weather, day of the week, or unusually slow days at the transfer station. If the field crew anticipated this outcome during the day of fieldwork, they replaced any loads not received with self-haul samples and adjusted targets for future sampling days to meet the overall project sample targets.

In December, two additional fieldwork days were scheduled (one at Bow Lake and one at Vashon) to make up for missed or invalid samples during the year. The following events resulted in adjustments to the fieldwork schedule:

- In February, a major snow event disrupted waste collection and delayed the fieldwork start date to March 2019.
- In November, the sort crew was unable to complete sampling at the Vashon facility due to equipment issues. This sampling day was rescheduled to December.

Table 10. Planned and Actual Samples by Facility and Month, 2019

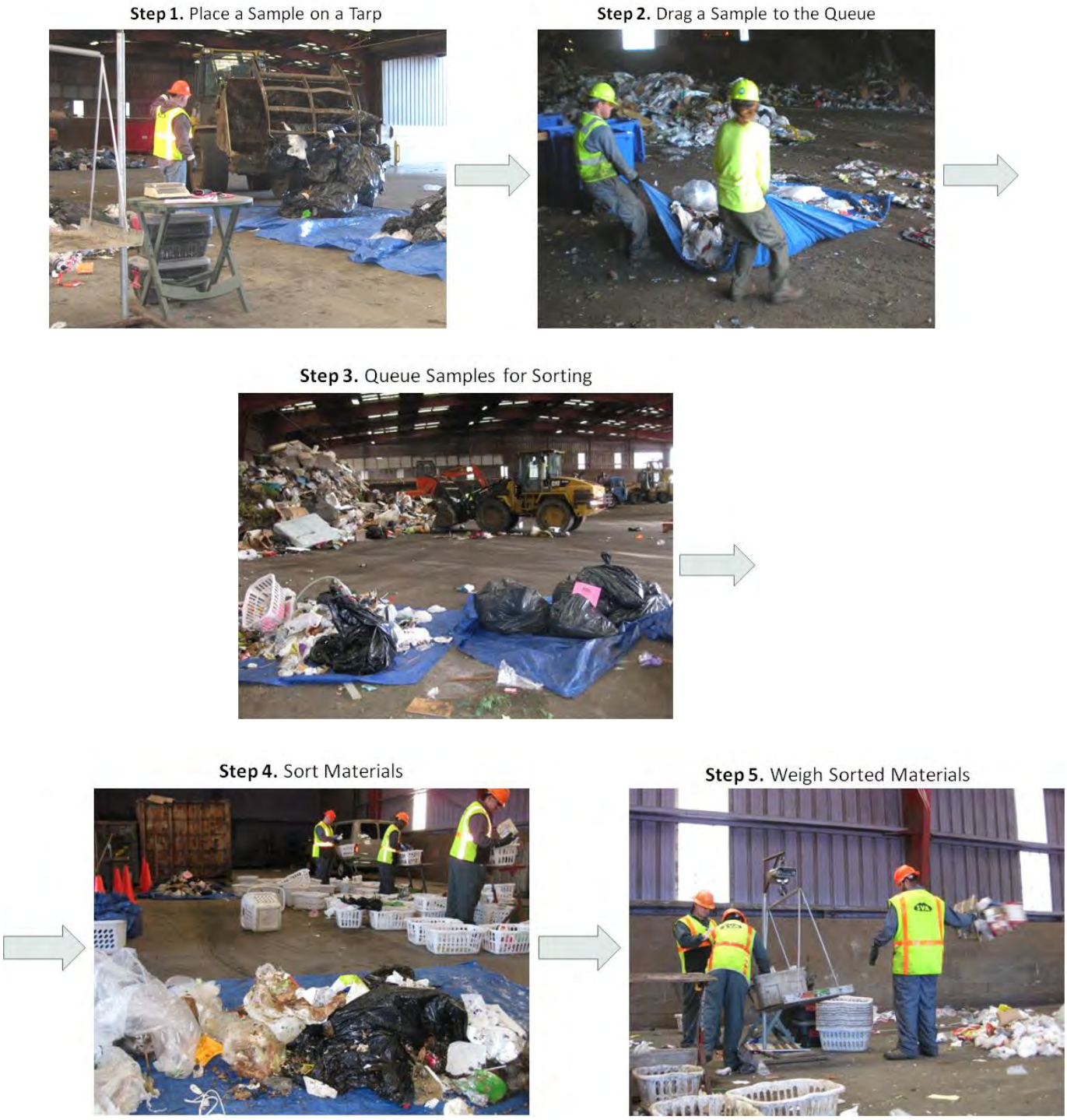
	March		May		July		September		October		November		December		Total	
	Plan	Actual	Plan	Actual	Plan	Actual	Plan	Actual	Plan	Actual	Plan	Actual	Plan	Actual	Plan	Actual
Algona	15	14			15	15			15	15	15	15			**60**	**59**
Bow Lake	15	14	30	27	15	14	15	15			15	15		16	**90**	**101**
Cedar Falls*											1	1			**1**	**1**
Enumclaw			15	15					15	14					**30**	**29**
Factoria	15	15			15	14	15	14			14	14			**59**	**57**
Houghton	15	15			15	15	15	15	15	14					**60**	**59**
Renton			15	15					15	15	14	15			**44**	**45**
Shoreline	15	12					15	14	15	12					**45**	**38**
Skykomish*											1	1			**1**	**1**
Vashon			15	14	15	14	15	14			15			19	**60**	**61**
Total	**75**	**70**	**75**	**71**	**75**	**72**	**75**	**72**	**75**	**70**	**75**	**61**	**0**	**35**	**450**	**451**

**The Skykomish drop box was sampled at Bow Lake in 2019 (though its waste usually goes to Houghton), and the Cedar Falls drop box was sampled at Factoria.*

When a selected vehicle arrived at the sample collection area, the Sort Crew Manager removed the *Sample Placard,* asked the driver to dump their vehicle's load, and then directed a loader operator to scoop a 200- to 250-pound portion of the waste dumped from the vehicle. The loader placed the scoop on a tarpaulin for sorting. The field crew sorted and weighed each of the 451 samples into 105 material types such as *high-grade paper* or *clear glass containers.* See *Appendix B. Material Definitions* for the full material definitions and examples. The Sort Crew Manager recorded the weight for each sorted material

type on the *Material Weight Tally Sheet* and reviewed the form. Examples of the *Sample Placard* and the *Material Weight Tally Sheet* can be found in *Appendix I. Example Field Forms.* Figure 6 illustrates the hand-sort procedure.

Figure 6. Sample Collection and Sorting Procedures



Analyze Data and Prepare Reports

Both the survey data and waste sort data were collected on paper forms and then transferred to electronic platforms for analysis. The survey data was entered into an Excel workbook, and the sort data was entered into OSCAR, a customized proprietary database, and reviewed for data-entry errors. Figure 7 shows a screenshot of the OSCAR online database. At the conclusion of the field work, waste composition estimates were calculated by aggregating waste sample data using a weighted average procedure. The calculations for the weighted averages were based on the vehicle surveys and waste tonnage data provided by King County Solid Waste Division. The composition calculations and weighting factors are described in *Appendix C. Waste Composition Calculation*.

Figure 7. Electronic Data-Entry Form in OSCAR

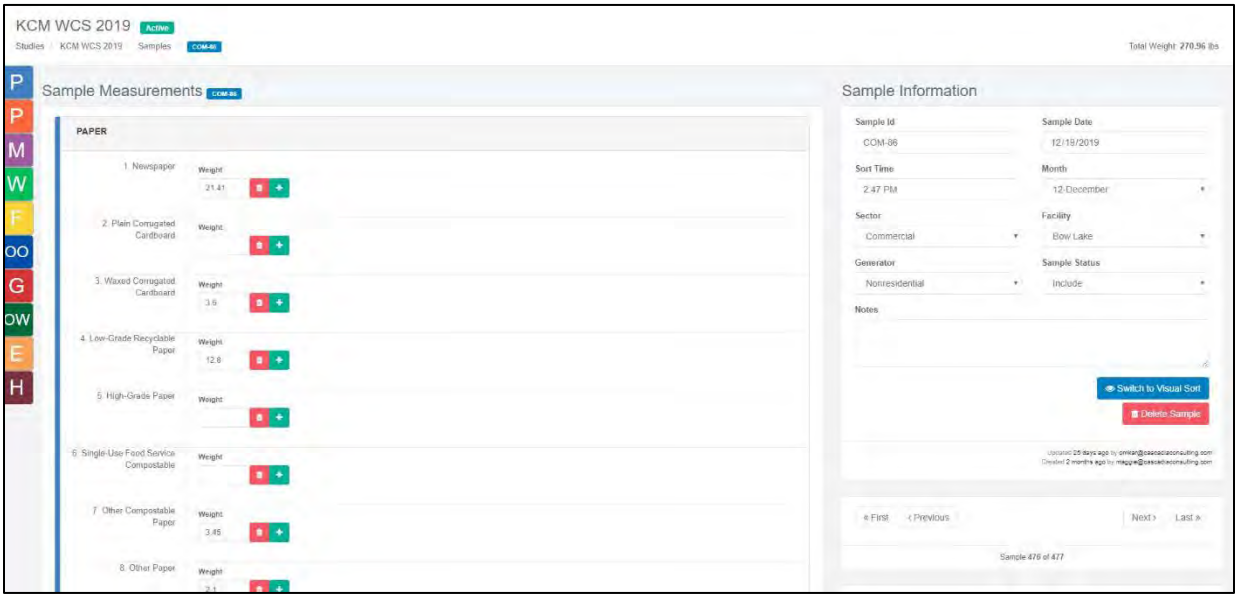


Table 11 shows the number of samples collected and sorted at each waste facility, and Table 12 shows the number of surveys completed at each waste facility in 2019.

Table 11. Number of Samples Collected by Facility

Site	Samples
Algona	59
Bow Lake	101
Cedar Falls Drop Box	1
Enumclaw	29
Factoria	57
Houghton	59
Renton	45
Shoreline	38
Skykomish Drop Box	1
Vashon	61
Total	**451**

Table 12. Number of Surveys Completed by Facility

Site	Surveys
Algona	881
Bow Lake	1,396
Cedar Falls Drop Box	132
Enumclaw	328
Factoria	723
Houghton	749
Renton	402
Shoreline	560
Skykomish Drop Box	1
Vashon	391
Total	**5,563**

Changes in Methodology from Previous Studies

The 2019 waste characterization study followed the same basic methodology as the 2015 and prior studies. Like the previous study, the 2019 study did not survey users of the Skykomish drop box, due to its low traffic volume and remote location; this is the main methodological difference from 2011 and prior studies. The following adjustments were made for the 2019 study:

- The number of material types increased from 97 types in 2015 to 105 types in 2019 to better align the list with materials currently accepted in diversion programs and to gather additional detail on materials of interest, such as food scraps and plastics, for future diversion programs. The 105 material types used in the study are described in *Appendix B. Material Definitions*.
- The sampling plan included two more sampling days (30 samples) than the 2015 study. These two extra days of sampling were completed at the Vashon transfer station, at the direction of the County, to more accurately characterize the waste arriving at that facility.

3. Waste Characterization Findings

Interpreting the Results

How Data Are Presented

For the overall disposed waste stream and for each substream, data are presented in three ways:

- First, an overview of waste composition by recoverability group is presented as a pie chart.
- Next is an overview of waste composition, by **Material Class**, in a pie chart.
- The third presentation is of the ten most prevalent individual *material types*, by weight in tons, shown in a table.

Material Designations

For the sake of clarity, recoverability groups such as Readily Recyclable and Limited Recyclability are capitalized. **Material Classes** such as **Paper**, **Plastic**, and **Glass** are capitalized and bolded. Material types such as *old newspaper (ONP), PET bottles,* and *used oil* are italicized.

All weight data throughout the report are presented in tons unless otherwise noted. Detailed tables listing the full composition and quantity results for the 105 material types are included in *Appendix D. Detailed Waste Composition Results.*

Rounding

When interpreting the results presented in the tables and figures in this report, it is important to consider the effect of rounding. To keep the waste composition tables and figures readable, estimated tonnages are rounded to the nearest ton, and estimated percentages are rounded to the nearest percent or tenth of a percent. Due to this rounding, the tonnages presented in the report, when added together, may not exactly match the subtotals and totals shown. Similarly, the percentages, when added together, may not exactly match the totals shown. Percentages less than 0.05% are shown as 0.0%.

It is important to recognize that the tons shown in the report were not calculated using the rounded percentages shown in the tables. Instead tons were calculated using more precise percentages in the data workbooks. Using the rounded percentages to calculate tonnages may yield results that differ from the numbers shown in the report.

For example, the rounded percentage for *mixed/other food waste, edible* in Table 14 is shown as 4.1%. If this rounded number had been used in the calculations, *mixed/other food waste, edible* would be 35,610 tons. However, using the more precise number (4.05166729489%), *mixed/other food waste, edible* is calculated as 35,190 tons (as shown), a difference of 420 tons.

Material Recoverability Groups

To identify additional diversion opportunities, material types were classified according to their recoverability, using three recoverability groups:

- **Readily Recyclable**—Materials for which recycling, composting, or digestion technologies are well-developed and for which many materials markets are well-developed. Infrastructure and programs may be readily available and are currently utilized. Includes materials accepted in both the recycling bin and the organics bin for the purpose of composting.
- **Limited Recyclability**—Materials for which recycling technologies, programs, and markets exist, but are either not well developed or not currently utilized.
- **Not Recyclable**—Materials that are not readily recyclable or face other market, technology, or program-related barriers.

Each material type was assigned in the previous study to one of the recoverability groups by Solid Waste Division staff based on the definitions above; County staff reviewed and updated these classifications for the 2019 study. The County notes that the definitions of recoverability groups are subject to change in the future as policies, markets, and technologies evolve. Table 13 shows how material types were categorized into recoverability groups at the time of this research.

Table 13. Recoverability Groups and Material Types *("Recyclable" includes recycling, composting, and digestion)*

Readily Recyclable	Readily Recyclable	Not Recyclable
High Grade Paper	Dimensional Lumber	Other Paper
Low Grade Recyclable Paper	Large Prunings	Expanded Polystyrene Products
Newspaper (ONP)	Stumps	Expanded Polystyrene Single-serve Food Packaging
Other Compostable Paper	Yard Waste	Foam Rubber and Padding
Plain Corrugated Cardboard (OCC/Kraft)	Other Textiles	Mixed Resin Plastic Products
Single Use Food Service Compostable Paper	Clothes & Other Recyclable	Other Plastic Packaging
Waxed Corrugated Cardboard (OCC)	Tires	Plastic and Other Materials
Compostable Plastics	A/V Equipment	Plastic Film Products
HDPE Bottles	Cell Phones	Plastic Garbage Bags
Industrial Packaging Film Plastic	Computer Peripherals	Other Mixed Metals (items >20% non-metal)
Non-industrial Packaging Film Plastic	CPUs	Kitchenware/Ceramics
#3 Packaging	CRT Computer Monitors & Televisions	Other Glass
#4 Packaging	Laptops	Contaminated Wood
#5 Packaging	Other Computer Monitors & Televisions	Roofing and Siding Wood
Other #6 Packaging	Other Electronics	Treated Wood
Other #7 Packaging	Printers/Copiers/Fax Machines	Animal Carcasses
Other Expanded Polystyrene Packaging	Small Household Appliances	Animal Feces
Other HDPE Containers	Tablets	Disposable Diapers
Other PET Containers	Mattresses	Miscellaneous Organics
PET Bottles	Compact Fluorescent Bulbs	Rubber Products
Recyclable Plastic Bags	Household Batteries	Ash
Aluminum Cans	Oil-based Paint	C&D Wastes
Compressed Gas Cylinders	Other Fluorescent Bulbs/Tubes	Miscellaneous Inorganics
Mixed Metals (items <20% non-metal)	Solvents and Thinners	Nondistinct Fines
Other Aluminum	Used Oil	Cleaners and Corrosives
Other Ferrous	Vehicle Batteries	Medical Waste
Other Non-Ferrous	**Limited Recyclability**	Other Hazardous Waste
Tinned Food Cans	Carpet Padding	Pesticides and Herbicides
Brown Glass Containers	Single Resin Plastic Products	
Clear Glass Containers	Other Wood	
Green Glass Containers	Asphalt Shingles	
Fruits & Vegetables, Edible	Carpet	
Fruits & Vegetables, Non-edible	Furniture	
Homegrown Fruits & Vegetables	Gypsum Wallboard	
Meat, Edible	Adhesives and Glue	
Meat, Non-edible	Antifreeze/Brake Fluid	
Mixed/Other Food, Edible	Gasoline and Fuel Oil	
Mixed/Other Food, Non-edible	Latex Paint	
Other Compostables	Pharmaceuticals and Vitamins	

Composition and Recoverability of Waste

The following sections describe the composition and recoverability of King County's overall disposed waste stream and its many substreams. More detailed composition and quantity data for each substream are included in *Appendix D. Detailed Waste Composition Results*.

Overall Disposed Waste

The overall waste composition is the weighted average of all 451 samples.

As shown in Figure 8, approximately 62 percent (541,166 tons) of the overall disposed waste was considered to be Readily Recyclable, as defined by King County, meaning that nearly two-thirds of the material could be recovered in the recycling or organics streams. Approximately 9 percent (81,104 tons) of the overall waste was considered to have Limited Recyclability, and the remaining 28 percent (246,262 tons) was Not Recyclable (and thus currently belongs in the disposed waste stream). Figure 9 presents the overall waste composition by material class. **Paper** (17.7%) and **Food** (15.6%) were the most prevalent materials, followed by **Wood/Yard** and **Other Organics** (both 14.8%).

Figure 8. Disposed Waste Recoverability, Overall, 2019

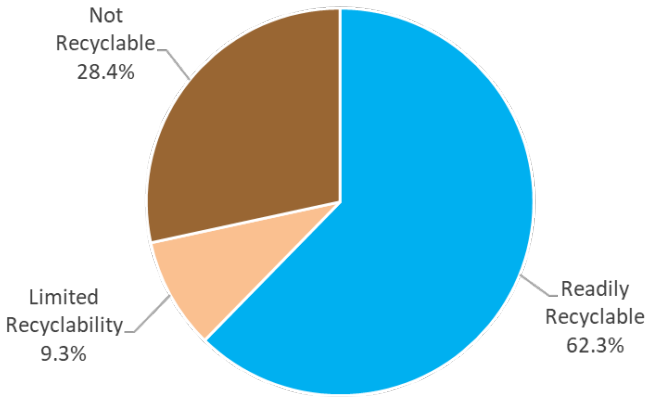


Figure 9. Disposed Waste Composition, Overall, 2019

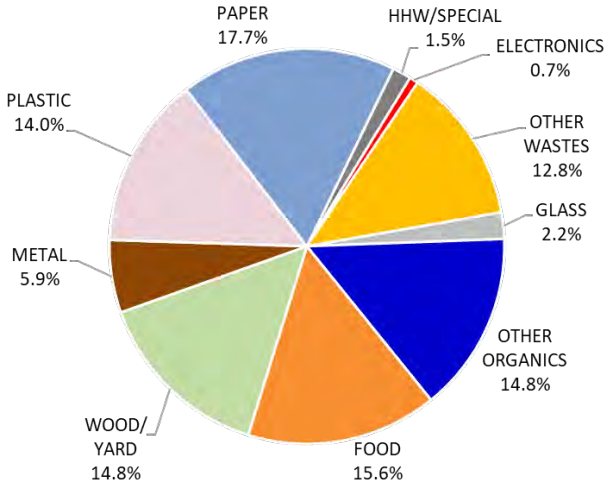


Table 14 lists the ten most prevalent disposed materials in King County. *Dimensional lumber/engineered wood* (7.0%) and *low-grade recyclable paper* (5.9%) were the two most common materials in the disposed waste stream, followed by *disposable diapers* (5.3%). Seven of the top ten materials disposed were Readily Recyclable.

Table 14. Ten Most Prevalent Disposed Materials, Overall, 2019

Material	Est. Percent	Est. Tons
Dimensional Lumber/Engr. Wood	7.0%	61,002
Low-Grade Recyclable Paper	5.9%	51,508
Disposable Diapers	5.3%	45,800
Other Compostable Paper	4.5%	39,483
Mixed/Other Food Waste, Non-edible	4.2%	36,094
Mixed/Other Food Waste, Edible	4.1%	35,190
C&D Wastes (except wood)	4.0%	35,118
Animal Feces	3.9%	33,997
Plain Corrugated Cardboard (OCC)	3.6%	31,430
Non-Industrial Packaging Film Plastic	3.4%	29,718
Total for Top Materials	**46.0%**	**399,339**

Residential Substreams

The residential waste composition is the weighted average of 279 samples from the commercially collected residential and self-haul residential substreams.

As Figure 10 shows, 59% (285,066 tons) of King County's residential waste was Readily Recyclable. Nearly one-third (29.3% and 141,499 tons) was Not Recyclable, and 11.6% was Limited Recyclability (56,697 tons). Figure 11 shows that **Wood/Yard** (17.8%) and **Other Organics** (17.0%) were most prevalent, followed by **Other Wastes** (14.9%) and **Food** (14.8%). In residential loads, **Wood/Yard** material in self-haul (60,341 tons) was more than double that of commercially collected (25,801 tons).

Figure 10. Disposed Waste Recoverability, Residential Substreams, 2019

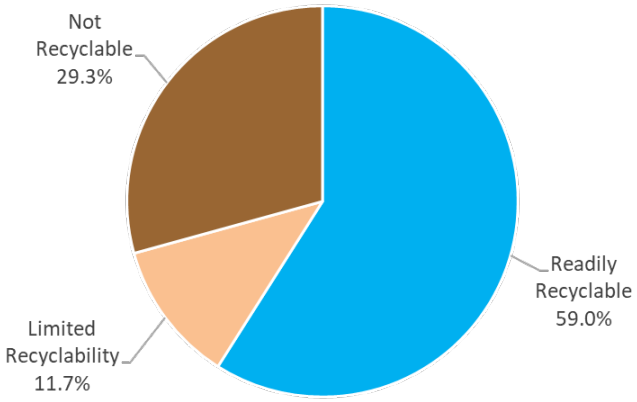
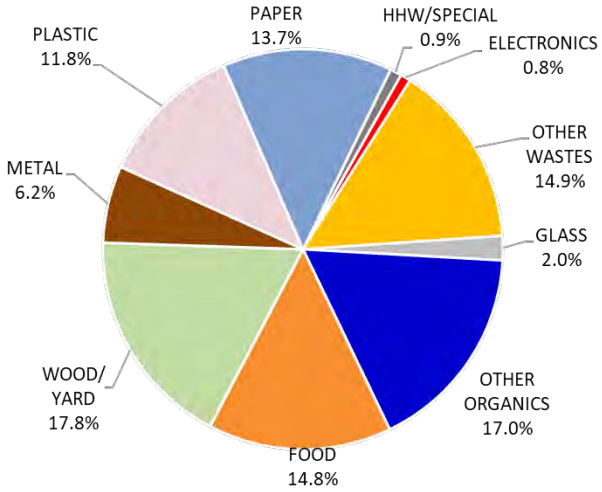


Figure 11. Disposed Waste Composition, Residential Substreams, 2019



As Table 15 shows, seven of the top ten material types were Readily Recyclable. The top two Readily Recyclable materials were *dimensional lumber/engineered wood* (8.4%) and *low-grade recyclable paper* (4.8%). Self-haul generated most of the *dimensional lumber*, which was far less common in commercial collection. The top Not Recyclable materials were *disposable diapers* (6.3%), *animal feces* (5.5%), and *C&D wastes* (4.5%). The top ten materials accounted for slightly less than half of residential waste.

Table 15. Ten Most Prevalent Disposed Materials, Residential Substreams, 2019

Material	Est. Percent	Est. Tons
Dimensional Lumber/Engr. Wood	8.4%	40,511
Disposable Diapers	6.3%	30,505
Animal Feces	5.5%	26,461
Low-Grade Recyclable Paper	4.8%	23,434
C&D Wastes (except wood)	4.5%	21,590
Other Compostable Paper	3.8%	18,470
Mixed/Other Food Waste, Edible	3.8%	18,322
Fruits & Vegetables, Non-edible	3.4%	16,666
Mixed/Other Food Waste, Non-edible	3.4%	16,546
Plain Corrugated Cardboard (OCC)	2.9%	13,843
Total for Top Materials	**46.8%**	**226,348**

Nonresidential Substreams

The nonresidential disposed waste composition is the weighted average of 172 samples from the commercially collected nonresidential and self-haul nonresidential substreams.

The key recoverability and material class findings for King County's nonresidential substream are shown below. Figure 12 shows that approximately two-thirds of nonresidential waste was Readily Recyclable (66.5% and 256,100 tons), and 6.3 percent was Limited Recyclability (24,407 tons). The remaining third (27.2% and 104,763 tons) was Not Recyclable. As shown in Figure 13, **Paper** (22.7%), **Plastic** (16.9%), and **Food** (16.6%) were the most prevalent material classes.

Figure 12. Disposed Waste Recoverability, Nonresidential Substreams, 2019

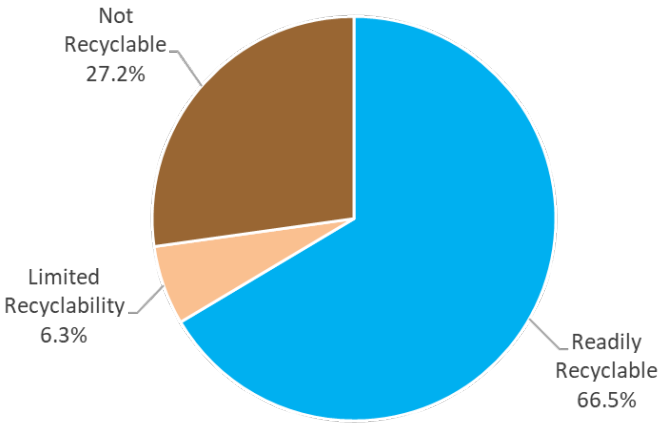


Figure 13. Disposed Waste Composition, Nonresidential Substreams, 2019

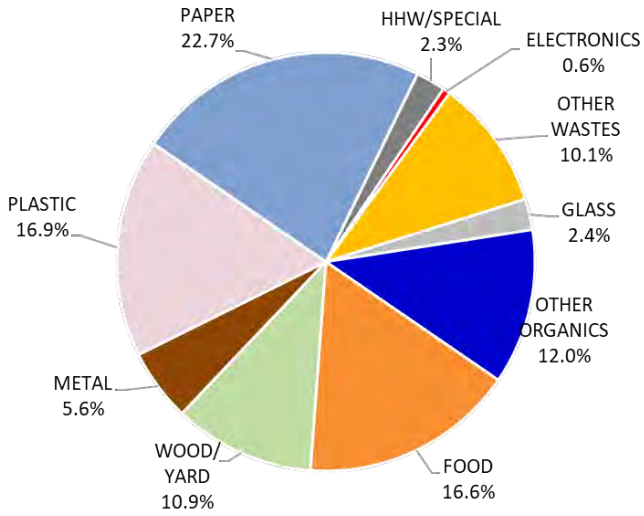


Table 16 shows the ten most prevalent disposed materials in nonresidential substreams. *Low-grade recyclable paper* (7.3%), *other compostable paper* (5.5%), and *dimensional lumber/engineered wood* (5.3%) were the top three. *Mixed/other food waste, non-edible*; *mixed/other food waste, edible*; and *fruits & vegetables, non-edible* were in the top ten and together totaled 12.7 percent (48,887 tons).

Table 16. Ten Most Prevalent Disposed Materials, Nonresidential Substreams, 2019

Material	Est. Percent	Est. Tons
Low-Grade Recyclable Paper	7.3%	28,074
Other Compostable Paper	5.5%	21,013
Dimensional Lumber/Engr. Wood	5.3%	20,491
Mixed/Other Food Waste, Non-edible	5.1%	19,548
Plain Corrugated Cardboard (OCC)	4.6%	17,587
Mixed/Other Food Waste, Edible	4.4%	16,868
Non-Industrial Packaging Film Plastic	4.2%	16,283
Disposable Diapers	4.0%	15,295
C&D Wastes (except wood)	3.5%	13,528
Fruits & Vegetables, Non-edible	3.2%	12,471
Total for Top Materials	**47.0%**	**181,158**

Commercially Collected Substreams

The commercial disposed waste composition is the weighted average of 270 samples from the commercially collected residential and the commercially collected nonresidential substreams.

As shown in Figure 14, over two-thirds of King County's commercially collected disposed waste was Readily Recyclable (66.4% and 451,806 tons) or Limited Recyclability (4.8% and 32,692 tons), and the remaining portion was Not Recyclable (28.8% and 195,621 tons). As shown in Figure 15, **Paper** (20.8%) was the most prevalent material class, followed by **Food** (19.2%) and **Other Organics** (17.4%).

Figure 14. Disposed Waste Recoverability, Commercially Collected Substreams, 2019

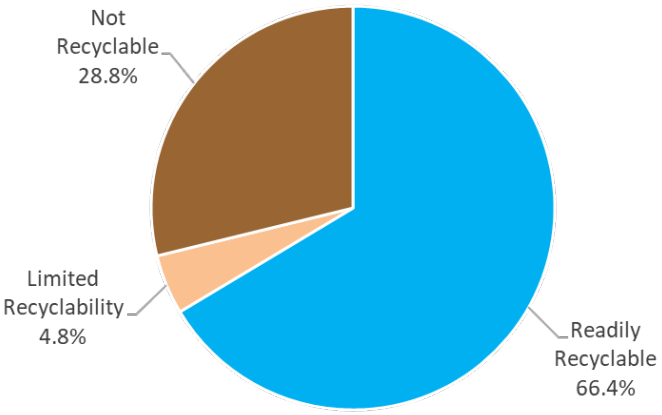


Figure 15. Disposed Waste Composition, Commercially Collected Substreams, 2019

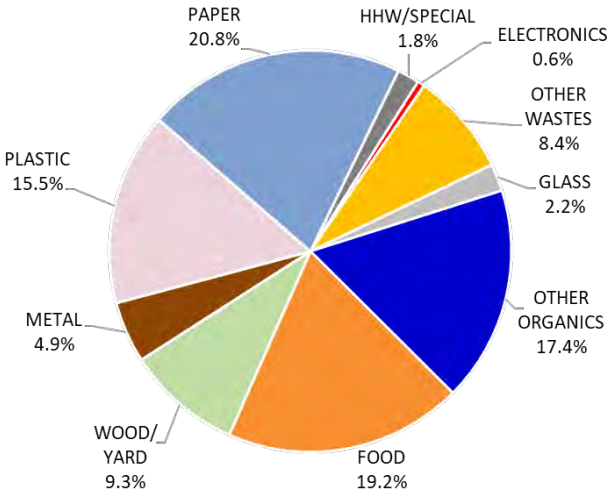


Table 17 shows the ten most prevalent materials in commercially collected substreams. *Low-grade recyclable paper* (7.0%); *other compostable paper* (5.7%); *mixed/other food waste, non-edible* (5.1%); and *mixed/other food waste, edible* (4.9%) were the most prevalent Readily Recyclable materials. Two of these materials were Not Recyclable: *disposable diapers* and *animal feces*; together, they totaled 11.3 percent (76,899 tons) of commercial collection and were most prevalent in residential substreams.

Table 17. Ten Most Prevalent Disposed Materials, Commercially Collected Substreams, 2019

Material	Est. Percent	Est. Tons
Low-Grade Recyclable Paper	7.0%	47,839
Disposable Diapers	6.6%	44,997
Other Compostable Paper	5.7%	38,508
Mixed/Other Food Waste, Non-edible	5.1%	34,715
Mixed/Other Food Waste, Edible	4.9%	33,539
Animal Feces	4.7%	31,902
Dimensional Lumber/Engr. Wood	4.4%	29,718
Non-Industrial Packaging Film Plastic	4.2%	28,591
Fruits & Vegetables, Non-edible	4.1%	27,922
Plain Corrugated Cardboard (OCC)	3.9%	26,472
Total for Top Materials	**50.6%**	**344,202**

Commercially Collected Residential Substream

The composition data in this section are based on 114 samples from the commercially collected residential substream.

As shown in Figure 16, nearly two-thirds (64.7% and 201,120 tons) of King County's commercially collected residential disposed waste was Readily Recyclable. Nearly one-third (30.4% and 94,446 tons) was Not Recyclable, and 4.9% was Limited Recyclability (15,074 tons). Figure 17 shows **Other Organics** (23.2%), **Food** (21.3%), and **Wood/Yard** (8.3%) together represented more than half of the substream.

Figure 16. Disposed Waste Recoverability, Commercially Collected Residential Substream, 2019

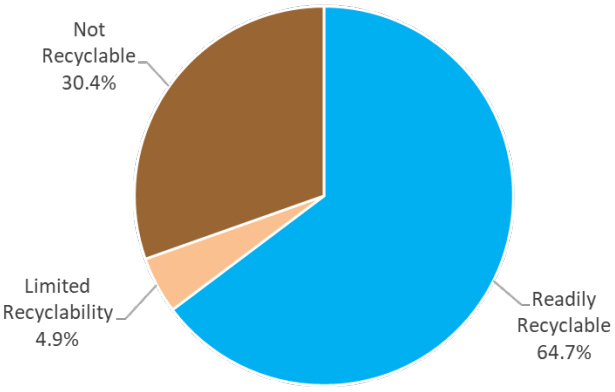


Figure 17. Disposed Waste Composition, Commercially Collected Residential Substream, 2019

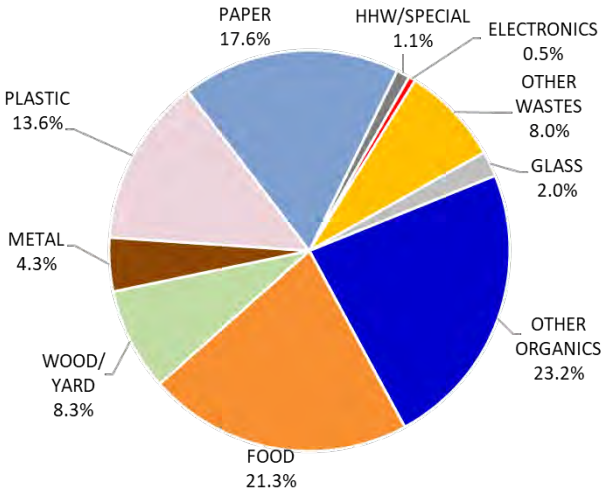


Table 18 presents the ten most prevalent disposed materials in the commercially collected residential substream. *Disposable diapers* (9.6%), *animal feces* (7.8%), and *low-grade recyclable paper* (6.4%) were the three most prevalent material types.

Table 18. Ten Most Prevalent Disposed Materials, Commercially Collected Residential Substream, 2019

Material	Est. Percent	Est. Tons
Disposable Diapers	9.6%	29,702
Animal Feces	7.8%	24,366
Low-Grade Recyclable Paper	6.4%	19,801
Other Compostable Paper	5.6%	17,495
Mixed/Other Food Waste, Edible	5.4%	16,671
Fruits & Vegetables, Non-edible	5.0%	15,450
Mixed/Other Food Waste, Non-edible	4.9%	15,170
Non-Industrial Packaging Film Plastic	4.0%	12,331
Dimensional Lumber/Engr. Wood	3.6%	11,230
Fruits & Vegetables, Edible	3.4%	10,556
Total for Top Materials	**55.6%**	**172,773**

Commercially Collected Nonresidential Substream

The composition data in this section are based on 156 commercially collected nonresidential samples.

Figure 18 shows the recovery potential for the commercially collected nonresidential substream. Nearly 68 percent (250,686 tons) of King County's commercially collected nonresidential disposed waste was Readily Recyclable. Approximately one-quarter was Not Recyclable (27.4% and 101,175 tons), and the remaining 4.8 percent was Limited Recyclability (17,618 tons).

Figure 19 presents the waste composition data by material class. **Paper** (23.6%), **Food** (17.3%), and **Plastic** (17.2%) were the three most prevalent material classes.

Figure 18. Disposed Waste Recoverability, Commercially Collected Nonresidential Substream, 2019

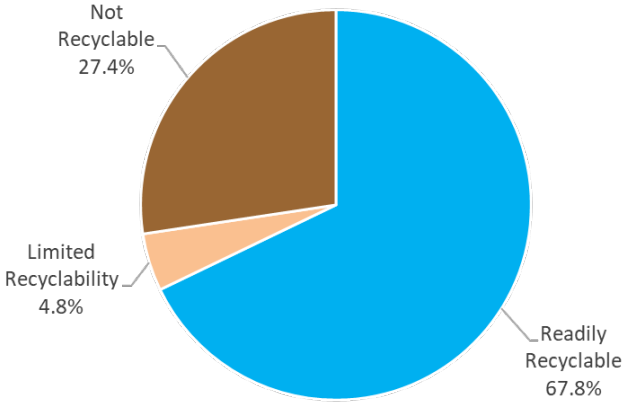


Figure 19. Disposed Waste Composition, Commercially Collected Nonresidential Substream, 2019

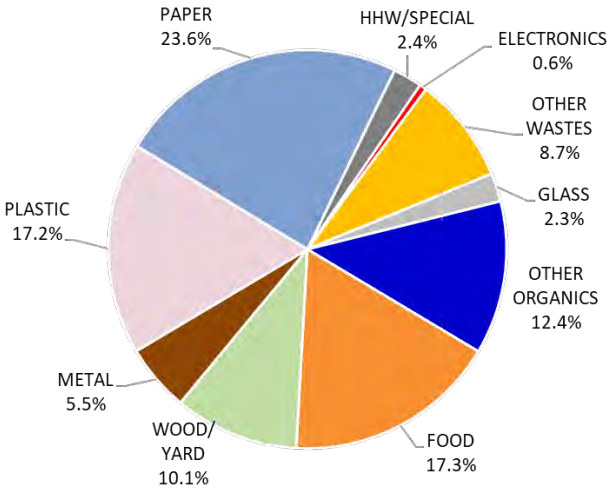


Table 19 lists the ten most prevalent disposed materials in the commercially collected nonresidential substream. Together, the top ten materials represented nearly half of the substream. *Low-grade recyclable paper* (7.6%); *other compostable paper* (5.7%); and *mixed/other food waste, non-edible* (5.3%) were the most common materials found in this substream.

Table 19. Ten Most Prevalent Disposed Materials, Commercially Collected Nonresidential Substream, 2019

Material	Est. Percent	Est. Tons
Low-Grade Recyclable Paper	7.6%	28,037
Other Compostable Paper	5.7%	21,013
Mixed/Other Food Waste, Non-edible	5.3%	19,546
Dimensional Lumber/Engr. Wood	5.0%	18,488
Plain Corrugated Cardboard (OCC)	4.7%	17,404
Mixed/Other Food Waste, Edible	4.6%	16,868
Non-Industrial Packaging Film Plastic	4.4%	16,260
Disposable Diapers	4.1%	15,295
Fruits & Vegetables, Non-edible	3.4%	12,471
C&D Wastes (except wood)	3.3%	12,197
Total for Top Materials	**48.1%**	**177,580**

Self-haul Substreams

The self-haul disposed waste composition is the weighted average of 181 samples from the self-haul residential and self-haul nonresidential substreams.

Figure 20 summarizes recovery potential for King County's self-haul substreams. Just over 47 percent (89,360 tons) was Readily Recyclable, approximately one-quarter was Not Recyclable (26.9% and 50,642 tons), and the remaining quarter was Limited Recyclability (25.7% and 48,412 tons). Figure 21 shows the self-haul disposed waste composition by material class. **Wood/Yard** (34.5%) and **Other Wastes** (28.7%) contributed more than half the material in the self-haul substreams (119,161 tons). Most self-haul material was from residential sources (172,622 tons), compared to nonresidential sources (15,792 tons).

Figure 20. Disposed Waste Recoverability, Self-haul

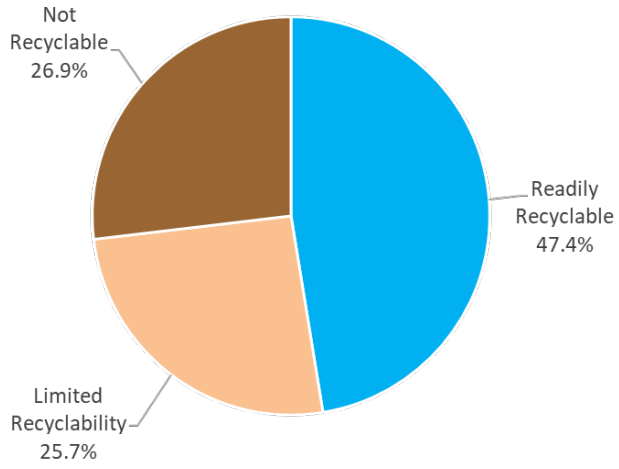
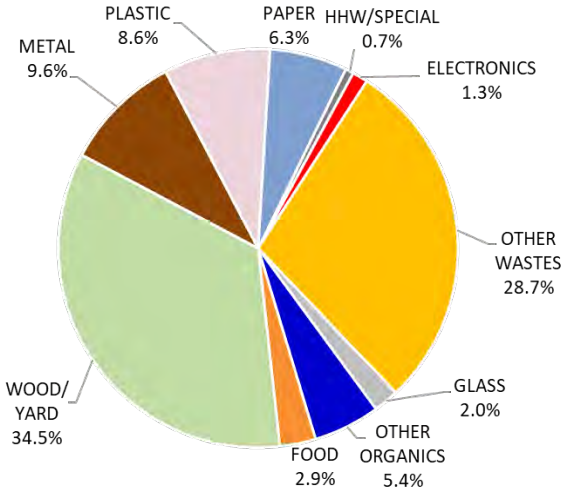


Figure 21. Disposed Waste Composition, Self-haul



As shown in Table 20, *dimensional lumber/engineered wood* (16.6%), *C&D wastes* (8.8%), and *other wood* (7.1%) were the most prevalent materials in the self-haul substreams, with nearly one-third of the total. The top ten most common materials composed about 62 percent of self-haul substreams.

Table 20. Ten Most Prevalent Disposed Materials, Self-haul Substreams, 2019

Material	Est. Percent	Est. Tons
Dimensional Lumber/Engr. Wood	16.6%	31,284
C&D Wastes (except wood)	8.8%	16,633
Other Wood	7.1%	13,384
Furniture	5.9%	11,041
Contaminated Wood	4.9%	9,214
Mattresses	4.4%	8,355
Gypsum Wallboard	4.2%	7,844
Other Ferrous	3.7%	7,046
Mixed Metals (>80% metal, <20% non-metal)	3.6%	6,803
Single-Resin Plastic Products	2.9%	5,518
Total for Top Materials	**62.2%**	**117,123**

Self-haul Residential Substream

All 165 self-haul residential samples are aggregated to estimate the composition for the substream.

Figure 22 shows that nearly half of material in the self-haul residential stream was Readily Recyclable (48.6% and 83,946 tons). The remaining material was split between Limited Recyclability (24.1% and 41,623 tons) and Not Recyclable (27.3% and 47,053 tons). Figure 23 presents the material composition by material class. The most prevalent material classes were **Wood/Yard** (33.0%) and **Other Wastes** (27.4%), which together contributed approximately two-thirds of the substream (107,631 tons).

Figure 22. Disposed Waste Recoverability, Self-haul Residential Substream, 2019

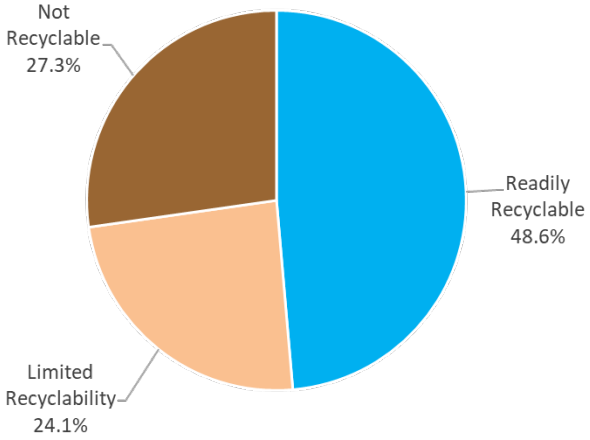


Figure 23. Disposed Waste Composition, Self-haul Residential Substream, 2019

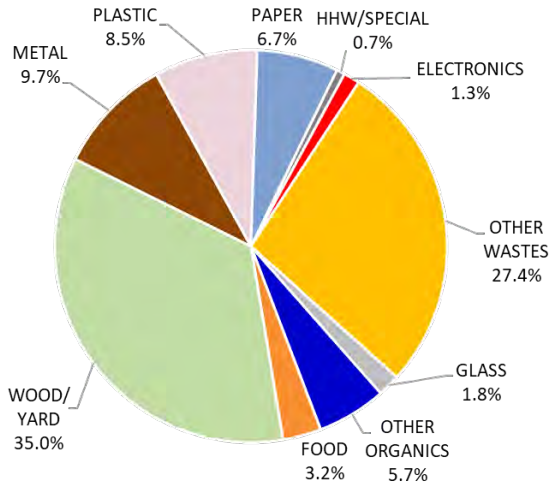


Table 21 summarizes the ten most prevalent disposed materials in the self-haul residential substream. *Dimensional lumber/engineered wood* represented 17.0 percent of this substream, followed by *C&D wastes* (8.9%) and *other wood* (7.0%).

Table 21. Ten Most Prevalent Disposed Materials, Self-haul Residential Substream, 2019

Material	Est. Percent	Est. Tons
Dimensional Lumber/Engr. Wood	17.0%	29,281
C&D Wastes (except wood)	8.9%	15,302
Other Wood	7.0%	12,041
Furniture	5.3%	9,116
Contaminated Wood	4.8%	8,324
Gypsum Wallboard	4.1%	7,067
Mattresses	4.1%	7,030
Other Ferrous	3.7%	6,362
Mixed Metals (>80% metal, <20% non-metal)	3.6%	6,236
Single-Resin Plastic Products	2.8%	4,828
Total for Top Materials	**61.2%**	**105,588**

Self-haul Nonresidential Substream

The self-haul nonresidential composition is based on 16 self-haul nonresidential samples.

The key recoverability and material class findings for King County's self-haul nonresidential substream are shown in Figure 24 and Figure 25. Approximately one-third of self-haul nonresidential waste was Readily Recyclable (34.3% and 5,414 tons), and 43 percent was Limited Recyclability (6,789). Less than a quarter (22.7% and 3,589 tons) was Not Recyclable. The most prevalent material classes were **Other Wastes** (43.5%) and **Wood/Yard** (29.5%), contributing nearly three-quarters of the material from the self-haul nonresidential substream.

Figure 24. Disposed Waste Recoverability, Self-haul Nonresidential Substream, 2019

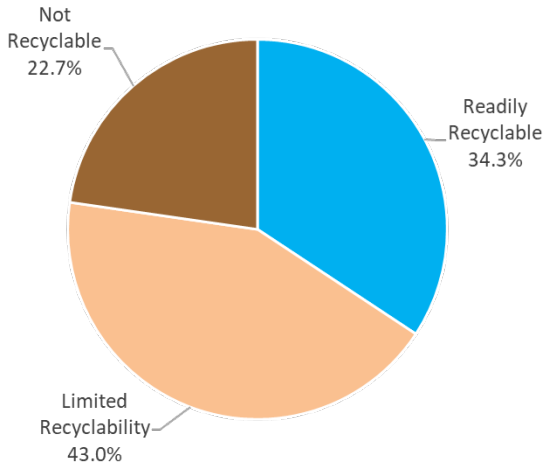
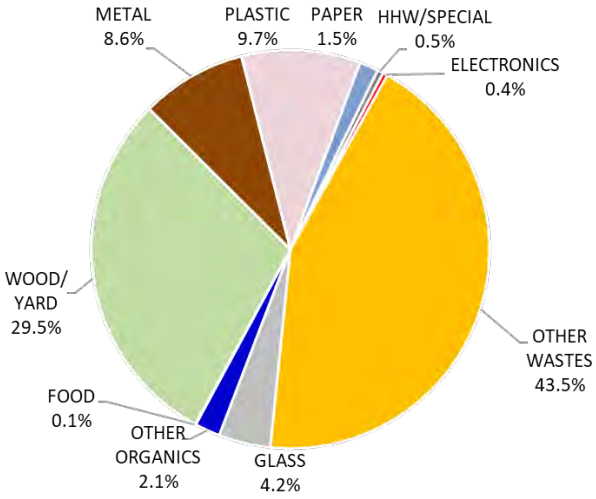


Figure 25. Disposed Waste Composition, Self-haul Nonresidential Substream, 2019



As shown in Table 22, *dimensional lumber/engineered wood* (12.7%) and *furniture* (12.2%) together composed approximately one-quarter of the self-haul nonresidential substream. The top ten most prevalent materials accounted for nearly 80 percent of material in this substream.

Table 22. Ten Most Prevalent Disposed Materials, Self-haul Nonresidential Substream, 2019

Material	Est. Percent	Est. Tons
Dimensional Lumber/Engr. Wood	12.7%	2,003
Furniture	12.2%	1,925
Carpet	9.2%	1,445
Other Wood	8.5%	1,343
C&D Wastes (except wood)	8.4%	1,331
Mattresses	8.4%	1,325
Contaminated Wood	5.6%	890
Gypsum Wallboard	4.9%	777
Single-Resin Plastic Products	4.4%	690
Other Ferrous	4.3%	684
Total for Top Materials	**78.6%**	**12,413**

Waste Characterization Changes Over Time

Comparing waste composition data collected during previous studies with the current study allows for a useful examination of trends and changes in the disposed waste stream over time. This section presents both statistical comparisons at the individual material level and higher-level comparisons.

Statistical Comparisons

This section presents findings from statistical comparisons between the 2019 disposed waste composition data and the previous study in 2015. The analysis examines statistical differences, using *t*-tests, between the 2019 and 2015 studies. The analysis is used to determine if changes in the composition of King County's disposed waste stream are statistically significant. Examining potential causes of the changes in waste composition over time was beyond the scope of this research.

The year-to-year comparisons were made by examining the changes in the composition percentages for selected material groupings. The material groupings included:

- Newspaper
- Cardboard and Kraft paper
- Other curbside paper
- Curbside recyclable containers
- Compostable organics (including food)
- Construction and demolition wastes
- Wood waste
- Hazardous waste

Statistical tests were used to analyze differences in the composition percentages between years for the following substreams:

- Commercially collected single-family residential
- Commercially collected multifamily residential
- Commercially collected nonresidential
- Self-haul (including both residential and nonresidential)

The differences in material groupings between studies can be divided into two main categories:

- **Statistically significant**—These findings can be considered true differences because the probability of observing these results if there had been no actual year-to-year change is low. The difference was statistically significant if the *p*-value is less than or equal to 0.0125.
- **Strong trend**—Although the results did not meet the requirements of the study's conservative statistical tests, the data suggest a potential change. The difference was considered a strong trend if the *p*-value was greater than 0.0125 but less than or equal to 0.02.

Because the waste composition results are expressed as percentages, rather than absolute tonnages, significant changes for one material may affect the percentages for other materials. For example, increases over time in materials recycled may alter the percentages for other materials remaining in the disposed waste stream.

Overall, Newspaper decreased by about 82 percent. This decrease was about 79 percent in single-family residential sector, about 79 percent in multifamily residential sector, about 83 percent in nonresidential sector, and about 78 percent in self-haul sector. This decrease was statistically significant in these sectors. This significant decline in Newspaper could be a combined effect of reduced consumption of print-copy newspaper (resulting in lower generation of newspaper) and increased diversion of Newspaper through residential recycling (better diversion).

Overall, Organics decreased by about 30 percent. This decrease was about 27 percent in nonresidential sector (statistically significant), and about 46 percent in self-haul sector (statistically significant).

More curbside recyclables were found in the residential disposed waste stream in 2019 compared to 2015. Other Curbside Paper, which consists of the recyclable paper types *low grade paper* and *high grade paper*, showed a strong upward trend (25% increase). The increase was statistically significant in single-family residential (39% increase), multifamily residential (54% increase), and non-residential (40% increase) sectors. Also, there was a 30 percent increase in disposed Curbside Containers in single-family residential sector (statistically significant) compared to 2015.

Comparisons identified as "statistically significant" or "strong trend" in the tested substreams are summarized in Table 23.

Table 23. Waste Composition Changes and Trends, 2015 vs. 2019

	Material Grouping	Composition† 2015	Composition† 2019	Relative Change in Composition	t-Statistic	p-Value	Strength of Results
Overall							
Overall	Newspaper	1.4%	0.3%	-81.6% ▼	10.6696	0.0000 *	stat. significant
Overall	Other Curbside Paper	4.3%	5.3%	24.8% ▲	2.4220	0.0156	strong trend
Overall	Organics	27.3%	19.2%	-29.6% ▼	5.4020	0.0000 *	stat. significant
Commercially Collected							
Single Family	Newspaper	2.1%	0.4%	-78.8% ▼	6.0636	0.0000 *	stat. significant
Single Family	Other Curbside Paper	4.3%	6.0%	38.7% ▲	3.0343	0.0028 *	stat. significant
Single Family	Curbside Containers	5.8%	7.5%	30.0% ▲	2.8379	0.0052 *	stat. significant
Multifamily	Newspaper	2.0%	0.4%	-79.3% ▼	5.7134	0.0000 *	stat. significant
Multifamily	Other Curbside Paper	5.4%	8.2%	53.8% ▲	2.9341	0.0046 *	stat. significant
Nonresidential	Newspaper	1.6%	0.3%	-83.1% ▼	7.2402	0.0000 *	stat. significant
Nonresidential	Other Curbside Paper	6.0%	8.4%	40.2% ▲	3.1083	0.0021 *	stat. significant
Nonresidential	Organics	37.3%	27.2%	-27.2% ▼	3.9994	0.0001 *	stat. significant
Self-haul							
Self-haul	Newspaper	0.6%	0.1%	-77.7% ▼	3.3816	0.0008 *	stat. significant
Self-haul	Organics	10.9%	5.9%	-46.3% ▼	2.6359	0.0088 *	stat. significant

†*Composition data was unweighted for the t-test.*

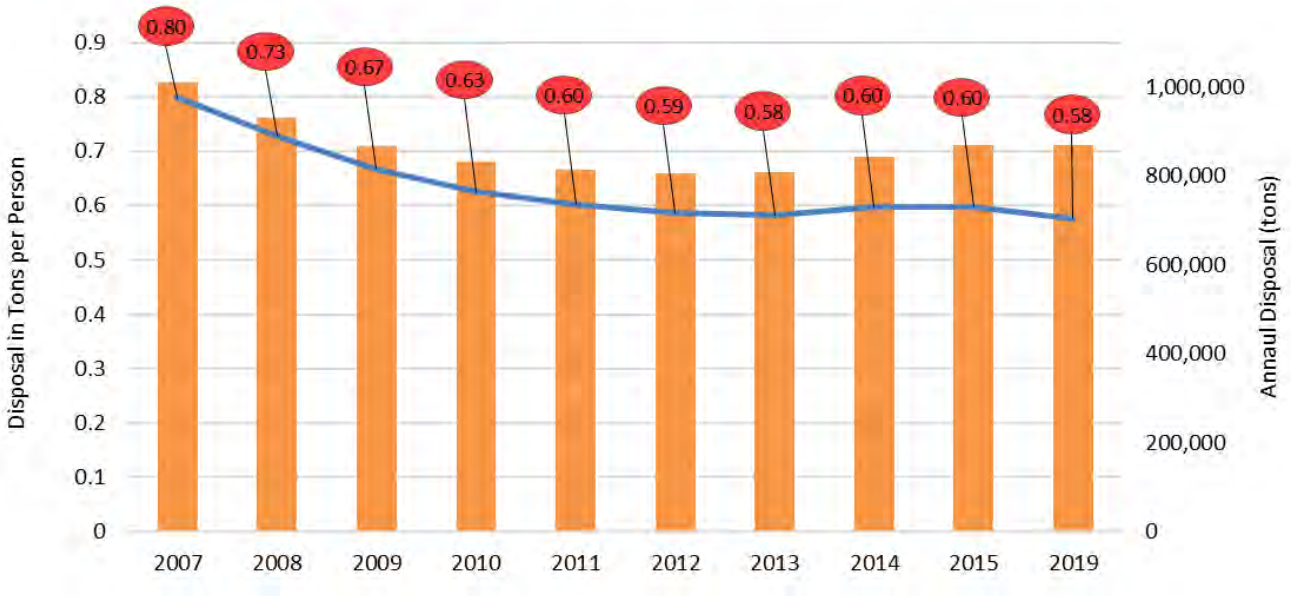
**Differences with a p-value of 0.0125 or less were considered statistically significant (abbreviated as "stat. significant" in table); "strong trend" was defined as a p-value greater than 0.0125 but less than or equal to 0.02.*

More detail regarding the material groupings and the statistical analyses can be found in *Appendix F. Waste Composition Comparisons to Previous Studies.* Detailed *t*-test results for each substream can be found in the same appendix beginning with Table 71.

Other Waste Data Comparisons

This section presents high-level comparisons of changes in the overall disposed waste stream in King County over time. Figure 26 shows the trend in waste disposal per person in King County from 2007 through 2019. The annual tons disposed are derived from County-reported tonnage in 2019 and from historical waste characterization data from King County. The population data for King County, excluding Seattle, is based on U.S. Census estimates. The total disposed tonnage in King County was highest in 2007 (1,010,429 tons); thereafter it decreased steadily to the lowest in 2012 (806,915 tons). Since then, the total annual tonnage has increased to 868,532 tons in 2019. King County's population (excluding Seattle) has increased from about 1.25 million in 2007 to about 1.5 million in 2019. With a decrease in disposed tonnage and an increase in population, the per-person disposal rate has decreased from 0.80 tons per person per year in 2007 to 0.58 tons per person per year in 2019, marking a 27.5 percent decrease from 2007 levels. Despite growth in the regional economy, the average disposal per person reached its lowest level since 2013.

Figure 26. Per-Person Disposal from 2007 through 2019



As shown in Figure 27, the proportion of Readily Recyclable materials disposed increased slightly in 2019 (62.3%) compared to 2015 (61.8%), but down noticeably compared to that in 2011 (68.8%). Overall, Readily Recyclable material has decreased slightly since 2007. Part of the increase between 2007 and 2011 may be attributable to changes in the material list and recoverability groups. Since then, the material list has remained largely consistent, with minimal changes. For example, material type *other #3-#7 packaging* from 2011 was considered a Readily Recyclable material. Subsequently, the material

type was divided into individual resin types (*#3 packaging, #4 packaging, #5 packaging, #6 packaging, #7 packaging*), with these individual material types also classified as Readily Recyclable.

The proportion of materials that were Limited Recyclability decreased from about 17 percent in 2007 to nearly 8 percent in 2011. Thereafter, these materials stayed relatively stable at approximately 9 percent in 2019. The proportion of Not Recyclable materials increased from about 19 percent in 2007 to its high of 30 percent in 2015. In 2019, the Not Recyclable material proportion decreased slightly to 28 percent.

In the county's disposed waste, Readily Recyclable materials continued to occupy the largest share of the waste, more than 60 percent in each study period. Materials of Limited Recyclability were the smallest in proportion and remained at a similar level since 2011. Materials that are Not Recyclable increased noticeably from 2007 through 2015 and then decreased slightly in 2019. Figure 27 shows the proportion of disposed waste from 2007 through 2019 by recoverability group.

Figure 27. Disposed Waste Recoverability from 2007 through 2019

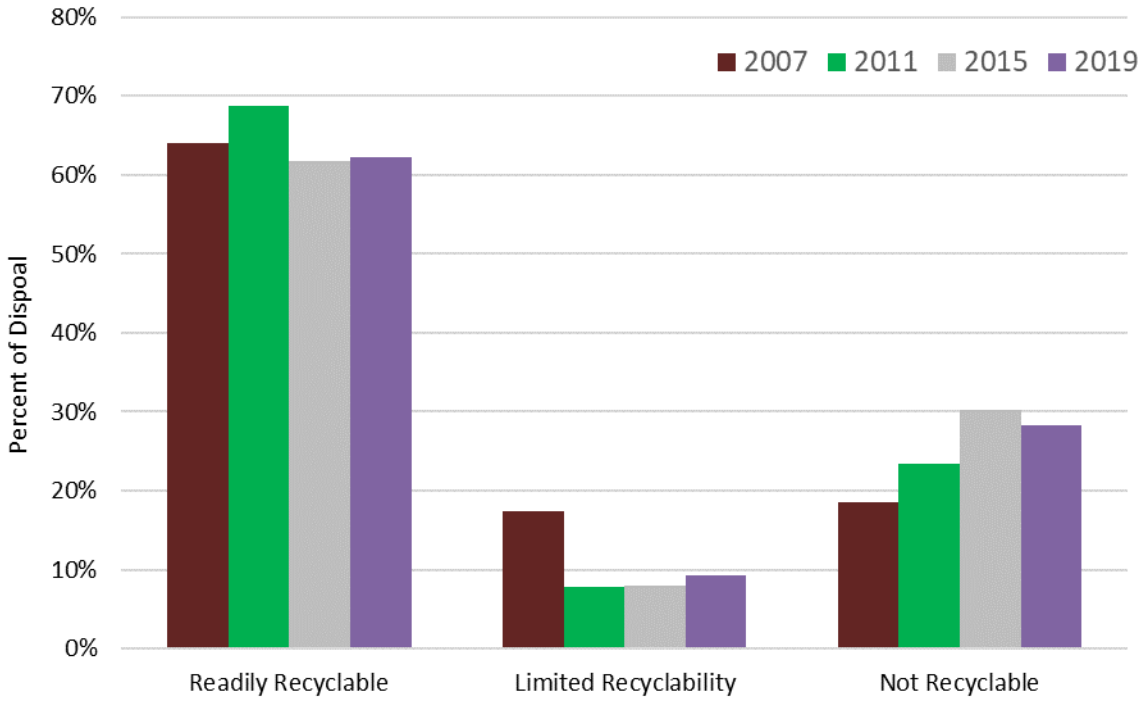
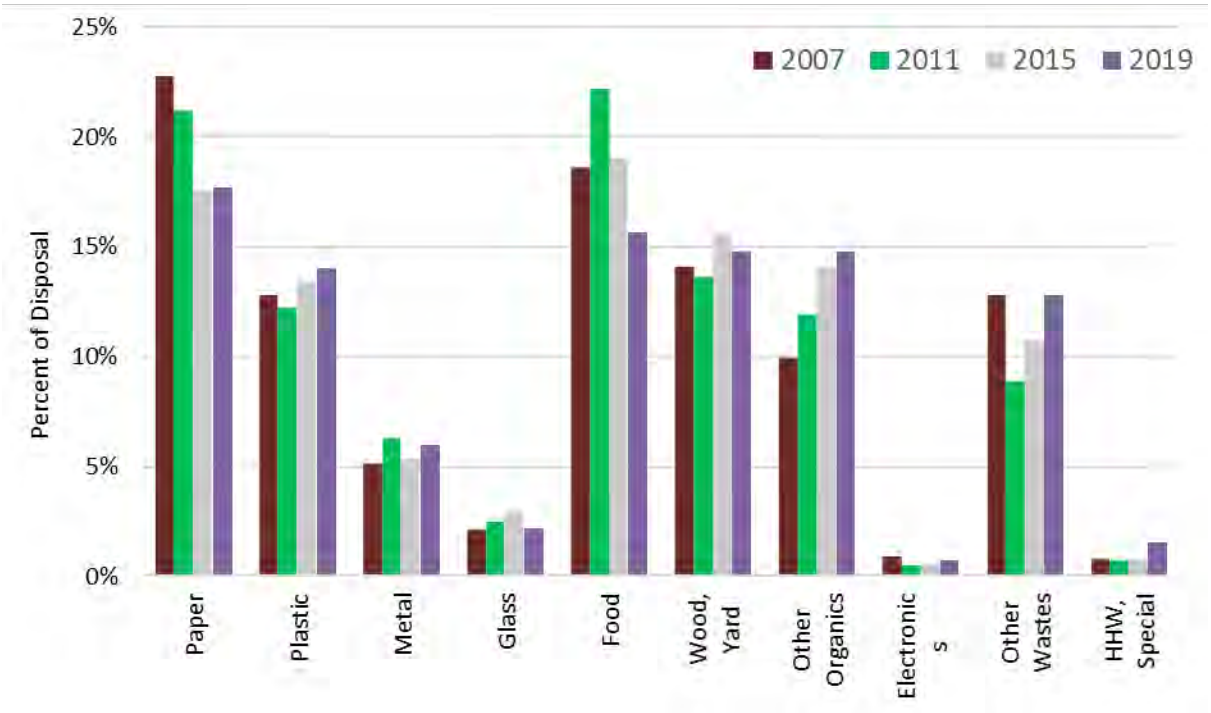


Figure 28 shows the proportion of disposed waste from 2007 through 2019 by material class categories, including these trends:

- **Paper** decreased from 22.7 percent in 2007 to 17.5 percent in 2019.
- **Plastic** increased from 12.1 percent in 2011 to 14 percent in 2019.
- The share of **Food** decreased from 22.1 percent in 2011 to 15.6 percent in 2019.
- **Other Organics** increased from 10 percent 2007 to 14.8 percent in 2019.
- **HHW, Special** increased to 1.5 percent in 2019 from less than 1 percent in previous years.

Figure 28. Material Classes from 2007 through 2019



4. Transfer Station Customer Survey Findings

In 2019, eight transfer stations and two drop box facilities in King County completed more than 818,500 transactions. During that time, the field crew conducted 5,563 interviews with customers delivering waste for disposal generated inside King County, excluding Seattle, to determine who uses each facility and why. Each survey day, a surveyor interviewed the driver of every vehicle entering the facility.[10] This section presents the findings of these customer surveys. *Appendix A. Sample and Survey Methodology* explains the study methodology. The figures in this section describe the portion of waste transactions (customers, loads, visits, or users) surveyed at disposal facilities, not the weight or tonnages of the waste they delivered.

Hauler Type

Overall, 80 percent of haulers surveyed disposed waste from the residential sector. Self-haul residential customers represented the majority (72%) of customers surveyed. Commercially collected nonresidential customers represented 12 percent, and self-haul nonresidential customers represented 8 percent of total surveys. Table 24 summarizes these results. Detailed results by facility are found in *Appendix E. Detailed Customer Survey Results*.

Table 24. Reported Generator Type by Hauler Type, 2019

Survey Responses, n=5563	Commercially Collected	Self-haul	Total
Residential	8%	72%	**80%**
Nonresidential	12%	8%	**20%**
Subtotal	***20%***	***80%***	***100%***
No Response	0%	0%	**0%**
Total	**20%**	**80%**	**100%**

Estimates are rounded to the nearest percent and, when added together, may not equal 100%, due to rounding.

Vehicle Type

As shown in Table 25, passenger vehicles (70%) were the most common vehicle type hauling waste to transfer stations. Commercially collected loads were about evenly divided between drop box (47%) and packer vehicles (50%), with a small portion delivered in other large vehicles (2%). The majority (87%) of self-haul loads were delivered in passenger vehicles, while 10 percent were brought in other large vehicles. Examples of the vehicle types may be found in *Appendix I. Example Field Forms*. More detailed results by facility are shown in *Appendix E. Detailed Customer Survey Results*.

[10] If traffic became too congested, the surveyor skipped a few vehicles to avoid traffic flow problems at the facility.

Table 25. Observed Vehicle Types by Hauler Type, 2019

Survey Responses, n=5563	Commercially Collected	Self-haul	Overall
Dropbox	47%	0%	**9%**
Packer	50%	0%	**10%**
Passenger Vehicle	1%	87%	**70%**
Large Other	1%	10%	**8%**
Subtotal	***99%***	***97%***	***97%***
No Response	1%	3%	**3%**
Total	**100%**	**100%**	**100%**

Estimates are rounded to the nearest percent and, when added together, may not equal 100%, due to rounding.

Waste Type

Table 26 summarizes the reported waste type disposed by transfer station customers. Overall, nearly three-quarters of customers (72%) reported disposing of Mixed Garbage, followed by Construction and Demolition Debris (13%). The remaining 11 percent of customers reported disposing of Special Waste or Yard Waste. The majority of commercially collected (82%) and self-haul (69%) customers reported disposing of Mixed Garbage. More detailed results by facility can be found in *Appendix E. Detailed Customer Survey Results*.

Table 26. Reported Waste Type by Hauler Type, 2019

Survey Responses, n=5563	Commercially Collected	Self-haul	Overall
Mixed Garbage	82%	69%	**72%**
Construction & Demolition	1%	17%	**13%**
Yard Waste	0%	11%	**9%**
Special Waste	0%	2%	**2%**
Subtotal	***84%***	***99%***	***96%***
No Response	16%	1%	**4%**
Total	**100%**	**100%**	**100%**

Estimates are rounded to the nearest percent and, when added together, may not equal 100%, due to rounding.

Generator Type

Table 27 and Table 28 detail the generator types by subtype and by facility for the commercially collected and self-haul substreams. More detailed results can be found in *Appendix E. Detailed Customer Survey Results*.

Commercially Collected

The Vashon transfer station had the highest reported proportion of residential loads; 57 percent of commercially collected customers reported disposing of residential waste. Bow Lake had the lowest proportion of residential loads (30%) and highest proportion of nonresidential loads (62%). The Bow Lake transfer station operates 24 hours a day and receives substantial nonresidential traffic between the hours of midnight and 8 a.m. Approximately 18 percent of customers at Bow Lake reported disposing of single-family residential loads, the lowest proportion of single-family residential loads among the surveyed facilities. The single-family proportion was highest at Vashon (43%). At Vashon, no customers reported disposing of multifamily loads, the lowest proportion among the surveyed facilities.

Approximately half (51%) of the commercially collected substream surveyed consisted of nonresidential loads, and 41 percent were residential loads. Single-family residential loads represented approximately 63 percent of commercially collected residential loads and 26 percent of all commercially collected loads. Table 27 shows the reported generator type by facility for commercially collected loads. Commercially collected loads are not accepted at the Skykomish and Cedar Falls drop boxes.

Table 27. Reported Generator Type by Facility, Commercially Collected, 2019

Commercially Collected, n=1108	Algona	Bow Lake	Enumclaw	Factoria	Houghton	Renton	Shoreline	Vashon	Overall
Residential	**43%**	**30%**	**41%**	**41%**	**47%**	**53%**	**53%**	**57%**	**41%**
Single Family	27%	17%	18%	30%	32%	35%	40%	43%	26%
Multifamily	16%	10%	18%	7%	15%	16%	9%	0%	12%
Mixed Residential	0%	4%	6%	4%	1%	3%	4%	14%	3%
Nonresidential	50%	62%	53%	48%	46%	30%	38%	29%	51%
Mixed Residential & Nonres.	7%	7%	6%	11%	7%	17%	9%	14%	9%
Subtotal	***100%***	***100%***	***100%***	***100%***	***100%***	***100%***	***100%***	***100%***	***100%***
No Response	0%	0%	0%	0%	0%	0%	0%	0%	0%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Estimates are rounded to the nearest percent and, when added together, may not equal 100%, due to rounding.

Self-haul

At each facility, over 85 percent of self-haul loads were from single-family residential sources; the proportion was highest at Cedar Falls drop box (98%) and lowest at the Algona transfer station (86%). The self-haul substream was approximately 90 percent single-family residential loads and 9 percent nonresidential loads. The remaining 1 percent consisted of mixed residential and nonresidential loads. Table 28 shows the reported generator type by facility for self-haul loads.

Table 28. Reported Generator Type by Facility, Self-haul, 2019

Self-haul, n=4455	Algona	Bow Lake	Cedar Falls	Enumclaw	Factoria	Houghton	Renton	Shoreline	Vashon	Overall
Residential	**86%**	**87%**	**98%**	**94%**	**91%**	**92%**	**94%**	**92%**	**92%**	**90%**
Single Family	86%	87%	98%	94%	91%	92%	94%	92%	92%	90%
Multifamily	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Mixed Residential	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Nonresidential	**12%**	**12%**	**2%**	**5%**	**8%**	**7%**	**5%**	**7%**	**7%**	**9%**
Mixed Residential & Nonres.	**2%**	**1%**	**0%**	**1%**	**1%**	**1%**	**0%**	**1%**	**1%**	**1%**
Subtotal	***100%***	***100%***	***100%***	***100%***	***100%***	***100%***	***100%***	***100%***	***100%***	***100%***
No Response	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Estimates are rounded to the nearest percent and, when added together, may not equal 100%, due to rounding.

Contractors and Landscapers

As part of the survey, self-haul customers disposing of loads of Yard Waste or Construction & Demolition Debris (C&D Debris) were asked if they were a contractor or landscaper. Table 29 presents the proportion of C&D Debris and Yard Waste loads from each source (residential, nonresidential, and mixed) brought by contractors, landscapers, and other self-haul customer types.

As shown, contractors and landscapers combined brought over two-thirds (69%) of the C&D Debris and Yard Waste loads from nonresidential sources. Only 26 percent of residential C&D Debris and Yard waste loads surveyed were hauled by contractors or landscapers. The majority (69%) of self-haul C&D Debris and Yard Waste loads disposed of at transfer stations were brought in by other users. More detailed results by facility can be found in *Appendix E. Detailed Customer Survey Results*.

Table 29. Proportion of C&D Debris and Yard Waste by Type of Self-haul Customer and Generator, 2019

Self-haul, n=1788	Residential	Nonresidential	Mixed	No Response	Overall
Contractors	22%	62%	0%	0%	**26%**
Landscapers	4%	7%	0%	0%	**5%**
Other Users	73%	31%	0%	0%	**69%**
Total	**100%**	**100%**	**0%**	**0%**	**100%**

Estimates are rounded to the nearest percent and, when added together, may not equal 100%, due to rounding.

Curbside Garbage Service

Table 30 details the proportion of residential self-haul customers who reported subscribing to curbside garbage service and the proportion that did not. Approximately 57 percent of residential self-haul customers reported subscribing to curbside garbage service at home. At the Houghton transfer station, 71 percent of customers reported subscribing to curbside garbage service, the highest proportion at any transfer station. At the Vashon transfer station, 27 percent of customers reported subscribing to curbside garbage service, the lowest proportion at any transfer station.

Table 30. Reported Subscription to Curbside Garbage by Facility, Residential Self-haul, 2019

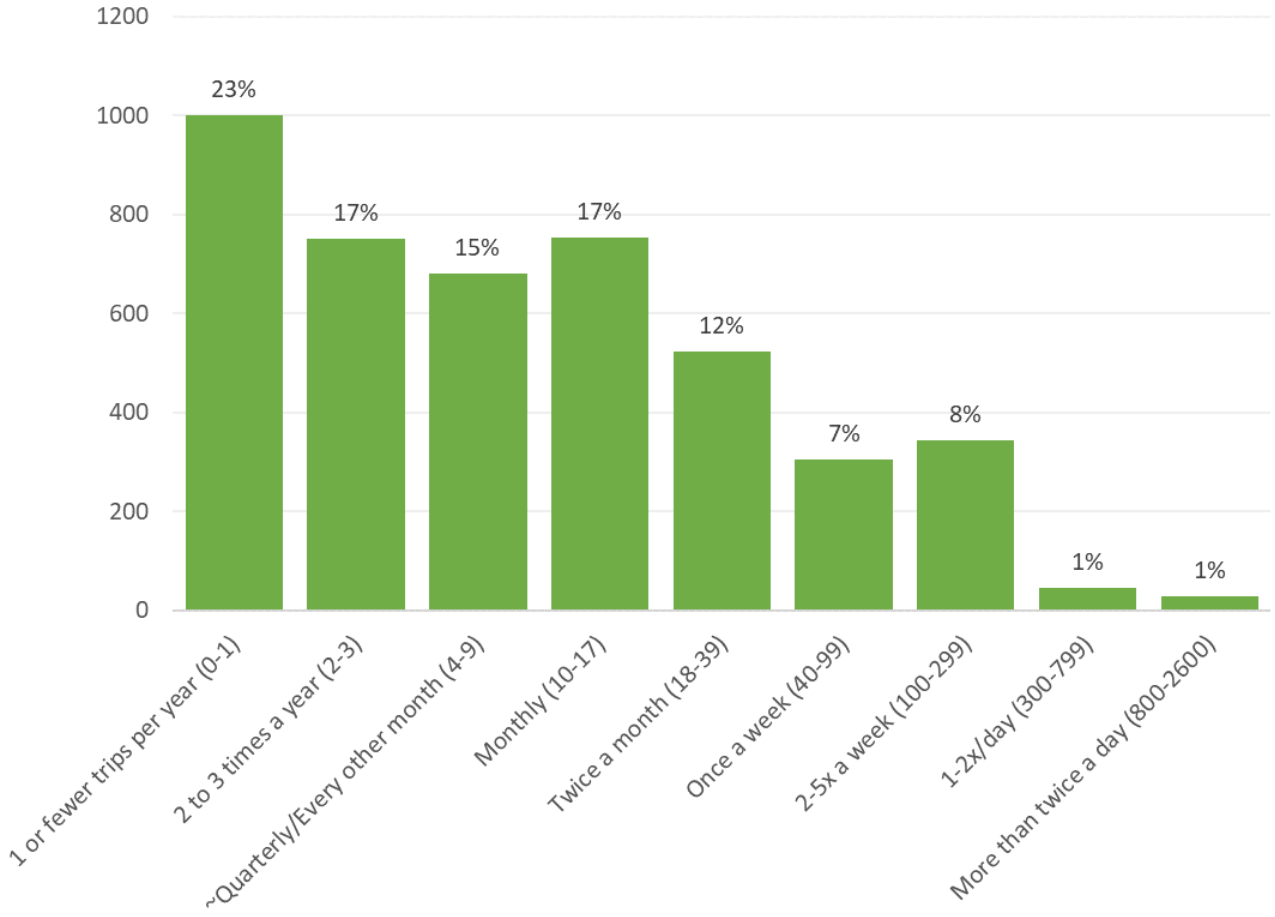
Residential Self-haul, n=4023	Algona	Bow Lake	Cedar Falls	Enumclaw	Factoria	Houghton	Renton	Shoreline	Vashon	Overall
Subscribe	43%	59%	70%	60%	61%	71%	67%	65%	27%	57%
Do Not Subscribe	13%	19%	24%	33%	8%	6%	22%	12%	53%	19%
Subtotal	***56%***	***78%***	***94%***	***93%***	***69%***	***77%***	***89%***	***76%***	***79%***	***76%***
No Response	44%	22%	6%	7%	31%	23%	11%	24%	21%	24%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Estimates are rounded to the nearest percent and, when added together, may not equal 100%, due to rounding.

Trip Frequency

Self-haul customers were asked the number of visits they make to the transfer station per day, week, month, year, or ever. Their responses were then converted to visits per year (that is, "twice a week" is calculated as 104 visits per year). Responses ranged from fewer than one trip per year up to multiple trips per day. Figure 29 shows the reported number of trips, grouped by approximate frequency per time period (days, weeks, months, or years).

Figure 29. Reported Approximate Trip Frequency by Self-Haul Customers Surveyed, 2019



Residential Generators

Table 31 and Table 32 show the average number of annual visits residential self-haul customers made to each facility. Residential self-haulers were sorted into two groups: those who subscribe to curbside garbage collection service and those who do not subscribe. Users who did not respond to this question were primarily contractors, landscapers, and other independent hauling companies that did not know if their clients subscribed to curbside garbage service.

Table 31 summarizes the data for all residential self-haul customers (including contractors, landscapers, and independent haulers). An employee for an independent hauler, including companies such as 1-800-GOT-JUNK, frequently makes several visits per day. To avoid a skew in the results due to this small number of respondents making hundreds of visits per year, Table 32 summarizes the annualized visits for the residential self-haul customers making fewer than two visits per day.

All Residential Users

Residential self-haul customers who do not subscribe to curbside garbage service made, on average, about 10 more visits per year to disposal facilities than residential self-haulers who subscribe to garbage collection (26.2 visits vs. 15.4 visits). This average was weighted by the portion of self-haul customers surveyed at each transfer station. Users who did not respond to this question (mainly contractors, landscapers, and other independent hauling companies) made about 68 visits per year on average. Of the residential self-haul customers that subscribe to curbside garbage service, users of the Shoreline transfer station made the most visits (26.4) annually. Table 31 shows these results.

Table 31. Reported Trips per Year by Curbside Garbage Subscription and by Facility, Residential Self-haul, 2019

Residential Self-haul, n=4023	Algona	Bow Lake	Cedar Falls	Enumclaw	Factoria	Houghton	Renton	Shoreline	Vashon	Overall
Subscribe	11.9	19.1	16.2	10.9	12.9	9.1	7.0	26.4	24.1	**15.4**
Do Not Subscribe	16.8	33.5	24.3	17.8	105.4	22.3	20.1	75.7	0.0	**26.2**
No Response	27.1	71.2	20.6	25.1	108.7	81.4	68.6	84.1	83.1	**68.0**
Facility Average	**19.2**	**33.5**	**18.4**	**14.2**	**50.1**	**26.6**	**16.7**	**45.7**	**23.6**	**30.0**

Residential Users Making Fewer than Two Visits per Day

Residential self-haul customers making fewer than two visits per day that do not subscribe to curbside garbage service made, on average, more than twice as many visits to disposal facilities than residential self-haulers that subscribe to curbside garbage service (24.9 visits vs. 11.8 visits). This average was weighted by the proportion of self-haul customers surveyed at each transfer station. Users making fewer than two visits per day who did not respond to this question (primarily contractors, landscapers, and other independent hauling companies) averaged nearly 36 annual visits to the transfer station. Of the residential self-haul customers who subscribe to curbside garbage service, Vashon transfer station customers made the most visits to a King County facility (18.8 visits). Table 32 details the results.

Table 32. Reported Trips per Year by Subscription and by Facility, Residential Self-haul Users Making Fewer Than Two Trips per Day, 2019

Residential Self-haul Making <2 Visits/Day, n=3945	Algona	Bow Lake	Cedar Falls	Enumclaw	Factoria	Houghton	Renton	Shoreline	Vashon	Overall
Subscribe	8.5	13.4	10.5	11.0	11.3	9.2	7.0	17.3	18.8	**11.8**
Do Not Subscribe	16.8	30.7	24.3	17.8	38.3	22.3	20.4	35.1	23.0	**24.9**
No Response	10.2	41.7	23.6	25.1	38.7	54.8	55.0	40.2	59.1	**35.8**
Facility Average	**10.2**	**22.5**	**14.4**	**14.2**	**20.6**	**19.9**	**15.0**	**23.7**	**28.6**	**19.5**

Nonresidential Generators

Table 33 and Table 34 show the average number of annual visits nonresidential self-haul customers made to each facility. Nonresidential self-haulers were sorted into two groups: those who subscribe to curbside garbage collection service and those who do not subscribe. Users who did not respond to this question were primarily contractors, landscapers, and other independent hauling companies that did not know if their client subscribed to curbside garbage service.

Table 33 summarizes the data for all nonresidential self-haul customers (including contractors, landscapers, and independent haulers). An employee for an independent hauler, including companies such as 1-800-GOT-JUNK, frequently makes several visits per day. To avoid a skew in the results due to this small number of respondents making hundreds of visits per year, Table 34 summarizes the annualized visits for the nonresidential self-haul customers making fewer than two visits per day.

All Nonresidential Users

Nonresidential self-haul customers who do not subscribe to curbside garbage service at their place of business made, on average, as many visits per year to disposal facilities as nonresidential self-haulers who subscribe to curbside garbage service (62.0 visits vs. 62.7 visits). Averages for each group of customers were weighted by the proportion of self-haul customers surveyed at each transfer station. Of the nonresidential self-haul customers who subscribe to curbside garbage service, users of the Bow Lake facility made the most annual visits to a King County transfer station (146.1 visits) followed by Vashon (133.3 visits), as shown in Table 33.

Table 33. Reported Trips per Year by Curbside Garbage Subscription and Facility, Nonresidential Self-haul, 2019

Nonresidential Self-haul, n=430	Algona	Bow Lake	Cedar Falls	Enumclaw	Factoria	Houghton	Renton	Shoreline	Vashon	Overall
Subscribe	44.9	146.1	24.0	6.6	32.4	16.1	22.4	15.7	133.3	**62.7**
Do Not Subscribe	157.2	63.2	0.0	29.3	56.3	87.7	15.0	39.4	30.7	**62.0**
No Response	123.9	91.7	104.0	65.2	70.9	98.0	193.1	73.0	76.2	**97.9**
Facility Average	**116.3**	**97.3**	**64.0**	**42.9**	**59.6**	**73.0**	**106.1**	**50.5**	**72.8**	**85.9**

Nonresidential Users Making Fewer than Two Visits per Day

Nonresidential self-haul customers making fewer than two visits per day who do not subscribe to curbside garbage service made, on average, about 18 more visits per year to transfer stations than nonresidential self-haulers who subscribe to curbside garbage service (49.2 visits vs. 30.7 visits). Averages for each group of customers were weighted by the proportion of self-haul customers surveyed at each transfer station. Of the nonresidential self-haul customers who subscribe to curbside garbage service, users of the Bow Lake transfer station made the most annual visits to a King County facility (45.7 visits), followed by Algona (44.9 visits) and Vashon (44.0 visits). Table 34 shows these results.

Table 34. Reported Trips per Year by Curbside Garbage Subscription and by Facility, Nonresidential Self-haul Users Making Fewer Than Two Trips per Day, 2019

Nonresidential Self-haul Making <2 Visits/Day, n=407	Algona	Bow Lake	Cedar Falls	Enumclaw	Factoria	Houghton	Renton	Shoreline	Vashon	Overall
Subscribe	44.9	45.7	24.0	6.6	32.4	16.1	22.4	15.7	44.0	**30.7**
Do Not Subscribe	32.6	63.2	0.0	29.3	56.3	87.7	15.0	39.4	30.7	**49.2**
No Response	52.2	61.8	104.0	65.2	38.6	40.0	54.8	51.8	76.2	**55.0**
Facility Average	**45.4**	**55.2**	**64.0**	**42.9**	**38.8**	**34.3**	**33.9**	**37.8**	**62.4**	**46.5**

Reasons for Self-haul

The surveyors asked self-haul customers their reason for self-hauling waste to the transfer station. Table 35 and Table 36 present the five most common reasons for self-hauling, by facility, for residential and nonresidential customers. The data include subscribers to curbside garbage service and non-subscribers.

All responses from residential and nonresidential customers regarding reasons for self-hauling waste can be found in *Appendix E. Detailed Customer Survey Results*.

Residential

The most common reason for self-haul reported by residential generators was “Large volume [of garbage]” (42%). The remaining top four reasons were “Cleaning home or workplace” (23%), “Other” (12%), “Cheaper/Saves money” (10%), and “Convenience” (9%).

Table 35. Most Common Reasons to Self-haul by Facility, Residential Generators, 2019

Residential, n=1384	Algona	Bow Lake	Cedar Falls	Enumclaw	Factoria	Houghton	Renton	Shoreline	Vashon	Overall
Large Volume	39%	59%	33%	10%	33%	72%	33%	43%	9%	**42%**
Cleaning home or workplace	24%	19%	12%	37%	31%	11%	40%	24%	17%	**23%**
Cheaper / Saves money	9%	6%	22%	21%	5%	1%	12%	9%	20%	**10%**
Convenience	14%	4%	16%	17%	5%	7%	6%	3%	23%	**9%**
No / Bad Service	3%	3%	7%	7%	0%	3%	1%	9%	6%	**4%**
Subtotal	***89%***	***91%***	***90%***	***92%***	***74%***	***93%***	***92%***	***88%***	***74%***	***88%***
All other responses	11%	9%	10%	8%	26%	7%	8%	12%	26%	**12%**
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Estimates are rounded to the nearest percent and, when added together, may not equal 100%, due to rounding.

Nonresidential

The most common reason to self-haul reported by nonresidential generators was "Large volume [of garbage]" (37%). The remaining top four reasons were "Cleaning home or workplace" (26%), "Other" (19%), "Convenience" (9%), and "No/bad service" (5%).

Table 36. Most Common Reasons to Self-haul by Facility, Nonresidential Generators, 2019

Nonresidential, n=57	Algona	Bow Lake	Cedar Falls	Enumclaw	Factoria	Houghton	Renton	Shoreline	Vashon	Overall
Large Volume	0%	55%	0%	33%	0%	29%	0%	33%	25%	**37%**
Cleaning home or workplace	33%	21%	0%	33%	60%	43%	0%	33%	0%	**26%**
Convenience	33%	0%	0%	33%	0%	14%	50%	0%	25%	**9%**
No / Bad Service	33%	3%	0%	0%	0%	0%	50%	0%	0%	**5%**
Cheaper / Saves money	0%	7%	0%	0%	0%	0%	0%	0%	0%	**4%**
Subtotal	***100%***	***86%***	***0%***	***100%***	***60%***	***86%***	***100%***	***67%***	***50%***	***81%***
All other responses	0%	14%	100%	0%	40%	14%	0%	33%	50%	**19%**
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Estimates are rounded to the nearest percent and, when added together, may not equal 100%, due to rounding.

Load Origin

The surveyors asked every customer the city of origin for their load. Additionally, self-haul customers were asked the load's zip code of origin. Table 37, Table 38, and Table 39 present the load origin for commercially collected and self-haul customers.

Commercially Collected

Table 37 details the reported city of origin for commercially collected loads to the County's facilities; Cedar Falls and Skykomish did not receive commercially collected loads. Among commercially collected loads surveyed, 94 percent of respondents named a city location in King County outside Seattle, and 3 percent reported unincorporated locations, including Ravensdale, Vashon, and other unincorporated areas. Kent (12%) was the most commonly reported city of origin for commercially collected loads.

Table 37. Reported City of Origin for Loads by Facility, Commercially Collected, 2019

Commercially Collected, n=1108	Algona	Bow Lake	Enumclaw	Factoria	Houghton	Renton	Shoreline	Vashon	Overall
Algona	2%								
Auburn	49%	1%							11%
Bellevue				54%	5%				10%
Bothell				2%	7%		38%		3%
Burien		10%							3%
Carnation				1%					
Clyde Hill				1%					
Covington	3%								1%
Des Moines		6%							2%
Duvall					2%				
Enumclaw			76%						1%
Fall City *(unincorp.)*						1%			
Federal Way	32%	1%							7%
Issaquah				11%		1%			2%
Kenmore					3%		2%		1%
Kent	5%	37%							12%
Kirkland					31%				5%
Lake Forest Park					1%				
Maple Valley						4%			
Medina				1%	2%				
Mercer Island				10%					2%
Newcastle				1%		4%			
Normandy Park		1%							
North Bend				3%		1%			1%
Pacific	4%								1%
Preston *(unincorp.)*						1%			
Ravensdale *(unincorp.)*			6%						
Redmond				3%	36%				7%
Renton		11%			1%	81%			9%
Sammamish				7%	3%				2%
SeaTac		17%							5%
Shoreline							53%		2%
Skykomish				1%					
Skyway *(unincorp.)*						3%			
Snoqualmie				2%	2%				1%
Tukwila		8%							3%
Vashon *(unincorp.)*								100%	1%
Woodinville					7%				1%
White Center *(unincorp.)*		1%							
Seattle		2%		1%			4%		1%
Subtotal Incorporated King County minus Seattle	***97%***	***93%***	***76%***	***94%***	***99%***	***91%***	***94%***	***0%***	***94%***
Unincorporated King County	2%	3%	18%			9%		100%	3%
Subtotal All King County	***99%***	***96%***	***94%***	***94%***	***99%***	***100%***	***94%***	***100%***	***97%***
Seattle		2%		1%			4%		1%
Outside King County			6%		1%				
No Response	1%	1%		6%			2%		2%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Estimates are rounded to the nearest percent and, when added together, may not equal 100%, due to rounding. Values less than 0.5% are left blank.

Self-haul

Table 38 details the reported city of origin for self-haul loads to each of the County's facilities, except Skykomish where surveys were not conducted. Among self-haul loads surveyed, 73 percent of respondents named a city location in King County outside Seattle or Milton, and 12 percent reported unincorporated locations, including Skyway, Vashon, and other unincorporated areas. Vashon (9%) was the most commonly reported origin for self-haul loads, though it is not incorporated; its island location and lack of service from major commercial haulers drive high levels of self-hauling. Seattle (8%) was next most common, followed by Kent (7%) and Renton (7%).

Table 38. Reported City of Origin for Loads by Facility, Self-haul, 2019

Self-Haul, n=4455	Algona	Bow Lake	Cedar Falls	Enumclaw	Factoria	Houghton	Renton	Shoreline	Vashon	Overall
Algona	3%									
Auburn	30%	5%		6%						6%
Bellevue		1%			39%	8%	2%			6%
Black Diamond				5%						
Bothell						7%		1%		1%
Burien		7%					1%			2%
Carnation			3%		2%	1%				
Clyde Hill					1%					
Covington	3%	1%		3%			1%			1%
Des Moines		11%								3%
Duvall			1%			3%				
Enumclaw				50%						4%
Fall City *(unincorp.)*			7%		1%	1%				
Federal Way	25%	9%					1%			6%
Hobart							1%			
Issaquah			2%		10%	1%	6%			2%
Kenmore						1%		4%		1%
Kent	7%	23%		2%	1%	1%	5%			7%
Kirkland					3%	31%				4%
Lake Forest Park								6%		1%
Maple Valley	2%	1%		14%			6%			2%
Medina					2%					
Mercer Island					7%					1%
Newcastle					2%		2%			
Normandy Park		2%								1%
North Bend			49%		2%		1%			2%
Pacific	3%									
Preston *(unincorp.)*			2%							
Ravensdale *(unincorp.)*				7%						
Redmond					4%	20%				3%
Renton	1%	7%	1%	1%	4%	1%	62%			7%
Sammamish			2%		9%	2%	1%			2%
SeaTac		8%								2%
Shoreline								36%		4%
Skyway *(unincorp.)*		2%					3%			1%
Snoqualmie			30%		3%					1%
Tukwila		5%								1%
Vashon *(unincorp.)*									99%	9%
Woodinville					1%	12%		1%		2%
Seattle	1%	8%			3%	3%	4%	44%		8%
Subtotal Incorp. King County minus Seattle & Milton	***76%***	***82%***	***89%***	***82%***	***91%***	***88%***	***89%***	***50%***	***0%***	***73%***
Unincorporated King County	2%	4%	11%	10%	2%	3%	6%	1%	99%	12%
Subtotal All King County	***78%***	***86%***	***99%***	***92%***	***93%***	***91%***	***95%***	***51%***	***99%***	***85%***
Milton	2%									
Seattle	1%	8%			3%	3%	4%	44%		8%
Outside King County	18%	5%	1%	7%		4%	1%	5%		5%
No Response	2%	1%		1%	4%	2%				1%
Total	**98%**	**100%**	**100%**	**100%**	**100%**	**99%**	**100%**	**100%**	**100%**	**100%**

Estimates are rounded to the nearest percent and, when added together, may not equal 100%, due to rounding.
Values less than 0.5% are left blank.

Table 39 details the reported zip code of origin for self-haul loads to each of the County's facilities. The most frequently reported origin zip code was 98070 (Vashon), accounting for 5 percent of customers surveyed. The response rate was low because many respondents reported a city rather than a zip code.

Table 39. Reported Zip Code of Origin for Loads by Facility, Self-haul, 2019

Zip Code, n=4454	Algona	Bow Lake	Cedar Falls	Enumclaw	Factoria	Houghton	Renton	Shoreline	Vashon	Overall
98000										
98001	8%	2%								2%
98002	5%	1%								1%
98003	4%	2%								1%
98004					3%	2%				1%
98005					1%	3%	1%			1%
98006					5%		1%			1%
98007					2%					
98008					3%	1%				
98010				1%						
98011						4%				1%
98012						2%				
98013										
98014			1%		1%	1%				
98017										
98019			1%			3%				
98020								1%		
98021						1%				
98022				22%						2%
98023	7%	2%								1%
98024			2%			1%				
98025										
98026								1%		
98027			2%		4%		3%			1%
98028						1%		3%		
98029			1%		1%					
98030	1%	2%								
98031		4%								1%
98032	1%	3%								1%
98033					1%	6%				1%
98034						13%				2%
98035										
98036										
98037										
98038	1%			6%			5%			1%
98039					1%					
98040					3%					
98041										
98042	3%	2%		3%			2%			1%
98043										
98044										
98045			23%		1%					1%
98047	1%									
98048										
98050			2%							
98051				4%						
98052					2%	11%				2%
98053						5%				1%
98054										
98055		1%					2%			
98056					1%		14%			1%

Estimates are rounded to the nearest percent and, when added together, may not equal 100%, due to rounding. Values less than .5% are left blank

Zip Code, Continued	Algona	Bow Lake	Cedar Falls	Enumclaw	Factoria	Houghton	Renton	Shoreline	Vashon	Overall
98057							1%			
98058		1%					7%			1%
98059					2%		12%			1%
98061										
98064										
98065			10%		1%					
98066										
98067										
98068			2%							
98070									64%	5%
98071										
98072						6%		1%		1%
98074			1%		1%	2%				
98075			1%		3%					
98076										
98077						3%				
98078										
98083										
98085										
98089							1%			
98090										
98091										
98092	5%			2%						1%
98098										
98100										
98101										
98102										
98103								1%		
98104			2%							
98105								2%		
98106										
98107								2%		
98108										
98109								1%		
98111										
98112										
98113										
98115								3%		
98116										
98117								1%		
98118		1%								
98119										
98120										
98121										
98122										
98123										
98125								9%		1%
98126										
98128										
98130										

Estimates are rounded to the nearest percent and, when added together, may not equal 100%, due to rounding. Values less than .5% are left blank

Zip Code, Continued	Algona	Bow Lake	Cedar Falls	Enumclaw	Factoria	Houghton	Renton	Shoreline	Vashon	Overall
98132										
98133								11%		1%
98134										
98135								1%		
98136										
98137										
98138										
98139										
98144										
98146		1%								
98148		2%								
98150										
98153										
98155								11%		1%
98158										
98160										
98165										
98166		3%								1%
98167										
98168		3%								1%
98170										
98172										
98174										
98177								7%		1%
98178		1%					5%			1%
98179										
98181										
98186										
98188		3%								1%
98195										
98196										
98198		7%								2%
98199										
98203										
98204										
98206										
98208										
98223										
98224										
98231										
98232										
98233										
98234										
98242										
98246										
98258										
98260										
98270										
98272										
98275										
98276										
98282										
98290										
98296						1%				
98301										
98308										
98312										
98320										
98321				3%						
98323										
98324										
98325										
98331										
98333										
98334										
98335										
98338										
98354	1%									
98357										
98360										
98362										
98371	2%									
98372	3%									
98373										
98374										
98377										
98385										
98387										
98390	1%									

Estimates are rounded to the nearest percent and, when added together, may not equal 100%, due to rounding. Values less than .5% are left blank

Zip Code, Continued	Algona	Bow Lake	Cedar Falls	Enumclaw	Factoria	Houghton	Renton	Shoreline	Vashon	Overall
98391	1%									
98402										
98403										
98404										
98405										
98408										
98409										
98422	1%									
98424	1%									
98432										
98434										
98443										
98444										
98445										
98466										
98467										
98473										
98512										
98572										
98580										
98601										
98603										
98682										
98752										
98818										
98827										
98842										
98862										
98866										
98891										
98902										
98918										
98934										
Subtotal	***49%***	***47%***	***45%***	***44%***	***39%***	***68%***	***58%***	***59%***	***64%***	***52%***
No Response	51%	53%	55%	56%	61%	32%	42%	41%	36%	48%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

5. Appendices

Appendix A. Sample and Survey Methodology

Overview

The objective of the 2019 waste composition study was to provide robust composition data for King County's disposed waste. By sorting approximately 450 randomly selected samples, Cascadia produced representative composition estimates for the residential, commercial, and self-haul substreams. Cascadia also combined these substream compositions to calculate statistically reliable estimates of waste disposed overall and for the residential and nonresidential disposed waste streams in King County, outside of Seattle. The current project followed the same basic methodology as the previous study conducted in 2015.

This appendix outlines the sampling methodology for the current study. The material definitions, quality control plan, health and safety plan, and example field forms are included in separate appendices.

Define Sampling Populations

To gain a clearer understanding of waste flows, the total disposed waste stream was divided into various substreams. Such division was useful because the various substreams often have different waste types, user profiles, and public programs for reaching customers. Substreams were identified according to the source, or generator, of the waste (residential or nonresidential) and how materials were delivered to waste sites (commercially collected or self-haul).[11] The study focused on the materials arriving at King County's public transfer stations. Private facilities, including designated sites for receiving construction and demolition (C&D) materials, were not included in this study. Many C&D materials continue to be self-hauled to the King County transfer stations, although county regulations since 2016 require that mixed C&D materials and C&D waste from jobsites be sent to a designated C&D facility.

These terms were used to define the substreams:

- **Residential waste** is generated at single-family or multifamily dwellings.
- **Nonresidential waste** is generated at businesses, schools, government offices, and other institutions that are not residences.
- **Commercial haulers** are firms that contract with local governments to operate a garbage collection company or operate under a state franchise in a particular geographic area.[12]
- **Self-haulers** are residents or businesses that bring waste themselves to transfer stations or drop boxes.[13]

[11] This study excluded waste from the construction, demolition and land-clearing (CDL) substream that was disposed at special facilities designated for the purpose; C&D-type materials at County facilities were included.
[12] The City of Enumclaw and the Town of Skykomish operate their own waste collection systems, rather than contracting with commercial haulers. These materials were classified as commercially collected loads in the study.
[13] Self-haul loads were categorized as residential or nonresidential according to the source of the load, not the type of hauler. For example, some companies, such as contractors and landscapers, collect waste from homes or

In this study, disposed waste loads were first divided into residential and nonresidential waste streams. These categories were then further divided into either commercially collected or self-haul substreams, as shown in Table 40. In some cases, loads contained a mixture of material from residential and nonresidential generators, but these "mixed loads" represented only a small portion of the total waste.

Table 40. Definitions of Disposed Waste Streams and Substreams

Waste Stream	Commercially Collected Substream	Self-haul Substream
Residential Waste	Commercially collected waste from residential sources	Self-haul waste from residential sources
Nonresidential Waste	Commercially collected waste from nonresidential sources	Self-haul waste from nonresidential sources
Mixed Residential and Nonresidential Waste	Commercially collected waste from residential and nonresidential sources	Self-haul waste from residential and nonresidential sources

Allocate Samples

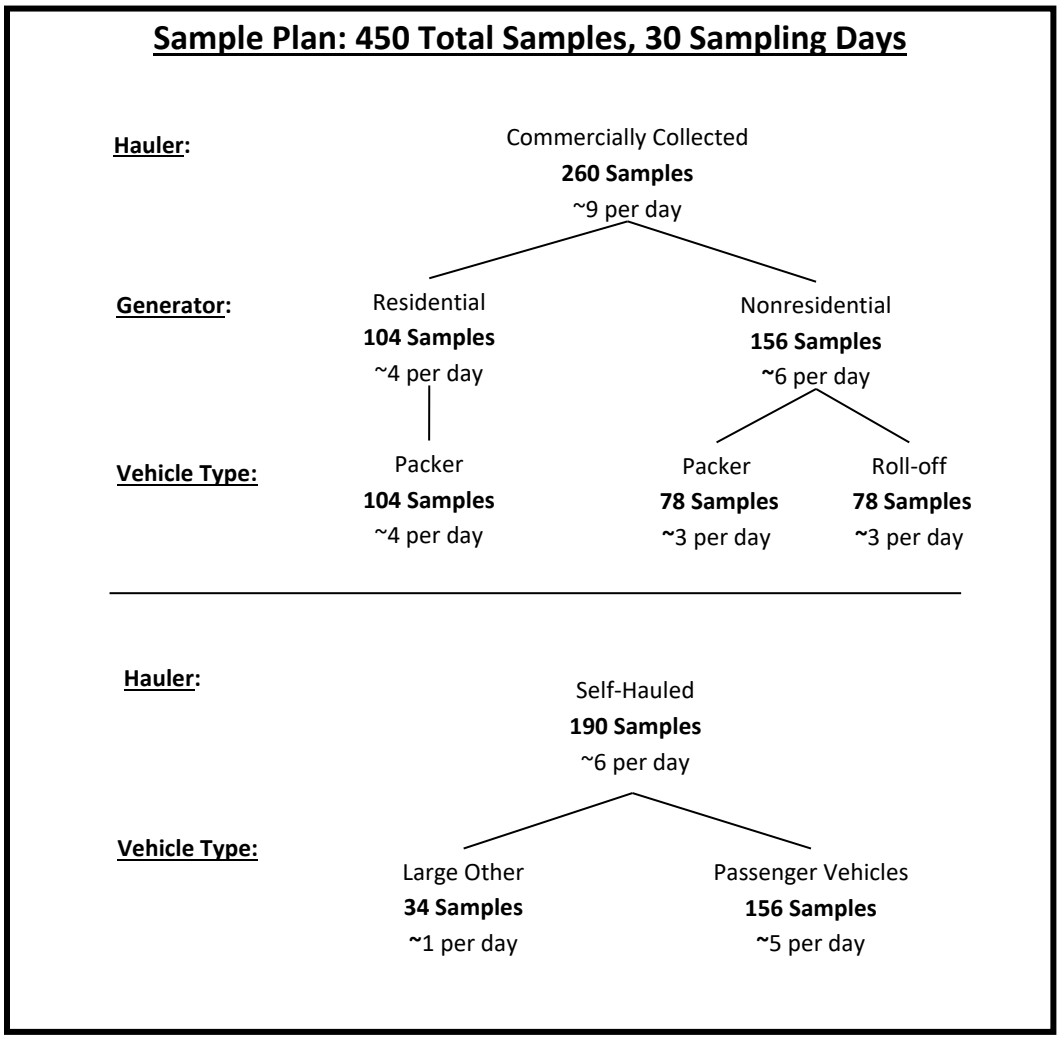
To provide reliable waste composition estimates, Cascadia hand-sorted approximately 450 randomly selected samples from eight King County transfer stations and two drop boxes. The samples were divided among commercially collected residential, commercially collected nonresidential, self-haul residential, and self-haul nonresidential waste.

Cascadia planned to complete 30 days of sampling, 15 samples per day, which is two days (and 30 samples) more than in previous Waste Monitoring Program studies. At the County's request, these two extra days of sampling were completed at the Vashon transfer station to more accurately characterize the waste arriving at that facility. The number of sampling days allocated to each facility was approximately proportional to the annual tonnage handled by that facility. No sampling days were allocated to the Skykomish or Cedar Falls drop box sites; instead Cascadia worked with the County and the appropriate hauler to ensure that at least one drop box from each site was delivered to Factoria or Houghton, respectively, during sampling days at those sites. In 2019, the Skykomish drop box was sampled at Bow Lake instead of Houghton for logistical reasons.

Figure 30 shows the distribution of planned samples. Approximately 104 commercially collected residential, 156 commercially collected nonresidential, and 190 self-haul (residential and nonresidential) samples were to be sorted over 30 days. Using predetermined sampling intervals, Cascadia intended to sample an average of 15 loads per day, resulting in a total of 450 planned samples.

businesses. These loads were considered self-haul residential if the waste originates from a residence, even though the company, not the resident, delivers the material to a waste facility.

Figure 30. Planned Sample Allocation, 2019



As shown, greater numbers of samples were allocated to the commercially collected nonresidential and self-haul substreams. The waste found in these streams is more variable from load to load. Higher variability means that additional samples are required to provide precision levels comparable to the commercially collected residential substream.

Within the commercially collected nonresidential substream, the samples were evenly divided among packer trucks and drop boxes (78 samples for each vehicle type). The self-haul samples were divided between passenger vehicles (156 samples) and other large vehicles (34 samples). The planned numbers of samples for each sampling stratum are shown in Table 41.

Table 41. Planned and Actual Samples by Sampling Strata, 2019

Sampling Strata	Number of Samples	
	Plan	Actual
Commercially Collected Residential	104	114
Commercially Collected Packer Trucks	78	75
Commercially Collected Dropboxes	80	81
Self-haul Passenger Vehicles	156	148
Self-haul Large Other	34	33
Total	**452**	**451**

Apportion Sampling and Surveying Days

A total of 30 sampling days were scheduled for the 2019 study, divided into six sampling events typically lasting five days each. Waste was sampled from ten King County facilities, including eight transfer stations and two drop boxes.

Sites with relatively more vehicle traffic were allocated additional sampling days. During the study year, sampling at Bow Lake occurred six times, plus one make-up day, while Algona, Factoria, Houghton, and Vashon were sampled four times. Shoreline and Renton hosted waste sampling three times, and the Enumclaw facility was visited twice. Waste disposed at the Skykomish and Cedar Falls facilities is consolidated into drop boxes, and the drop boxes are then hauled to the Houghton and Factoria transfer stations, respectively, for disposal. Because of this arrangement and because only self-haul customers use the two drop box sites, self-haul residential samples from Skykomish and Cedar Falls were collected from the drop boxes as they were tipped at the receiving transfer stations. In 2019, the Skykomish drop box was sampled at Bow Lake instead of Houghton for logistical reasons.

Surveying took place at nine of the County's ten transfer stations. Skykomish was excluded from surveying due to its extremely low traffic volume and remote location. Surveying was completed over 44 days, including one Saturday at each surveyed facility and across all three shifts at Bow Lake. Every sampling day including surveying, but not every survey day included sampling.

Assign Facilities to Dates

To capture any seasonal variation in the composition of waste or the mix of vehicles using the transfer stations, sampling occurred every other month and surveying nearly every month starting in March 2019. Cascadia used the random function in Microsoft Excel to select the first sampling day each month. The random number generated was used to assign a first sampling day in March, May, or July to each facility. Subsequent sampling days at each site were then distributed based on the number of planned sampling days for that facility. The interval between sampling or surveying days at a site varied depending on how often the site was visited by the project team during the study period.

Table 42 shows the planned sampling and surveying dates for each facility. Survey-only days are shown in **blue**. Sort days (which included surveys) are shown in black.

Table 42. Sampling and Surveying Calendar *(Sorts also included surveying; Survey-only events are noted in blue)*

Month	#	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
March	6	18 Shoreline Sort	19 Factoria Sort	20 Bow Lake-Day Sort	21 Algona Sort	22 Houghton Sort	23 Vashon Survey
April	0						
May	6	20 Renton Sort	21 Bow Lake-Day Sort	22 Vashon Sort	23 Bow Lake-Evening Sort	24 Enumclaw Sort	25 Cedar Falls Survey
June	3	10 Bow Lake-Evening Svy		19 Enumclaw Survey			15 Factoria Survey
July	6	22 Bow Lake-Day Sort	23 Algona Sort	24 Factoria Sort	25 Houghton Sort	26 Vashon Sort	27 Shoreline Survey
August	1						17 Houghton Survey
September	6	23 Vashon Sort	24 Bow Lake-Night Sort	25 Houghton Sort	26 Factoria Sort	27 Shoreline Sort	21 Algona Survey
October	6	21 Houghton Sort	22 Enumclaw Sort	23 Renton Sort	24 Shoreline Sort	25 Algona Sort	26 Bow Lake-Day Svy
November	6	4 Factoria Sort	5 Renton Sort	6 Algona Sort	7 Bow Lake-Day Sort	8 Vashon Survey	9 Enumclaw Survey
December	3			18 (make-up) Vashon Sort	19 (make-up) Bow Lake-Day Sort	13 Cedar Falls Survey	14 Renton Survey
Shifts	**44**	7	6	8	7	7	9

Determine Sampling Frequency

Sampling frequency refers to the process by which particular vehicles were selected for sampling. Vehicles were randomly selected for sampling through systematic selection process as they arrived at each facility during a sampling day. A staff member was designated as the "Gatekeeper." The Gatekeeper surveyed and counted all incoming vehicles and applied the process described below to select loads from which samples were extracted. The survey script is detailed in a following section.

1. For each sampling day and each disposed waste stream, the expected number, *L*, of arriving loads from each stream was estimated using the vehicle survey data obtained in 2015. The number *L* was then reduced by 20% (equal to 0.8 x *L*). This was done to ensure that the targeted number of loads for each disposed waste stream could be selected on each sampling day, even if traffic was lighter than expected.

2. Next, the sampling interval *n* was determined to ensure systematic sampling of vehicles. If *r* represents the number of samples needed for the disposed waste stream and 0.8 x *L* represents the number of expected loads from the disposed waste stream, then *n* is calculated by dividing 0.8 x *L* by *r*. To facilitate this process, a *Daily Vehicle Selection Sheet* was constructed for each day, and every n^{th} vehicle was selected for sampling. An example of a sample vehicle selection sheet appears in *Appendix I. Example Field Forms*.

Field Procedures

Vehicle Surveys

All incoming vehicles were surveyed using the following survey script.

AS THE VEHICLE APPROACHES:

Select a numbered card; record the number.

Decide whether the vehicle is a commercial hauler or self-haul (review the attached list of garbage companies) and record the collection type.

Observe and record the vehicle type (from the list on the survey form; ask driver if you are uncertain).

Observe and record whether they are pulling a trailer ("X" if yes).

STOP THE VEHICLE, THEN BEGIN QUESTIONS:

All Drivers:

Introduction: "Hello, King County is conducting a customer survey today."

Hand the driver the numbered card. "This card will be collected when you leave the facility. Please don't leave without returning the card."

Ask where the load is from. Refer to the sheet entitled "City of Origin." If the load is from somewhere not on the list of cities, verify whether the load is from Unincorporated King County, all over King County, or Outside King County. Record the city on the survey form.

Ask the driver whether the load is yard waste, construction and demolition debris (C&D)), MSW/mixed garbage, or special waste (refer to attached sheet for definition of special waste). Record the waste type.

If the waste type is yard waste or C&D, ask the driver if he/she is a contractor/builder or a landscaper. Record only if he/she is contractor/builder or landscaper.

Ask the driver where the load was generated: single-family residential, multifamily residential, mixed residential, mixed residential and nonresidential, or nonresidential (business/institutional). Record the generator type.

Self-haul Drivers Only:

Ask the driver how often he/she visits any transfer station. Record the trips/period in terms of XX times per DAY, WEEK, MONTH or YEAR only. For example, write down 3/year if he/she says, "once every four months."

Ask the driver from which ZIP code the load originated.

Skip if Contractor of Landscaper:

Ask the driver whether he/she has curbside garbage service (circle yes or no). This question pertains to a) home if the driver indicated the load is from his/her home or b) business if the driver indicated the load is from his/her business.

Ask the driver why he/she is self-hauling today. If the driver previously answered "no" to having curbside garbage service, ask why he/she does not subscribe instead of asking why he/she is self-hauling. Refer to the list provided to code the answer.

All Drivers:

Record any additional comments the driver may offer. Thank the driver for his/her time and responses.

AS THE VEHICLE DEPARTS THE FACILITY:

Remove the numbered card and ask for the transaction receipt.

If you have a two-person survey team, the second person will record the numbered card's number and the ticket number on the exit form.

If only one person is conducting the survey, you will record the ticket number on the survey form, making sure to write it next to the correct numbered card number.

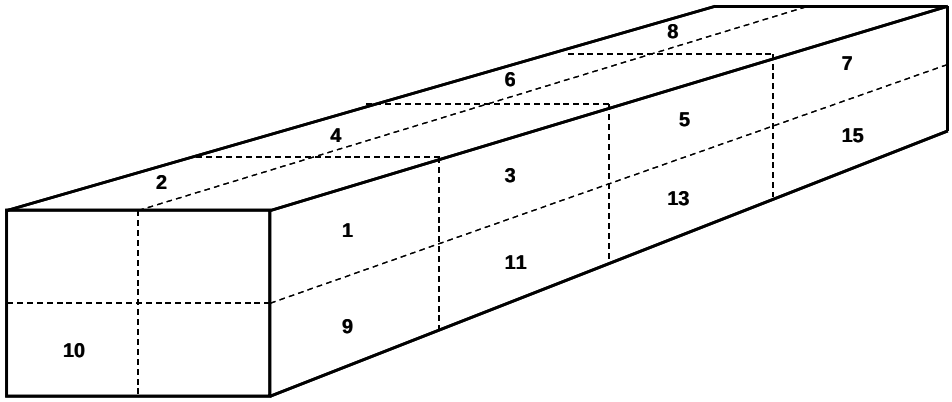
Survey responses were recorded using customized *Customer Survey Forms*.

Obtaining Samples for Sorting

Using the process described in the previous section, the Gatekeeper determined which vehicles were to be sampled. For a vehicle to be eligible for sampling, the load had to match one of the targeted disposed waste stream categories. If the vehicle was eligible and was the correct n^{th} vehicle, the Gatekeeper placed a *Sample Placard* on the vehicle's windshield or dashboard. At the sorting area, the Sort Crew Manager intercepted the vehicle, took the *Sample Placard*, and recorded the sample ID number from the sample placard onto the *Material Weight Tally Sheet*. Examples of these field forms are included in *Appendix I. Example Field Forms*.

If selected for sampling, commercially collected loads arriving in compactors, roll-off containers, or packer trucks were instructed to dump their contents in an elongated pile. The sample was selected using an imaginary 16-cell grid (Figure 31) superimposed over the dumped material. The Sort Crew Manager then located the randomly pre-selected cell to be sorted. If the designated cell was blocked due to site constraints, an alternate cell was randomly selected. Then, approximately 225 to 275 pounds of waste was extracted by machine or hand from the designated cell and placed on a tarp.

Figure 31. The 16-Cell Grid Applied to Selected Loads



Samples from large (greater than 500 pounds) self-haul loads were selected using the same random cell selection method as commercially collected loads. If the self-haul load weighed less than 250 pounds, the entire load was sorted as a sample.

After the extracted material was deposited on the tarp, the Sort Crew Manager checked the weight of each sample manually. If judged to be too light, additional material was pulled from the same cell area until the desired weight was achieved. Samples judged to be excessively heavy were pared down by removing a homogenous slice of material from the tarp.

Sorting Samples

Once a sample was selected, extracted from the load, and placed on a clean tarp, it was sorted by hand into the 105 material types. Sorted materials were placed in plastic laundry baskets for weighing and recording. The Sort Crew Manager monitored the homogeneity of the baskets as material accumulated, rejecting items that were improperly classified. Open laundry baskets allowed the Sort Crew Manager to see the material at all times. The Sort Crew Manager also verified the purity of each component as it was weighed and recorded on the sampling form.

All sampling records were checked for accuracy, completeness, and legibility before being entered into a Microsoft Access database customized for this study.

Appendix B. Material Definitions

To identify additional diversion opportunities, material types were classified according to their recoverability. Solid Waste Division staff assigned each material type to one of the recoverability groups as defined in the *Material Recoverability Groups* section on page 18 and listed in the table below. The material types have evolved over time to meet particular interests of King County (e.g., expanded food waste categories and more detailed plastic categories) while maintaining comparability across studies. New materials added in the 2019 study are marked with an asterisk (*).

Recoverability Groups (RG): **RR** = Readily Recyclable, **LR** = Limited Recyclability, **NR** = Not Recyclable.

RG	#	PAPER
RR	1	**Old Newspaper (ONP)**—printed groundwood newsprint and other minimally bleached groundwood. This category also includes some glossy paper typically used in newspaper insert advertisements, unless found separately.
RR	2	**Plain Corrugated Cardboard (OCC/Kraft Bags)**—Kraft linerboard, containerboard cartons, and shipping boxes with corrugated paper medium (unwaxed). This category also includes Kraft (brown) paper bags. **Excludes waxed and plastic-coated cardboard, solid boxboard, and bags that are not pure unbleached Kraft.**
RR	3	**Waxed Corrugated Cardboard**—Kraft linerboard, containerboard, cartons, and other boxes with a wax coating. Examples include commercial produce boxes.
RR	4	**Low-Grade Recyclable Paper**—all recyclable paper other than that listed in another category. This list includes magazines, phone books, junk mail, used envelopes, other material with sticky labels, construction paper, blueprint and thermal copy paper (NCR paper), fax paper, bright-dyed paper (fiesta or neon colors), paperback books, colored manila envelopes, and groundwood catalogues. This category also includes polycoated paperboard, aseptic packaging and other low-grade recyclable papers used in packaging, including polycoated or aseptic milk, non-compostable/polycoated cups or tubs, ice cream or juice containers, plastic-coated cardboard, poly-lined chipboard, chipboard and other solid boxboard such as for beer, cereal, and soda cans, clothing forms, egg cartons (molded pulp), and other boxes.
RR	5	**High-Grade Paper**—white and lightly colored bond, rag, or stationary grade paper. This category comprises high-grade paper, which includes white ledger, colored ledger, computer cards, bond, copy machine paper, manila envelopes and continuous-feed computer printouts and forms of various types. **Excludes glossy coated paper such as magazines, bright papers, groundwood publications such as catalogs.**
RR	6	**Single-use Food Service Compostable Paper**—includes paper soiled with food used in a "single-use food service" capacity. Examples include paper plates, compostable paper cups (no plastic coating), pizza boxes, french-fry containers. **Does not include napkins or paper towels** (see #7).
RR	7	**Other Compostable Paper**—includes paper soiled with food ***not* used in a "food service" capacity** (see #6). Examples include napkins, paper towels, coffee filters, and tissue. Also includes shredded paper.

NR	8	**Other Paper**—includes materials that are primarily paper but combined with other materials that are **not** easily recyclable. Examples include frozen juice cans, oil cans, paper with foil laminates, foil-lined paper, spiral bound notebooks, carbon paper, photographs, microwave containers, gift wrapping paper, and hardcover books.
RG	**#**	**PLASTICS**
RR	9	**PET Bottles**—all bottles made from polyethylene terephthalate (PET), consisting of pop/soda, oil, liquor, and other types of bottles (SPI code #1).
RR	10	**Other PET Containers**—PET containers other than bottles.
RR	11	**HDPE Bottles**—all bottles made of high-density polyethylene (HDPE), such as milk, juice, detergent, and other bottles (SPI code #2).
RR	12	**Other HDPE Containers**—HDPE containers other than bottles.
RR	13	**#3 Packaging***—rigid bottles and containers, with SPI code #3.
RR	14	**#4 Packaging***—rigid bottles and containers, with SPI code #4.
RR	15	**#5 Packaging***—rigid bottles and containers, with SPI code #5.
RR	16	**Other #6 Packaging***—rigid bottles and containers, with SPI code #6. **Does not include Expanded Polystyrene** (see #19, #20, and #21).
RR	17	**Other Non-Compostable/Non-PLA #7 Packaging***—other non-compostable rigid bottles and containers, with SPI code #7 **not marked as PLA**.
RR	18	**Compostable Plastics**—all items made from compostable materials such as corn or potatoes, with the words "compostable" on the product; includes compostable plastic items, such as film "plastic" bags made of materials such as corn starch or soy designed to compost (e.g. BioBag, EcoSafe) and compostable plastic ("PLA") containers and packaging (e.g. cups/lids, bowls, clamshells, plates, trays, cutlery, straws). Compostable plastic containers and packaging are marked with the words "compostable" or "#7 PLA" in the plastic identifier.
NR	19	**Expanded Polystyrene Single Serve Food Packaging**—expanded polystyrene packaging used for carrying food. Examples include food trays, cups, plates, clamshells, egg cartons, and other packaging.
RR	20	**Other Expanded Polystyrene Packaging**—any expanded polystyrene packaging **not used for food service** (see #19), such as molded packing blocks and Styrofoam peanuts.
NR	21	**Expanded Polystyrene Products**—expanded polystyrene products such as some ice-chests, floatation devices, and EPS wig forms. This does **not include EPS insulation**, which is categorized in Construction/Demolition (see #70).
RR	22	**Recyclable Plastic Bags**—plastic shopping bags used to contain merchandise to transport from the place of purchase, given out by the store with the purchase. This type includes dry cleaning bags and newspaper bags intended for one-time use. Does **not include produce bags**.

RR	23	**Non-industrial Packaging Film Plastic**—all film used as food packaging or in another non-industrial capacity. Include produce bags, ziplock bags, juice or food pouches (baby food, tuna), frozen vegetable bags, bread bags, food wrappers such as candy bar wrappers, deli bags, and other film packaging with a label or sticker.
RR	24	**Industrial Packaging Film Plastic**—film plastic used for large-scale packaging or transport packaging. Examples include shrink-wrap, mattress bags, furniture wrap, and film bubble wrap.
NR	25	**Plastic Garbage Bags**—plastic bags sold for use as trash bags, for both residential and commercial use. This type includes garbage, kitchen, compactor, can-liner, yard, lawn, leaf, and recycling bags. This type does **not include other plastic bags, like shopping bags, that might have been used to contain trash**.
NR	26	**Plastic Film Products**—items made of film plastic **not** intended for a single use, such as shower curtains, kid's pools, and utility tarps.
NR	27	**Other Plastic Packaging**—all other non-film packaging that does **not** fit into the above categories including caps, closures, rigid bubble packaging, and other miscellaneous non-film packaging items.
LR	28	**Single Resin Plastic Products**—primarily rigid or solid consumer items made from a single resin type. Examples include dishware, utensils (single-use or durable plastic), straws, other household items, vinyl products, plastic furniture and toys, car parts, and hangers. Also includes thermoset plastics such as Formica, fiberglass, and other related products.
NR	29	**Mixed Resin Plastic Products**—primarily rigid or solid consumer items made from more than one type of plastic resin. Examples include hairbrushes, toothbrushes, and pens.
NR	30	**Foam Rubber and Padding**—foam materials, consisting primarily of polyurethane, such as foam mattress pads.
LR	31	**Carpet Padding**—foam material used for carpet padding.
NR	32	**Plastic and Other Materials**—items predominantly made of plastic, but are combined with other material, such as three-ring binders, some toys, razors, some kitchenware and car parts with wood or metal components.
RG	**#**	**WOOD AND YARD**
RR	33	**Dimensional Lumber/Engineered Wood**—both clean and painted wood commonly used in construction for framing and related uses, including 2 x 4's, 2 x 6's, and sheets of plywood, strandboard, and particle board. Includes pallets and crates.
NR	34	**Treated Wood**—wood treated with preservatives such as creosote, including dimension lumber. This category may also include some treated plywood, strandboard, chemically treated wood, and other wood.
NR	35	**Contaminated Wood**—wood contaminated with other wastes in such a way that they cannot easily be separated but consisting primarily (over 50 percent) of wood. Examples include wood with sheetrock attached.

NR	36	**Roofing and Siding Wood**—painted or unpainted wood from demolition or construction waste commonly used for siding or roofing of buildings. This category includes only wood products, such as cedar shingles or shakes.
RR	37	**Stumps**—stumps of trees and shrubs, with any adhering soil.
RR	38	**Large Prunings**—other natural woods, such as logs and branches over four inches in diameter (four inches is the limit used for defining prunings as yard wastes).
RR	39	**Yard Wastes**—leaves, grass clippings, garden wastes, and brush up to 4 inches in diameter.
LR	40	**Other Wood**—other types of wood including wood products that do **not** fit into the above categories, including all-wood furniture.
RG	**#**	**FOOD**
RR	41	**Fruits and Vegetables, Edible***—the edible portion of food that comes from a plant but does **not** appear to have grown on the customer's property. Examples include vegetables and fruits. Includes fruits and vegetables in the original or another container when the container weight is less than 10% of the total weight.
RR	42	**Fruits and Vegetables, Non-edible***—the non-edible portions of food that comes from plants. Examples include fruit peels, vegetable peelings and potato skins, pits, cores, juiced oranges.
RR	43	**Homegrown Fruits and Vegetables***—food that comes from a plant growing on or cleared from the customer's property. Examples will include fruits and vegetables disposed of in the set-out because of falling or pruning from trees and gardens.
RR	44	**Meat, Edible***—the edible portion of non-dairy food that comes from an animal. Examples include eggs and eggs in shell, fresh meat, cooked meat, and meat scraps. **Does not include dairy products such as cheese and milk** (see #46). Includes meat in the original or another container when the container weight is less than 10% of the total weight.
RR	45	**Meat, Non-edible***—the non-edible portions of food that comes from an animal. Examples include eggshells, bones, gristle and meat trimmings, fish skins, and seafood shells.
RR	46	**Mixed/Other Food Waste, Edible***—the edible portion of any food that cannot be put in the above categories. Examples include food items that are a combination of the above categories, as well as grains, crackers, bread, dairy, cereal, soda, beer, bottled water, and juice. Includes edible food in the original or another container when the container weight is less than 10% of the total weight.
RR	47	**Mixed/Other Food Waste, Non-edible***—the non-edible portion any food that cannot be put in the above categories. Examples include food items that are a combination of the above categories, and coffee grounds or tea packets. Includes non-edible food in the original or another container when the container weight is less than 10% of total weight.
RR	48	**Other Compostables***—other compostable organic materials, **not** included above, such as popsicle sticks, chopsticks, and toothpicks.

RG	#	OTHER ORGANICS
RR	49	**Textiles: Clothes & Other Recyclables**—fabric materials including natural and man-made textile materials such as cottons, wools, silks, woven nylon, rayon, polyesters and other materials. This category includes clothing, rags, curtains, cloth diapers, and other fabrics.
RR	50	**Other Textiles**—upholstery, shoes, and other non-recyclable products including leather products.
NR	51	**Disposable Diapers**—diapers and similar products made from a combination of fibers, synthetic, and/or natural, and made for a single use. This category includes fecal matter contained within, sanitary napkins and tampons, and adult disposable protective undergarments. **Does not include diapers that are all cloth and not originally intended for single use** (see #49, Textiles).
NR	52	**Rubber Products**—items made of natural and synthetic rubber, including door mats, car parts, hoses, rubber toys, and other products. **Does not include tires or foam rubber.**
RR	53	**Tires**—whole tires from automobiles, trucks, motorcycles, bicycles, and other vehicles.
NR	54	**Animal Carcasses**—carcasses of small animals and pieces of larger animals, unless the waste is the result of food storage or preparation.
NR	55	**Animal Feces**—feces from animals including kitty litter and bedding.
NR	56	**Miscellaneous Organics**—hair, wax, soap, cosmetics, shampoo, and other organics **not** otherwise classified.
RG	#	GLASS
RR	57	**Clear Glass Containers**—bottles and jars that are clear in color; used for food, soft drinks, beer, and wine.
RR	58	**Green Glass Containers**—bottles and jars that are green in color; used for food, soft drinks, beer, and wine.
RR	59	**Brown Glass Containers**—bottles and jars that are brown in color; used for food, soft drinks, beer, and wine. This category also includes blue glass containers.
NR	60	**Kitchenware/Ceramics**—glass or ceramic cooking ware, dishware, and other products.
NR	61	**Other Glass**—window glass, automotive glass, glass table-tops, mirrors, light bulbs and any other glass item that does **not** fit into a category above.
RG	#	METALS
RR	62	**Aluminum Cans**—beverage cans composed of aluminum only.
RR	63	**Other Aluminum**—other types of aluminum containers such as pans and trays; includes foil and foil products or packages and all other aluminum materials including furniture, house siding, cookware, and scrap.
RR	64	**Tinned Food Cans**—tin-plated steel cans (food cans); does not include other bi-metals, paint cans, or other types of steel cans.

RR	65	**Other Ferrous**—ferrous and alloyed ferrous scrap materials, without nonmetal contaminants, including household, industrial, and commercial products such as other cans and containers. This category includes scrap iron and steel to which a magnet adheres.
RR	66	**Other Non-Ferrous**—copper, brass, bronze, aluminum bronze, lead, pewter, zinc, and other metal materials **not** derived from iron to which a magnet will **not** adhere. Examples include brass doorknobs and copper pipes. **Metals that are significantly contaminated are not included** (see #67 and #68).
RR	67	**Mixed Metals**—composite, multi-metal products such as engines and electric motors with minor non-metal contaminants. The metal content must be more than 80% by weight of the material.
NR	68	**Other Mixed Metals**—metals combined with significant amounts of other materials, such as umbrellas and coated wire. The non-metal content of the item must be greater than 20% by weight.
RR	69	**Compressed Gas Cylinders**—metal gas tanks and cylinders most often used to contain propane or butane.
RG	**#**	**OTHER WASTES**
NR	70	**Construction/Demolition Waste (except wood)**—construction, demolition, or land clearing waste that cannot be placed into one of the above categories, such as concrete, plaster, rocks, gravel, bricks, toilets, and non-wood roofing materials, and insulation of various types (including foam, fiberglass etc.).
LR	71	**Asphalt Shingles**—roofing material composed of fiberglass or organic felts saturated with asphalt and covered with asphalt and inert aggregates. Commonly known as three-tab roofing shingles.
NR	72	**Ash**—material remaining after the combustion process, present in the waste stream as ash from fireplaces and wood stoves, used charcoal from grills, and similar materials.
NR	73	**Non-distinct Fines**—soil, sand, dirt, and similar non-distinct materials.
LR	74	**Gypsum Wallboard**—calcium sulfate dihydrate sandwiched between heavy layers of Kraft-type paper.
LR	75	**Furniture**—furniture made of mixed materials and in any condition. (For all-wood furniture, see #40, Other Wood.)
RR	76	**Mattresses**—mattresses made of mixed materials and in any condition.
LR	77	**Carpet**—general category of flooring applications consisting of various natural or synthetic fibers bonded to some type of backing material.
NR	78	**Miscellaneous Inorganics**—other non-combustible, inorganic material **not** classified elsewhere. Also includes non-C&D plaster and concrete statuary, dryer sheets, dryer lint, cleaning pads (Swiffer), wipes, gel packs, cigarette butts/filters, or other products.

RG	#	ELECTRONICS
RR	79	**Small Household Appliances**—small household appliances such as toasters, broilers, can openers, microwaves, coffee machines, and blenders.
RR	80	**Audio/Visual Equipment**—stereos, VCRs, DVD players, large radios, gaming systems, cable or satellite television control boxes, and audio/visual equipment. **Does not include televisions or monitors** (see #84 and #85).
RR	81	**Printers/Copiers/Fax Machines**—computer printers (both inkjet and laser), facsimile machines, and photo copying machines.
RR	82	**Central Processing Units (CPUs)**—such as computer hard drives when the CPU is a separate component in the system.
RR	83	**Computer Peripherals**—computer peripherals including keyboards, gaming controllers, and mice.
RR	84	**CRT Computer Monitors and Televisions**—computer monitors and televisions containing a cathode ray tube (CRT), Includes items with built in optical drives or other processors.
RR	85	**Other Computer Monitors and Televisions**—all non-CRT monitors and televisions (LCD, plasma, OLED, etc.). Includes items with built in optical drives or other processors such as an iMac or personal DVD player. Control of the content viewed on the item must be performed by an external control device such as a keyboard, mouse, or remote. **Does not include tablets or other small touchscreen personal computing devices** (see #88 and #89).
RR	86	**Laptops**—all laptop and notebook computers. Must have a permanently attached, physical keyboard.
RR	87	**Cell Phones**—Personal electronic devices primarily intended for mobile voice communication over a cellular network. This includes both smartphones and traditional cell phones.
RR	88	**Tablets**—Personal computing and entertainment devices with a screen greater than 4". Examples include video display devices, e-readers, and touch screen portable computers. This type includes products like the iPad, Kindle Fire, Nook, Surface, and Galaxy tablet.
RR	89	**Other Electronics**—includes scanners, personal digital assistants (PDAs), portable music players, answering machines, electronic toys, and any other electronic item with some circuitry **not** categorized elsewhere and with displays less than 4" when the item includes a display.
RG	**#**	**HOUSEHOLD HAZARDOUS/SPECIAL WASTE**
RR	90	**Used Oil**—used lubricating oils, primarily used in cars but including other types with similar characteristics and oil filters.
RR	91	**Vehicle Batteries**—car, motorcycle, and other lead-acid batteries used for motorized vehicles.
RR	92	**Household Batteries—**batteries of various sizes and types, as commonly used in households, including alkaline and button cell batteries.
LR	93	**Latex Paint**—water-based paints and similar products.

RR	94	**Oil-Based Paint**—solvent-based paints, varnishes, and similar products.
RR	95	**Solvents and Thinners**—various solvents, including chlorinated and flammable solvents, paint strippers, solvents contaminated with other products such as paints, degreasers and some other cleaners if the primary ingredient is (or was) a solvent, and alcohols such as methanol and isopropanol.
LR	96	**Adhesives and Glue**—glues and adhesives of various sorts, including rubber cement, wood putty, glazing and spackling compounds, caulking compounds, grout, and joint and auto body fillers.
NR	97	**Cleaners and Corrosives**—various acids and bases whose primary purpose is to clean surfaces, unclog drains, or perform other actions.
NR	98	**Pesticides and Herbicides**—variety of chemicals whose purpose is to discourage or kill pests, weeds, or microorganisms. Fungicides and wood preservatives, such as pentachlorophenol, are also included.
LR	99	**Gasoline and Fuel Oil**—gasoline, diesel fuel, and fuel oils.
LR	100	**Antifreeze/Brake Fluid**—automobile and other antifreeze mixtures based on ethylene or propylene glycol; also brake and other automotive fluids (except motor oil).
NR	101	**Medical Waste**—wastes related to medical activities, including syringes, intravenous (I.V.) tubing, bandages, and other wastes.
LR	102	**Pharmaceuticals and Vitamins**—means both prescription and over-the-counter medications and supplements in all forms, including pills, liquid medications, creams, and ointments. **Does not include containers for these items, except for tubes for creams and ointments and other containers that cannot be easily separated from the product they contain.**
RR	103	**Compact Fluorescent Bulbs**—all compact fluorescent bulbs.
RR	104	**Other Fluorescent Bulbs and Tubes**—includes other fluorescent lighting and fluorescent tube lighting.
NR	105	**Other Hazardous Waste**—asbestos-containing wastes if this is the primary hazard associated with the waste; gunpowder, unspent ammunition, picric acid and other potentially explosive chemicals; radioactive materials (but smoke alarms are classified as "other plastic"); items that contain mercury, such as thermometers, thermostats, jewelry and mercury switches (**excludes batteries**); and other hazardous wastes that do **not** fit into the above categories.

Appendix C. Waste Composition Calculation

Estimating Waste Composition

Waste composition estimates were calculated using a method that gave equal weighting or "importance" to each sample within a given stratum. Confidence intervals (error ranges) were calculated based on assumptions of normality in the composition estimates.

In the descriptions of calculation methods, these variables are used frequently:

- *i* denotes an individual sample;
- *j* denotes the material type;
- c_j is the weight of the material type *j* in a sample;
- *w* is the weight of an entire sample;
- r_j is the composition estimate for material *j* (*r* stands for *ratio*);
- *s* denotes a particular stream or substream of the waste stream; and
- *n* denotes the number of samples in the particular group being analyzed at that step.

Estimating the Composition

For a given stratum (that is, for the samples belonging to the same generator type collected by the same hauler type), the composition estimate denoted by r_j represents the ratio of the component's weight to the total weight of all the samples in the stratum. This estimate was 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; and
- 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 *yard waste* are shown.

	Sample 1	Sample 2	Sample 3
Weight (*c*) of *yard waste* (in lbs.)	5	3	4
Total Sample Weight (*w*) (in lbs.)	80	70	90

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

To find the composition estimate for the component *yard waste*, 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%. In other words, 5% of the sampled material, by weight, is *yard waste.* This finding is then projected onto the stratum being examined in this step of the analysis.

The confidence interval for this estimate was derived in two steps. First, the variance around the estimate was 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, refer to *Sampling Techniques, 3rd Edition* by William G. Cochran [John Wiley & Sons, Inc., 1977].)

Second, precision levels at the 90% confidence level were calculated for a component's mean:

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

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

Composition results for strata were then combined, using a weighted averaging method, to estimate the composition of larger portions of the disposed waste stream. For example, the commercially collected residential substream was combined with the commercially collected nonresidential substream to estimate the composition for King County's commercially collected disposed waste stream. The relative tonnages associated with each stratum served as the weighting factors. The calculation was performed as follows:

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

where:

- *p* = the proportion of tonnage contributed by the noted waste stratum (the weighting factor);
- *r* = ratio of component weight to total waste weight in the noted waste stratum (the composition percent for the given material component); and
- 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 *yard waste*	5%	10%	10%
Tonnage	25,000	100,000	50,000
Proportion of tonnage (*p*)	14.3%	57.1%	28.6%

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

$$O_{Carpet} = (0.143 * 0.05) + (0.571 * 0.10) + (0.286 * 0.10) = 0.093 = 9.3\%$$

Therefore, 9.3% of this examined portion of the disposed waste stream is *yard waste*.

The variance of the weighted average was calculated as follows:

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

Composition results for all substreams were combined, using a weighted averaging method, to estimate the composition of King County's entire disposed waste stream. The relative tonnages associated with each substream served as the weighting factors. The calculation was 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 sector (the weighting factor);
- *r* = ratio of component weight to total waste weight in the noted waste sector (the composition percent for the given material component); and
- for *j* = 1 to *m*, where *m* = number of material components.

The following scenario illustrates the above equation. This example involves the component *yard waste* in three waste sectors.

	Substream 1	**Substream 2**	**Substream 3**
Ratio of *yard waste* (*r*)	0.05	0.10	0.15
Proportion of Tonnage (*p*)	50%	25%	25%

$$O_{Carpet} = (0.50 * 0.05) + (0.25 * 0.10) + (0.25 * 0.15) = 0.0875$$

So, it is estimated that 0.0875 or 8.75% of the entire disposed waste stream is composed of *yard waste*.

The variance of the weighted average was 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 D. Detailed Waste Composition Results

This appendix contains the detailed composition tables for all substreams. The detailed composition tables show the mean, error range, and tons for each material type as well as the substream tonnage and number of samples. In addition, this appendix contains the pie charts and top ten tables for the commercially collected single-family and multifamily residential substreams. All quantity data is presented in annual tons unless noted otherwise.

Means and Error Ranges

The data from the sorting process were treated with a statistical procedure that provided two kinds of information for each of the *material types*:

- The percent-by-weight estimated composition of waste, represented by the samples examined in the study; and
- The degree of precision of the composition estimates.

All estimates of precision were calculated at the 90% confidence level. The equations used in these calculations appear in *Appendix C. Waste Composition Calculation*. The example below illustrates how the results can be interpreted. In this example, the best estimate of the amount of *furniture* present in the universe of waste sampled is 7.3%. The figure 0.7% reflects the precision of the estimate. When calculations are performed at the 90% confidence level, we are 90% certain that the true amount of *furniture* is between 7.3% plus 0.7% and 7.3% minus 0.7%. In other words, we are 90% certain that the mean lies between 6.6% and 8.0%.

Error Range (+/-)

The error range is a measure of the spread of values in a collection of data. For instance, if the quantities of *furniture* were found to be nearly the same in each of the 451 samples collected for this study, the result would be a very narrow error range. By contrast, if some samples were composed of 75% *furniture* and others were 0% *furniture,* the results would show a much broader error range.

Another way to interpret the 90% confidence interval is this: If King County completed this study 100 times, in 90 of those times, the *furniture* mean composition would fall between 6.6 and 8.0 percent.

Material Type	Estimated Percent	+ / -
Furniture	7.3%	0.7%

Table 43. Detailed Composition, Overall Disposed Waste, 2019 Tons

Material	Estimated Percent	+/-	Estimated Tons
PAPER	**17.7%**	**0.9%**	**153,518**
Newspaper (ONP)	0.3%	0.1%	2,721
Plain Corrugated Cardboard (OCC)	3.6%	0.4%	31,430
Waxed Corrugated Cardboard (OCC)	0.3%	0.2%	2,430
Low-Grade Recyclable Paper	5.9%	0.4%	51,508
High-Grade Paper	0.5%	0.1%	4,162
Single-Use Food Service Compostable	1.0%	0.2%	8,582
Other Compostable Paper	4.5%	0.4%	39,483
Other Paper	1.5%	0.4%	13,201
PLASTIC	**14.0%**	**0.7%**	**121,922**
PET Bottles	0.7%	0.1%	6,354
Other PET Containers	0.4%	0.0%	3,234
HDPE Bottles	0.4%	0.0%	3,568
Other HDPE Containers	0.2%	0.1%	1,786
#3 Packaging	0.0%	0.0%	144
#4 Packaging	0.0%	0.0%	92
#5 Packaging	0.7%	0.1%	6,378
Other #6 Packaging (non-EPS)	0.2%	0.0%	1,777
Other #7 Packaging (non-compostable/non-PLA)	0.1%	0.0%	489
Compostable Plastics	0.1%	0.0%	830
EPS Single-Serve Food Packaging	0.3%	0.0%	2,247
Other EPS Packaging	0.3%	0.1%	2,299
EPS Products	0.0%	0.0%	231
Recyclable Plastic Bags	0.4%	0.1%	3,533
Non-Industrial Packaging Film Plastic	3.4%	0.3%	29,718
Industrial Packaging Film Plastic	0.8%	0.2%	6,787
Plastic Garbage Bags	2.0%	0.2%	17,455
Plastic Film Products	0.1%	0.0%	777
Other Plastic Packaging	0.3%	0.0%	2,428
Single-Resin Plastic Products	2.0%	0.3%	17,718
Mixed-Resin Plastic Products	0.3%	0.1%	2,697
Foam Rubber and Padding	0.2%	0.1%	1,902
Carpet Padding	0.2%	0.2%	2,138
Plastic and Other Materials	0.8%	0.3%	7,338
FOOD	**15.6%**	**1.0%**	**135,762**
Fruits & Vegetables, Edible	2.0%	0.2%	17,502
Fruits & Vegetables, Non-edible	3.4%	0.4%	29,137
Homegrown Fruits & Vegetables	0.1%	0.2%	1,055
Meat, Edible	0.9%	0.1%	8,026
Meat, Non-edible	0.8%	0.1%	6,693
Mixed/Other Food Waste, Edible	4.1%	0.4%	35,190
Mixed/Other Food Waste, Non-edible	4.2%	0.6%	36,094
Other Compostables	0.2%	0.2%	2,066
WOOD/YARD	**14.8%**	**1.5%**	**128,184**
Dimensional Lumber/Engr. Wood	7.0%	1.0%	61,002
Treated Wood	0.6%	0.3%	5,163
Contaminated Wood	1.9%	0.4%	16,844
Roofing and Siding Wood	0.1%	0.1%	692
Stumps	0.2%	0.2%	1,854
Large Prunings	0.4%	0.3%	3,266
Yard Waste	2.5%	0.8%	21,883
Other Wood	2.0%	0.5%	17,480
OTHER ORGANICS	**14.8%**	**1.1%**	**128,265**
Textiles: Clothes & Other Recy.	2.8%	0.5%	24,631
Other Textiles	1.4%	0.2%	11,835
Disposable Diapers	5.3%	0.5%	45,800
Rubber Products	1.0%	0.6%	8,343
Tires	0.1%	0.1%	895
Animal Carcasses	0.0%	0.0%	114
Animal Feces	3.9%	0.7%	33,997
Miscellaneous Organics	0.3%	0.1%	2,650
METAL	**5.9%**	**0.6%**	**51,604**
Aluminum Cans	0.3%	0.0%	2,690
Other Aluminum	0.3%	0.1%	2,973
Tinned Food Cans	0.3%	0.0%	3,029
Other Ferrous	2.3%	0.5%	20,056
Other Non-Ferrous	0.1%	0.1%	993
Mixed Metals (>80% metal, <20% non-meta	1.7%	0.3%	14,353
Other Mixed Metals (>20% non-metal)	0.8%	0.2%	7,285
Compressed Gas Cylinders	0.0%	0.0%	225
GLASS	**2.2%**	**0.4%**	**18,732**
Clear Glass Containers	0.8%	0.1%	6,822
Green Glass Containers	0.2%	0.1%	1,978
Brown Glass Containers	0.3%	0.0%	2,220
Kitchenware/Ceramics	0.3%	0.1%	2,744
Other Glass	0.6%	0.3%	4,968
ELECTRONICS	**0.7%**	**0.2%**	**6,178**
Small Household Appliances	0.3%	0.1%	3,035
A/V Equipment	0.1%	0.1%	746
Printers/Copiers/Fax Machines	0.0%	0.0%	372
CPUs	0.1%	0.1%	530
Computer Peripherals	0.0%	0.0%	146
CRT Computer Monitors & TVs	0.1%	0.1%	443
Other Computer Monitors & TVs (LCDs, etc	0.0%	0.0%	-
Laptops	0.0%	0.0%	95
Cell Phones	0.0%	0.0%	28
Tablets	0.0%	0.0%	-
Other Electronics	0.1%	0.0%	783
OTHER WASTES	**12.8%**	**1.3%**	**110,973**
C&D Wastes (except wood)	4.0%	0.8%	35,118
Asphalt Shingles	0.5%	0.3%	4,451
Ash	0.1%	0.0%	444
Nondistinct Fines	1.7%	0.4%	15,161
Gypsum Wallboard	1.2%	0.4%	10,040
Furniture	2.0%	0.7%	17,488
Mattresses	1.2%	0.5%	10,303
Carpet	0.9%	0.5%	7,976
Miscellaneous Inorganics	1.2%	0.2%	9,992
HHW/SPECIAL	**1.5%**	**0.5%**	**13,394**
Used Oil	0.0%	0.0%	155
Vehicle Batteries	0.0%	0.0%	48
Household Batteries	0.1%	0.0%	457
Latex Paint	0.3%	0.1%	2,200
Oil-based Paint	0.0%	0.0%	79
Solvents and Thinners	0.0%	0.0%	90
Adhesives and Glue	0.1%	0.1%	1,144
Cleaners and Corrosives	0.0%	0.0%	258
Pesticides and Herbicides	0.0%	0.0%	86
Gasoline and Fuel Oil	0.0%	0.0%	154
Antifreeze/Brake Fluid	0.0%	0.0%	33
Medical Waste	0.8%	0.5%	7,196
Pharmaceuticals and Vitamins	0.0%	0.0%	281
Compact Fluorescent Bulbs	0.0%	0.0%	70
Other Fluorescent Bulbs/Tubes	0.0%	0.0%	13
Other Hazardous Waste	0.1%	0.1%	1,129
Estimated Total	**100%**		**868,532**
Sample Count			**451**
Composition by Recoverability			
Readily Recyclable	62.3%	1.6%	541,166
Limited Recyclability	9.3%	1.0%	81,104
Not Recyclable	28.4%	1.5%	246,262
Estimated Total	**100.0%**		**868,532**

Confidence intervals calculated at the 90% confidence level. Percentages for material types may not total 100% due to rounding.

Table 44. Detailed Composition, Residential Substreams, 2019 Tons

Material	Estimated Percent	+/-	Estimated Tons
PAPER	**13.7%**	**0.9%**	**66,221**
Newspaper (ONP)	0.3%	0.1%	1,588
Plain Corrugated Cardboard (OCC)	2.9%	0.4%	13,843
Waxed Corrugated Cardboard (OCC)	0.0%	0.0%	37
Low-Grade Recyclable Paper	4.8%	0.4%	23,434
High-Grade Paper	0.2%	0.1%	848
Single-Use Food Service Compostable	0.6%	0.1%	3,074
Other Compostable Paper	3.8%	0.4%	18,470
Other Paper	1.0%	0.3%	4,926
PLASTIC	**11.8%**	**0.8%**	**56,862**
PET Bottles	0.6%	0.1%	3,020
Other PET Containers	0.3%	0.0%	1,566
HDPE Bottles	0.4%	0.0%	1,930
Other HDPE Containers	0.2%	0.0%	756
#3 Packaging	0.0%	0.0%	81
#4 Packaging	0.0%	0.0%	89
#5 Packaging	0.7%	0.1%	3,323
Other #6 Packaging (non-EPS)	0.1%	0.0%	715
Other #7 Packaging (non-compostable/non-PLA)	0.0%	0.0%	226
Compostable Plastics	0.0%	0.0%	182
EPS Single-Serve Food Packaging	0.3%	0.0%	1,275
Other EPS Packaging	0.2%	0.0%	791
EPS Products	0.0%	0.0%	163
Recyclable Plastic Bags	0.4%	0.0%	1,851
Non-Industrial Packaging Film Plastic	2.8%	0.2%	13,435
Industrial Packaging Film Plastic	0.2%	0.1%	1,065
Plastic Garbage Bags	1.4%	0.1%	6,779
Plastic Film Products	0.1%	0.1%	666
Other Plastic Packaging	0.2%	0.0%	1,177
Single-Resin Plastic Products	2.1%	0.4%	9,929
Mixed-Resin Plastic Products	0.2%	0.1%	1,091
Foam Rubber and Padding	0.2%	0.2%	1,144
Carpet Padding	0.3%	0.2%	1,396
Plastic and Other Materials	0.9%	0.4%	4,211
FOOD	**14.8%**	**1.0%**	**71,732**
Fruits & Vegetables, Edible	2.3%	0.4%	11,124
Fruits & Vegetables, Non-edible	3.4%	0.5%	16,666
Homegrown Fruits & Vegetables	0.0%	0.0%	138
Meat, Edible	1.0%	0.1%	4,814
Meat, Non-edible	0.8%	0.2%	3,686
Mixed/Other Food Waste, Edible	3.8%	0.4%	18,322
Mixed/Other Food Waste, Non-edible	3.4%	0.5%	16,546
Other Compostables	0.1%	0.1%	437
WOOD/YARD	**17.8%**	**2.1%**	**86,143**
Dimensional Lumber/Engr. Wood	8.4%	1.4%	40,511
Treated Wood	0.9%	0.5%	4,590
Contaminated Wood	2.1%	0.6%	10,367
Roofing and Siding Wood	0.1%	0.2%	692
Stumps	0.4%	0.4%	1,714
Large Prunings	0.6%	0.4%	2,685
Yard Waste	2.5%	0.9%	12,121
Other Wood	2.8%	0.7%	13,463
OTHER ORGANICS	**17.0%**	**1.3%**	**81,966**
Textiles: Clothes & Other Recy.	2.8%	0.5%	13,414
Other Textiles	1.5%	0.3%	7,199
Disposable Diapers	6.3%	0.6%	30,505
Rubber Products	0.4%	0.1%	1,929
Tires	0.1%	0.1%	466
Animal Carcasses	0.0%	0.0%	111
Animal Feces	5.5%	1.0%	26,461
Miscellaneous Organics	0.4%	0.1%	1,880

Material	Estimated Percent	+/-	Estimated Tons
METAL	**6.2%**	**0.8%**	**30,108**
Aluminum Cans	0.2%	0.0%	1,098
Other Aluminum	0.4%	0.1%	1,729
Tinned Food Cans	0.3%	0.0%	1,674
Other Ferrous	2.4%	0.5%	11,360
Other Non-Ferrous	0.1%	0.1%	721
Mixed Metals (>80% metal, <20% non-meta	1.8%	0.4%	8,830
Other Mixed Metals (>20% non-metal)	1.0%	0.2%	4,620
Compressed Gas Cylinders	0.0%	0.0%	77
GLASS	**2.0%**	**0.3%**	**9,523**
Clear Glass Containers	0.8%	0.1%	3,746
Green Glass Containers	0.2%	0.1%	1,089
Brown Glass Containers	0.3%	0.1%	1,300
Kitchenware/Ceramics	0.3%	0.1%	1,376
Other Glass	0.4%	0.2%	2,013
ELECTRONICS	**0.8%**	**0.3%**	**4,002**
Small Household Appliances	0.5%	0.2%	2,211
A/V Equipment	0.1%	0.1%	575
Printers/Copiers/Fax Machines	0.1%	0.1%	372
CPUs	0.1%	0.1%	362
Computer Peripherals	0.0%	0.0%	63
CRT Computer Monitors & TVs	0.0%	0.0%	46
Other Computer Monitors & TVs (LCDs, etc	0.0%	0.0%	-
Laptops	0.0%	0.0%	57
Cell Phones	0.0%	0.0%	21
Tablets	0.0%	0.0%	-
Other Electronics	0.1%	0.0%	294
OTHER WASTES	**14.9%**	**1.8%**	**72,139**
C&D Wastes (except wood)	4.5%	1.0%	21,590
Asphalt Shingles	0.8%	0.5%	3,652
Ash	0.1%	0.1%	428
Nondistinct Fines	1.6%	0.5%	7,599
Gypsum Wallboard	1.7%	0.6%	8,108
Furniture	2.5%	1.1%	12,239
Mattresses	1.8%	0.9%	8,776
Carpet	1.2%	0.7%	5,639
Miscellaneous Inorganics	0.9%	0.2%	4,109
HHW/SPECIAL	**0.9%**	**0.3%**	**4,565**
Used Oil	0.0%	0.0%	130
Vehicle Batteries	0.0%	0.0%	2
Household Batteries	0.0%	0.0%	174
Latex Paint	0.2%	0.1%	980
Oil-based Paint	0.0%	0.0%	62
Solvents and Thinners	0.0%	0.0%	64
Adhesives and Glue	0.2%	0.1%	922
Cleaners and Corrosives	0.0%	0.0%	176
Pesticides and Herbicides	0.0%	0.0%	86
Gasoline and Fuel Oil	0.0%	0.0%	133
Antifreeze/Brake Fluid	0.0%	0.0%	33
Medical Waste	0.3%	0.3%	1,268
Pharmaceuticals and Vitamins	0.0%	0.0%	204
Compact Fluorescent Bulbs	0.0%	0.0%	60
Other Fluorescent Bulbs/Tubes	0.0%	0.0%	3
Other Hazardous Waste	0.1%	0.0%	268

Estimated Total	**100%**		**483,262**
Sample Count			**279**
Composition by Recoverability			
Readily Recyclable	59.0%	2.0%	285,066
Limited Recyclability	11.7%	1.7%	56,697
Not Recyclable	29.3%	1.7%	141,499
Estimated Total	**100.0%**		**483,262**

Confidence intervals calculated at the 90% confidence level. Percentages for material types may not total 100% due to rounding.

Table 45. Detailed Composition, Nonresidential Substreams, 2019 Tons

Material	Estimated Percent	+/-	Estimated Tons
PAPER	**22.7%**	**1.8%**	**87,298**
Newspaper (ONP)	0.3%	0.1%	1,133
Plain Corrugated Cardboard (OCC)	4.6%	0.8%	17,587
Waxed Corrugated Cardboard (OCC)	0.6%	0.5%	2,394
Low-Grade Recyclable Paper	7.3%	0.8%	28,074
High-Grade Paper	0.9%	0.3%	3,314
Single-Use Food Service Compostable	1.4%	0.3%	5,508
Other Compostable Paper	5.5%	0.7%	21,013
Other Paper	2.1%	0.8%	8,275
PLASTIC	**16.9%**	**1.3%**	**65,060**
PET Bottles	0.9%	0.1%	3,334
Other PET Containers	0.4%	0.1%	1,667
HDPE Bottles	0.4%	0.1%	1,638
Other HDPE Containers	0.3%	0.1%	1,030
#3 Packaging	0.0%	0.0%	63
#4 Packaging	0.0%	0.0%	4
#5 Packaging	0.8%	0.1%	3,056
Other #6 Packaging (non-EPS)	0.3%	0.1%	1,062
Other #7 Packaging (non-compostable/non-PLA)	0.1%	0.0%	263
Compostable Plastics	0.2%	0.1%	649
EPS Single-Serve Food Packaging	0.3%	0.0%	972
Other EPS Packaging	0.4%	0.2%	1,507
EPS Products	0.0%	0.0%	68
Recyclable Plastic Bags	0.4%	0.1%	1,682
Non-Industrial Packaging Film Plastic	4.2%	0.6%	16,283
Industrial Packaging Film Plastic	1.5%	0.5%	5,722
Plastic Garbage Bags	2.8%	0.3%	10,676
Plastic Film Products	0.0%	0.0%	111
Other Plastic Packaging	0.3%	0.0%	1,250
Single-Resin Plastic Products	2.0%	0.5%	7,790
Mixed-Resin Plastic Products	0.4%	0.2%	1,606
Foam Rubber and Padding	0.2%	0.3%	758
Carpet Padding	0.2%	0.2%	742
Plastic and Other Materials	0.8%	0.4%	3,128
FOOD	**16.6%**	**1.8%**	**64,030**
Fruits & Vegetables, Edible	1.7%	0.3%	6,377
Fruits & Vegetables, Non-edible	3.2%	0.6%	12,471
Homegrown Fruits & Vegetables	0.2%	0.4%	917
Meat, Edible	0.8%	0.3%	3,213
Meat, Non-edible	0.8%	0.2%	3,007
Mixed/Other Food Waste, Edible	4.4%	0.8%	16,868
Mixed/Other Food Waste, Non-edible	5.1%	1.2%	19,548
Other Compostables	0.4%	0.4%	1,629
WOOD/YARD	**10.9%**	**2.2%**	**42,041**
Dimensional Lumber/Engr. Wood	5.3%	1.5%	20,491
Treated Wood	0.1%	0.1%	573
Contaminated Wood	1.7%	0.6%	6,478
Roofing and Siding Wood	0.0%	0.0%	-
Stumps	0.0%	0.1%	140
Large Prunings	0.2%	0.2%	580
Yard Waste	2.5%	1.3%	9,762
Other Wood	1.0%	0.6%	4,017
OTHER ORGANICS	**12.0%**	**1.9%**	**46,300**
Textiles: Clothes & Other Recy.	2.9%	0.8%	11,217
Other Textiles	1.2%	0.3%	4,636
Disposable Diapers	4.0%	0.8%	15,295
Rubber Products	1.7%	1.3%	6,414
Tires	0.1%	0.1%	430
Animal Carcasses	0.0%	0.0%	4
Animal Feces	2.0%	0.8%	7,536
Miscellaneous Organics	0.2%	0.1%	770
METAL	**5.6%**	**1.0%**	**21,496**
Aluminum Cans	0.4%	0.1%	1,592
Other Aluminum	0.3%	0.1%	1,244
Tinned Food Cans	0.4%	0.1%	1,355
Other Ferrous	2.3%	0.8%	8,696
Other Non-Ferrous	0.1%	0.0%	272
Mixed Metals (>80% metal, <20% non-meta	1.4%	0.5%	5,523
Other Mixed Metals (>20% non-metal)	0.7%	0.3%	2,665
Compressed Gas Cylinders	0.0%	0.0%	149
GLASS	**2.4%**	**0.7%**	**9,209**
Clear Glass Containers	0.8%	0.2%	3,076
Green Glass Containers	0.2%	0.1%	888
Brown Glass Containers	0.2%	0.1%	921
Kitchenware/Ceramics	0.4%	0.2%	1,368
Other Glass	0.8%	0.7%	2,956
ELECTRONICS	**0.6%**	**0.3%**	**2,175**
Small Household Appliances	0.2%	0.2%	823
A/V Equipment	0.0%	0.0%	171
Printers/Copiers/Fax Machines	0.0%	0.0%	-
CPUs	0.0%	0.1%	168
Computer Peripherals	0.0%	0.0%	82
CRT Computer Monitors & TVs	0.1%	0.1%	397
Other Computer Monitors & TVs (LCDs, etc	0.0%	0.0%	-
Laptops	0.0%	0.0%	38
Cell Phones	0.0%	0.0%	6
Tablets	0.0%	0.0%	-
Other Electronics	0.1%	0.1%	489
OTHER WASTES	**10.1%**	**1.6%**	**38,834**
C&D Wastes (except wood)	3.5%	1.3%	13,528
Asphalt Shingles	0.2%	0.2%	800
Ash	0.0%	0.0%	16
Nondistinct Fines	2.0%	0.6%	7,562
Gypsum Wallboard	0.5%	0.3%	1,932
Furniture	1.4%	0.6%	5,250
Mattresses	0.4%	0.3%	1,526
Carpet	0.6%	0.6%	2,337
Miscellaneous Inorganics	1.5%	0.5%	5,883
HHW/SPECIAL	**2.3%**	**1.0%**	**8,829**
Used Oil	0.0%	0.0%	24
Vehicle Batteries	0.0%	0.0%	46
Household Batteries	0.1%	0.1%	283
Latex Paint	0.3%	0.2%	1,221
Oil-based Paint	0.0%	0.0%	17
Solvents and Thinners	0.0%	0.0%	26
Adhesives and Glue	0.1%	0.1%	222
Cleaners and Corrosives	0.0%	0.0%	82
Pesticides and Herbicides	0.0%	0.0%	-
Gasoline and Fuel Oil	0.0%	0.0%	21
Antifreeze/Brake Fluid	0.0%	0.0%	-
Medical Waste	1.5%	1.0%	5,928
Pharmaceuticals and Vitamins	0.0%	0.0%	77
Compact Fluorescent Bulbs	0.0%	0.0%	9
Other Fluorescent Bulbs/Tubes	0.0%	0.0%	10
Other Hazardous Waste	0.2%	0.3%	862
Estimated Total	**100%**		**385,270**
Sample Count			**172**
Composition by Recoverability			
Readily Recyclable	66.5%	2.7%	256,100
Limited Recyclability	6.3%	1.1%	24,407
Not Recyclable	27.2%	2.5%	104,763
Estimated Total	**100.0%**		**385,270**

Confidence intervals calculated at the 90% confidence level. Percentages for material types may not total 100% due to rounding.

Table 46. Detailed Composition, Commercially Collected Substreams, 2019 Tons

Material	Estimated Percent	+/-	Estimated Tons
PAPER	**20.8%**	**1.2%**	**141,711**
Newspaper (ONP)	0.4%	0.1%	2,453
Plain Corrugated Cardboard (OCC)	3.9%	0.5%	26,472
Waxed Corrugated Cardboard (OCC)	0.4%	0.3%	2,430
Low-Grade Recyclable Paper	7.0%	0.5%	47,839
High-Grade Paper	0.6%	0.2%	4,065
Single-Use Food Service Compostable	1.2%	0.2%	8,357
Other Compostable Paper	5.7%	0.5%	38,508
Other Paper	1.7%	0.5%	11,587
PLASTIC	**15.5%**	**0.8%**	**105,672**
PET Bottles	0.9%	0.1%	6,075
Other PET Containers	0.5%	0.1%	3,116
HDPE Bottles	0.5%	0.0%	3,346
Other HDPE Containers	0.2%	0.1%	1,601
#3 Packaging	0.0%	0.0%	139
#4 Packaging	0.0%	0.0%	92
#5 Packaging	0.8%	0.1%	5,774
Other #6 Packaging (non-EPS)	0.3%	0.0%	1,727
Other #7 Packaging (non-compostable/non-PLA)	0.1%	0.0%	477
Compostable Plastics	0.1%	0.0%	821
EPS Single-Serve Food Packaging	0.3%	0.0%	2,196
Other EPS Packaging	0.3%	0.1%	2,019
EPS Products	0.0%	0.0%	93
Recyclable Plastic Bags	0.5%	0.1%	3,431
Non-Industrial Packaging Film Plastic	4.2%	0.4%	28,591
Industrial Packaging Film Plastic	0.9%	0.3%	6,348
Plastic Garbage Bags	2.4%	0.2%	16,518
Plastic Film Products	0.0%	0.0%	332
Other Plastic Packaging	0.3%	0.0%	2,174
Single-Resin Plastic Products	1.8%	0.3%	12,201
Mixed-Resin Plastic Products	0.3%	0.1%	1,877
Foam Rubber and Padding	0.2%	0.2%	1,694
Carpet Padding	0.0%	0.0%	248
Plastic and Other Materials	0.7%	0.2%	4,783
FOOD	**19.2%**	**1.2%**	**130,282**
Fruits & Vegetables, Edible	2.5%	0.3%	16,927
Fruits & Vegetables, Non-edible	4.1%	0.5%	27,922
Homegrown Fruits & Vegetables	0.2%	0.2%	1,055
Meat, Edible	1.1%	0.2%	7,582
Meat, Non-edible	1.0%	0.2%	6,485
Mixed/Other Food Waste, Edible	4.9%	0.6%	33,539
Mixed/Other Food Waste, Non-edible	5.1%	0.7%	34,715
Other Compostables	0.3%	0.3%	2,057
WOOD/YARD	**9.3%**	**1.6%**	**63,184**
Dimensional Lumber/Engr. Wood	4.4%	1.1%	29,718
Treated Wood	0.1%	0.1%	657
Contaminated Wood	1.1%	0.4%	7,630
Roofing and Siding Wood	0.0%	0.0%	-
Stumps	0.1%	0.1%	368
Large Prunings	0.4%	0.3%	2,849
Yard Waste	2.6%	1.0%	17,866
Other Wood	0.6%	0.3%	4,096
OTHER ORGANICS	**17.4%**	**1.4%**	**118,081**
Textiles: Clothes & Other Recy.	3.1%	0.5%	21,096
Other Textiles	1.4%	0.3%	9,472
Disposable Diapers	6.6%	0.6%	44,997
Rubber Products	1.1%	0.8%	7,628
Tires	0.1%	0.1%	690
Animal Carcasses	0.0%	0.0%	60
Animal Feces	4.7%	0.8%	31,902
Miscellaneous Organics	0.3%	0.1%	2,237

Material	Estimated Percent	+/-	Estimated Tons
METAL	**4.9%**	**0.7%**	**33,578**
Aluminum Cans	0.4%	0.1%	2,575
Other Aluminum	0.4%	0.1%	2,595
Tinned Food Cans	0.4%	0.0%	2,878
Other Ferrous	1.9%	0.5%	13,009
Other Non-Ferrous	0.1%	0.0%	460
Mixed Metals (>80% metal, <20% non-meta	1.1%	0.3%	7,550
Other Mixed Metals (>20% non-metal)	0.6%	0.2%	4,326
Compressed Gas Cylinders	0.0%	0.0%	184
GLASS	**2.2%**	**0.4%**	**14,881**
Clear Glass Containers	0.9%	0.1%	6,284
Green Glass Containers	0.3%	0.1%	1,727
Brown Glass Containers	0.3%	0.0%	1,985
Kitchenware/Ceramics	0.3%	0.1%	2,174
Other Glass	0.4%	0.4%	2,710
ELECTRONICS	**0.6%**	**0.2%**	**3,808**
Small Household Appliances	0.3%	0.1%	1,797
A/V Equipment	0.0%	0.0%	257
Printers/Copiers/Fax Machines	0.0%	0.0%	-
CPUs	0.1%	0.1%	530
Computer Peripherals	0.0%	0.0%	127
CRT Computer Monitors & TVs	0.1%	0.1%	397
Other Computer Monitors & TVs (LCDs, etc	0.0%	0.0%	-
Laptops	0.0%	0.0%	95
Cell Phones	0.0%	0.0%	25
Tablets	0.0%	0.0%	-
Other Electronics	0.1%	0.0%	580
OTHER WASTES	**8.4%**	**1.3%**	**56,812**
C&D Wastes (except wood)	2.7%	0.9%	18,484
Asphalt Shingles	0.2%	0.1%	1,132
Ash	0.0%	0.0%	266
Nondistinct Fines	2.0%	0.5%	13,287
Gypsum Wallboard	0.3%	0.2%	2,196
Furniture	0.9%	0.6%	6,447
Mattresses	0.3%	0.3%	1,948
Carpet	0.5%	0.4%	3,564
Miscellaneous Inorganics	1.4%	0.3%	9,488
HHW/SPECIAL	**1.8%**	**0.6%**	**12,110**
Used Oil	0.0%	0.0%	138
Vehicle Batteries	0.0%	0.0%	48
Household Batteries	0.1%	0.0%	414
Latex Paint	0.2%	0.1%	1,560
Oil-based Paint	0.0%	0.0%	75
Solvents and Thinners	0.0%	0.0%	26
Adhesives and Glue	0.1%	0.1%	964
Cleaners and Corrosives	0.0%	0.0%	230
Pesticides and Herbicides	0.0%	0.0%	81
Gasoline and Fuel Oil	0.0%	0.0%	21
Antifreeze/Brake Fluid	0.0%	0.0%	33
Medical Waste	1.1%	0.6%	7,183
Pharmaceuticals and Vitamins	0.0%	0.0%	231
Compact Fluorescent Bulbs	0.0%	0.0%	67
Other Fluorescent Bulbs/Tubes	0.0%	0.0%	13
Other Hazardous Waste	0.2%	0.1%	1,028

Estimated Total	**100%**		**680,118**
Sample Count			**270**
Composition by Recoverability			
Readily Recyclable	66.4%	1.8%	451,806
Limited Recyclability	4.8%	0.9%	32,692
Not Recyclable	28.8%	1.7%	195,621
Estimated Total	**100.0%**		**680,118**

Confidence intervals calculated at the 90% confidence level. Percentages for material types may not total 100% due to rounding.

Table 47. Detailed Composition, Commercially Collected Residential Substream, 2019 Tons

Material	Estimated Percent	+/-	Estimated Tons
PAPER	**17.6%**	**1.2%**	**54,654**
Newspaper (ONP)	0.4%	0.2%	1,321
Plain Corrugated Cardboard (OCC)	2.9%	0.6%	9,068
Waxed Corrugated Cardboard (OCC)	0.0%	0.0%	37
Low-Grade Recyclable Paper	6.4%	0.6%	19,801
High-Grade Paper	0.2%	0.1%	751
Single-Use Food Service Compostable	0.9%	0.2%	2,849
Other Compostable Paper	5.6%	0.6%	17,495
Other Paper	1.1%	0.3%	3,331
PLASTIC	**13.6%**	**0.8%**	**42,137**
PET Bottles	0.9%	0.1%	2,743
Other PET Containers	0.5%	0.0%	1,450
HDPE Bottles	0.6%	0.1%	1,709
Other HDPE Containers	0.2%	0.1%	597
#3 Packaging	0.0%	0.0%	76
#4 Packaging	0.0%	0.0%	88
#5 Packaging	0.9%	0.1%	2,721
Other #6 Packaging (non-EPS)	0.2%	0.0%	665
Other #7 Packaging (non-compostable/non-PLA)	0.1%	0.0%	214
Compostable Plastics	0.1%	0.0%	172
EPS Single-Serve Food Packaging	0.4%	0.0%	1,224
Other EPS Packaging	0.2%	0.0%	529
EPS Products	0.0%	0.0%	26
Recyclable Plastic Bags	0.6%	0.1%	1,750
Non-Industrial Packaging Film Plastic	4.0%	0.4%	12,331
Industrial Packaging Film Plastic	0.2%	0.1%	644
Plastic Garbage Bags	1.9%	0.2%	5,864
Plastic Film Products	0.1%	0.0%	221
Other Plastic Packaging	0.3%	0.0%	932
Single-Resin Plastic Products	1.6%	0.4%	5,101
Mixed-Resin Plastic Products	0.1%	0.1%	414
Foam Rubber and Padding	0.3%	0.3%	936
Carpet Padding	0.0%	0.0%	35
Plastic and Other Materials	0.5%	0.2%	1,695
FOOD	**21.3%**	**1.5%**	**66,262**
Fruits & Vegetables, Edible	3.4%	0.5%	10,556
Fruits & Vegetables, Non-edible	5.0%	0.8%	15,450
Homegrown Fruits & Vegetables	0.0%	0.1%	138
Meat, Edible	1.4%	0.2%	4,369
Meat, Non-edible	1.1%	0.3%	3,479
Mixed/Other Food Waste, Edible	5.4%	0.6%	16,671
Mixed/Other Food Waste, Non-edible	4.9%	0.7%	15,170
Other Compostables	0.1%	0.1%	429
WOOD/YARD	**8.3%**	**2.4%**	**25,801**
Dimensional Lumber/Engr. Wood	3.6%	1.4%	11,230
Treated Wood	0.1%	0.1%	453
Contaminated Wood	0.7%	0.4%	2,042
Roofing and Siding Wood	0.0%	0.0%	-
Stumps	0.1%	0.1%	228
Large Prunings	0.7%	0.7%	2,269
Yard Waste	2.6%	1.3%	8,157
Other Wood	0.5%	0.2%	1,422
OTHER ORGANICS	**23.2%**	**1.9%**	**72,106**
Textiles: Clothes & Other Recy.	3.2%	0.6%	10,022
Other Textiles	1.6%	0.4%	4,995
Disposable Diapers	9.6%	1.0%	29,702
Rubber Products	0.4%	0.2%	1,234
Tires	0.1%	0.1%	262
Animal Carcasses	0.0%	0.0%	56
Animal Feces	7.8%	1.5%	24,366
Miscellaneous Organics	0.5%	0.1%	1,469

Material	Estimated Percent	+/-	Estimated Tons
METAL	**4.3%**	**0.8%**	**13,440**
Aluminum Cans	0.3%	0.0%	984
Other Aluminum	0.5%	0.1%	1,418
Tinned Food Cans	0.5%	0.1%	1,523
Other Ferrous	1.6%	0.6%	4,998
Other Non-Ferrous	0.1%	0.0%	215
Mixed Metals (>80% metal, <20% non-meta	0.8%	0.3%	2,594
Other Mixed Metals (>20% non-metal)	0.5%	0.2%	1,673
Compressed Gas Cylinders	0.0%	0.0%	36
GLASS	**2.0%**	**0.3%**	**6,338**
Clear Glass Containers	1.0%	0.2%	3,208
Green Glass Containers	0.3%	0.1%	840
Brown Glass Containers	0.3%	0.1%	1,065
Kitchenware/Ceramics	0.3%	0.1%	822
Other Glass	0.1%	0.0%	404
ELECTRONICS	**0.5%**	**0.3%**	**1,695**
Small Household Appliances	0.3%	0.2%	1,020
A/V Equipment	0.0%	0.0%	97
Printers/Copiers/Fax Machines	0.0%	0.0%	-
CPUs	0.1%	0.2%	362
Computer Peripherals	0.0%	0.0%	44
CRT Computer Monitors & TVs	0.0%	0.0%	-
Other Computer Monitors & TVs (LCDs, etc	0.0%	0.0%	-
Laptops	0.0%	0.0%	57
Cell Phones	0.0%	0.0%	19
Tablets	0.0%	0.0%	-
Other Electronics	0.0%	0.0%	95
OTHER WASTES	**8.0%**	**2.0%**	**24,850**
C&D Wastes (except wood)	2.0%	1.1%	6,287
Asphalt Shingles	0.1%	0.2%	335
Ash	0.1%	0.1%	250
Nondistinct Fines	1.9%	0.7%	5,780
Gypsum Wallboard	0.3%	0.2%	1,041
Furniture	1.0%	1.2%	3,122
Mattresses	0.6%	0.7%	1,746
Carpet	0.9%	0.8%	2,672
Miscellaneous Inorganics	1.2%	0.3%	3,616
HHW/SPECIAL	**1.1%**	**0.5%**	**3,359**
Used Oil	0.0%	0.0%	114
Vehicle Batteries	0.0%	0.0%	2
Household Batteries	0.0%	0.0%	131
Latex Paint	0.1%	0.1%	413
Oil-based Paint	0.0%	0.0%	58
Solvents and Thinners	0.0%	0.0%	-
Adhesives and Glue	0.2%	0.2%	746
Cleaners and Corrosives	0.0%	0.0%	148
Pesticides and Herbicides	0.0%	0.0%	81
Gasoline and Fuel Oil	0.0%	0.0%	-
Antifreeze/Brake Fluid	0.0%	0.0%	33
Medical Waste	0.4%	0.4%	1,255
Pharmaceuticals and Vitamins	0.0%	0.0%	153
Compact Fluorescent Bulbs	0.0%	0.0%	57
Other Fluorescent Bulbs/Tubes	0.0%	0.0%	2
Other Hazardous Waste	0.1%	0.0%	166

Estimated Total	**100%**		**310,640**
Sample Count			**114**
Composition by Recoverability			
Readily Recyclable	64.7%	2.3%	201,120
Limited Recyclability	4.9%	1.6%	15,074
Not Recyclable	30.4%	2.0%	94,446
Estimated Total	**100.0%**		**310,640**

Confidence intervals calculated at the 90% confidence level. Percentages for material types may not total 100% due to rounding.

Figure 32. Waste Recoverability, Commercially Collected Residential Substream, 2019

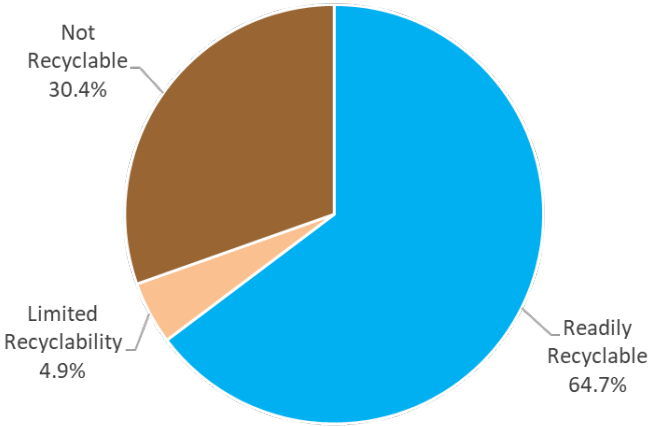


Figure 33. Waste Composition, Commercially Collected Residential Substream, 2019

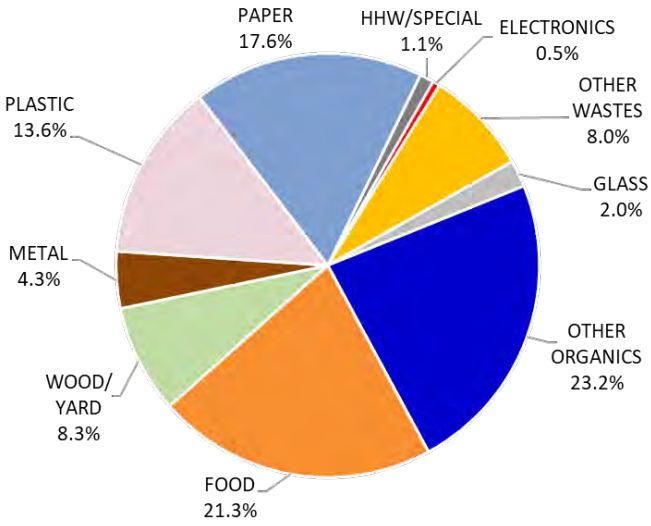


Table 48. Ten Most Prevalent Disposed Materials, Commercially Collected Residential Substream, 2019

Material	Est. Percent	Est. Tons
Disposable Diapers	9.6%	29,702
Animal Feces	7.8%	24,366
Low-Grade Recyclable Paper	6.4%	19,801
Other Compostable Paper	5.6%	17,495
Mixed/Other Food Waste, Edible	5.4%	16,671
Fruits & Vegetables, Non-edible	5.0%	15,450
Mixed/Other Food Waste, Non-edible	4.9%	15,170
Non-Industrial Packaging Film Plastic	4.0%	12,331
Dimensional Lumber/Engr. Wood	3.6%	11,230
Fruits & Vegetables, Edible	3.4%	10,556
Total for Top Materials	**55.6%**	**172,773**

Table 49. Detailed Composition, Commercially Collected Single-family Residential Substream, 2019 Tons

Material	Estimated Percent	+ / -	Estimated Tons
PAPER	**16.7%**	**1.4%**	**34,633**
Newspaper (ONP)	0.4%	0.2%	891
Plain Corrugated Cardboard (OCC)	2.6%	0.7%	5,472
Waxed Corrugated Cardboard (OCC)	0.0%	0.0%	37
Low-Grade Recyclable Paper	5.6%	0.6%	11,568
High-Grade Paper	0.2%	0.2%	508
Single-Use Food Service Compostable	0.9%	0.3%	1,930
Other Compostable Paper	5.9%	0.7%	12,323
Other Paper	0.9%	0.2%	1,904
PLASTIC	**13.6%**	**0.9%**	**28,325**
PET Bottles	0.7%	0.1%	1,436
Other PET Containers	0.5%	0.1%	995
HDPE Bottles	0.5%	0.1%	1,016
Other HDPE Containers	0.2%	0.1%	421
#3 Packaging	0.0%	0.0%	53
#4 Packaging	0.0%	0.0%	76
#5 Packaging	0.9%	0.1%	1,835
Other #6 Packaging (non-EPS)	0.2%	0.0%	441
Other #7 Packaging (non-compostable/non-PLA)	0.1%	0.0%	172
Compostable Plastics	0.1%	0.0%	106
EPS Single-Serve Food Packaging	0.4%	0.0%	815
Other EPS Packaging	0.2%	0.0%	361
EPS Products	0.0%	0.0%	23
Recyclable Plastic Bags	0.5%	0.1%	1,076
Non-Industrial Packaging Film Plastic	4.5%	0.5%	9,250
Industrial Packaging Film Plastic	0.2%	0.1%	434
Plastic Garbage Bags	2.0%	0.3%	4,163
Plastic Film Products	0.1%	0.1%	168
Other Plastic Packaging	0.3%	0.0%	569
Single-Resin Plastic Products	1.6%	0.5%	3,388
Mixed-Resin Plastic Products	0.1%	0.0%	167
Foam Rubber and Padding	0.2%	0.2%	510
Carpet Padding	0.0%	0.0%	-
Plastic and Other Materials	0.4%	0.2%	849
FOOD	**22.0%**	**1.9%**	**45,665**
Fruits & Vegetables, Edible	3.9%	0.8%	8,172
Fruits & Vegetables, Non-edible	4.7%	1.0%	9,793
Homegrown Fruits & Vegetables	0.1%	0.1%	138
Meat, Edible	1.5%	0.3%	3,088
Meat, Non-edible	1.2%	0.4%	2,445
Mixed/Other Food Waste, Edible	5.1%	0.8%	10,508
Mixed/Other Food Waste, Non-edible	5.4%	0.9%	11,135
Other Compostables	0.2%	0.2%	387
WOOD/YARD	**8.3%**	**3.2%**	**17,202**
Dimensional Lumber/Engr. Wood	3.8%	1.9%	7,912
Treated Wood	0.2%	0.2%	451
Contaminated Wood	0.3%	0.3%	632
Roofing and Siding Wood	0.0%	0.0%	-
Stumps	0.1%	0.2%	228
Large Prunings	0.8%	0.9%	1,608
Yard Waste	2.7%	1.8%	5,636
Other Wood	0.4%	0.2%	735
OTHER ORGANICS	**25.1%**	**2.5%**	**52,061**
Textiles: Clothes & Other Recy.	3.0%	0.8%	6,313
Other Textiles	1.2%	0.3%	2,583
Disposable Diapers	10.4%	1.3%	21,599
Rubber Products	0.5%	0.3%	1,013
Tires	0.1%	0.1%	262
Animal Carcasses	0.0%	0.0%	56
Animal Feces	9.3%	2.1%	19,236
Miscellaneous Organics	0.5%	0.2%	999
METAL	**4.4%**	**0.9%**	**9,100**
Aluminum Cans	0.2%	0.0%	495
Other Aluminum	0.5%	0.1%	1,006
Tinned Food Cans	0.4%	0.1%	901
Other Ferrous	1.6%	0.6%	3,262
Other Non-Ferrous	0.0%	0.0%	103
Mixed Metals (>80% metal, <20% non-meta	1.0%	0.4%	2,033
Other Mixed Metals (>20% non-metal)	0.6%	0.2%	1,264
Compressed Gas Cylinders	0.0%	0.0%	36
GLASS	**1.8%**	**0.3%**	**3,741**
Clear Glass Containers	0.8%	0.2%	1,635
Green Glass Containers	0.3%	0.1%	616
Brown Glass Containers	0.3%	0.1%	558
Kitchenware/Ceramics	0.3%	0.2%	645
Other Glass	0.1%	0.1%	288
ELECTRONICS	**0.3%**	**0.2%**	**605**
Small Household Appliances	0.2%	0.2%	382
A/V Equipment	0.0%	0.0%	91
Printers/Copiers/Fax Machines	0.0%	0.0%	-
CPUs	0.0%	0.0%	45
Computer Peripherals	0.0%	0.0%	18
CRT Computer Monitors & TVs	0.0%	0.0%	-
Other Computer Monitors & TVs (LCDs, etc	0.0%	0.0%	-
Laptops	0.0%	0.0%	-
Cell Phones	0.0%	0.0%	-
Tablets	0.0%	0.0%	-
Other Electronics	0.0%	0.0%	69
OTHER WASTES	**6.6%**	**1.9%**	**13,811**
C&D Wastes (except wood)	2.1%	1.2%	4,444
Asphalt Shingles	0.2%	0.2%	335
Ash	0.1%	0.1%	223
Nondistinct Fines	2.2%	1.0%	4,486
Gypsum Wallboard	0.2%	0.2%	465
Furniture	0.1%	0.2%	201
Mattresses	0.3%	0.5%	697
Carpet	0.3%	0.3%	539
Miscellaneous Inorganics	1.2%	0.3%	2,418
HHW/SPECIAL	**1.3%**	**0.7%**	**2,614**
Used Oil	0.1%	0.0%	114
Vehicle Batteries	0.0%	0.0%	1
Household Batteries	0.0%	0.0%	84
Latex Paint	0.2%	0.2%	413
Oil-based Paint	0.0%	0.0%	58
Solvents and Thinners	0.0%	0.0%	-
Adhesives and Glue	0.3%	0.3%	710
Cleaners and Corrosives	0.0%	0.0%	95
Pesticides and Herbicides	0.0%	0.1%	81
Gasoline and Fuel Oil	0.0%	0.0%	-
Antifreeze/Brake Fluid	0.0%	0.0%	-
Medical Waste	0.4%	0.6%	845
Pharmaceuticals and Vitamins	0.0%	0.0%	57
Compact Fluorescent Bulbs	0.0%	0.0%	49
Other Fluorescent Bulbs/Tubes	0.0%	0.0%	-
Other Hazardous Waste	0.1%	0.0%	109
Estimated Total	**100%**		**207,759**
Sample Count			**74**
Composition by Recoverability			
Readily Recyclable	64.0%	2.5%	132,862
Limited Recyclability	3.3%	0.8%	6,843
Not Recyclable	32.8%	2.5%	68,054
Estimated Total	**100.0%**		**207,759**

Confidence intervals calculated at the 90% confidence level. Percentages for material types may not total 100% due to rounding.

Figure 34. Waste Recoverability, Commercially Collected Single-family Residential Substream, 2019

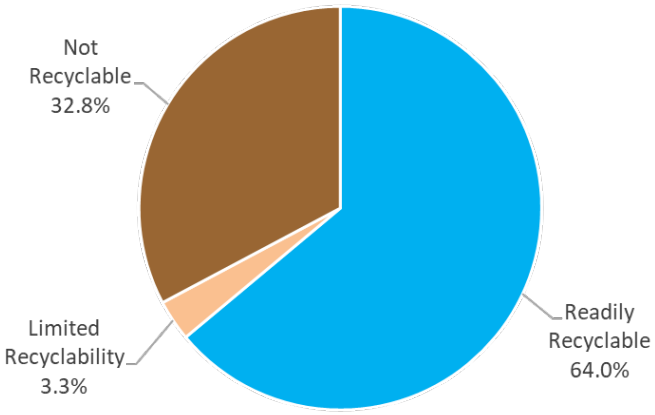


Figure 35. Waste Composition, Commercially Collected Single-family Residential Substream, 2019

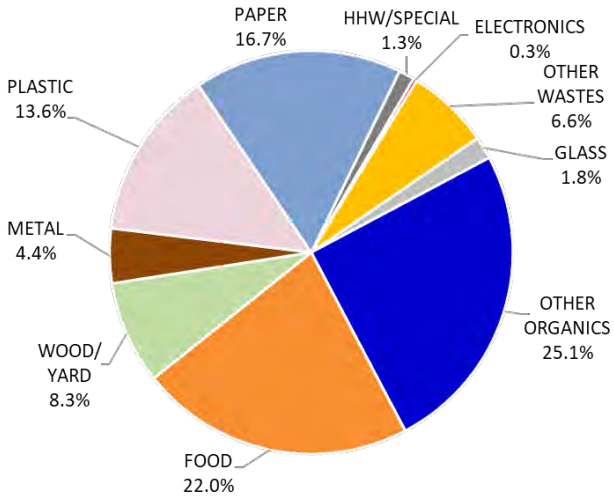


Table 50. Ten Most Prevalent Disposed Materials, Commercially Collected Single-family Residential Substream, 2019

Material	Est. Percent	Est. Tons
Disposable Diapers	10.4%	21,599
Animal Feces	9.3%	19,236
Other Compostable Paper	5.9%	12,323
Low-Grade Recyclable Paper	5.6%	11,568
Mixed/Other Food Waste, Non-edible	5.4%	11,135
Mixed/Other Food Waste, Edible	5.1%	10,508
Fruits & Vegetables, Non-edible	4.7%	9,793
Non-Industrial Packaging Film Plastic	4.5%	9,250
Fruits & Vegetables, Edible	3.9%	8,172
Dimensional Lumber/Engr. Wood	3.8%	7,912
Total for Top Materials	**58.5%**	**121,496**

Table 51. Detailed Composition, Commercially Collected Multifamily Residential Substream, 2019 Tons

Material	Estimated Percent	+ / -	Estimated Tons
PAPER	**19.5%**	**2.6%**	**20,020**
Newspaper (ONP)	0.4%	0.1%	430
Plain Corrugated Cardboard (OCC)	3.5%	0.9%	3,596
Waxed Corrugated Cardboard (OCC)	0.0%	0.0%	-
Low-Grade Recyclable Paper	8.0%	1.2%	8,233
High-Grade Paper	0.2%	0.1%	244
Single-Use Food Service Compostable	0.9%	0.3%	919
Other Compostable Paper	5.0%	1.0%	5,171
Other Paper	1.4%	0.9%	1,427
PLASTIC	**13.4%**	**1.8%**	**13,811**
PET Bottles	1.3%	0.2%	1,307
Other PET Containers	0.4%	0.1%	455
HDPE Bottles	0.7%	0.1%	693
Other HDPE Containers	0.2%	0.1%	176
#3 Packaging	0.0%	0.0%	23
#4 Packaging	0.0%	0.0%	12
#5 Packaging	0.9%	0.1%	887
Other #6 Packaging (non-EPS)	0.2%	0.0%	224
Other #7 Packaging (non-compostable/non-PLA)	0.0%	0.0%	42
Compostable Plastics	0.1%	0.0%	66
EPS Single-Serve Food Packaging	0.4%	0.1%	408
Other EPS Packaging	0.2%	0.0%	168
EPS Products	0.0%	0.0%	2
Recyclable Plastic Bags	0.7%	0.1%	673
Non-Industrial Packaging Film Plastic	3.0%	0.4%	3,081
Industrial Packaging Film Plastic	0.2%	0.2%	210
Plastic Garbage Bags	1.7%	0.3%	1,701
Plastic Film Products	0.1%	0.0%	52
Other Plastic Packaging	0.4%	0.1%	363
Single-Resin Plastic Products	1.7%	0.5%	1,713
Mixed-Resin Plastic Products	0.2%	0.2%	246
Foam Rubber and Padding	0.4%	0.6%	426
Carpet Padding	0.0%	0.1%	35
Plastic and Other Materials	0.8%	0.7%	846
FOOD	**20.0%**	**2.4%**	**20,596**
Fruits & Vegetables, Edible	2.3%	0.6%	2,385
Fruits & Vegetables, Non-edible	5.5%	1.2%	5,658
Homegrown Fruits & Vegetables	0.0%	0.0%	-
Meat, Edible	1.2%	0.4%	1,281
Meat, Non-edible	1.0%	0.2%	1,033
Mixed/Other Food Waste, Edible	6.0%	1.2%	6,163
Mixed/Other Food Waste, Non-edible	3.9%	1.0%	4,034
Other Compostables	0.0%	0.0%	42
WOOD/YARD	**8.4%**	**2.9%**	**8,599**
Dimensional Lumber/Engr. Wood	3.2%	2.0%	3,318
Treated Wood	0.0%	0.0%	2
Contaminated Wood	1.4%	1.1%	1,410
Roofing and Siding Wood	0.0%	0.0%	-
Stumps	0.0%	0.0%	-
Large Prunings	0.6%	0.8%	661
Yard Waste	2.5%	1.5%	2,521
Other Wood	0.7%	0.5%	687
OTHER ORGANICS	**19.5%**	**2.7%**	**20,044**
Textiles: Clothes & Other Recy.	3.6%	0.9%	3,708
Other Textiles	2.3%	1.0%	2,411
Disposable Diapers	7.9%	1.5%	8,104
Rubber Products	0.2%	0.1%	221
Tires	0.0%	0.0%	-
Animal Carcasses	0.0%	0.0%	-
Animal Feces	5.0%	1.7%	5,130
Miscellaneous Organics	0.5%	0.3%	470

Material	Estimated Percent	+ / -	Estimated Tons
METAL	**4.2%**	**1.4%**	**4,340**
Aluminum Cans	0.5%	0.1%	489
Other Aluminum	0.4%	0.1%	411
Tinned Food Cans	0.6%	0.2%	623
Other Ferrous	1.7%	1.4%	1,736
Other Non-Ferrous	0.1%	0.1%	111
Mixed Metals (>80% metal, <20% non-meta	0.5%	0.3%	561
Other Mixed Metals (>20% non-metal)	0.4%	0.3%	409
Compressed Gas Cylinders	0.0%	0.0%	-
GLASS	**2.5%**	**0.5%**	**2,597**
Clear Glass Containers	1.5%	0.3%	1,574
Green Glass Containers	0.2%	0.1%	224
Brown Glass Containers	0.5%	0.2%	506
Kitchenware/Ceramics	0.2%	0.1%	177
Other Glass	0.1%	0.1%	116
ELECTRONICS	**1.1%**	**0.8%**	**1,090**
Small Household Appliances	0.6%	0.6%	638
A/V Equipment	0.0%	0.0%	7
Printers/Copiers/Fax Machines	0.0%	0.0%	-
CPUs	0.3%	0.5%	317
Computer Peripherals	0.0%	0.0%	26
CRT Computer Monitors & TVs	0.0%	0.0%	-
Other Computer Monitors & TVs (LCDs, etc.	0.0%	0.0%	-
Laptops	0.1%	0.1%	57
Cell Phones	0.0%	0.0%	19
Tablets	0.0%	0.0%	-
Other Electronics	0.0%	0.0%	26
OTHER WASTES	**10.7%**	**4.8%**	**11,039**
C&D Wastes (except wood)	1.8%	2.0%	1,843
Asphalt Shingles	0.0%	0.0%	-
Ash	0.0%	0.0%	26
Nondistinct Fines	1.3%	0.3%	1,294
Gypsum Wallboard	0.6%	0.5%	576
Furniture	2.8%	3.7%	2,921
Mattresses	1.0%	1.6%	1,049
Carpet	2.1%	2.4%	2,133
Miscellaneous Inorganics	1.2%	0.6%	1,197
HHW/SPECIAL	**0.7%**	**0.6%**	**745**
Used Oil	0.0%	0.0%	-
Vehicle Batteries	0.0%	0.0%	2
Household Batteries	0.0%	0.0%	47
Latex Paint	0.0%	0.0%	-
Oil-based Paint	0.0%	0.0%	-
Solvents and Thinners	0.0%	0.0%	-
Adhesives and Glue	0.0%	0.0%	36
Cleaners and Corrosives	0.1%	0.0%	53
Pesticides and Herbicides	0.0%	0.0%	-
Gasoline and Fuel Oil	0.0%	0.0%	-
Antifreeze/Brake Fluid	0.0%	0.1%	33
Medical Waste	0.4%	0.5%	410
Pharmaceuticals and Vitamins	0.1%	0.1%	96
Compact Fluorescent Bulbs	0.0%	0.0%	8
Other Fluorescent Bulbs/Tubes	0.0%	0.0%	2
Other Hazardous Waste	0.1%	0.0%	57

Estimated Total	**100%**		**102,881**
Sample Count			**40**
Composition by Recoverability			
Readily Recyclable	66.3%	4.7%	68,258
Limited Recyclability	8.0%	4.5%	8,230
Not Recyclable	25.7%	3.5%	26,393
Estimated Total	**100.0%**		**102,881**

Confidence intervals calculated at the 90% confidence level. Percentages for material types may not total 100% due to rounding.

Table 52. Detailed Composition, Commercially Collected Nonresidential Substream, 2019 Tons

Material	Estimated Percent	+/-	Estimated Tons
PAPER	**23.6%**	**1.9%**	**87,057**
Newspaper (ONP)	0.3%	0.1%	1,131
Plain Corrugated Cardboard (OCC)	4.7%	0.9%	17,404
Waxed Corrugated Cardboard (OCC)	0.6%	0.6%	2,394
Low-Grade Recyclable Paper	7.6%	0.8%	28,037
High-Grade Paper	0.9%	0.3%	3,314
Single-Use Food Service Compostable	1.5%	0.4%	5,508
Other Compostable Paper	5.7%	0.7%	21,013
Other Paper	2.2%	0.8%	8,256
PLASTIC	**17.2%**	**1.3%**	**63,535**
PET Bottles	0.9%	0.1%	3,332
Other PET Containers	0.5%	0.1%	1,666
HDPE Bottles	0.4%	0.1%	1,637
Other HDPE Containers	0.3%	0.1%	1,004
#3 Packaging	0.0%	0.0%	63
#4 Packaging	0.0%	0.0%	4
#5 Packaging	0.8%	0.1%	3,053
Other #6 Packaging (non-EPS)	0.3%	0.1%	1,062
Other #7 Packaging (non-compostable/non-PLA)	0.1%	0.0%	263
Compostable Plastics	0.2%	0.1%	649
EPS Single-Serve Food Packaging	0.3%	0.0%	972
Other EPS Packaging	0.4%	0.2%	1,490
EPS Products	0.0%	0.0%	67
Recyclable Plastic Bags	0.5%	0.1%	1,682
Non-Industrial Packaging Film Plastic	4.4%	0.6%	16,260
Industrial Packaging Film Plastic	1.5%	0.5%	5,704
Plastic Garbage Bags	2.9%	0.3%	10,653
Plastic Film Products	0.0%	0.0%	111
Other Plastic Packaging	0.3%	0.1%	1,241
Single-Resin Plastic Products	1.9%	0.5%	7,100
Mixed-Resin Plastic Products	0.4%	0.2%	1,464
Foam Rubber and Padding	0.2%	0.3%	758
Carpet Padding	0.1%	0.1%	212
Plastic and Other Materials	0.8%	0.4%	3,088
FOOD	**17.3%**	**1.9%**	**64,021**
Fruits & Vegetables, Edible	1.7%	0.3%	6,370
Fruits & Vegetables, Non-edible	3.4%	0.6%	12,471
Homegrown Fruits & Vegetables	0.2%	0.4%	917
Meat, Edible	0.9%	0.3%	3,213
Meat, Non-edible	0.8%	0.2%	3,007
Mixed/Other Food Waste, Edible	4.6%	0.9%	16,868
Mixed/Other Food Waste, Non-edible	5.3%	1.2%	19,546
Other Compostables	0.4%	0.5%	1,629
WOOD/YARD	**10.1%**	**2.2%**	**37,383**
Dimensional Lumber/Engr. Wood	5.0%	1.6%	18,488
Treated Wood	0.1%	0.1%	204
Contaminated Wood	1.5%	0.6%	5,588
Roofing and Siding Wood	0.0%	0.0%	-
Stumps	0.0%	0.1%	140
Large Prunings	0.2%	0.2%	580
Yard Waste	2.6%	1.4%	9,709
Other Wood	0.7%	0.4%	2,674
OTHER ORGANICS	**12.4%**	**1.9%**	**45,975**
Textiles: Clothes & Other Recy.	3.0%	0.9%	11,074
Other Textiles	1.2%	0.3%	4,477
Disposable Diapers	4.1%	0.8%	15,295
Rubber Products	1.7%	1.4%	6,394
Tires	0.1%	0.1%	428
Animal Carcasses	0.0%	0.0%	4
Animal Feces	2.0%	0.8%	7,536
Miscellaneous Organics	0.2%	0.1%	768
METAL	**5.5%**	**1.0%**	**20,138**
Aluminum Cans	0.4%	0.1%	1,591
Other Aluminum	0.3%	0.1%	1,177
Tinned Food Cans	0.4%	0.1%	1,355
Other Ferrous	2.2%	0.8%	8,011
Other Non-Ferrous	0.1%	0.0%	245
Mixed Metals (>80% metal, <20% non-meta	1.3%	0.5%	4,956
Other Mixed Metals (>20% non-metal)	0.7%	0.3%	2,653
Compressed Gas Cylinders	0.0%	0.0%	149
GLASS	**2.3%**	**0.7%**	**8,542**
Clear Glass Containers	0.8%	0.2%	3,076
Green Glass Containers	0.2%	0.1%	887
Brown Glass Containers	0.2%	0.1%	921
Kitchenware/Ceramics	0.4%	0.2%	1,353
Other Glass	0.6%	0.7%	2,306
ELECTRONICS	**0.6%**	**0.3%**	**2,113**
Small Household Appliances	0.2%	0.2%	776
A/V Equipment	0.0%	0.0%	160
Printers/Copiers/Fax Machines	0.0%	0.0%	-
CPUs	0.0%	0.1%	168
Computer Peripherals	0.0%	0.0%	83
CRT Computer Monitors & TVs	0.1%	0.1%	397
Other Computer Monitors & TVs (LCDs, etc	0.0%	0.0%	-
Laptops	0.0%	0.0%	38
Cell Phones	0.0%	0.0%	6
Tablets	0.0%	0.0%	-
Other Electronics	0.1%	0.1%	485
OTHER WASTES	**8.7%**	**1.6%**	**31,962**
C&D Wastes (except wood)	3.3%	1.3%	12,197
Asphalt Shingles	0.2%	0.2%	797
Ash	0.0%	0.0%	16
Nondistinct Fines	2.0%	0.6%	7,506
Gypsum Wallboard	0.3%	0.2%	1,155
Furniture	0.9%	0.6%	3,325
Mattresses	0.1%	0.1%	202
Carpet	0.2%	0.2%	893
Miscellaneous Inorganics	1.6%	0.5%	5,872
HHW/SPECIAL	**2.4%**	**1.1%**	**8,752**
Used Oil	0.0%	0.0%	24
Vehicle Batteries	0.0%	0.0%	46
Household Batteries	0.1%	0.1%	283
Latex Paint	0.3%	0.2%	1,147
Oil-based Paint	0.0%	0.0%	17
Solvents and Thinners	0.0%	0.0%	26
Adhesives and Glue	0.1%	0.1%	218
Cleaners and Corrosives	0.0%	0.0%	82
Pesticides and Herbicides	0.0%	0.0%	-
Gasoline and Fuel Oil	0.0%	0.0%	21
Antifreeze/Brake Fluid	0.0%	0.0%	-
Medical Waste	1.6%	1.0%	5,928
Pharmaceuticals and Vitamins	0.0%	0.0%	77
Compact Fluorescent Bulbs	0.0%	0.0%	9
Other Fluorescent Bulbs/Tubes	0.0%	0.0%	10
Other Hazardous Waste	0.2%	0.3%	862
Estimated Total	**100%**		**369,478**
Sample Count			**156**
Composition by Recoverability			
Readily Recyclable	67.8%	2.8%	250,686
Limited Recyclability	4.8%	1.0%	17,618
Not Recyclable	27.4%	2.6%	101,175
Estimated Total	**100.0%**		**369,478**

Confidence intervals calculated at the 90% confidence level. Percentages for material types may not total 100% due to rounding.

Table 53. Detailed Composition, Self-haul Substreams, 2019 Tons

Material	Estimated Percent	+/-	Estimated Tons
PAPER	**6.3%**	**1.0%**	**11,807**
Newspaper (ONP)	0.1%	0.1%	269
Plain Corrugated Cardboard (OCC)	2.6%	0.5%	4,958
Waxed Corrugated Cardboard (OCC)	0.0%	0.0%	-
Low-Grade Recyclable Paper	1.9%	0.6%	3,670
High-Grade Paper	0.1%	0.0%	97
Single-Use Food Service Compostable	0.1%	0.1%	225
Other Compostable Paper	0.5%	0.2%	975
Other Paper	0.9%	0.3%	1,614
PLASTIC	**8.6%**	**1.5%**	**16,251**
PET Bottles	0.1%	0.0%	279
Other PET Containers	0.1%	0.0%	118
HDPE Bottles	0.1%	0.0%	222
Other HDPE Containers	0.1%	0.0%	185
#3 Packaging	0.0%	0.0%	6
#4 Packaging	0.0%	0.0%	0
#5 Packaging	0.3%	0.2%	604
Other #6 Packaging (non-EPS)	0.0%	0.0%	50
Other #7 Packaging (non-compostable/non-PLA)	0.0%	0.0%	13
Compostable Plastics	0.0%	0.0%	9
EPS Single-Serve Food Packaging	0.0%	0.0%	51
Other EPS Packaging	0.1%	0.1%	280
EPS Products	0.1%	0.0%	138
Recyclable Plastic Bags	0.1%	0.0%	102
Non-Industrial Packaging Film Plastic	0.6%	0.2%	1,127
Industrial Packaging Film Plastic	0.2%	0.1%	438
Plastic Garbage Bags	0.5%	0.1%	938
Plastic Film Products	0.2%	0.1%	445
Other Plastic Packaging	0.1%	0.1%	254
Single-Resin Plastic Products	2.9%	0.8%	5,518
Mixed-Resin Plastic Products	0.4%	0.2%	819
Foam Rubber and Padding	0.1%	0.1%	208
Carpet Padding	1.0%	0.8%	1,891
Plastic and Other Materials	1.4%	0.8%	2,555
FOOD	**2.9%**	**0.9%**	**5,480**
Fruits & Vegetables, Edible	0.3%	0.1%	575
Fruits & Vegetables, Non-edible	0.6%	0.4%	1,215
Homegrown Fruits & Vegetables	0.0%	0.0%	-
Meat, Edible	0.2%	0.1%	444
Meat, Non-edible	0.1%	0.1%	208
Mixed/Other Food Waste, Edible	0.9%	0.3%	1,651
Mixed/Other Food Waste, Non-edible	0.7%	0.4%	1,378
Other Compostables	0.0%	0.0%	8
WOOD/YARD	**34.5%**	**3.7%**	**65,000**
Dimensional Lumber/Engr. Wood	16.6%	2.8%	31,284
Treated Wood	2.4%	1.3%	4,506
Contaminated Wood	4.9%	1.5%	9,214
Roofing and Siding Wood	0.4%	0.6%	692
Stumps	0.8%	1.0%	1,485
Large Prunings	0.2%	0.2%	416
Yard Waste	2.1%	1.1%	4,018
Other Wood	7.1%	2.0%	13,384
OTHER ORGANICS	**5.4%**	**1.1%**	**10,185**
Textiles: Clothes & Other Recy.	1.9%	0.6%	3,535
Other Textiles	1.3%	0.4%	2,363
Disposable Diapers	0.4%	0.2%	803
Rubber Products	0.4%	0.1%	716
Tires	0.1%	0.2%	205
Animal Carcasses	0.0%	0.0%	54
Animal Feces	1.1%	0.6%	2,095
Miscellaneous Organics	0.2%	0.1%	413
METAL	**9.6%**	**1.7%**	**18,026**
Aluminum Cans	0.1%	0.0%	115
Other Aluminum	0.2%	0.1%	378
Tinned Food Cans	0.1%	0.0%	151
Other Ferrous	3.7%	1.0%	7,046
Other Non-Ferrous	0.3%	0.3%	533
Mixed Metals (>80% metal, <20% non-meta	3.6%	1.0%	6,803
Other Mixed Metals (>20% non-metal)	1.6%	0.5%	2,959
Compressed Gas Cylinders	0.0%	0.0%	41
GLASS	**2.0%**	**0.6%**	**3,851**
Clear Glass Containers	0.3%	0.1%	538
Green Glass Containers	0.1%	0.1%	251
Brown Glass Containers	0.1%	0.1%	235
Kitchenware/Ceramics	0.3%	0.1%	569
Other Glass	1.2%	0.6%	2,259
ELECTRONICS	**1.3%**	**0.5%**	**2,370**
Small Household Appliances	0.7%	0.3%	1,238
A/V Equipment	0.3%	0.3%	489
Printers/Copiers/Fax Machines	0.2%	0.2%	372
CPUs	0.0%	0.0%	-
Computer Peripherals	0.0%	0.0%	19
CRT Computer Monitors & TVs	0.0%	0.0%	46
Other Computer Monitors & TVs (LCDs, etc	0.0%	0.0%	-
Laptops	0.0%	0.0%	-
Cell Phones	0.0%	0.0%	3
Tablets	0.0%	0.0%	-
Other Electronics	0.1%	0.1%	203
OTHER WASTES	**28.7%**	**3.5%**	**54,161**
C&D Wastes (except wood)	8.8%	2.0%	16,633
Asphalt Shingles	1.8%	1.4%	3,319
Ash	0.1%	0.1%	178
Nondistinct Fines	1.0%	0.6%	1,874
Gypsum Wallboard	4.2%	1.7%	7,844
Furniture	5.9%	2.0%	11,041
Mattresses	4.4%	2.0%	8,355
Carpet	2.3%	1.5%	4,412
Miscellaneous Inorganics	0.3%	0.2%	504
HHW/SPECIAL	**0.7%**	**0.3%**	**1,284**
Used Oil	0.0%	0.0%	17
Vehicle Batteries	0.0%	0.0%	-
Household Batteries	0.0%	0.0%	43
Latex Paint	0.3%	0.2%	640
Oil-based Paint	0.0%	0.0%	4
Solvents and Thinners	0.0%	0.0%	64
Adhesives and Glue	0.1%	0.1%	179
Cleaners and Corrosives	0.0%	0.0%	28
Pesticides and Herbicides	0.0%	0.0%	5
Gasoline and Fuel Oil	0.1%	0.1%	133
Antifreeze/Brake Fluid	0.0%	0.0%	-
Medical Waste	0.0%	0.0%	13
Pharmaceuticals and Vitamins	0.0%	0.0%	51
Compact Fluorescent Bulbs	0.0%	0.0%	3
Other Fluorescent Bulbs/Tubes	0.0%	0.0%	1
Other Hazardous Waste	0.1%	0.0%	102
Estimated Total	**100%**		**188,414**
Sample Count			**181**
Composition by Recoverability			
Readily Recyclable	47.4%	3.5%	89,360
Limited Recyclability	25.7%	3.5%	48,412
Not Recyclable	26.9%	2.9%	50,642
Estimated Total	**100.0%**		**188,414**

Confidence intervals calculated at the 90% confidence level. Percentages for material types may not total 100% due to rounding.

Table 54. Detailed Composition, Self-haul Residential Substream, 2019 Tons

Material	Estimated Percent	+/-	Estimated Tons
PAPER	**6.7%**	**1.1%**	**11,567**
Newspaper (ONP)	0.2%	0.1%	267
Plain Corrugated Cardboard (OCC)	2.8%	0.6%	4,776
Waxed Corrugated Cardboard (OCC)	0.0%	0.0%	-
Low-Grade Recyclable Paper	2.1%	0.7%	3,633
High-Grade Paper	0.1%	0.0%	97
Single-Use Food Service Compostable	0.1%	0.1%	225
Other Compostable Paper	0.6%	0.2%	975
Other Paper	0.9%	0.4%	1,595
PLASTIC	**8.5%**	**1.5%**	**14,726**
PET Bottles	0.2%	0.0%	277
Other PET Containers	0.1%	0.0%	116
HDPE Bottles	0.1%	0.0%	221
Other HDPE Containers	0.1%	0.0%	159
#3 Packaging	0.0%	0.0%	6
#4 Packaging	0.0%	0.0%	0
#5 Packaging	0.3%	0.2%	601
Other #6 Packaging (non-EPS)	0.0%	0.0%	50
Other #7 Packaging (non-compostable/non-PLA)	0.0%	0.0%	13
Compostable Plastics	0.0%	0.0%	9
EPS Single-Serve Food Packaging	0.0%	0.0%	51
Other EPS Packaging	0.2%	0.1%	263
EPS Products	0.1%	0.1%	138
Recyclable Plastic Bags	0.1%	0.0%	101
Non-Industrial Packaging Film Plastic	0.6%	0.2%	1,104
Industrial Packaging Film Plastic	0.2%	0.1%	421
Plastic Garbage Bags	0.5%	0.1%	915
Plastic Film Products	0.3%	0.1%	445
Other Plastic Packaging	0.1%	0.1%	245
Single-Resin Plastic Products	2.8%	0.8%	4,828
Mixed-Resin Plastic Products	0.4%	0.2%	677
Foam Rubber and Padding	0.1%	0.1%	208
Carpet Padding	0.8%	0.7%	1,361
Plastic and Other Materials	1.5%	0.9%	2,516
FOOD	**3.2%**	**1.0%**	**5,471**
Fruits & Vegetables, Edible	0.3%	0.1%	568
Fruits & Vegetables, Non-edible	0.7%	0.4%	1,215
Homegrown Fruits & Vegetables	0.0%	0.0%	-
Meat, Edible	0.3%	0.1%	444
Meat, Non-edible	0.1%	0.1%	208
Mixed/Other Food Waste, Edible	1.0%	0.3%	1,651
Mixed/Other Food Waste, Non-edible	0.8%	0.5%	1,376
Other Compostables	0.0%	0.0%	8
WOOD/YARD	**35.0%**	**3.9%**	**60,341**
Dimensional Lumber/Engr. Wood	17.0%	3.0%	29,281
Treated Wood	2.4%	1.4%	4,137
Contaminated Wood	4.8%	1.5%	8,324
Roofing and Siding Wood	0.4%	0.6%	692
Stumps	0.9%	1.0%	1,485
Large Prunings	0.2%	0.3%	416
Yard Waste	2.3%	1.2%	3,965
Other Wood	7.0%	2.0%	12,041
OTHER ORGANICS	**5.7%**	**1.2%**	**9,860**
Textiles: Clothes & Other Recy.	2.0%	0.7%	3,392
Other Textiles	1.3%	0.4%	2,204
Disposable Diapers	0.5%	0.3%	803
Rubber Products	0.4%	0.2%	696
Tires	0.1%	0.2%	204
Animal Carcasses	0.0%	0.0%	54
Animal Feces	1.2%	0.7%	2,095
Miscellaneous Organics	0.2%	0.1%	411
METAL	**9.7%**	**1.8%**	**16,668**
Aluminum Cans	0.1%	0.0%	114
Other Aluminum	0.2%	0.1%	311
Tinned Food Cans	0.1%	0.0%	151
Other Ferrous	3.7%	1.0%	6,362
Other Non-Ferrous	0.3%	0.3%	506
Mixed Metals (>80% metal, <20% non-meta	3.6%	1.0%	6,236
Other Mixed Metals (>20% non-metal)	1.7%	0.6%	2,946
Compressed Gas Cylinders	0.0%	0.0%	41
GLASS	**1.8%**	**0.6%**	**3,185**
Clear Glass Containers	0.3%	0.1%	538
Green Glass Containers	0.1%	0.1%	250
Brown Glass Containers	0.1%	0.1%	235
Kitchenware/Ceramics	0.3%	0.1%	554
Other Glass	0.9%	0.5%	1,609
ELECTRONICS	**1.3%**	**0.5%**	**2,308**
Small Household Appliances	0.7%	0.3%	1,191
A/V Equipment	0.3%	0.3%	478
Printers/Copiers/Fax Machines	0.2%	0.2%	372
CPUs	0.0%	0.0%	-
Computer Peripherals	0.0%	0.0%	19
CRT Computer Monitors & TVs	0.0%	0.0%	46
Other Computer Monitors & TVs (LCDs, etc	0.0%	0.0%	-
Laptops	0.0%	0.0%	-
Cell Phones	0.0%	0.0%	3
Tablets	0.0%	0.0%	-
Other Electronics	0.1%	0.1%	199
OTHER WASTES	**27.4%**	**3.6%**	**47,290**
C&D Wastes (except wood)	8.9%	2.1%	15,302
Asphalt Shingles	1.9%	1.5%	3,317
Ash	0.1%	0.1%	178
Nondistinct Fines	1.1%	0.7%	1,819
Gypsum Wallboard	4.1%	1.8%	7,067
Furniture	5.3%	2.0%	9,116
Mattresses	4.1%	2.1%	7,030
Carpet	1.7%	1.1%	2,967
Miscellaneous Inorganics	0.3%	0.2%	493
HHW/SPECIAL	**0.7%**	**0.3%**	**1,207**
Used Oil	0.0%	0.0%	17
Vehicle Batteries	0.0%	0.0%	-
Household Batteries	0.0%	0.0%	43
Latex Paint	0.3%	0.2%	567
Oil-based Paint	0.0%	0.0%	4
Solvents and Thinners	0.0%	0.0%	64
Adhesives and Glue	0.1%	0.1%	175
Cleaners and Corrosives	0.0%	0.0%	28
Pesticides and Herbicides	0.0%	0.0%	5
Gasoline and Fuel Oil	0.1%	0.1%	133
Antifreeze/Brake Fluid	0.0%	0.0%	-
Medical Waste	0.0%	0.0%	13
Pharmaceuticals and Vitamins	0.0%	0.0%	51
Compact Fluorescent Bulbs	0.0%	0.0%	3
Other Fluorescent Bulbs/Tubes	0.0%	0.0%	1
Other Hazardous Waste	0.1%	0.0%	102
Estimated Total	**100%**		**172,622**
Sample Count			**165**
Composition by Recoverability			
Readily Recyclable	48.6%	3.7%	83,946
Limited Recyclability	24.1%	3.7%	41,623
Not Recyclable	27.3%	3.1%	47,053
Estimated Total	**100.0%**		**172,622**

Confidence intervals calculated at the 90% confidence level. Percentages for material types may not total 100% due to rounding.

Table 55. Detailed Composition, Self-haul Nonresidential Substream, 2019 Tons

Material	Estimated Percent	+/-	Estimated Tons
PAPER	**1.5%**	**0.7%**	**240**
Newspaper (ONP)	0.0%	0.0%	2
Plain Corrugated Cardboard (OCC)	1.2%	0.8%	183
Waxed Corrugated Cardboard (OCC)	0.0%	0.0%	-
Low-Grade Recyclable Paper	0.2%	0.2%	37
High-Grade Paper	0.0%	0.0%	0
Single-Use Food Service Compostable	0.0%	0.0%	-
Other Compostable Paper	0.0%	0.0%	-
Other Paper	0.1%	0.1%	19
PLASTIC	**9.7%**	**6.2%**	**1,525**
PET Bottles	0.0%	0.0%	2
Other PET Containers	0.0%	0.0%	2
HDPE Bottles	0.0%	0.0%	1
Other HDPE Containers	0.2%	0.2%	26
#3 Packaging	0.0%	0.0%	-
#4 Packaging	0.0%	0.0%	-
#5 Packaging	0.0%	0.0%	3
Other #6 Packaging (non-EPS)	0.0%	0.0%	0
Other #7 Packaging (non-compostable/non-PLA)	0.0%	0.0%	0
Compostable Plastics	0.0%	0.0%	-
EPS Single-Serve Food Packaging	0.0%	0.0%	-
Other EPS Packaging	0.1%	0.1%	17
EPS Products	0.0%	0.0%	1
Recyclable Plastic Bags	0.0%	0.0%	1
Non-Industrial Packaging Film Plastic	0.1%	0.1%	23
Industrial Packaging Film Plastic	0.1%	0.1%	17
Plastic Garbage Bags	0.1%	0.1%	23
Plastic Film Products	0.0%	0.0%	-
Other Plastic Packaging	0.1%	0.1%	9
Single-Resin Plastic Products	4.4%	2.6%	690
Mixed-Resin Plastic Products	0.9%	1.2%	142
Foam Rubber and Padding	0.0%	0.0%	-
Carpet Padding	3.4%	5.4%	530
Plastic and Other Materials	0.2%	0.2%	39
FOOD	**0.1%**	**0.1%**	**9**
Fruits & Vegetables, Edible	0.0%	0.1%	7
Fruits & Vegetables, Non-edible	0.0%	0.0%	-
Homegrown Fruits & Vegetables	0.0%	0.0%	-
Meat, Edible	0.0%	0.0%	-
Meat, Non-edible	0.0%	0.0%	-
Mixed/Other Food Waste, Edible	0.0%	0.0%	-
Mixed/Other Food Waste, Non-edible	0.0%	0.0%	2
Other Compostables	0.0%	0.0%	-
WOOD/YARD	**29.5%**	**11.8%**	**4,658**
Dimensional Lumber/Engr. Wood	12.7%	6.6%	2,003
Treated Wood	2.3%	2.3%	369
Contaminated Wood	5.6%	6.5%	890
Roofing and Siding Wood	0.0%	0.0%	-
Stumps	0.0%	0.0%	-
Large Prunings	0.0%	0.0%	-
Yard Waste	0.3%	0.5%	53
Other Wood	8.5%	9.5%	1,343
OTHER ORGANICS	**2.1%**	**1.2%**	**325**
Textiles: Clothes & Other Recy.	0.9%	0.8%	143
Other Textiles	1.0%	1.1%	158
Disposable Diapers	0.0%	0.0%	-
Rubber Products	0.1%	0.2%	20
Tires	0.0%	0.0%	2
Animal Carcasses	0.0%	0.0%	-
Animal Feces	0.0%	0.0%	-
Miscellaneous Organics	0.0%	0.0%	2
METAL	**8.6%**	**5.4%**	**1,358**
Aluminum Cans	0.0%	0.0%	1
Other Aluminum	0.4%	0.5%	67
Tinned Food Cans	0.0%	0.0%	-
Other Ferrous	4.3%	3.0%	684
Other Non-Ferrous	0.2%	0.3%	27
Mixed Metals (>80% metal, <20% non-meta	3.6%	3.1%	566
Other Mixed Metals (>20% non-metal)	0.1%	0.1%	13
Compressed Gas Cylinders	0.0%	0.0%	-
GLASS	**4.2%**	**4.5%**	**666**
Clear Glass Containers	0.0%	0.0%	-
Green Glass Containers	0.0%	0.0%	1
Brown Glass Containers	0.0%	0.0%	-
Kitchenware/Ceramics	0.1%	0.1%	15
Other Glass	4.1%	4.5%	650
ELECTRONICS	**0.4%**	**0.5%**	**62**
Small Household Appliances	0.3%	0.5%	47
A/V Equipment	0.1%	0.1%	11
Printers/Copiers/Fax Machines	0.0%	0.0%	-
CPUs	0.0%	0.0%	-
Computer Peripherals	0.0%	0.0%	-
CRT Computer Monitors & TVs	0.0%	0.0%	-
Other Computer Monitors & TVs (LCDs, etc	0.0%	0.0%	-
Laptops	0.0%	0.0%	-
Cell Phones	0.0%	0.0%	-
Tablets	0.0%	0.0%	-
Other Electronics	0.0%	0.0%	4
OTHER WASTES	**43.5%**	**12.5%**	**6,871**
C&D Wastes (except wood)	8.4%	5.9%	1,331
Asphalt Shingles	0.0%	0.0%	2
Ash	0.0%	0.0%	-
Nondistinct Fines	0.4%	0.5%	56
Gypsum Wallboard	4.9%	6.1%	777
Furniture	12.2%	9.0%	1,925
Mattresses	8.4%	6.4%	1,325
Carpet	9.2%	13.5%	1,445
Miscellaneous Inorganics	0.1%	0.1%	10
HHW/SPECIAL	**0.5%**	**0.8%**	**77**
Used Oil	0.0%	0.0%	-
Vehicle Batteries	0.0%	0.0%	-
Household Batteries	0.0%	0.0%	-
Latex Paint	0.5%	0.7%	73
Oil-based Paint	0.0%	0.0%	-
Solvents and Thinners	0.0%	0.0%	-
Adhesives and Glue	0.0%	0.0%	4
Cleaners and Corrosives	0.0%	0.0%	-
Pesticides and Herbicides	0.0%	0.0%	-
Gasoline and Fuel Oil	0.0%	0.0%	-
Antifreeze/Brake Fluid	0.0%	0.0%	-
Medical Waste	0.0%	0.0%	-
Pharmaceuticals and Vitamins	0.0%	0.0%	-
Compact Fluorescent Bulbs	0.0%	0.0%	-
Other Fluorescent Bulbs/Tubes	0.0%	0.0%	-
Other Hazardous Waste	0.0%	0.0%	-
Estimated Total	**100%**		**15,792**
Sample Count			**16**
Composition by Recoverability			
Readily Recyclable	34.3%	12.7%	5,414
Limited Recyclability	43.0%	12.6%	6,789
Not Recyclable	22.7%	8.4%	3,589
Estimated Total	**100.0%**		**15,792**

Confidence intervals calculated at the 90% confidence level. Percentages for material types may not total 100% due to rounding.

Appendix E. Detailed Customer Survey Results

This appendix includes data tables intended to explain the customer survey results in the main body of the report. In most cases, the tables in this appendix provide data for each facility individually instead of for all facilities combined as shown in the main body of the report.

Table 56. Detailed Reported Generator Type by Hauler Type and by Facility, 2019

Commercial haul, n=1108	Algona	Bow Lake	Cedar Falls	Enumclaw	Factoria	Houghton	Renton	Shoreline	Skykomish	Vashon	Overall
Residential	**12%**	**7%**	**0%**	**2%**	**11%**	**12%**	**10%**	**4%**	**0%**	**1%**	**8%**
Single Family	7%	4%	0%	1%	8%	8%	7%	3%	0%	1%	5%
Multifamily	4%	2%	0%	1%	2%	4%	3%	1%	0%	0%	2%
Mixed Single Family & Multifamily Residential	0%	1%	0%	0%	1%	0%	0%	0%	0%	0%	1%
Nonresidential	**13%**	**15%**	**0%**	**3%**	**13%**	**12%**	**6%**	**3%**	**0%**	**1%**	**10%**
Mixed Residential and Nonresidential	**2%**	**2%**	**0%**	**0%**	**3%**	**2%**	**3%**	**1%**	**0%**	**0%**	**2%**
Commercial Haul Subtotal	***27%***	***24%***	***0%***	***5%***	***27%***	***26%***	***19%***	***8%***	***0%***	***2%***	***20%***
No Response	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Self-haul, n=4455											
Residential	**63%**	**66%**	**98%**	**89%**	**66%**	**68%**	**76%**	**84%**	**100%**	**91%**	**72%**
Single Family	63%	66%	98%	89%	66%	68%	76%	84%	100%	91%	72%
Multifamily	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Mixed Single Family & Multifamily Residential	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Nonresidential	**9%**	**9%**	**2%**	**4%**	**6%**	**5%**	**4%**	**7%**	**0%**	**6%**	**7%**
Mixed Residential and Nonresidential	**1%**	**1%**	**0%**	**1%**	**1%**	**1%**	**0%**	**1%**	**0%**	**1%**	**1%**
Self-haul Subtotal	***73%***	***76%***	***100%***	***95%***	***73%***	***74%***	***81%***	***92%***	***100%***	***98%***	***80%***
No Response	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Total, n=5563	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Estimates are rounded to the nearest percent and, when added together, may not equal 100%, due to rounding.

Table 57. Observed Vehicle Types by Hauler Type and by Facility, 2019

Commercial haul, n=1108	Algona	Bow Lake	Cedar Falls	Enumclaw	Factoria	Houghton	Renton	Shoreline	Skykomish	Vashon	Overall
Dropbox	15%	13%	0%	2%	12%	9%	7%	3%	-	1%	9%
Packer	12%	10%	0%	3%	14%	16%	11%	5%	-	1%	10%
Large Other	0%	1%	0%	0%	0%	0%	0%	0%	-	0%	0%
Passenger Vehicles	0%	0%	0%	0%	0%	0%	0%	0%	-	0%	0%
Commercial Haul Subtotal	***27%***	***24%***	***0%***	***5%***	***27%***	***25%***	***19%***	***8%***	***-***	***2%***	***20%***
No Response	0%	0%	0%	0%	0%	0%	0%	0%	-	0%	0%
Self-haul, n=4455									-		
Dropbox	0%	0%	1%	0%	0%	0%	0%	0%	-	0%	0%
Packer	0%	0%	0%	0%	0%	0%	0%	0%	-	0%	0%
Large Other	8%	10%	2%	4%	9%	8%	7%	8%	-	8%	8%
Passenger Vehicles	65%	65%	97%	91%	63%	66%	73%	64%	-	89%	69%
Self-haul Subtotal	***73%***	***75%***	***100%***	***95%***	***72%***	***74%***	***81%***	***72%***	***-***	***97%***	***78%***
No Response	0%	1%	0%	0%	1%	0%	0%	20%	-	1%	3%
Total, n=5563	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**-**	**100%**	**100%**

Estimates are rounded to the nearest percent and, when added together, may not equal 100%, due to rounding.

Table 58. Reported Waste Type by Hauler Type and by Facility, 2019

Commercial haul, n=1108	Algona	Bow Lake	Cedar Falls	Enumclaw	Factoria	Houghton	Renton	Shoreline	Skykomish	Vashon	Overall
Mixed Garbage	19%	22%	0%	4%	22%	23%	12%	7%	0%	1%	16%
Construction&Demolition	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%
Yard Waste	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%
Special Waste	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Commercial Haul Subtotal	***19%***	***22%***	***0%***	***4%***	***22%***	***24%***	***12%***	***8%***	***0%***	***1%***	***17%***
No Response	8%	2%	0%	1%	5%	2%	7%	0%	0%	1%	3%
Self-haul, n=4455											
Mixed Garbage	56%	52%	76%	79%	46%	49%	66%	53%	100%	60%	55%
Construction&Demolition	9%	12%	13%	6%	15%	19%	9%	21%	0%	12%	13%
Yard Waste	5%	9%	11%	6%	9%	4%	2%	15%	0%	24%	9%
Special Waste	1%	2%	0%	2%	4%	1%	3%	1%	0%	2%	2%
Self-haul Subtotal	***72%***	***74%***	***99%***	***93%***	***73%***	***73%***	***81%***	***90%***	***100%***	***98%***	***79%***
No Response	1%	2%	1%	2%	1%	1%	0%	2%	0%	1%	1%
Total, n=5563	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Estimates are rounded to the nearest percent and, when added together, may not equal 100%, due to rounding.

Table 59. Reported Generator for Self-haul Contractors, Landscapers, and Other Users: All Facilities, 2019

	All Facilities, n=4455				
	Residential	Nonresidential	Mixed	No Response	Overall
Contractors	13%	47%	0%	0%	**17%**
Landscapers	2%	4%	0%	0%	**2%**
Other Users	85%	49%	0%	0%	**81%**
Total	**100%**	**100%**	**0%**	**0%**	**100%**

Estimates are rounded to the nearest percent and, when added together, may not equal 100%, due to rounding.

Table 60. Reported Generator for Self-haul Contractors, Landscapers, and Other Users: Algona, 2019

	Algona, n=643				
	Residential	Nonresidential	Mixed	No Response	Site Overall
Contractors	6%	43%	0%	0%	**12%**
Landscapers	1%	2%	0%	0%	**1%**
Other Users	93%	55%	0%	0%	**88%**
Total	**100%**	**100%**	**0%**	**0%**	**100%**

Estimates are rounded to the nearest percent and, when added together, may not equal 100%, due to rounding.

Table 61. Reported Generator for Self-haul Contractors, Landscapers, and Other Users: Bow Lake, 2019

	Bow Lake, n=1061				
	Residential	Nonresidential	Mixed	No Response	Site Overall
Contractors	16%	53%	0%	0%	**20%**
Landscapers	2%	6%	0%	0%	**2%**
Other Users	83%	41%	0%	0%	**77%**
Total	**100%**	**100%**	**0%**	**0%**	**100%**

Estimates are rounded to the nearest percent and, when added together, may not equal 100%, due to rounding.

Table 62. Reported Generator for Self-haul Contractors, Landscapers, and Other Users: Cedar Falls, 2019

	Cedar Falls Drop Box, n=132				
	Residential	Nonresidential	Mixed	No Response	Site Overall
Contractors	5%	50%	0%	0%	**5%**
Landscapers	0%	0%	0%	0%	**0%**
Other Users	95%	50%	0%	0%	**95%**
Total	**100%**	**100%**	**0%**	**0%**	**100%**

Estimates are rounded to the nearest percent and, when added together, may not equal 100%, due to rounding.

Table 63. Reported Generator for Self-haul Contractors, Landscapers, and Other Users: Enumclaw, 2019

	Enumclaw, n=311				
	Residential	Nonresidential	Mixed	No Response	Site Overall
Contractors	5%	39%	0%	0%	**7%**
Landscapers	0%	0%	0%	0%	**0%**
Other Users	94%	61%	0%	0%	**92%**
Total	**100%**	**100%**	**0%**	**0%**	**100%**

Estimates are rounded to the nearest percent and, when added together, may not equal 100%, due to rounding.

Table 64. Reported Generator for Self-haul Contractors, Landscapers, and Other Users: Factoria, 2019

	Factoria, n=529				
	Residential	Nonresidential	Mixed	No Response	Site Overall
Contractors	19%	50%	0%	0%	**22%**
Landscapers	4%	4%	0%	0%	**4%**
Other Users	77%	46%	0%	0%	**74%**
Total	**100%**	**100%**	**0%**	**0%**	**100%**

Estimates are rounded to the nearest percent and, when added together, may not equal 100%, due to rounding.

Table 65. Reported Generator for Self-haul Contractors, Landscapers, and Other Users: Houghton, 2019

	Houghton, n=556				
	Residential	Nonresidential	Mixed	No Response	Site Overall
Contractors	18%	51%	0%	0%	**20%**
Landscapers	0%	2%	0%	0%	**0%**
Other Users	82%	47%	0%	0%	**79%**
Total	**100%**	**100%**	**0%**	**0%**	**100%**

Estimates are rounded to the nearest percent and, when added together, may not equal 100%, due to rounding.

Table 66. Reported Generator for Self-haul Contractors, Landscapers, and Other Users: Renton, 2019

	Renton, n=325				
	Residential	Nonresidential	Mixed	No Response	Site Overall
Contractors	9%	56%	0%	0%	**12%**
Landscapers	1%	0%	0%	0%	**1%**
Other Users	90%	44%	0%	0%	**88%**
Total	**100%**	**100%**	**0%**	**0%**	**100%**

Estimates are rounded to the nearest percent and, when added together, may not equal 100%, due to rounding.

Table 67. Reported Generator for Self-haul Contractors, Landscapers, and Other Users: Shoreline, 2019

	Shoreline, n=513				
	Residential	Nonresidential	Mixed	No Response	Site Overall
Contractors	20%	39%	0%	0%	**21%**
Landscapers	3%	2%	0%	0%	**3%**
Other Users	77%	59%	0%	0%	**76%**
Total	**100%**	**100%**	**0%**	**0%**	**100%**

Estimates are rounded to the nearest percent and, when added together, may not equal 100%, due to rounding.

Table 68. Reported Generator for Self-haul Contractors, Landscapers, and Other Users: Vashon, 2019

	Vashon, n=384				
	Residential	Nonresidential	Mixed	No Response	Site Overall
Contractors	10%	27%	0%	0%	**11%**
Landscapers	7%	13%	0%	0%	**8%**
Other Users	83%	60%	0%	0%	**81%**
Total	**100%**	**100%**	**0%**	**0%**	**100%**

Estimates are rounded to the nearest percent and, when added together, may not equal 100%, due to rounding.

Table 69. Reported Reasons to Self-haul by Facility, Residential Generators, 2019

Residential, n=1384	Algona	Bow Lake	Cedar Falls	Enumclaw	Factoria	Houghton	Renton	Shoreline	Skykomish	Vashon	Overall
Large volume	39%	60%	33%	10%	34%	72%	33%	43%	-	9%	43%
Cheaper/saves money	9%	6%	22%	21%	5%	1%	12%	9%	-	20%	10%
Cleaning home or workplace	24%	19%	12%	37%	32%	11%	40%	24%	-	17%	23%
Convenience	14%	4%	16%	17%	5%	7%	6%	3%	-	23%	9%
Garbage						1%			-	2%	
Low generation	4%	1%			1%	1%	1%		-	9%	2%
Missed service	1%			1%	1%	1%	1%		-		1%
No/bad service	3%	3%	7%	7%		3%	1%	9%	-	6%	4%
Not aware					2%				-		
Not subscribed			5%	1%					-	1%	
Opt out					1%				-		
Other issues		1%	2%	1%	2%		1%	1%	-	2%	1%
Preference	3%	1%		4%	7%	2%	2%	1%	-	10%	3%
Recycling material		1%							-		
Special waste	4%	1%	3%	1%	7%	1%	2%	1%	-	1%	2%
Yard waste					5%	2%	1%	7%	-	1%	1%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**0%**	**100%**	**100%**

Estimates are rounded to the nearest percent and, when added together, may not equal 100%, due to rounding. Values less than .5% are left blank

Table 70. Reported Reasons to Self-haul by Facility, Nonresidential Generators, 2019

Nonresidential, n=57	Algona	Bow Lake	Cedar Falls	Enumclaw	Factoria	Houghton	Renton	Shoreline	Skykomish	Vashon	Overall
Large volume		57%		33%		29%		33%	-	25%	38%
Cheaper/saves money		7%							-		4%
Cleaning home or workplace	33%	21%		33%	60%	43%		33%	-		27%
Convenience	33%			33%		14%	50%		-	25%	9%
Garbage									-	25%	2%
Low generation									-		
Missed service									-		
No/bad service	33%	4%					50%		-		5%
Not aware									-		
Not subscribed									-		
Opt out									-		
Other issues					20%				-	25%	4%
Preference			100%					33%	-		4%
Recycling material		7%							-		4%
Special waste						14%			-		2%
Yard waste		3%			20%				-		4%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**0%**	**100%**	**100%**

Estimates are rounded to the nearest percent and, when added together, may not equal 100%, due to rounding. Values less than .5% are left blank

Appendix F. Waste Composition Comparisons to Previous Studies

Background

King County has completed periodic waste characterization studies since 1991 to monitor the types and amounts of materials disposed locally. Differences are often apparent between project years. In this appendix, selected results from the 2019 study are compared to findings from the 2015 study. This comparison identifies changes in the composition of disposed waste streams over time. The reasons why or how these changes occurred are not investigated. Future studies could be designed to identify the potential causes of these variations.

To control for population changes and other factors that may influence the total amount of waste disposed from year to year, the tests described in this appendix measure waste proportions, not tonnage. For example, if *old newspaper (ONP)* accounts for 5 percent of disposed waste totaling 1,000 tons during one study period and 5 percent of waste totaling 1,200 tons during another—while the amount of *old newspaper (ONP)* in terms of total tons has increased, the proportion of *old newspaper (ONP)*, 5 percent, in the disposed waste stream has not. The tests would indicate no change in *old newspaper (ONP)*.

The statistical tests used assume the hypothesis that there has been no change. For example, "There is no statistically significant difference, between the 2015 and 2019 study periods in the proportion of *old newspaper (ONP)* disposed in the commercially collected single-family substream." Statistics are then employed to look for evidence disproving the no-change hypothesis. A "significant" result means there is enough evidence to disprove the hypothesis and that it can be concluded that there is a true difference in composition over time. "Insignificant" results indicate that either 1) there is no true difference, or 2) even though there may appear to be a difference, there is not enough evidence to prove it because the findings are limited by sample size. It is also possible that changes occurred in waste categories that were not considered in this part of the analysis.

Table 71 lists the eight waste categories chosen for analysis. Composition variations were measured for the following substreams or combinations of substreams:

- Overall disposed waste
- Commercially collected waste from single-family residences
- Commercially collected waste from multifamily residences
- Commercially collected waste from nonresidential sources
- Self-hauled waste (from both residential and nonresidential sources)

Table 71. T-test Material Groupings

Material Type	T-test Material Category
Newspaper	Newspaper
Plain Corrugated Cardboard	Cardboard and Kraft
Waxed Corrugated Cardboard	Organics
Low-Grade Recyclable Paper	Other Curbside Paper
High-Grade Paper	Other Curbside Paper
Single-Use Food Service Compostable	Organics
Other Compostable Paper	Organics
PET Bottles	Curbside Containers
Other PET Containers	Curbside Containers
HDPE Bottles	Curbside Containers
Other HDPE Containers	Curbside Containers
#3 Packaging	Curbside Containers
#4 Packaging	Curbside Containers
#5 Packaging	Curbside Containers
Other #7 Packaging	Curbside Containers
Other #6 Packaging	Curbside Containers
Dimensional Lumber/Engr	Wood Waste
Treated Wood	Wood Waste
Contaminated Wood	Wood Waste
Contaminated Wood	Wood Waste
Roofing and Siding Wood	Wood Waste
Large Prunings	Organics
Yard Waste	Organics
Fruits Vegetables, Edible	Organics
Fruits Vegetables, Non-edible	Organics
Homegrown Fruits Vegetables	Organics
Meat, Edible	Organics
Meat, Non-edible	Organics
Mixed/Other Food, Edible	Organics
Mixed/Other Food, Non-edible	Organics
Clear Glass Containers	Curbside Containers
Green Glass Containers	Curbside Containers
Brown Glass Containers	Curbside Containers
Aluminum Cans	Curbside Containers
Other Aluminum	Curbside Containers
Tinned Food Cans	Curbside Containers
Other Ferrous	Curbside Containers
Other Non-Ferrous	Curbside Containers
CD Wastes	Construction & Demolition
Asphalt Shingles	Construction & Demolition
Ash	Construction & Demolition
Nondistinct Fines	Construction & Demolition
Gypsum Wallboard	Construction & Demolition
Carpet	Construction & Demolition
Miscellaneous Inorganics	Construction & Demolition
Used Oil	Hazardous
Vehicle Batteries	Hazardous
Household Batteries	Hazardous
Latex Paint	Hazardous
Oil-based Paint	Hazardous
Solvents and Thinners	Hazardous
Adhesives and Glue	Hazardous
Cleaners and Corrosives	Hazardous
Pesticides and Herbicides	Hazardous
Gasoline and Fuel Oil	Hazardous
Antifreeze/ Brake Fluid	Hazardous
Medical Waste	Hazardous
Pharmaceuticals and Vitamins	Hazardous
Compact Fluorescent Bulbs	Hazardous
Other Fluorescent Bulbs/ Tubes	Hazardous
Other Hazardous Waste	Hazardous

Statistical Considerations

The analyses are based on the component percentages, by weight, for each selected substream. These percentages are calculated by dividing the sum of the selected component weights by the sum of the corresponding sample weights. T-tests (modified for ratio estimation) were used to examine the study year-to-study year variation.

Normality

The distribution of some of the waste categories (particularly the hazardous materials) are skewed and may not follow a normal distribution. Although t-tests assume a normal distribution, they are very robust to departures from this assumption, particularly with large sample sizes. In addition, most of the selected categories are sums of several individual waste components, which improves our ability to meet the assumptions of normality.

Dependence

There may be dependence between waste types. (For example, if a person disposes of material A, they always dispose of material B simultaneously.) There is certainly a degree of dependence between the calculated percentages. (Since the percentages sum to 100, if the percentage of material A increases, the percentage of some other material must decrease.) This type of dependence is somewhat controlled by choosing only a portion of the waste categories for the analyses. Future studies might examine these two types of dependence explicitly.

Multiple T-Tests

In all statistical tests, there is a chance of incorrectly concluding that a result is significant. The year-to-year comparison required conducting several t-tests (one for each waste category within each set of substreams), each of which carries that risk. However, we were willing to accept only a 10% chance of making an incorrect conclusion. Therefore, each test was adjusted by setting the significance threshold to $\frac{0.10}{w}$ (where *w* = the number of t-tests).

The adjustment can be explained as follows:

For each test, we set a $1-\frac{0.10}{w}$ chance of not making a mistake, which results in a $\left(1-\frac{0.10}{w}\right)^{w}$ chance of not making a mistake during all *w* tests.

Since one minus the chance of not making a mistake equals the chance of making a mistake, by making this adjustment, we have set the risk of making a wrong conclusion during any one of the tests at $\left(1-\left(1-\frac{0.10}{w}\right)^{w}\right)=0.10$.

The chance of a "false positive" for this study is restricted to 10 percent overall, or 1.25 percent for each test (10% divided by the eight tests within each substream equals 1.25%).

For more detail regarding this issue, please refer to Section 11.2 "The Multiplicity Problem and the Bonferroni Inequality" of *An Introduction to Contemporary Statistics* by L.H. Koopmans (Duxbury Press, 1981).

Power Analysis

The greater the number of samples, the greater the ability to detect differences. In the future, an *a priori* power analysis might be used to determine how many samples would be required to detect a particular minimum difference of interest.

Interpreting the Calculation Results

The following tables summarize the *t*-test findings. The findings can be grouped into two main categories:

- **Statistically significant**—These findings can be considered true differences because the probability of observing these results if there had been no actual year-to-year change is low. The difference was statistically significant if the *p*-value is less than or equal to 0.0125.
- **Strong trend**—Although the results did not meet the requirements of the study's conservative statistical tests, the data suggest a possibly noteworthy change. The difference was considered a strong trend if the *p*-value was greater than 0.0125 but less than or equal to 0.02.

For the purposes of this study, only those calculation results with a *p*-value of less than 1.25% are considered statistically significant. As described above, the threshold for determining statistically significant results (the "alpha-level") is conservative, accounting for the fact that so many individual tests were calculated.

The *t*-statistic is calculated from the data: according to statistical theory, the larger the absolute value of the *t*-statistic, the less likely that the two populations have the same mean. The *p*-value describes the probability of observing the calculated t-statistic if there were no true difference between the population means.

Key Comparison Study Findings

- The proportion of **Organics** in the overall disposed waste stream decreased from 27.3 percent to 19.2 percent across the study periods. The t-statistic is relatively large (5.4020) and the probability (p-value) of observing that t-statistic if there had been no true difference between years is less than 0.01 percent. This value is less than the study's pre-determined threshold for statistically significant results (alpha-level of 1.25%); thus, the decrease in Organics is considered a true difference.
- Overall, *Cardboard* and *Kraft paper* remained somewhat steady in 2019. This slight increase (3.6%) is neither strong nor statistically significant.

- Overall, *Other Curbside Paper* increased by about 25 percent. This increase suggested a strong trend (*p*-value more than 0.0125 but less than 0.02).
- Overall, the proportion of *Newspaper* decreased by about 82 percent in 2019. This decrease was statistically significant.
- **Wood Waste** and **Construction and Demolition Debris** showed a strong increasing trend in 2019, although this trend was not statistically significant.
- **Curbside Containers** and **Hazardous Material** increased in 2019, but this increase was not statistically significant.

The *t*-test results for comparing the differences between the 2015 and 2019 study periods, along with the trend indicators, for each tested substream are summarized in the following tables. The *t*-test results for differences between the 2007 and 2019 study periods are also included below as reference.

Table 72. Overall Disposed Waste T-test Results, 2015 vs. 2019

Material Grouping	Composition† 2015	Composition† 2019	Change	Change in Composition	t-Statistic	p-Value	Strength of Results
Cardboard and Kraft	3.3%	3.4%	3.6% ▲	0.1% ▲	0.3225	0.7471	*not significant*
Newspaper	1.4%	0.3%	-81.6% ▼	-1.1% ▼	10.6696	0.0000 *	**stat. significant**
Other Curbside Paper	4.3%	5.3%	24.8% ▲	1.1% ▲	2.4220	0.0156	strong trend
Curbside Containers	6.5%	6.9%	6.1% ▲	0.4% ▲	0.6299	0.5289	*not significant*
Organics	27.3%	19.2%	-29.6% ▼	-8.1% ▼	5.4020	0.0000 *	**stat. significant**
Wood Waste	15.3%	17.4%	13.5% ▲	2.1% ▲	1.1242	0.2612	*not significant*
Construction & Demolition	9.3%	11.6%	25.4% ▲	2.4% ▲	1.6832	0.0927	*not significant*
Hazardous	0.8%	1.4%	86.0% ▲	0.7% ▲	1.7536	0.0798	*not significant*
Number of Samples	421	451					

†*Composition data was unweighted for the t-test.*

**Differences with a p-value of 0.0125 or less were considered statistically significant (abbreviated as "stat. significant" in table); "strong trend" was defined as a p-value greater than 0.0125 but less than or equal to 0.02.*

Table 73. Overall Disposed Waste T-test Results, 2007 vs. 2019

Material Grouping	Composition† 2007	Composition† 2019	Change	Change in Composition	t-Statistic	p-Value	Strength of Results
Cardboard and Kraft	5.8%	3.4%	-41.4% ▼	-2.4% ▼	3.9404	0.0001 *	**stat. significant**
Newspaper	1.5%	0.3%	-83.5% ▼	-1.3% ▼	8.4575	0.0000 *	**stat. significant**
Other Curbside Paper	6.5%	5.3%	-18.7% ▼	-1.2% ▼	2.4243	0.0155	strong trend
Curbside Containers	7.3%	6.9%	-5.2% ▼	-0.4% ▼	0.6501	0.5158	*not significant*
Organics	25.8%	19.2%	-25.5% ▼	-6.6% ▼	4.2651	0.0000 *	**stat. significant**
Wood Waste	12.1%	17.4%	43.5% ▲	5.3% ▲	3.0606	0.0023 *	**stat. significant**
Construction & Demolition	8.8%	11.6%	31.7% ▲	2.8% ▲	2.1292	0.0335	*not significant*
Hazardous	0.9%	1.4%	65.8% ▲	0.6% ▲	1.4591	0.1449	*not significant*
Number of Samples	421	451					

†*Composition data was unweighted for the t-test.*

**Differences with a p-value of 0.0125 or less were considered statistically significant (abbreviated as "stat. significant" in table); "strong trend" was defined as a p-value greater than 0.0125 but less than or equal to 0.02.*

Table 74. Commercially Collected Single-family Residential T-test Results, 2015 vs. 2019

Material Grouping	Composition† 2015	2019	Change	t-Statistic	p-Value	Strength of Results
Cardboard and Kraft	1.7%	2.6%	52.2% ▲	1.9214	0.0566	*not significant*
Newspaper	2.1%	0.4%	-78.8% ▼	6.0636	0.0000 *	**stat. significant**
Other Curbside Paper	4.3%	6.0%	38.7% ▲	3.0343	0.0028 *	**stat. significant**
Curbside Containers	5.8%	7.5%	30.0% ▲	2.8379	0.0052 *	**stat. significant**
Organics	36.5%	33.5%	-8.4% ▼	1.4149	0.1592	*not significant*
Wood Waste	2.6%	3.4%	34.3% ▲	0.5338	0.5943	*not significant*
Construction & Demolition	2.4%	5.7%	132.6% ▲	2.1479	0.0333	*not significant*
Hazardous	0.5%	1.3%	178.1% ▲	1.8147	0.0716	*not significant*
Number of Samples	78	73				

†*Composition data was unweighted for the t-test.*

**Differences with a p-value of 0.0125 or less were considered statistically significant (abbreviated as "stat. significant" in table).*

Table 75. Commercially Collected Single-family Residential T-test Results, 2007 vs. 2019

Material Grouping	Composition† 2007	2019	Change	t-Statistic	p-Value	Strength of Results
Cardboard and Kraft	2.5%	2.6%	1.5% ▲	0.0537	0.9573	*not significant*
Newspaper	2.6%	0.4%	-82.8% ▼	3.2885	0.0013 *	**stat. significant**
Other Curbside Paper	7.5%	6.0%	-19.5% ▼	2.0902	0.0383	*not significant*
Curbside Containers	7.7%	7.5%	-3.4% ▼	0.3233	0.7469	*not significant*
Organics	39.4%	33.5%	-15.0% ▼	2.2629	0.0251	*not significant*
Wood Waste	1.4%	3.4%	143.7% ▲	1.4779	0.1415	*not significant*
Construction & Demolition	3.6%	6.0%	65.9% ▲	1.5640	0.1199	*not significant*
Hazardous	0.6%	1.3%	113.6% ▲	1.1567	0.2492	*not significant*
Number of Samples	40	73				

†*Composition data was unweighted for the t-test.*

**Differences with a p-value of 0.0125 or less were considered statistically significant (abbreviated as "stat. significant" in table).*

Table 76. Commercially Collected Multifamily Residential T-test Results, 2015 vs. 2019

Material Grouping	Composition† 2015	2019	Change	t-Statistic	p-Value	Strength of Results
Cardboard and Kraft	3.7%	3.5%	-5.0% ▼	0.2105	0.8340	*not significant*
Newspaper	2.0%	0.4%	-79.3% ▼	5.7134	0.0000 *	**stat. significant**
Other Curbside Paper	5.4%	8.2%	53.8% ▲	2.9341	0.0046 *	**stat. significant**
Curbside Containers	8.3%	9.2%	11.5% ▲	0.7328	0.4663	*not significant*
Organics	35.2%	29.0%	-17.5% ▼	1.9376	0.0569	*not significant*
Wood Waste	4.9%	5.3%	6.4% ▲	0.1304	0.8966	*not significant*
Construction & Demolition	1.7%	7.0%	303.8% ▲	2.2154	0.0301	*not significant*
Hazardous	0.4%	0.7%	69.8% ▲	0.6932	0.4906	*not significant*
Number of Samples	29	40				

†*Composition data was unweighted for the t-test.*

**Differences with a p-value of 0.0125 or less were considered statistically significant (abbreviated as "stat. significant" in table).*

Table 77. Commercially Collected Multifamily Residential T-test Results, 2007 vs. 2019

Material Grouping	Composition† 2007	2019	Change	t-Statistic	p-Value	Strength of Results
Cardboard and Kraft	4.8%	3.5%	-27.8% ▼	1.6763	0.0983	*not significant*
Newspaper	2.5%	0.4%	-83.4% ▼	4.2423	0.0001 *	**stat. significant**
Other Curbside Paper	10.0%	8.2%	-17.5% ▼	1.6270	0.1084	*not significant*
Curbside Containers	9.1%	9.2%	1.0% ▲	0.0682	0.9458	*not significant*
Organics	34.9%	29.0%	-16.9% ▼	1.7587	0.0832	*not significant*
Wood Waste	2.7%	5.3%	93.9% ▲	1.6497	0.1037	*not significant*
Construction & Demolition	2.1%	7.0%	243.2% ▲	2.8533	0.0058 *	**stat. significant**
Hazardous	1.1%	0.7%	-31.7% ▼	0.6610	0.5109	*not significant*
Number of Samples	60	40				

†*Composition data was unweighted for the t-test.*

**Differences with a p-value of 0.0125 or less were considered statistically significant (abbreviated as "stat. significant" in table).*

Table 78. Commercially Collected Nonresidential T-test Results, 2015 vs. 2019

Material Grouping	Composition† 2015	Composition† 2019	Change	t-Statistic	p-Value	Strength of Results
Cardboard and Kraft	4.8%	4.7%	-2.7% ▼	0.1907	0.8489	*not significant*
Newspaper	1.6%	0.3%	-83.1% ▼	7.2402	0.0000 *	**stat. significant**
Other Curbside Paper	6.0%	8.4%	40.2% ▲	3.1083	0.0021 *	**stat. significant**
Curbside Containers	7.2%	7.5%	3.7% ▲	0.3279	0.7432	*not significant*
Organics	37.3%	27.2%	-27.2% ▼	3.9994	0.0001 *	**stat. significant**
Wood Waste	6.6%	8.2%	24.0% ▲	0.8786	0.3803	*not significant*
Construction & Demolition	5.3%	7.6%	43.9% ▲	1.7081	0.0886	*not significant*
Hazardous	1.3%	2.6%	91.8% ▲	1.2338	0.2182	*not significant*
Number of Samples	154	156				

†*Composition data was unweighted for the t-test.*

**Differences with a p-value of 0.0125 or less were considered statistically significant (abbreviated as "stat. significant" in table).*

Table 79. Commercially Collected Nonresidential T-test Results, 2007 vs. 2019

Material Grouping	Composition† 2007	Composition† 2019	Change	t-Statistic	p-Value	Strength of Results
Cardboard and Kraft	9.1%	4.7%	-48.5% ▼	3.0813	0.0022 *	*stat. significant*
Newspaper	2.0%	0.3%	-86.0% ▼	6.4637	0.0000 *	**stat. significant**
Other Curbside Paper	8.7%	8.4%	-4.0% ▼	0.3877	0.6985	*not significant*
Curbside Containers	6.8%	7.5%	9.6% ▲	0.8051	0.4214	*not significant*
Organics	31.8%	27.2%	-14.5% ▼	1.7931	0.0739	*not significant*
Wood Waste	7.4%	8.2%	10.5% ▲	0.4168	0.6771	*not significant*
Construction & Demolition	5.5%	7.6%	39.1% ▲	1.6282	0.1045	*not significant*
Hazardous	0.7%	2.6%	271.4% ▲	2.2565	0.0247	*not significant*
Number of Samples	161	156				

†*Composition data was unweighted for the t-test.*

**Differences with a p-value of 0.0125 or less were considered statistically significant (abbreviated as "stat. significant" in table).*

Table 80. Self-haul T-test Results, 2015 vs. 2019

Material Grouping	Composition† 2015	2019	Change	t-Statistic	p-Value	Strength of Results
Cardboard and Kraft	2.5%	2.6%	6.5% ▲	0.2663	0.7902	*not significant*
Newspaper	0.6%	0.1%	-77.7% ▼	3.3816	0.0008 *	**stat. significant**
Other Curbside Paper	2.3%	2.1%	-10.0% ▼	0.3222	0.7475	*not significant*
Curbside Containers	6.0%	5.9%	-1.2% ▼	0.0510	0.9593	*not significant*
Organics	10.9%	5.9%	-46.3% ▼	2.6359	0.0088 *	**stat. significant**
Wood Waste	32.7%	32.1%	-2.0% ▼	0.1782	0.8587	*not significant*
Construction & Demolition	18.4%	18.6%	1.1% ▲	0.0656	0.9477	*not significant*
Hazardous	0.4%	0.7%	67.1% ▲	1.0161	0.3103	*not significant*
Number of Samples	160	181				

†*Composition data was unweighted for the t-test.*

**Differences with a p-value of 0.0125 or less were considered statistically significant (abbreviated as "stat. significant" in table).*

Table 81. Self-haul T-test Results, 2007 vs. 2019

Material Grouping	Composition† 2007	2019	Change	t-Statistic	p-Value	Strength of Results
Cardboard and Kraft	3.6%	2.6%	-28.1% ▼	1.7072	0.0887	*not significant*
Newspaper	0.5%	0.1%	-72.4% ▼	2.5948	0.0099 *	**stat. significant**
Other Curbside Paper	3.0%	2.1%	-30.4% ▼	1.1952	0.2328	*not significant*
Curbside Containers	7.1%	5.9%	-16.9% ▼	1.0112	0.3126	*not significant*
Organics	13.5%	5.9%	-56.6% ▼	3.6626	0.0003 *	**stat. significant**
Wood Waste	22.6%	32.1%	41.8% ▲	2.8498	0.0046 *	**stat. significant**
Construction & Demolition	15.8%	18.6%	17.5% ▲	0.9941	0.3209	*not significant*
Hazardous	1.0%	0.7%	-29.1% ▼	0.5084	0.6115	*not significant*
Number of Samples	160	181				

†*Composition data was unweighted for the t-test.*

**Differences with a p-value of 0.0125 or less were considered statistically significant (abbreviated as "stat. significant" in table).*

Appendix G. Quality Control Plan

This quality control plan throughout the 2019 King County Waste Monitoring study was executed to help ensure quality and consistency throughout fieldwork, data entry, and reporting.

Train Sorting Crew

To provide consistent sorting, the same crewmembers trained at the onset of the study continued to work until the study's completion in December 2019. All sorting crewmembers spent time in the field studying the components and practicing the sampling protocol. The training focused on the precise definitions for each waste component category and also covers safety procedures, sorting techniques, and quality control procedures.

The Gatekeeper (the person who selects vehicles for sampling) was a Cascadia staff member trained in survey methods and familiar with transfer station protocol, safety procedures, and vehicle types. The Gatekeeper also received training in selecting vehicles for sampling.

Select Vehicles

For each sampling day, the Gatekeeper tallied vehicles as they entered the transfer station on a *Vehicle Selection* form. The form indicated the sampling frequency and the number of vehicles needed for each substream and vehicle type. For each vehicle selected for sampling, the Gatekeeper placed a fluorescent pink "Sample" card on the windshield and directed the vehicle to the sorting crew. The brightly colored cards enabled the sorting crew to identify the selected vehicle easily.

The Gatekeeper assigned each vehicle a unique identification number and recorded it on both the pink card and the Gatekeeper form. When the driver proceeded to the sorting area, the Sort Crew Manager collected the pink card from the vehicle's driver.

Sample Waste

The crew sorted the waste samples by hand into plastic laundry baskets until only a small amount of homogeneous fine material remained. To ensure consistency among the samples, sorting crewmembers specialized in groups of materials, such as papers or plastics. The open laundry baskets allowed the Sort Crew Manager to observe the material at all times and to monitor the homogeneity of the components as they accumulated in the baskets.

Record and Review Data

The Sort Crew Manager recorded the composition weight information on a specially designed tally sheet. By combining the Cascadia designed tally sheet, database, and corresponding electronic data-entry forms together, Cascadia ensured accuracy, consistency among forms, and efficient recording of data.

After each month's sampling event, a designated Cascadia staff member entered the tally sheet data, and the sampling task manager reviewed the entered results to ensure accuracy and reliability.

Report Preparation

Cascadia calculated waste composition estimates using automated analytical tools that Cascadia staff developed. These automated tools reduced the possibility for human error and were tailored, as required, to meet the needs of the study.

The automated calculation tools provided basic information that Cascadia used as a checkpoint to help ensure valid and correct data analysis. For example, the analysis tools showed the total number of samples and the average net weight of the samples when computing composition estimates.

Appendix H. Health and Safety Plan

The seven-part Health and Safety Plan for Sky Valley Associates, the subcontractor assigned to perform the waste sorting, is detailed below:

Responsibility

Brad Anderson, acting as the designated Safety Officer, has the authority and the responsibility for implementing and maintaining the Health and Safety Program for Sky Valley Associates while working on-site. Managers and supervisors are responsible for implementing and maintaining safe working practices in their work areas and for answering worker questions about the Health and Safety Plan. A copy of this Health and Safety Plan is provided to all Sky Valley Associates employees.

The Health and Safety Plan is not a static plan. As conditions and situations arise, this Health and Safety Plan will be updated and augmented in accordance to OSHA and MSHA standards.

Compliance

All workers, including managers and supervisors, comply with safe and healthful work practices. Our goal is to ensure that all workers understand and comply with these practices. To accomplish this, our procedures include informing workers of the provisions of our program, evaluating the on-going safety performance of all workers, and providing additional training to workers whose safety performance may be deficient.

The employees of Sky Valley Associates often perform their duties as guests of many facilities. The procedures described in our program do not supersede the requirements which may already be in place at these facilities. Instead, this plan is designed to augment and work in conjunction with any site safety plans already existing at these facilities. We follow all host facility safety requirements which are more stringent than our own. Our safety procedures often exceed those of our host. Workers must follow our procedures, whether or not the host facility has any such requirements.

Communication

Sky Valley Associates is committed to providing a safe work environment for all of its workers. All managers and supervisors communicate with all workers about occupational safety and health in a form readily understandable by all workers. Workers are encouraged to inform their managers and supervisors about workplace hazards without fear of reprisal. If the safety of the entire team could be in jeopardy, or if anything is discovered that could cause injury or is unsafe, workers are advised to tell their manager or supervisor immediately.

Sky Valley Associates routinely communicates with and instructs employees orally about general safe work practices and hazards particular to each employee's job assignment. Our communication system includes these elements:

- New worker orientation, including discussion of safety and health policies and procedures,
- Worker training in the specific protocols of our field procedures,
- Scheduled and "tailgate" safety meetings,
- Posted or distributed safety information, and
- Periodic review of our Health and Safety Program.

The Safety Officer ensures that all field personnel have read, and understood, the master copy of this Health and Safety Plan document, and that all workers have received orientation and training on the safety protocols to be followed in conducting our work

The Safety Officer delegates daily on-site responsibilities to the Supervisor in charge of the work. Each Supervisor has the duties and responsibilities to:

- Ensure that the procedures in this document are followed for the day's work,
- Be familiar with local emergency services, and maintain a list of emergency phone numbers,
- Conduct "tailgate" health and safety meetings to notify workers of any changes in safety protocol,
- Inspect personal protective equipment and to ensure proper use of such equipment,
- Monitor on-site hazards and the early health warning signs (e.g., heat stress/stroke, dehydration, or fatigue) of site personnel, and
- Stop unsafe operations, and to summon emergency services when needed.

Nearly every day we work, the team is at a different facility. The supervisor will brief workers on health and safety protocols of the host site. This will include emergency evacuation and rally point information, to ensure that, if an emergency occurs, all Sky Valley Associates workers will adhere to site-specific evacuation and management procedures.

Hazard Assessment

We assess possible work hazards, and the procedures to work safely around them, when:

- We initially established our Health & Safety protocols,
- New substances, processes, procedures or equipment which present potential new hazards are introduced into our workplace,
- New, previously unidentified hazards are recognized,
- Workplace conditions warrant an assessment, and
- When occupational injuries and illnesses occur.

Each day, Supervisors are to identify and evaluate workplace hazards which may be present at each work site. We routinely encounter the same day-to-day risks when we conduct our work. Yet, every facility is different and may present its own particular hazards. These are possible hazards that may occur during the field work:

Physical hazards

- Cuts and punctures
- Lifting
- Slipping and falling
- Heat stress and fatigue
- Traffic or heavy equipment movement
- Noise exposure
- Animal and/or insect bites
- Airborne contaminants such as dust and windblown debris

Chemical and biological hazards

- Liquid spills from containers
- Household and hazardous chemicals
- Household hazardous wastes
- Medical wastes
- Blood/body fluid contaminated items
- Hypodermic needles

Due to the nature of waste composition sampling, exposures to airborne pathogens and subcutaneous introduction of pathogens are possible. Because of this, all Sky Valley Associates employees will be given the opportunity to be vaccinated with tetanus and Hepatitis B vaccines at the cost of Sky Valley Associates. Any employee that forfeits having the vaccine will do so in writing.

Accident/Exposures Investigation

Procedures for investigating workplace accidents and hazardous substance exposures include:

- Interviewing injured workers and witnesses,
- Examining the workplace for factors associated with the accident/exposure,
- Determining the cause of the accident/exposure,
- Taking corrective action to prevent the accident/exposure from reoccurring, and
- Recording the findings and actions taken.

Hazard Correction

Timely corrective action will be taken to remedy an unsafe condition, practice or procedure. When an imminent hazard exists that cannot be immediately abated without endangering employee(s) and/or property, we will remove all exposed workers from the area.

Training and Instruction

All Sky Valley Associates workers, including managers and supervisors, shall have training and instruction on general and job-specific safety and health practices. Training and instruction is provided:

- To all new workers,
- To all workers given new job assignments for which training has not previously provided,
- Whenever new substances, processes, procedures or equipment are introduced to the workplace and represent a new safety or health hazard,
- Whenever Sky Valley Associates is made aware of a new or previously unrecognized hazard,
- To supervisors to familiarize them with the hazards to which workers may be exposed, and
- To all workers regarding hazards specific to each employee's job assignment.

Sky Valley Associates provides for its workers the proper safety equipment for performance of duties associated with waste sampling. These items include:

- Coveralls or protective outer wear (optional),
- Rubber gloves and liners (required),
- Lower back support apparatus (optional),
- Hearing protection (optional/based on site requirements),
- Safety glasses (optional/based on site requirements),
- Reflective safety vests (required),
- Hard hats and liners (required), and
- Knee pads (optional).

During the conduct of fieldwork, the personnel health and safety guidelines below are to be followed:

- Workers should be in good physical condition, maintain a current tetanus booster and Hepatitis B shot, and not be over-sensitive to odors and dust. All workers must be able to communicate in English and be able to read warning signs/labels.
- Workers should routinely check personal protective equipment and work clothing for proper fit and condition and replace or repair defective items immediately.
- Workers must look at what they are picking up or sorting, as seeing the material first is the most effective way to prevent cuts and punctures. Workers must use one of the small rakes or shovels to move material around for sorting.
- Workers must lift properly and ask for assistance when lifting heavy or bulky items and be particularly careful when tired or fatigued.
- Workers must be on the lookout for slipping and tripping hazards.
- Workers should not attempt to identify unknown chemical substances in unlabeled containers.
- Workers much wash hands and face before eating or drinking and must smoke only in designated areas.
- Workers should consume plenty of fluids on hot days and watch for signs of heat-related illness.
- Workers should know the surroundings and alert to the possibility of unexpected hazards.
- Workers must alert the Supervisor if feeling ill, overly fatigued, or injured. Even minor cuts and injuries must be treated immediately.

Appendix I. Example Field Forms

This appendix contains examples of the following field forms:

- Customer Survey Form
- Vehicle Type Identification Form
- Daily Vehicle Selection Sheet
- Sample Placard
- Material Weight Tally Sheet

Figure 36. Customer Survey Form, Front

As All Vehicles Approach					*Ask All Vehicles*								*Ask Self-Haul Only*					
																Skip if CB/Landscaper		
ID	Collection Type	Vehicle Type	Trailer	Net Weight	City	Sector					Waste Type	**Contractor or Landscaper**	Trips to Any Station per Time Period		ZIP Code	**Subscribe Curbside Garbage Service?**	**Why Self-Haul?**	Comments
Either a number from a card or a sample ID if chosen for a sample.	C comm'l. S self-haul	1 Rear Packer 2 Front Packer 3 Side Packer 4 DB, Loose 5 DB, Compacted 6 Pick-up, Van, SUV 7 Large Other 8 Car	X if Yes	Record in Pounds (lbs) when possible	If city is not on the list of King County cities, clarify whether it is inside or outside of King County	SF: Single-family residential MF: Multi-family residential RES: Residential NRES: Non-residential If 100%, just check box. If not, fill out percents (must total 100%).					**Y Yard Waste** **C Construction/ Demolition** M Mixed Garbage S Special Waste	If waste type = **Y** yard waste or **C** construction/demo., then ask: CB Contractor/Builder LN Landscaper	(Number)	(Circle time period) D day W week M month Y year E ever *(or <1 per 10 yrs)*		Yes No	If "**No**" to Garbage Service, ask "Why don't you subscribe to curbside garbage service?"	
						If Commercial:			If Self-haul									
						%SF	%MF	% NRes	%RES	%NRES								
	C S										Y C M S	CB LN		D W M Y E	98 _____	Y N		
	C S										Y C M S	CB LN		D W M Y E	98 _____	Y N		
	C S										Y C M S	CB LN		D W M Y E	98 _____	Y N		
	C S										Y C M S	CB LN		D W M Y E	98 _____	Y N		
	C S										Y C M S	CB LN		D W M Y E	98 _____	Y N		
	C S										Y C M S	CB LN		D W M Y E	98 _____	Y N		
	C S										Y C M S	CB LN		D W M Y E	98 _____	Y N		
	C S										Y C M S	CB LN		D W M Y E	98 _____	Y N		
	C S										Y C M S	CB LN		D W M Y E	98 _____	Y N		
	C S										Y C M S	CB LN		D W M Y E	98 _____	Y N		
	C S										Y C M S	CB LN		D W M Y E	98 _____	Y N		
	C S										Y C M S	CB LN		D W M Y E	98 _____	Y N		
	C S										Y C M S	CB LN		D W M Y E	98 _____	Y N		
	C S										Y C M S	CB LN		D W M Y E	98 _____	Y N		
	C S										Y C M S	CB LN		D W M Y E	98 _____	Y N		
	C S										Y C M S	CB LN		D W M Y E	98 _____	Y N		
	C S										Y C M S	CB LN		D W M Y E	98 _____	Y N		
	C S										Y C M S	CB LN		D W M Y E	98 _____	Y N		
	C S										Y C M S	CB LN		D W M Y E	98 _____	Y N		
	C S										Y C M S	CB LN		D W M Y E	98 _____	Y N		

Figure 37. Customer Survey Form, Back

Complete this section for every page

Page _____ of _____

Date _____

Surveyor(s) _____

_____

Circle the site:

Algona	Shoreline
Bow Lake	Houghton
Cedar Falls	Renton
Enumclaw	Skykomish
Factoria	Vashon Island

Complete this section for first page only

Inclement Weather? _____

Start Time _____ Stop Time _____

Other Notes about Today's Surveying:

Figure 38. Vehicle Type Identification Form

1. Rear Packer	2. Front Packer	3. Side Packer
		
4. Drop Box, Loose	**5. Drop Box, Compacted**	**6. Pick-up, Van, SUV**
		
7. Large Other		
		
8. Car	**9. Semi Truck**	
		

Figure 39. Daily Vehicle Selection Sheet

King County Waste Monitoring Study
Vehicle Selection Form

Site: Houghton

Date: Monday, 10/21/19

Cross off one number for each type of vehicle entering the station.

When you reach the number circled, this vehicle should be asked to go to the sorting area to dump its load for sampling.

Continue for each block, beginning at #1, on the next line until the required number of vehicles is sampled.

Do not sample any commercial loads coming from Seattle.

FRANCHISED RESIDENTIAL	NEED 4
1 2 3 (4) 1 2 3 (4) 1 2 3 (4) 1 2 3 (4)	packer trucks or drop boxes (compacting and loose)

FRANCHISED NONRESDROPBOX	NEED 3
1 (2) 1 (2) 1 (2)	both compacting and loose drop boxes

FRANCHISED NONRES PACKER	NEED 3
1 2 (3) 1 2 (3) 1 2 (3)	make up difference with FRANCHISED RESIDENTIAL, if not enough

SELF-HAUL PASSENGER	NEED 4
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 (16) 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 (16) 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 (16) 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 (16)	

SELF-HAUL LARGE OTHER	NEED 1
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 (17)	

Figure 40. Sample Placard

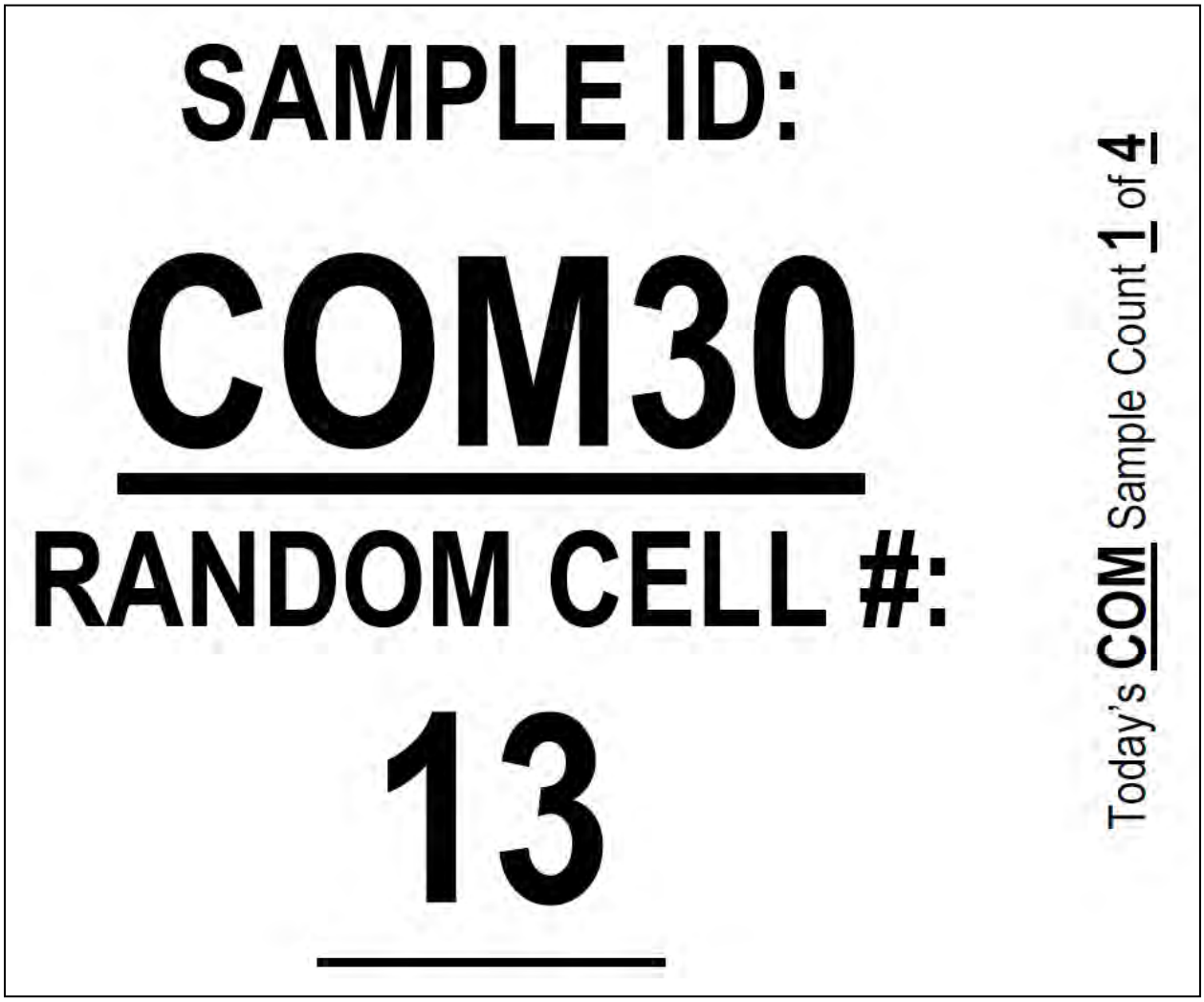


Figure 41. Material Weight Tally Sheet, Front

2019 King County Waste Composition Study (KCM Task 7) — Tally Sheet - Page 1

PAPER	1 Newspaper (ONP)				
	2 Plain Corrugated Cardboard (OCC)				
	3 Waxed Corrugated Cardboard (OCC)				
	4 Low-Grade Recyclable Paper				
	5 High-Grade Paper				
	6 Single-Use Food Service Compostable				
	7 Other Compostable Paper				
	8 Other Paper				
PLASTIC	9 PET Bottles				
	10 Other PET Containers				
	11 HDPE Bottles				
	12 Other HDPE Containers				
	13 #3 Packaging				
	14 #4 Packaging				
	15 #5 Packaging				
	16 Other #6 Packaging (non-EPS)				
	17 Other #7 Packaging (non-compostable/non-PLA)				
	18 Compostable Plastics				
	19 EPS Single-Serve Food Packaging				
	20 Other EPS Packaging				
	21 EPS Products				
	22 Recyclable Plastic Bags				
	23 Non-Industrial Packaging Film Plastic				
	24 Industrial Packaging Film Plastic				
	25 Plastic Garbage Bags				
	26 Plastic Film Products				
	27 Other Plastic Packaging				
	28 Single-Resin Plastic Products				
	29 Mixed-Resin Plastic Products				
	30 Foam Rubber and Padding				
	31 Carpet Padding				
	32 Plastic and Other Materials				
METAL	62 Aluminum Cans				
	63 Other Aluminum				
	64 Tinned Food Cans				
	65 Other Ferrous				
	66 Other Non-Ferrous				
	67 Mixed Metals (>80% metal, <20% non-metal)				
	68 Other Mixed Metals (>20% non-metal)				
	69 Compressed Gas Cylinders				

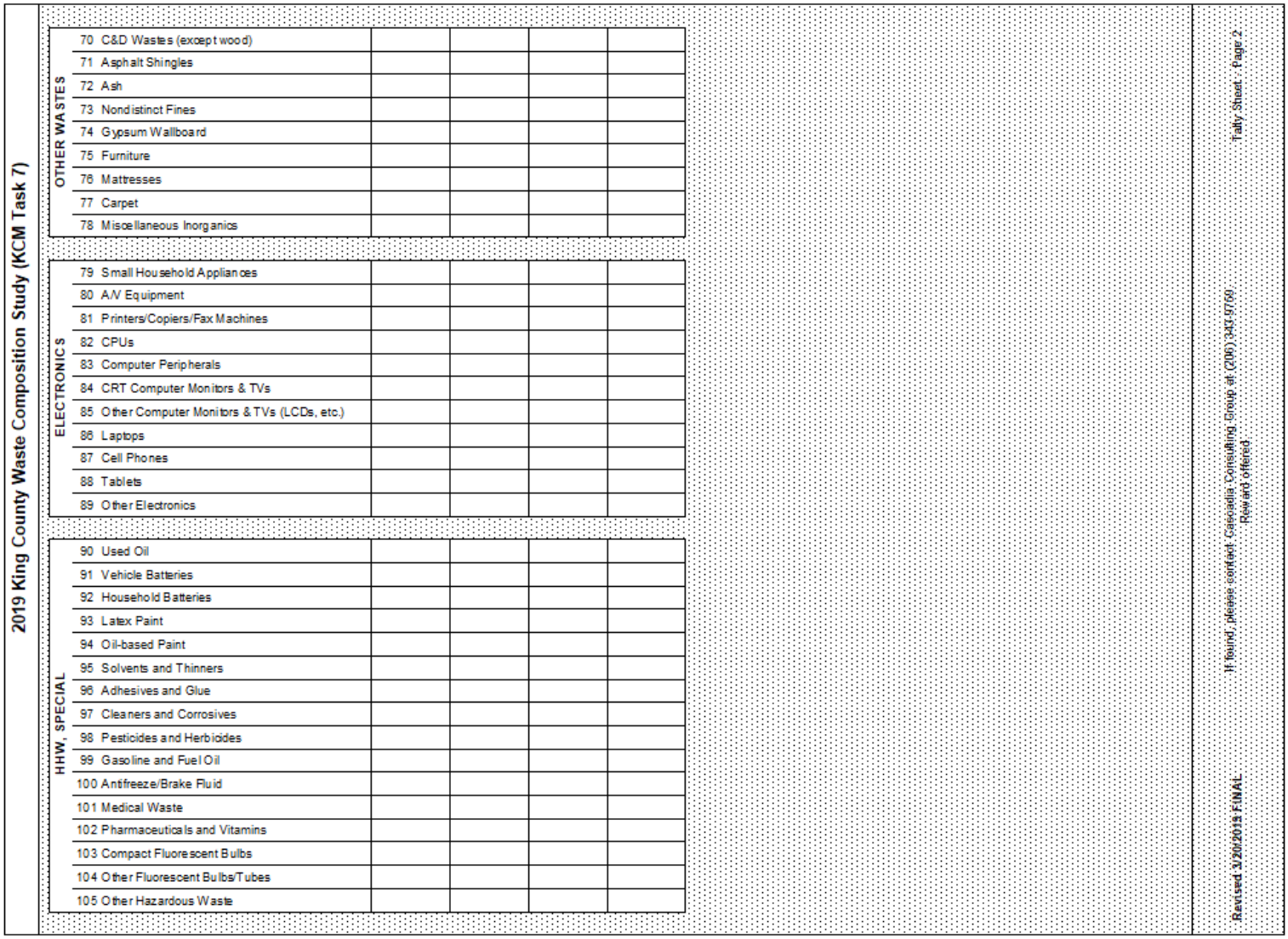
WOOD, YARD	33 Dimensional Lumber/Engr. Wood				
	34 Treated Wood				
	35 Contaminated Wood				
	36 Roofing and Siding Wood				
	37 Stumps				
	38 Large Prunings				
	39 Yard Waste				
	40 Other Wood				
FOOD	41 Fruits & Vegetables, Edible				
	42 Fruits & Vegetables, Non-edible				
	43 Homegrown Fruits & Vegetables				
	44 Meat, Edible				
	45 Meat, Non-edible				
	46 Mixed/Other Food Waste, Edible				
	47 Mixed/Other Food Waste, Non-edible				
	48 Other Compostables				
OTHER ORGANICS	49 Textiles: Clothes & Other Recy.				
	50 Other Textiles				
	51 Disposable Diapers				
	52 Rubber Products				
	53 Tires				
	54 Animal Carcasses				
	55 Animal Feces				
	56 Miscellaneous Organics				
GLASS	57 Clear Glass Containers				
	58 Green Glass Containers				
	59 Brown Glass Containers				
	60 Kitchenware/Ceramics				
	61 Other Glass				

DATE | TIME

FACILITY ☐ Photo?

SAMPLE #

Figure 42. Material Weight Tally Sheet, Back



2019 King County Waste Composition Study (KCM Task 7)

OTHER WASTES	70 C&D Wastes (except wood)				
	71 Asphalt Shingles				
	72 Ash				
	73 Nondistinct Fines				
	74 Gypsum Wallboard				
	75 Furniture				
	76 Mattresses				
	77 Carpet				
	78 Miscellaneous Inorganics				
ELECTRONICS	79 Small Household Appliances				
	80 A/V Equipment				
	81 Printers/Copiers/Fax Machines				
	82 CPUs				
	83 Computer Peripherals				
	84 CRT Computer Monitors & TVs				
	85 Other Computer Monitors & TVs (LCDs, etc.)				
	86 Laptops				
	87 Cell Phones				
	88 Tablets				
	89 Other Electronics				
HHW, SPECIAL	90 Used Oil				
	91 Vehicle Batteries				
	92 Household Batteries				
	93 Latex Paint				
	94 Oil-based Paint				
	95 Solvents and Thinners				
	96 Adhesives and Glue				
	97 Cleaners and Corrosives				
	98 Pesticides and Herbicides				
	99 Gasoline and Fuel Oil				
	100 Antifreeze/Brake Fluid				
	101 Medical Waste				
	102 Pharmaceuticals and Vitamins				
	103 Compact Fluorescent Bulbs				
	104 Other Fluorescent Bulbs/Tubes				
	105 Other Hazardous Waste				

Tally Sheet - Page 2

If found, please contact Cascadia Consulting Group at (206) 343-9759
Reward offered

Revised 3/20/2019 FINAL

Appendix J. Estimated Changes in Greenhouse Gas Emissions from Diversion

This appendix estimates the potential change in greenhouse gas (GHG) emissions associated with increased diversion of typical curbside recyclable and compostable materials. The GHG emissions calculations were performed using the U.S. EPA's Waste Reduction Model (WARM), Version 15, which estimates the GHG emissions associated with different materials management options.

USEPA has developed emissions factors for approximately 60 materials based on the environmental footprint of each material associated with production and collection through final disposition of each discarded product or packaging material.[14] Not every one of the WARM materials has a direct analogue with the material list used in this King County study. As shown in Table 82, Cascadia aggregated 68 "Readily Recyclable" and "Limited Recyclability" material types into WARM material types for analysis. The remaining material types in the King County study were aggregated and modeled in the category of Mixed MSW. The study materials were categorized as "Recycle" or "Compost" according to their preferred management pathway in the WARM analysis (that is, the option with lower greenhouse gas emissions).

[14] Detailed documentation about the development of lifecycle GHG emissions factors for materials can be found at the following location: https://www3.epa.gov/warm/pdfs/WARM_Documentation.pdf

Table 82. Material Types Included in the Waste Reduction Model (WARM) Greenhouse Gas Analysis

King County Study Materials: Readily Recyclable and Limited Recyclability	WARM Materials (Version 15)	Material Group (WARM)	Recoverability Group (King County)	Disposition in WARM
Plain Corrugated Cardboard (OCC)	Corrugated Containers	Paper	Readily Recyclable	Recycle
Waxed Corrugated Cardboard (OCC)	Corrugated Containers	Paper	Readily Recyclable	Recycle
Low-Grade Recyclable Paper	Magazines/Third-class Mail	Paper	Readily Recyclable	Recycle
Newspaper (ONP)	Newspaper	Paper	Readily Recyclable	Recycle
High-Grade Paper	Office Paper	Paper	Readily Recyclable	Recycle
Mixed/Other Food Waste, Edible	Food Waste (non-meat)	Food Waste	Readily Recyclable	Compost
Mixed/Other Food Waste, Non-edible	Food Waste (non-meat)	Food Waste	Readily Recyclable	Compost
Meat, Edible	Food Waste (meat only)	Food Waste	Readily Recyclable	Compost
Meat, Non-edible	Food Waste (meat only)	Food Waste	Readily Recyclable	Compost
Fruits & Vegetables, Edible	Fruits and Vegetables	Food Waste	Readily Recyclable	Compost
Fruits & Vegetables, Non-edible	Fruits and Vegetables	Food Waste	Readily Recyclable	Compost
Homegrown Fruits & Vegetables	Fruits and Vegetables	Food Waste	Readily Recyclable	Compost
Yard Waste	Yard Trimmings	Yard Trimmings	Readily Recyclable	Compost
Large Prunings	Branches	Yard Trimmings	Readily Recyclable	Compost
Stumps	Branches	Yard Trimmings	Readily Recyclable	Compost
HDPE Bottles	HDPE	Mixed Plastics	Readily Recyclable	Recycle
Other HDPE Containers	HDPE	Mixed Plastics	Readily Recyclable	Recycle
Other PET Containers	PET	Mixed Plastics	Readily Recyclable	Recycle
PET Bottles	PET	Mixed Plastics	Readily Recyclable	Recycle
#3 Packaging	Mixed Plastics	Mixed Plastics	Readily Recyclable	Recycle
#4 Packaging	Mixed Plastics	Mixed Plastics	Readily Recyclable	Recycle
#5 Packaging	Mixed Plastics	Mixed Plastics	Readily Recyclable	Recycle
Other #6 Packaging (non-EPS)	Mixed Plastics	Mixed Plastics	Readily Recyclable	Recycle
Other #7 Packaging (non-compostable/non-PLA)	Mixed Plastics	Mixed Plastics	Readily Recyclable	Recycle
Other EPS Packaging	Mixed Plastics	Mixed Plastics	Readily Recyclable	Recycle
Recyclable Plastic Bags	Mixed Plastics	Mixed Plastics	Readily Recyclable	Recycle
Non-Industrial Packaging Film Plastic	Mixed Plastics	Mixed Plastics	Readily Recyclable	Recycle
Industrial Packaging Film Plastic	Mixed Plastics	Mixed Plastics	Readily Recyclable	Recycle
Single-Resin Plastic Products	Mixed Plastics	Mixed Plastics	Limited Recyclability	Recycle
Compostable Plastics	PLA	Bioplastics	Readily Recyclable	Compost
CPUs	Desktop CPUs	Electronics	Readily Recyclable	Recycle
Cell Phones	Portable Electronic Devices	Electronics	Readily Recyclable	Recycle
Laptops	Portable Electronic Devices	Electronics	Readily Recyclable	Recycle
Tablets	Portable Electronic Devices	Electronics	Readily Recyclable	Recycle
Other Computer Monitors & TVs (LCDs, etc.)	Flat-Panel Displays	Electronics	Readily Recyclable	Recycle
CRT Computer Monitors & TVs	CRT Displays	Electronics	Readily Recyclable	Recycle
Computer Peripherals	Electronic Peripherals	Electronics	Readily Recyclable	Recycle
Printers/Copiers/Fax Machines	Hard-Copy Devices	Electronics	Readily Recyclable	Recycle
A/V Equipment	Mixed Electronics	Electronics	Readily Recyclable	Recycle
Other Electronics	Mixed Electronics	Electronics	Readily Recyclable	Recycle
Small Household Appliances	Mixed Electronics	Electronics	Readily Recyclable	Recycle
Aluminum Cans	Aluminum Cans	Metals	Readily Recyclable	Recycle
Other Aluminum	Aluminum Ingot	Metals	Readily Recyclable	Recycle
Other Non-Ferrous	Aluminum Ingot	Metals	Readily Recyclable	Recycle
Other Ferrous	Steel Cans	Metals	Readily Recyclable	Recycle
Tinned Food Cans	Steel Cans	Metals	Readily Recyclable	Recycle
Compressed Gas Cylinders	Mixed Metals	Metals	Readily Recyclable	Recycle
Mixed Metals (>80% metal, <20% non-metal)	Mixed Metals	Metals	Readily Recyclable	Recycle
Brown Glass Containers	Glass	Glass	Readily Recyclable	Recycle
Clear Glass Containers	Glass	Glass	Readily Recyclable	Recycle
Green Glass Containers	Glass	Glass	Readily Recyclable	Recycle
Asphalt Shingles	Asphalt Shingles	Construction Materials	Limited Recyclability	Recycle
Carpet	Carpet	Construction Materials	Limited Recyclability	Recycle
Carpet Padding	Carpet	Construction Materials	Limited Recyclability	Recycle
Dimensional Lumber/Engr. Wood	Dimensional Lumber	Construction Materials	Readily Recyclable	Recycle
Gypsum Wallboard	Drywall	Construction Materials	Limited Recyclability	Recycle
Tires	Tires	Tires	Readily Recyclable	Recycle
Furniture	Mixed Recyclables	Mixed Materials	Limited Recyclability	Recycle
Household Batteries	Mixed Recyclables	Mixed Materials	Readily Recyclable	Recycle
Latex Paint	Mixed Recyclables	Mixed Materials	Limited Recyclability	Recycle
Mattresses	Mixed Recyclables	Mixed Materials	Readily Recyclable	Recycle
Oil-based Paint	Mixed Recyclables	Mixed Materials	Readily Recyclable	Recycle
Other Textiles	Mixed Recyclables	Mixed Materials	Readily Recyclable	Recycle
Other Wood	Mixed Recyclables	Mixed Materials	Limited Recyclability	Recycle
Solvents and Thinners	Mixed Recyclables	Mixed Materials	Readily Recyclable	Recycle
Textiles: Clothes & Other Recy.	Mixed Recyclables	Mixed Materials	Readily Recyclable	Recycle
Used Oil	Mixed Recyclables	Mixed Materials	Readily Recyclable	Recycle
Vehicle Batteries	Mixed Recyclables	Mixed Materials	Readily Recyclable	Recycle
Single-Use Food Service Compostable	Mixed Organics	Mixed Materials	Readily Recyclable	Compost
Other Compostable Paper	Mixed Organics	Mixed Materials	Readily Recyclable	Compost
Other Compostables	Mixed Organics	Mixed Materials	Readily Recyclable	Compost

The results from the model depend not only on the composition of materials in the analysis, but also on the characteristics of the landfill and transportation methods. For this analysis, Cascadia assumed the following factors, as also used in the 2015 waste characterization study:

- An emissions factor for electricity based on the average Pacific-region grid; this factor is used to calculate the avoided emissions associated with power production from landfill gas (LFG) capture and recovery. WARM likely overestimates the benefits of LFG capture in Washington State due to the high level of hydroelectric power and low levels of coal power in the state.
- A landfill gas (LFG) collection efficiency based on landfill management standards that meet California regulatory requirements, the highest level of LFG collection efficiency in the model.
- A decomposition rate of materials in the landfill based on wet conditions, greater than 40 inches of precipitation per year.
- Transportation distances for materials from the curb to its end-of-life management facility as shown in Table 83; travel distances were assumed to be the same as in the 2015 King County waste characterization study for comparability. WARM assumes that diesel fuel vehicles are used and calculates emissions factors, though emissions in King County may be different due to use of compressed natural gas (CNG) in many collection vehicles. WARM also does not account for the emissions from shipping recyclables to markets overseas.

Table 83: Modeled Transportation Distances

Materials Management Facility	Estimated Travel Distance (miles)
Landfill	24.51
Combustion	29.55
Recycling	21.64
Composting	31.46

The GHG emissions analysis also includes emissions from process energy for equipment used to handle materials at compost facilities, recycling processors, and landfills. The GHG emissions *reduction* analysis also considered:

- Carbon storage in landfills and increase in soil carbon storage from applying compost to soils.[15]
- Forest carbon storage from recycling of paper products, which result in annual tree harvests declining below otherwise anticipated levels.
- Fugitive emissions from composting.

Most emission factors support increased diversion, as recycling typically requires less energy than manufacturing using virgin materials. For some organic materials, such as leaves and branches, the model shows landfilling with methane capture results in greater net reductions in greenhouse gases than composting. WARM focuses on GHG emissions and does not reflect other benefits of composting, such as soil and plant health.

[15] For quantitative soil carbon estimates for WARM, EPA used Century, a soil organic matter model, to simulate and calculate soil carbon storage from various composting scenarios.

Greenhouse Gas Emissions Estimates

Recovered Tons

The analysis used WARM to model the potential changes in GHG emissions when 25%, 50%, and 75% of an individual material was diverted from landfill disposal to recycling or composting, as appropriate depending on the material.

Table 84 lists in the "Baseline Disposed" column how many tons of each material type franchised haulers and self-haul customers in King County disposed in 2019. The subsequent three columns, "Recovered at 25% Diversion," "Recovered at 50% Diversion," and "Recovered at 75% Diversion," specify the tonnages used in the GHG analysis for each modeled diversion level. The diversion level specifies the quantity of the remaining disposed material that gets diverted. For example, an estimated 22,825 tons of *steel cans* were disposed annually. If 25% by weight of those *steel cans* were recovered, that would be an additional 5,706 tons of *steel cans* recovered.

Table 84. Recovered Tons at Each Modeled Diversion Level

WARM Material Types	Tons			
	Baseline Disposed	Recovered at 25% Diversion	Recovered at 50% Diversion	Recovered at 75% Diversion
Corrugated Containers	33,921	8,480	16,961	25,441
Magazines/Third-class Mail	51,675	12,919	25,838	38,757
Newspaper	2,737	684	1,368	2,052
Office Paper	4,185	1,046	2,092	3,138
Food Waste (non-meat)	71,681	17,920	35,840	53,761
Food Waste (meat only)	14,813	3,703	7,406	11,110
Fruits and Vegetables	47,988	11,997	23,994	35,991
Yard Trimmings	21,946	5,487	10,973	16,460
Branches	5,136	1,284	2,568	3,852
HDPE	5,356	1,339	2,678	4,017
PET	9,617	2,404	4,809	7,213
Mixed Plastics	69,098	17,275	34,549	51,824
PLA	835	209	418	626
Desktop CPUs	506	127	253	380
Portable Electronic Devices	123	31	62	93
Flat-Panel Displays	0	0	0	0
CRT Displays	443	111	221	332
Electronic Peripherals	146	37	73	110
Hard-copy Devices	369	92	184	276
Mixed Electronics	4,510	1,127	2,255	3,382
Aluminum Cans	2,627	657	1,313	1,970
Aluminum Ingot	3,882	970	1,941	2,911
Steel Cans	22,825	5,706	11,413	17,119
Mixed Metals	14,484	3,621	7,242	10,863
Glass	11,031	2,758	5,515	8,273
Asphalt Shingles	4,435	1,109	2,217	3,326
Carpet	10,040	2,510	5,020	7,530
Dimensional Lumber	60,613	15,153	30,306	45,460
Drywall	9,908	2,477	4,954	7,431
Tires	900	225	450	675
Mixed Recyclables	84,069	21,017	42,034	63,052
Mixed Organics	50,418	12,604	25,209	37,813
Total WARM Materials - diverted	**0**	**155,079**	**310,158**	**465,237**
Total WARM Materials - landfilled	620,317	465,237	310,158	155,079
Mixed MSW	248,216	248,216	248,216	248,216
Total MSW (WARM + MSW)	**868,532**	**868,532**	**868,532**	**868,532**

Estimated Changes in GHG Emissions

The change in GHG emissions for each material is measured in metric tons of carbon dioxide equivalent ($MtCO_2e$) and shown in Table 85. (Note that metric tons are the units used in WARM; King County's greenhouse gas inventory reports in megagrams of carbon dioxide equivalent, $MgCO_2e$, which are equivalent to one million grams, one thousand kilograms, or one metric ton.) For the emissions associated with the baseline tons, negative values indicate that landfilling is a net carbon sink ("good"), and positive values indicate that landfilling is a net carbon source ("bad") for that materials. These values assume high landfill gas collection at Cedar Hills landfill and estimated avoided emissions associated with power production from LFG capture and recovery. As noted above, WARM likely overestimates the benefits of LFG capture in Washington State due to the high level of hydroelectric power and low levels of coal power in the state.

The magnitude of the reduction (or increase) in GHG emissions per material depends on both the quantity of the material diverted and the material itself. Each material has a different GHG emission reduction potential based on how readily it degrades in the landfill, how far it travels to market, and other factors. *Dimensional Lumber* showed the greatest reduction potential (-84,733 $MtCO_2e$ at 25% diversion) among materials that can be diverted through increased recycling. This material was followed by *Mixed Recyclables* (-83,060 $MtCO_2e$ at 25% diversion). These materials offer greater reduction potential at 25%, 50%, and 75% diversion rates. Larger negative numbers, as seen in the diversion scenarios, indicate greater greenhouse gas reduction benefits.

Diverting 25% of each material in Table 85 from disposal results in net reduction of 220,090 $MtCO_2e$ per year; this equals the annual emissions from over 47,500 passenger vehicles or the emissions from the electricity used by about 37,260 homes for a year.[16]

[16] Equivalencies calculated using the U.S. EPA *Greenhouse Gas Equivalencies Calculator* available at www.epa.gov/energy/greenhouse-gas-equivalencies-calculator and the equivalencies built into the WARM model.

Table 85. Change in Metric Tons CO_2e Greenhouse Gas Emissions at Each Modeled Diversion Level

WARM Material Types	Baseline GHG Tons ($MtCO_2e$) Under Current Waste	GHG Tons ($MtCO_2e$) from Alternative Scenarios		
		at 25% Diversion	at 50% Diversion	at 75% Diversion
Corrugated Containers	-10,682	-34,597	-58,512	-82,427
Magazines/third-class mail	-30,254	-62,343	-94,432	-126,522
Newspaper	-2,844	-3,986	-5,127	-6,269
Office Paper	1,697	-1,723	-5,143	-8,563
Food Waste (non-meat)	20,967	12,603	4,240	-4,124
Food Waste (meat only)	4,333	2,604	876	-852
Fruits and Vegetables	14,037	8,437	2,838	-2,761
Yard Trimmings	-6,585	-5,732	-4,878	-4,025
Branches	-4,148	-3,297	-2,445	-1,594
HDPE	113	-1,057	-2,227	-3,397
PET	203	-2,608	-5,419	-8,229
Mixed Plastics	1,456	-16,711	-34,878	-53,046
PLA	-1,371	-1,059	-747	-435
Desktop CPUs	11	-180	-372	-563
Portable Electronic Devices	3	-31	-64	-98
CRT Displays	9	-56	-122	-188
Electronic Peripherals	3	-11	-26	-40
Hard-Copy Devices	8	-46	-100	-154
Mixed Electronics	95	-818	-1,731	-2,644
Aluminum Cans	55	-5,953	-11,960	-17,968
Aluminum Ingot	82	-6,929	-13,940	-20,951
Steel Cans	481	-10,092	-20,664	-31,237
Mixed Metals	305	-15,670	-31,645	-47,620
Glass	232	-586	-1,405	-2,223
Asphalt Shingles	93	-29	-152	-274
Carpet	212	-5,818	-11,849	-17,879
Dimensional Lumber	-63,120	-84,733	-106,346	-127,958
Drywall	-597	-382	-167	47
Tires	19	-70	-160	-249
Mixed Recyclables	-30,991	-83,060	-135,129	-187,198
Mixed Organics	1,260	-1,076	-3,412	-5,749
Mixed MSW	4,496	4,496	4,496	4,496
Total	**-100,423**	**-320,513**	**-540,603**	**-760,693**
Net GHG Reductions	NA	**-220,090**	**-440,180**	**-660,270**

** For greenhouse gas emissions, negative values indicate that landfilling—assuming high landfill gas collection efficiency at Cedar Hills landfill—represents a net carbon sink ("good"), and positive values indicate that landfilling is a net carbon source ("bad") for that material. Larger negative numbers, as seen in the diversion scenarios, indicate greater greenhouse gas reduction benefits.*