City of Seattle

2021-22 Residential and Commercial Organics Composition Study

FINAL July 2023

CASCADIA
CONSULTING GROUP

ACKNOWLEDGMENTS

To the management and staff in the following facilities and organizations, we thank you for your support and guidance during these challenging times.

- Seattle Public Utilities (SPU) – Solid Waste, Finance, Transfer Station Operations
- WM – Routing and Hauling
- Recology – Routing and Hauling
- Sky Valley Associates (SVA)
- Eco-Lógica

LINKS TO PREVIOUS REPORTS

All past reports on Seattle's solid waste composition studies are available on the Seattle Public Utilities website.[1] Links to the two previous organics stream studies are below. *Please note that links were published in July 2023 and are subject to change.*

- **2016 Organics Stream Composition Study**
  https://www.seattle.gov/documents/Departments/SPU/Documents/Reports/Organics%20Composition%20Study_2016.pdf
- **2012 Organics Stream Composition Study**
  https://www.seattle.gov/documents/Departments/SPU/Documents/Reports/OrganicsStreamCompositionStudy2012.pdf

[1] www.seattle.gov/utilities/about/reports/solid-waste/composition-studies

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EXECUTIVE SUMMARY

Why did we do this study?

This 2021–22 organics stream composition study is the City of Seattle's third study since 2012 to provide statistically reliable data on the composition of organics collected from its single-family residential, multifamily residential, and commercial customer sectors. Along with studies of garbage and recycling streams, these studies help Seattle Public Utilities (SPU) better understand the types and quantities of waste generated to measure progress and inform future waste prevention and diversion goals, programs, and policies.

How did we do this study?

In 2021–22, Cascadia Consulting Group (Cascadia) carried out six seasonal sampling events in which field teams collected 615 samples of material set out for SPU-contracted organics collection. These samples included 202 from single-family homes, 210 from multifamily properties, and 203 from commercial businesses. Single-family samples were collected from organics collection trucks, while multifamily and commercial samples were collected directly from customer carts.[2] The residential study began in September 2021, and the commercial study was delayed until January 2022 to give businesses more time to recover from the COVID-19 pandemic.

Cascadia hand-sorted these samples into 26 specific material types that were grouped into four broad material classes and three recoverability classes. Many charts in the analysis further break down the compostable recoverability class into three groups: yard waste, food waste, and other compostables. These charts also combine non-compostable and potentially recoverable materials into contaminants, meaning materials that do not belong in the organics cart.

Cascadia used an industry-standard weighted-average procedure to calculate composition estimates for each sector overall and by season and collection zone within each sector.[3] Appendix A describes the study methodology and Appendix B presents the material list.

How many tons of organics are collected?

During the residential organics study period (September 2021 to August 2022), haulers WM and Recology collected 85,935 tons of material from single-family homes through SPU-contracted

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[2] This study only included materials residents and commercial customers set out in carts, not dumpsters. For more details, please refer to Appendix A for more details.

[3] To keep figures readable, estimated tonnages are rounded to the nearest ton, and estimated percentages are rounded to the nearest percent or tenth of a percent. In tables, estimated tonnages are rounded to the nearest tenth of a ton. Numbers in the text use the same rounding as the figure or table being referenced. Percentages less than 0.05% are shown as 0.0%. True zeros in tables are displayed as a dash ("–"). As a result, using the rounded percentages to calculate tonnages or sums may yield results that differ from the numbers shown in the report.

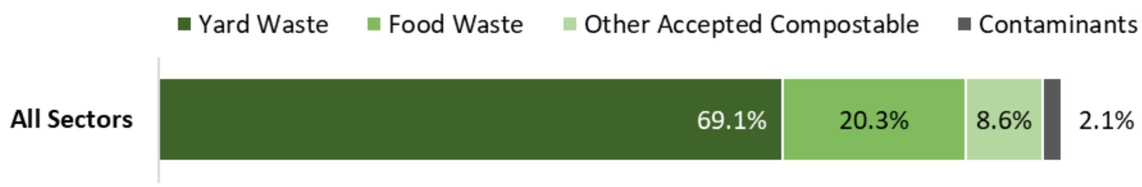
cart organics collection service and 3,986 tons from multifamily properties with SPU-contracted cart organics collection service. During the commercial study period (January to December 2022), haulers collected 4,893 tons from commercial businesses through SPU-contracted cart organics collection service.

This study excluded organics collected through services outside of SPU's contracts, such as businesses with private contracts with haulers. In 2022, an estimated 92% of commercial organic (53,778 tons) material collected were collected through private contracts between businesses and haulers, which are not reflected in these study results.

How much of the organics stream is compostable?

Compostable materials include only items that are currently accepted in SPU's residential and commercial sector compost collection programs. They do not include items categorized as potentially compostable or non-compostable. For all sectors combined, 97.9% of materials collected through the SPU-contracted organics stream were compostable (Figure 1). The largest share was yard waste (69.1%) followed by food waste (20.3%). Because the commercial and residential studies occurred in different timeframes, this analysis presents composition percentages but not tons.

Figure 1. Compostability Group Composition: All Sectors

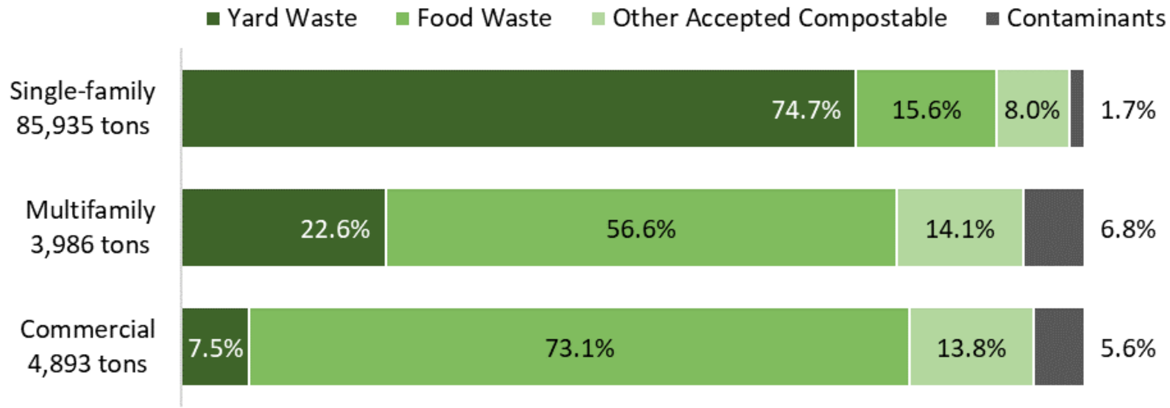


Single-family: 98.3% (84,455 tons) were compostable (Figure 2). The largest share was yard waste (74.7%; 64,207 tons), followed by food waste (15.6%; 13,374 tons).

Multifamily: 93.2% (3,715 tons) were compostable. The largest share was food waste 56.6%; 2,255 tons), followed by yard waste (22.6%; 899 tons).

Commercial: 94.4% (4,618 tons) were compostable. The largest share was food waste (73.1%; 3,575 tons), followed by other accepted compostable items (13.8%; 677 tons). Other accepted compostable items include uncoated paper and certified compostable paper and plastic items.

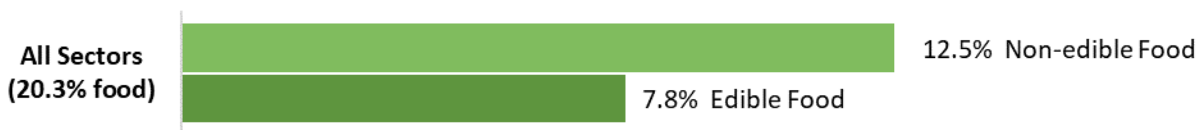
Figure 2. Compostability Group Composition by Sector



How much edible food is in the organics stream?

SPU is supportive of state and regional goals to reduce food waste and is developing its own metrics and targets around food waste. The 2021–22 organics study estimated how much of the organics stream was food including edible food, such as whole fruits and meat, and non-edible food, such as fruit peels and eggshells. For all sectors combined (Figure 3), 20.3% was food, which included edible food (7.8%) and non-edible food (12.5%). Figure 4 shows results of each of the three sectors separately.

Figure 3. Edible and Inedible Food Waste: All Sectors

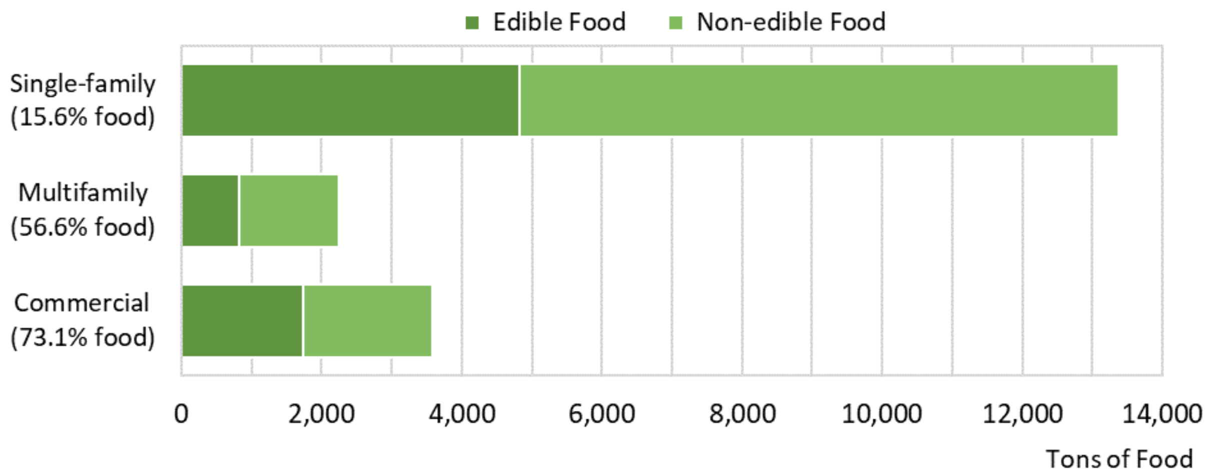


Single-family: 15.6% (13,374 tons) was food, which included edible food (5.6%; 4,823 tons) and non-edible food (10%; 8,551).

Multifamily: 56.6% (2,255 tons) was food, which included edible food (20.5%; 817 tons) and non-edible food (36.1%; 1,438 tons).

Commercial: 73.1% (3,575 tons) was food, which included edible food (35.4%; 1,732 tons) and non-edible food (37.7%; 1,843 tons).

Figure 4. Edible and Inedible Food Waste by Sector



What are the most common contaminants in organics?

For the 2021–22 organics study, contaminants include non-compostable material types and potentially compostable paper and plastic. For all sectors combined, 2.1% of collected materials were contaminants. The most common contaminant material types were potentially compostable paper (0.6%), other non-recoverable waste (0.3%), and pet waste (0.2%). Other non-recoverable waste includes materials not otherwise categorized such as non-recyclable glass, hazardous waste, and diapers.

Single-family organics: 1.7% (1,480 tons) were contaminants. The most common material types were potentially compostable paper (0.6%), other non-recoverable waste (0.2%), and recyclable plastic containers (0.2%).

Multifamily organics: 6.8% (270 tons) were contaminants. The most common material types were other non-recoverable waste (1.6%), pet waste (1.4%), and potentially compostable paper (1.3%).

Commercial organics: 5.6% (276 tons) were contaminants. The most common material types were potentially compostable paper (1.1%), pet waste (0.8%), and non-compostable film (0.8%).

What materials are most common in the organics stream?

Table 1 presents the detailed composition results for all sectors combined for organics collected through SPU contracts. For all sectors combined, the most common material type by weight was grass/leaves (65.0%). The rest of the three most common material types for all sectors combined were inedible vegetative food (11.6%) and universally compostable paper (4.3%).

Table 1. Organics Composition: All Sectors

Material	Est. %	+ / -	Material	Est. %	+ / -
Organics	**90.4%**	**0.5%**	**Plastic**	**1.5%**	**0.1%**
Grass/Leaves	65.0%	1.7%	Approved Single-use Plastic Packaging	0.4%	0.0%
Prunings	4.0%	0.8%	Compostable Film	0.6%	0.1%
Packaged Edible Vegetative Food	0.1%	0.0%	Potentially Compostable Plastic	0.1%	0.0%
Non-packaged Edible Vegetative Food	3.3%	0.3%	Non-compostable Film	0.2%	0.0%
Packaged Edible Other Food	0.3%	0.1%	Recyclable Plastic Containers	0.2%	0.0%
Non-packaged Edible Other Food	4.1%	0.4%	Other Non-recoverable Plastic	0.1%	0.0%
Inedible Vegetative Food	11.6%	0.9%	**Other**	**0.7%**	**0.1%**
Inedible Other Food	0.9%	0.1%	Recyclable Glass	0.1%	0.0%
Fats, Oils, & Grease	0.0%	0.0%	Recyclable Metal	0.1%	0.0%
Other Compostable Organics	1.1%	0.3%	Pet Waste	0.2%	0.1%
Paper	**7.3%**	**0.4%**	Other Non-recoverable Waste	0.3%	0.1%
Universally Compostable Paper	4.3%	0.2%			
Mixed Recyclable Paper	2.1%	0.2%	**Compostable**	**97.9%**	0.2%
Approved Single-use Paper Packaging	0.1%	0.0%	**Potentially Compostable**	**0.7%**	0.1%
Potentially Compostable Paper	0.6%	0.1%	**Non-compostable**	**1.4%**	0.1%
Polycoated Paper	0.2%	0.0%	**Estimated Total**	**100%**	
Other Non-compostable Paper	0.1%	0.0%	Sample Count	615	

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

Table 2 presents the detailed composition results for single-family, multifamily, and commercial organics collected through SPU contracts. For all three sectors, the largest material class was organics (79.4% to 91.5%), which is primarily yard and food waste. Paper (6.7% to 13.4%) was the second largest material class for all three sectors. The most common material types varied across the sectors.

Single-family: The most common material type was grass/leaves (70.4%). The second and third most common material types were inedible vegetative food (9.4%) and prunings (4.3%).

Multifamily: The two most common material types were inedible vegetative food (33.4%) and grass/leaves (21.5%). The third most common material type was non-packaged edible other food (10.3%).

Commercial: The two most common material types were inedible vegetative food (32.5%) and non-packaged edible other food (26.4%). The third most common material type was universally compostable paper (9.9%).

Table 2. Organics Composition by Sector

	Single-family 2021-2022			Multifamily 2021-2022			Commercial 2022		
	Est. %	+ / -	Est. Tons	Est. %	+ / -	Est. Tons	Est. %	+ / -	Est. Tons
Compostable	**98.3%**	0.2%	**84,455.0**	**93.2%**	1.3%	**3,715.4**	**94.4%**	1.3%	**4,617.5**
Potentially Compostable	**0.7%**	0.1%	**569.2**	**1.6%**	0.2%	**63.4**	**1.4%**	0.4%	**66.3**
Non-compostable	**1.1%**	0.1%	**910.6**	**5.2%**	1.3%	**206.7**	**4.3%**	1.2%	**209.4**
Organics	**91.5%**	**0.5%**	**78,619.1**	**79.4%**	**1.7%**	**3,166.3**	**80.8%**	**2.0%**	**3,955.0**
Grass/Leaves	70.4%	1.8%	60,521.3	21.5%	3.4%	858.4	5.4%	2.5%	265.8
Prunings	4.3%	0.8%	3,685.5	1.0%	0.5%	40.8	2.0%	1.9%	99.8
Packaged Edible Vegetative Food	0.1%	0.0%	54.8	0.5%	0.3%	18.6	0.2%	0.1%	7.6
Non-packaged Edible Vegetative Food	2.8%	0.3%	2,396.6	8.2%	0.9%	325.7	7.4%	1.8%	363.3
Packaged Edible Other Food	0.2%	0.1%	155.8	1.6%	0.5%	62.6	1.5%	0.8%	71.5
Non-packaged Edible Other Food	2.6%	0.4%	2,215.8	10.3%	1.7%	410.6	26.4%	3.5%	1,289.8
Inedible Vegetative Food	9.4%	0.9%	8,067.4	33.4%	2.4%	1,330.0	32.5%	3.6%	1,591.4
Inedible Other Food	0.6%	0.1%	479.9	2.7%	0.6%	106.4	5.1%	1.4%	250.6
Fats, Oils, & Grease	0.0%	0.0%	3.5	0.0%	0.0%	1.4	0.0%	0.0%	0.9
Other Compostable Organics	1.2%	0.3%	1,038.6	0.3%	0.2%	11.8	0.3%	0.2%	14.3
Paper	**6.7%**	**0.4%**	**5,783.1**	**13.2%**	**0.9%**	**526.7**	**13.4%**	**1.4%**	**654.0**
Universally Compostable Paper	3.9%	0.3%	3,318.6	8.0%	0.7%	319.5	9.9%	1.1%	486.1
Mixed Recyclable Paper	2.1%	0.2%	1,774.2	3.4%	0.3%	134.4	1.3%	0.2%	62.8
Approved Single-use Paper Packaging	0.0%	0.0%	29.8	0.1%	0.0%	3.6	0.4%	0.5%	18.3
Potentially Compostable Paper	0.6%	0.1%	500.6	1.3%	0.2%	53.6	1.1%	0.3%	51.4
Polycoated Paper	0.1%	0.0%	109.8	0.2%	0.0%	7.1	0.6%	0.3%	29.9
Other Non-compostable Paper	0.1%	0.0%	50.1	0.2%	0.1%	8.6	0.1%	0.1%	5.5
Plastic	**1.3%**	**0.1%**	**1,117.2**	**4.0%**	**0.5%**	**161.4**	**3.9%**	**0.5%**	**190.4**
Approved Single-use Plastic Packaging	0.4%	0.0%	311.0	1.0%	0.1%	38.3	0.3%	0.1%	17.0
Compostable Film	0.5%	0.1%	402.3	1.3%	0.1%	53.4	1.6%	0.2%	78.4
Potentially Compostable Plastic	0.1%	0.0%	68.5	0.2%	0.0%	9.9	0.3%	0.1%	14.9
Non-compostable Film	0.2%	0.0%	137.1	0.7%	0.3%	28.2	0.8%	0.2%	37.3
Recyclable Plastic Containers	0.2%	0.0%	144.8	0.5%	0.1%	21.2	0.4%	0.1%	21.1
Other Non-recoverable Plastic	0.1%	0.0%	53.5	0.3%	0.1%	10.4	0.4%	0.2%	21.7
Other	**0.5%**	**0.1%**	**415.3**	**3.3%**	**1.0%**	**131.2**	**1.9%**	**0.9%**	**93.9**
Recyclable Glass	0.0%	0.0%	33.4	0.2%	0.2%	7.4	0.3%	0.1%	13.0
Recyclable Metal	0.0%	0.0%	40.2	0.2%	0.1%	6.9	0.3%	0.1%	16.1
Pet Waste	0.2%	0.1%	135.7	1.4%	0.7%	55.1	0.8%	0.8%	37.5
Other Non-recoverable Waste	0.2%	0.1%	206.0	1.6%	0.6%	61.9	0.6%	0.3%	27.2
Estimated Total	**100%**		**85,934.8**	**100%**		**3,985.5**	**100%**		**4,893.2**
Sample Count			202			210			203

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

How has Seattle's organics stream changed over time?

Cascadia examined statistical differences between the 2016 and 2022 studies to determine if changes in the composition were statistically significant. Overall, there were very few statistically significant differences.

Single-family: Yard waste decreased from 78.6% to 74.7%. Food waste increased from 12.7% to 15.6%, and contaminants increased from 1.0% to 1.7%.

Multifamily and Commercial: There were no statistically significant differences.

OVERVIEW

Seattle Public Utilities (SPU) contracts with two haulers, Recology and WM, to collect recycling, food and yard waste, and garbage from residential and commercial customers located within Seattle.[4] Businesses are not required to subscribe to City-contracted collection services, but businesses that generate food waste or compostable paper must either self-haul or subscribe to compost collection services. Seattle also plans and implements programs and policies for waste prevention, recycling, and composting to eliminate or minimize waste and to manage the remaining waste responsibly. Comprehensive solid waste composition studies, such as this one, help SPU guide its materials management efforts and assess progress toward its goals.

Introduction and Background

In 1989, Seattle adopted its first solid waste plan with recommendations for managing and recovering waste that were informed by Seattle's first solid waste composition study conducted in 1988.[5] That first study included commercial, residential, and self-haul waste. Self-haul means material that businesses and residents deliver directly to transfer stations. Over the last three decades, SPU has conducted many more studies to build one of the most extensive datasets in the United States for guiding its role in municipal solid waste contract management, planning, implementation, and evaluation.

Seattle has encouraged composting for more than three decades. Yard debris such as leaves, grass, and plant trimmings have not been allowed in the garbage since 1989. Food and yard waste (or compost) collection service is required for nearly every home in Seattle. Since 2012, food and yard waste service has been required for all residential buildings, and since 2015, food and compostable paper have been prohibited in the garbage.[6]

This 2021–22 organics stream composition study (2021–22 organics study) is the third study to provide statistically reliable data on the composition of organics collected from residential and commercial customers in Seattle. These studies help SPU better understand the types and quantities of materials recovered for composting. SPU will use the results of this study to:

- Continue its long-term measurement of system performance and progress toward goals.
- Understand the potential for additional waste prevention and diversion to inform Seattle's Waste Prevention Strategic Plan and other future programs and policies.

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[4] Seattle Public Utilities, Business and Commercial Collection, https://www.seattle.gov/utilities/your-services/collection-and-disposal/garbage/business-and-commercial-collection

[5] Seattle Public Utilities, On the Road to Recovery: Seattle's Integrated Solid Waste Management Plan, 1989.

[6] Seattle Municipal Code prohibits the disposal of food scraps, compostable paper, yard waste, and recyclables in residential garbage (SMC 21.36.083 at https://library.municode.com/wa/seattle/codes/municipal_code?nodeId=TIT21UT_SUBTITLE_IIISOWA_CH21.36SOWACO_SUBCHAPTER_IISOWACO_21.36.083RERERE) and commercial garbage (SMC 21.36.082 at https://library.municode.com/wa/seattle/codes/municipal_code?nodeId=TIT21UT_SUBTITLE_IIISOWA_CH21.36SOWACO_SUBCHAPTER_IISOWACO_21.36.082CORERE).

- Inform the development of new metrics for quantifying waste prevention and diversion that SPU will use to replace its current weight-based 70% diversion rate goal.[7]

Study Overview

Cascadia Consulting Group (Cascadia) characterized material that was set out in carts for curbside organics collection by single-family residences, multifamily residences, and commercial businesses using SPU-contracted haulers from all four geographic collection zones in Seattle (Figure 5). This study includes commercial organics only from businesses that subscribe to organics service through SPU's collection contract.

Figure 5. Map of Collection Zones

(Adapted from https://www.seattle.gov/utilities/your-services/collection-and-disposal/garbage/business-and-commercial-collection)

This study excludes organics that residents and businesses self-hauled to Seattle's transfer stations or private composting facilities. It also excludes organics from the commercial sector collected by haulers outside SPU's contracts. An estimated 92% of commercial sector organics were collected outside of SPU's contracts in 2022.

From September 2021 to August 2022, SPU-contracted haulers collected 85,935 tons of organics from single-family homes and 3,986 tons from multifamily properties. In 2022, SPU-contracted haulers collected 4,893 tons from commercial businesses. Over six sampling events across all four seasons in 2021 and 2022, Cascadia collected and hand-sorted a total of 615 organics

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[7] Seattle City Council, Resolution 32082, https://seattle.legistar.com/View.ashx?M=F&ID=11980794&GUID=BE725536-B68B-4BB7-955B-06323DD335FE&G=FFE3B678-CEF6-4197-84AC-5204EA4CFC0C

samples: 202 from single-family, 210 from multifamily, and 203 from commercial customers. Cascadia sorted each sample into 26 specific material types across four broad material classes and three recoverability classes. Many charts in the analysis further break down the compostable recoverability class into three groups: yard waste, food waste, and other compostables. These charts also combine non-compostable and potentially recoverable materials into contaminants, meaning materials that do not belong in the organics cart.

Summary of Key Results

During the residential organics study period (September 2021 to August 2022), SPU-contracted haulers collected 85,935 tons of organics from single-family homes and 3,986 tons from multifamily properties. During the commercial study period (January to December 2022), SPU-contracted haulers collected 4,893 tons from commercial businesses.

For all sectors combined, 97.9% of materials collected through the SPU-contracted organics stream were compostable (Figure 6). The largest share was yard waste (69.1%) followed by food waste (20.3%). Because the commercial and residential studies occurred in different timeframes, this analysis presents composition percentages but not tons.

Figure 6. Compostability Group Composition: All Sectors

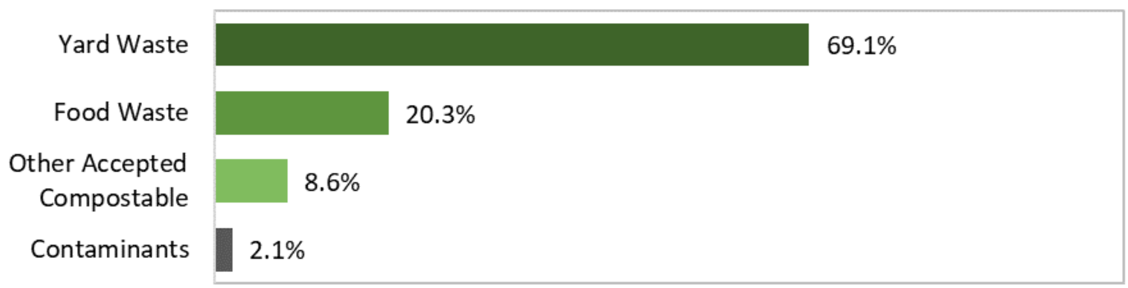
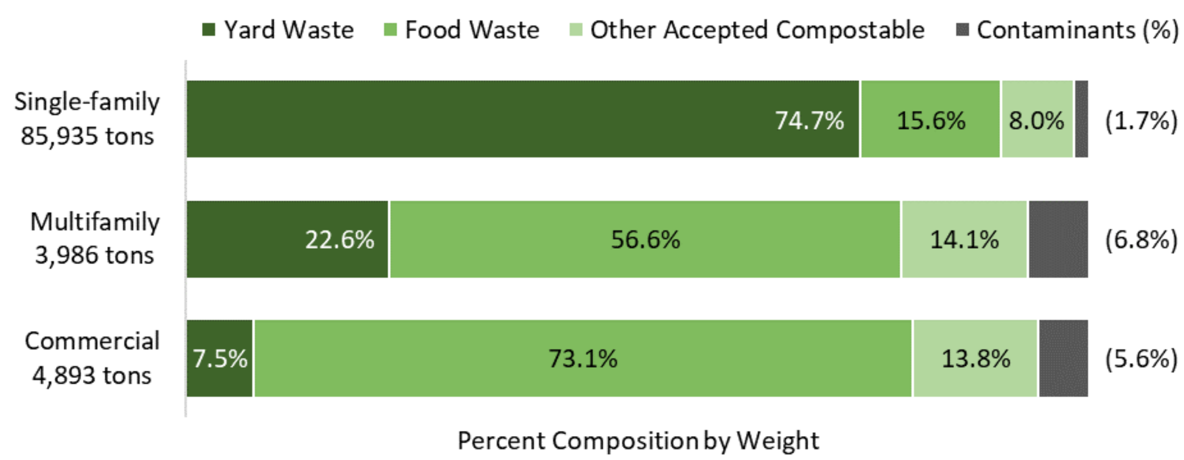


Figure 7 shows key results for each sector.

Figure 7. Compostability Group Composition by Sector



Single-family: 98.3% (84,455 tons) were compostable. The largest share was yard waste (74.7%; 64,207 tons), followed by food waste (15.6%; 13,374 tons).

Multifamily: 93.2% (3,715 tons) were compostable. The largest share was food waste (56.6%; 2,255 tons), followed by yard waste (22.6%; 899 tons).

Commercial: 94.4% (4,618 tons) were compostable. The largest share was food waste (73.1%; 3,575 tons), followed by other accepted compostable items (13.8%; 677 tons). Other accepted compostable items include uncoated paper and certified compostable paper and plastic food service ware.

Report Outline

- **Study Methodology** summarizes how Cascadia collected and analyzed data.
- **Composition Results** describes findings for 2021–22 composition results for organics for all sectors combined and by sector (single-family, multifamily, and commercial) and compares current results by sector to the 2016 study.
- **Appendix A** provides the detailed study methodology.
- **Appendix B** defines the 26 specific material types, four broad material classes, three recoverability classes, and changes from the previous 2016 study.
- **Appendix C** contains progress reports on samples collected for each sampling event.
- **Appendix D** contains detailed waste composition tables for all analyses conducted for sectors overall, by season, by zone, and by demographics.
- **Appendix E** shows example photos of samples with varying levels of contamination.
- **Appendix F** describes an analysis of whether the weather from the week before sampling was representative of average weather for the sampling month, to identify potential impacts on yard waste.

STUDY METHODOLOGY

This section summarizes the methodology for the 2022 organics study, including the approach to the study design, fieldwork, data analysis, and reporting. This section also describes differences in the study design and conditions compared to the 2016 organics study. Appendix A presents the study design with more details on the study methodology, and Appendix B lists the full material list, definitions, material classes, and recoverability classes.

Study Design

At the start of the project, SPU and Cascadia made key decisions about the study design. To the extent possible, we aligned methods and material definitions with past studies to be able to compare results. When developing the study design, SPU and Cascadia reviewed and updated:

- The material list with material types, material classes, and recoverability classes.
- Planned allocations of samples across seasons, collection zones, and other factors.
- Procedures for selecting and scheduling loads to sample.
- Procedures for collecting and sorting samples from loads.
- Fieldwork protocols for health and safety.

Cascadia classed material into 26 material types. The materials were grouped into four broad material classes for this 2022 organics study: organics, paper, plastic, and other. Each of the 26 material types was also categorized by recoverability class, defined in Table 3. Many charts in the analysis further break down the compostable recoverability class into three groups: yard waste, food waste, and other compostables. These charts also combine non-compostable and potentially recoverable materials into contaminants, meaning materials that do not belong in the organics cart.

Table 3. Recoverability Classes and Definitions

Compostable	Materials currently accepted in Seattle's composting program including yard waste, food waste, and other compostables. Other compostables include uncoated paper and items certified as compostable by Cedar Grove, the Biodegradable Products Institute, or the Compost Manufacturing Alliance. In this study, food waste included packaged food, although some packaging is a contaminant.
Potentially Compostable	Materials labeled as compostable or biodegradable but are not currently approved by SPU as compostable food service ware. These materials are considered contaminants.
Non-compostable	Materials that cannot be composted. They include recyclable materials and materials that should be disposed of as garbage.

Fieldwork

Cascadia collected and sorted a total of 615 samples over 6 sampling events: 202 single-family samples, 210 multifamily samples, and 203 commercial samples. Each sampling event consisted of four to five consecutive days once every season from September 2021 to December 2022. The four seasons are spring (March to May), summer (June to August), fall (September to November), and winter (December to February).

Selecting and Scheduling Loads to Sample

The study design set quotas to allocate samples proportionally across the three sectors, four seasons, and four geographical collection zones. Before each sampling day, Cascadia randomly pre-selected single-family organics collection routes for contracted haulers to deliver loads for sampling, including extra routes in case the originally selected routes could not be sampled. Cascadia also randomly pre-selected multifamily and commercial properties to collect samples from.

Composition study results for single-family and multifamily are based on a 12-month sampling period from September 2021 through August 2022. SPU delayed commercial organics sampling to January through December 2022 to allow businesses more time to recover from economic disruptions due to the COVID-19 pandemic. Table 4 describes the number of samples from each sector collected at each sampling event and Table 5 summarizes sample counts by sector, season, and zone.

Table 4. Sampling Calendar

Season	Sample Dates	Single-family	Mulitfamily	Commercial	Overall
Fall	9/20/21 - 9/23/21	53	42	-	**95**
Winter	12/6/21 - 12/9/21	48	58	-	**106**
Spring	4/5/22 - 4/8/22	51	52	-	**103**
	4/11/22 - 4/14/22	-	-	53	**53**
Summer	8/8/22 - 8/10/22	50	58	-	**108**
	8/15/22 - 8/18/22	-	-	50	**50**
Fall	10/10/22 - 10/13/22	-	-	50	**50**
Winter	12/5/22 - 12/7/22	-	-	50	**50**
Total Samples		**202**	**210**	**203**	**615**

Table 5. Sample Counts by Sector, Season, and Zone

	Single-family				Mulitfamily				Commercial		Overall
City Zone	1	2	3	4	1	2	3	4	1/4	2/3	All Zones
Winter	13	11	11	13	13	13	18	14	24	27	**157**
Spring	12	14	14	11	13	13	13	13	27	26	**156**
Summer	11	15	11	13	15	15	15	13	27	23	**158**
Fall	14	14	12	13	12	13	5	12	24	25	**144**
Total Samples	**50**	**54**	**48**	**50**	**53**	**54**	**51**	**52**	**102**	**101**	**615**

Collecting and Sorting Samples

For single-family sampling, the contracted haulers collected the material from the pre-selected routes and delivered it to the South Transfer Station for sampling. As the pre-selected route vehicle entered the facility, Cascadia verified information with the driver of the collection truck. A South Transfer Station staff person scooped up an approximately 200-pound sample of organics tipped from the vehicle and put it on a tarp for sorting.

For multifamily and commercial sampling, Cascadia collected material at pre-selected multifamily and commercial properties from carts ranging from 32 gallons to 96 gallons on the designated collection day. This study examined material only from organics carts because carts represent the vast majority of multifamily and commercial organics collection through SPU contracts, dumpsters are difficult collect samples from, and previous studies examined only organics carts. At each property, Cascadia emptied organics carts onto a tarp, then tied and labeled the contents as a single sample. The average sample weighed 50 pounds for multifamily and 46 pounds for commercial. Cascadia collected 12-13 samples per sampling day and delivered the samples to the South Transfer Station for sorting.

Cascadia then hand-sorted each sample into 26 material types and weighed them. The data was recorded electronically into a customized database and reviewed for data entry errors.

Data Analysis and Reporting

After each sampling event, Cascadia reviewed data again to identify and address anomalies or potential errors. At the end of the study, Cascadia calculated organics composition estimates in percentage compositions and tonnages. Cascadia developed composition estimates by aggregating sampling data with a weighted-average procedure that used 2021 and 2022 waste tonnage data provided by SPU. Please see Appendix A for more details on the study calculations, including the weighted-average process.

The analysis presents results in composition tables (see Table 9, Table 12, Table 16, and Table 19) with overall estimated percent composition of each material class and type by weight, including the 90 percent confidence interval for each material type. Appendix A presents the detailed formulas for how organics composition percentages were calculated. Cascadia calculated tonnages by material type by multiplying the estimated composition percentages by the estimated total tons of organics that SPU reported was collected by haulers during the study period for each sector or subgroup with the sector. Cascadia also calculated average pounds collected per household or unit per week using data from SPU on the number of single-family households and multifamily units in Seattle (Table 6).

Table 6. Single-family Household and Multifamily Units

	Single-family		Multifamily	
	Households	% total	Units	% total
Zone 1	47,390	14%	31,085	9%
Zone 2	32,510	10%	26,310	8%
Zone 3	37,489	11%	77,197	23%
Zone 4	56,751	17%	28,766	9%
All Zones	**174,140**	**52%**	**163,358**	**48%**

Cascadia also conducted statistical analysis comparing results from the 2022 study to results from the most recent 2016 organics study.

Differences from the 2016 Organics Study

The study design for the 2021-2022 study differed in some ways from the 2016 study, primarily in the material list used. Key updates in the 2021-2022 study were:

- Food material types were sub-divided into edible and non-edible food
- A new category was created for “fats, oils, and grease”
- “Disposable diapers” and “hazardous items” from the 2016 material list were merged with “other non-compostable, non-recyclable items”
- Potentially compostable paper and plastic were considered contaminants in 2021–2022 but not in 2016

COMPOSITION RESULTS

This section presents composition results in tonnages and percentages for material type, material class, recoverability class, and compostability group. Results from the 2021–22 study are presented in the following sector-specific sections:

- **Composition overall**, across all sectors and for each sector, includes a summary chart of composition by compostability group, detailed compositions of food waste and contaminant material classes, and a detailed composition table with all material types.
- **Composition by season and zone,** for individual sectors, summarizes how results varied across the four seasons (fall, winter, spring, and summer) and Seattle's four collection zones.
- **Composition by demographics**, for only the single-family sector, examines whether results varied by median household income or average household size.
- **Comparison with previous study section** uses statistical analysis to compare composition percentages by uniform material class groupings for the 2021–22 study with the 2016 organics study.

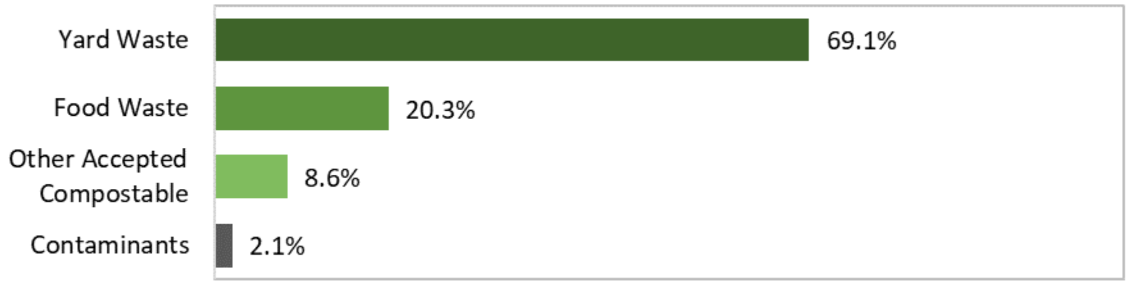
Composition tables presenting the estimated percentage of materials by weight also describe the 90% confidence interval for each material type. Estimated tonnages are rounded to the nearest ton, and estimated percentages are rounded to the nearest percent or tenth of a percent. Numbers in the text use the same rounding as the figure or table being referenced. Percentages less than 0.05% are shown as 0.0%. True zeros in tables are displayed as a dash ("–"). Using the rounded percentages to calculate tonnages or sums may yield results that differ from the numbers shown in the report.

Results for All Sectors Combined

This section summarizes the composition findings and analysis of 615 samples characterized from customers across all sectors using contracted collection. Because the commercial and residential sampling periods in this study occurred in different timeframes, this analysis presents composition percentages but not tons.

Overall, 97.9% of organics collected from all sectors were compostable. Yard waste was the largest share of contract-collected organics (69.1%), shown in Figure 8. Food waste was another 20.3%. Other accepted compostable items, which include uncoated paper and certified compostable paper and plastic products, made up 8.6% of organics for all sectors combined.

Figure 8. Compostability Group Composition: All Sectors



SPU is supportive of state and regional goals to reduce food waste and is developing its own metric and targets around food waste. Food waste made up 20.3% of organics for all sectors combined (Table 7). Edible food, such as whole fruits and meat, made up an estimated 7.8%, including both packaged and non-packaged food. Most edible food was not packaged (7.4% non-packaged vs. 0.4% packaged). Non-edible food, such as fruit peels and eggshells, made up 12.5%. Non-edible food was not divided into packaged versus non-packaged.

Table 7. Ranked Food Waste Material Types: All Sectors

Material	Est. %	+ / -
Edible Food	**7.8%**	
Non-packaged Edible Other Food	4.1%	0.4%
Non-packaged Edible Vegetative Food	3.3%	0.3%
Packaged Edible Other Food	0.3%	0.1%
Packaged Edible Vegetative Food	0.1%	0.0%
Non-edible Food	**12.5%**	
Inedible Vegetative Food	11.6%	0.9%
Inedible Other Food	0.9%	0.1%
Fats, Oils, & Grease	0.0%	0.0%
Total All Sectors Food	**20.3%**	**1.2%**

Contaminants made up 2.1% of contract-collected organics for all sectors combined (Table 8). Contaminants included potentially compostable materials (0.7%) and non-compostable materials (1.4%). The most common contaminant material types by weight were potentially compostable paper (0.6%), other non-recoverable waste (0.3%), and pet waste (0.2%). Other non-recoverable waste includes materials not otherwise categorized such as non-recyclable glass, hazardous waste, and diapers.

Table 8. Ranked Contaminants in Organics Stream: All Sectors

Material	Est. %	+ / -
Potentially Compostable Paper	0.6%	0.1%
Other Non-recoverable Waste	0.3%	0.1%
Pet Waste	0.2%	0.1%
Non-compostable Film	0.2%	0.0%
Recyclable Plastic Containers	0.2%	0.0%
Polycoated Paper	0.2%	0.0%
Potentially Compostable Plastic	0.1%	0.0%
Other Non-recoverable Plastic	0.1%	0.0%
Other Non-compostable Paper	0.1%	0.0%
Recyclable Metal	0.1%	0.0%
Recyclable Glass	0.1%	0.0%
All Sectors Total Contaminants	**2.1%**	**0.2%**

Table 9 presents the detailed composition results for contract-collected organics for all sectors combined. The largest material class was organics (90.4%). Paper made up 7.3% and plastic made up 1.5% of organics for all sectors combined.

The most common material type by weight was grass/leaves (65.0%). The rest of the five most common material types were inedible vegetative food (11.6%), universally compostable paper (4.3%), non-packaged edible other food (4.1%), and prunings (4.0%).

Table 9. Organics Composition: All Sectors

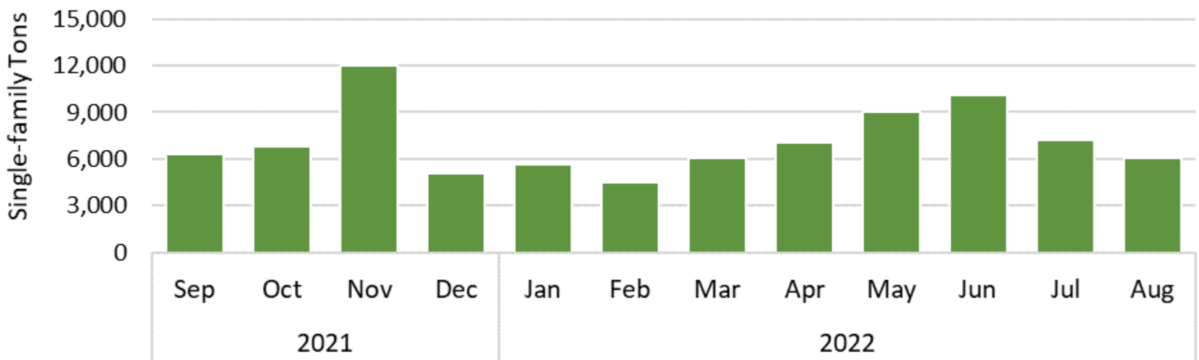
Material	Est. %	+ / -	Material	Est. %	+ / -
Organics	**90.4%**	**0.5%**	**Plastic**	**1.5%**	**0.1%**
Grass/Leaves	65.0%	1.7%	Approved Single-use Plastic Packaging	0.4%	0.0%
Prunings	4.0%	0.8%	Compostable Film	0.6%	0.1%
Packaged Edible Vegetative Food	0.1%	0.0%	Potentially Compostable Plastic	0.1%	0.0%
Non-packaged Edible Vegetative Food	3.3%	0.3%	Non-compostable Film	0.2%	0.0%
Packaged Edible Other Food	0.3%	0.1%	Recyclable Plastic Containers	0.2%	0.0%
Non-packaged Edible Other Food	4.1%	0.4%	Other Non-recoverable Plastic	0.1%	0.0%
Inedible Vegetative Food	11.6%	0.9%	**Other**	**0.7%**	**0.1%**
Inedible Other Food	0.9%	0.1%	Recyclable Glass	0.1%	0.0%
Fats, Oils, & Grease	0.0%	0.0%	Recyclable Metal	0.1%	0.0%
Other Compostable Organics	1.1%	0.3%	Pet Waste	0.2%	0.1%
Paper	**7.3%**	**0.4%**	Other Non-recoverable Waste	0.3%	0.1%
Universally Compostable Paper	4.3%	0.2%			
Mixed Recyclable Paper	2.1%	0.2%	**Compostable**	**97.9%**	0.2%
Approved Single-use Paper Packaging	0.1%	0.0%	**Potentially Compostable**	**0.7%**	0.1%
Potentially Compostable Paper	0.6%	0.1%	**Non-compostable**	**1.4%**	0.1%
Polycoated Paper	0.2%	0.0%	**Estimated Total**	**100%**	
Other Non-compostable Paper	0.1%	0.0%	Sample Count	615	

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

Single-family Results

This section summarizes the composition findings and analysis of 202 samples characterized from single-family customers during the study period. SPU's contractors collected 85,935 tons of organic material from the single-family residential sector between September 2021 and August 2022. Figure 9 shows tons by month during this period.

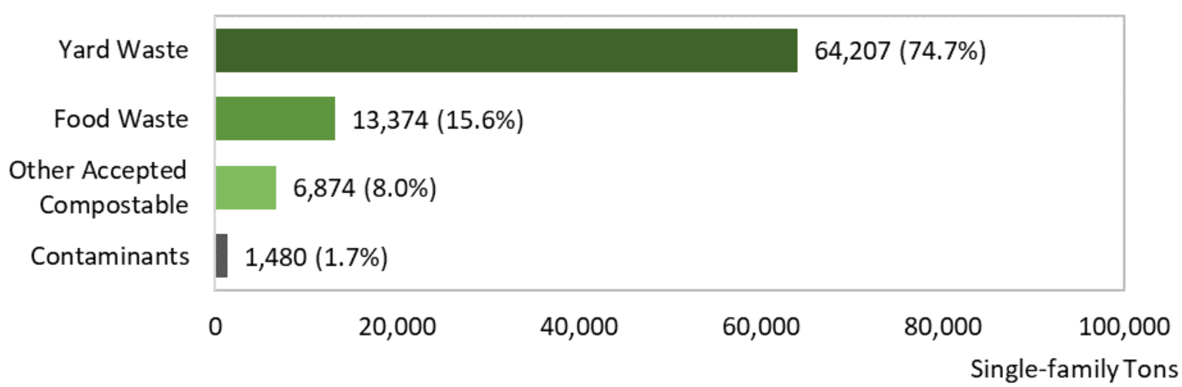
Figure 9. Monthly Contractor Collected Single-family Organics Tons



Single-family Composition Overall

Overall, 98.3% (84,455 tons) of single-family organics were compostable. Yard waste was the largest share of single-family organics (74.7%; 64,207 tons), shown in Figure 10. Food waste was another 15.6% (13,374 tons). Other accepted compostable items, which include uncoated paper and certified compostable paper and plastic products, made up 8.0% (6,874 tons) of single-family organics.

Figure 10. Compostability Group Composition: Single-family



Food made up 15.6% (13,373.7 tons) of single-family organics (Table 10). The most common individual food material type was inedible vegetative food (9.4%; 8,067.4 tons), which includes fruit peels and potato skins. Edible food made up an estimated 5.6% (4,823.0 tons), including both packaged and non-packaged food. Most edible food was not packaged (5.4 % non-packaged vs. 0.2% packaged). Non-edible food made up 10.0% (8,550.7 tons).

Table 10. Ranked Food Waste Material Types: Single-family

Material	Est. %	+ / -	Est. Tons
Edible Food	**5.6%**		4,823.0
Non-packaged Edible Vegetative Food	2.8%	0.3%	2,396.6
Non-packaged Edible Other Food	2.6%	0.4%	2,215.8
Packaged Edible Other Food	0.2%	0.1%	155.8
Packaged Edible Vegetative Food	0.1%	0.0%	54.8
Non-edible Food	**10.0%**		8,550.7
Inedible Vegetative Food	9.4%	0.9%	8,067.4
Inedible Other Food	0.6%	0.1%	479.9
Fats, Oils, & Grease	0.0%	0.0%	3.5
Total Single-family Food	**15.6%**	**1.3%**	**13,373.7**

Contaminants made up 1.7% (1,479.8 tons) of single-family organics (Table 11). Contaminants included potentially compostable materials (0.7%, 569.2 tons) and non-compostable materials (1.1%, 910.6 tons). The most common contaminant material types by weight were potentially compostable paper (0.6%), other non-recoverable waste (0.2%), and recyclable plastic containers (0.2%).

Table 11. Ranked Contaminants in Organics Stream: Single-family

Material	Est. %	+ / -	Est. Tons
Potentially Compostable Paper	0.6%	0.1%	500.6
Other Non-recoverable Waste	0.2%	0.1%	206.0
Recyclable Plastic Containers	0.2%	0.0%	144.8
Non-compostable Film	0.2%	0.0%	137.1
Pet Waste	0.2%	0.1%	135.7
Polycoated Paper	0.1%	0.0%	109.8
Potentially Compostable Plastic	0.1%	0.0%	68.5
Other Non-recoverable Plastic	0.1%	0.0%	53.5
Other Non-compostable Paper	0.1%	0.0%	50.1
Recyclable Metal	0.0%	0.0%	40.2
Recyclable Glass	0.0%	0.0%	33.4
Total Single-family Contaminants	**1.7%**	**0.2%**	**1,479.8**

Table 12 presents the detailed composition results for the single-family organics stream. The largest material class was organics (91.5%; 78.619.1 tons). Paper made up 6.7% (5,783.1 tons) and plastic made up 1.3% (1,117.2 tons) of single-family organics.

The most common material type by weight was grass/leaves (70.4%). The rest of the five most common material types were inedible vegetative food (9.4%), prunings (4.3%), universally compostable paper (3.9%), and non-packaged edible vegetative food (2.8%).

Table 12. Organics Composition: Single-family

Material	Est. %	+ / -	Est. Tons	Material	Est. %	+ / -	Est. Tons
Organics	**91.5%**	**0.5%**	**78,619.1**	**Plastic**	**1.3%**	**0.1%**	**1,117.2**
Grass/Leaves	70.4%	1.8%	60,521.3	Approved Single-use Plastic Packaging	0.4%	0.0%	311.0
Prunings	4.3%	0.8%	3,685.5	Compostable Film	0.5%	0.1%	402.3
Packaged Edible Vegetative Food	0.1%	0.0%	54.8	Potentially Compostable Plastic	0.1%	0.0%	68.5
Non-packaged Edible Vegetative Food	2.8%	0.3%	2,396.6	Non-compostable Film	0.2%	0.0%	137.1
Packaged Edible Other Food	0.2%	0.1%	155.8	Recyclable Plastic Containers	0.2%	0.0%	144.8
Non-packaged Edible Other Food	2.6%	0.4%	2,215.8	Other Non-recoverable Plastic	0.1%	0.0%	53.5
Inedible Vegetative Food	9.4%	0.9%	8,067.4	**Other**	**0.5%**	**0.1%**	**415.3**
Inedible Other Food	0.6%	0.1%	479.9	Recyclable Glass	0.0%	0.0%	33.4
Fats, Oils, & Grease	0.0%	0.0%	3.5	Recyclable Metal	0.0%	0.0%	40.2
Other Compostable Organics	1.2%	0.3%	1,038.6	Pet Waste	0.2%	0.1%	135.7
Paper	**6.7%**	**0.4%**	**5,783.1**	Other Non-recoverable Waste	0.2%	0.1%	206.0
Universally Compostable Paper	3.9%	0.3%	3,318.6				
Mixed Recyclable Paper	2.1%	0.2%	1,774.2	**Compostable**	**98.3%**	0.2%	**84,455.0**
Approved Single-use Paper Packaging	0.0%	0.0%	29.8	**Potentially Compostable**	**0.7%**	0.1%	**569.2**
Potentially Compostable Paper	0.6%	0.1%	500.6	**Non-compostable**	**1.1%**	0.1%	**910.6**
Polycoated Paper	0.1%	0.0%	109.8	**Estimated Total**	**100%**		**85,934.8**
Other Non-compostable Paper	0.1%	0.0%	50.1	Sample Count			202

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

Single-family Composition by Season and Zone

Tonnages collected from single-family customers by contracted haulers during the study period varied across seasons from 15,267 tons in winter up to 25,143 tons in fall (Figure 12). Per household per week, this equates to an average of 13.5 pounds in winter and 22.2 pounds in fall, using SPU data on the total number of single-family households in Seattle (Figure 11). The estimated percentage of food waste was greatest in fall (18.4%) and lowest in summer (11.6%), shown in Figure 12. Contamination ranged from 1.4% in summer up to 2.2% in spring. Across all four seasons, the most common material by weight was grass/leaves, making up 67.9% to 72.8%.

Figure 11. Overall Average Pounds per Household by Season: Single-family

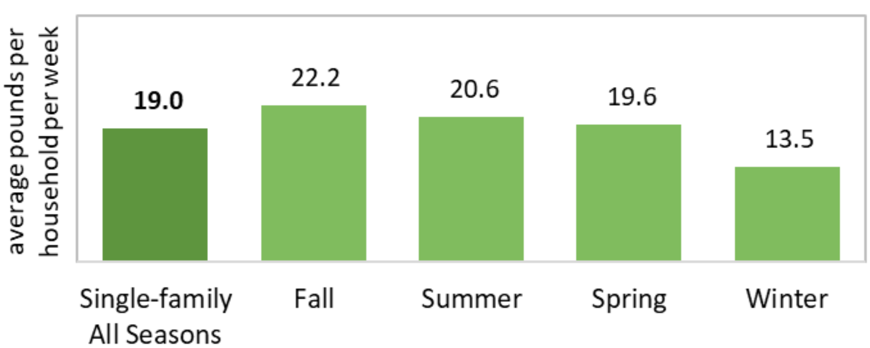
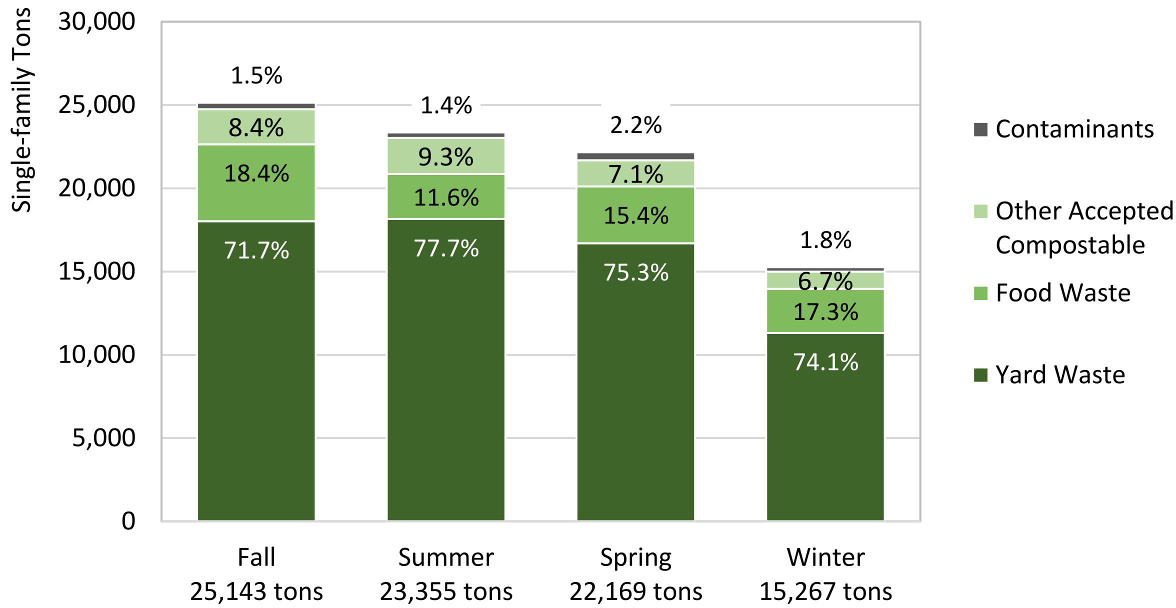


Figure 12. Compostability Group Composition by Season: Single-family



Tonnages collected from single-family customers varied across geographic collection zones from 15,702 in zone 2 up to 29,323 in zone 4 (Figure 14). Average pounds per household per week ranged from 18.2 pounds in zone 3 up to 19.9 pounds in zone 4 (Figure 13). The estimated percentage of food waste was greatest in zone 4 (18.5%) and lowest in zone 3 (10.9%), shown in Figure 14. Contaminants ranged from 1.5% in zone 1 up to 1.8% in the three other zones. Across all four zones, the most common material by weight was grass/leaves, making up 67.2% to 75.2% of single-family organics.

Figure 13. Overall Average Pounds per Household by Zone: Single-family

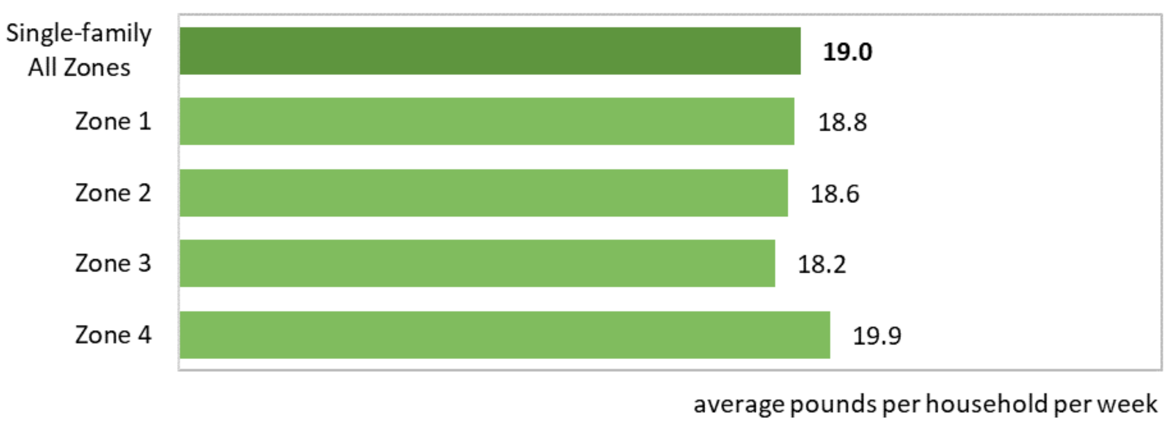
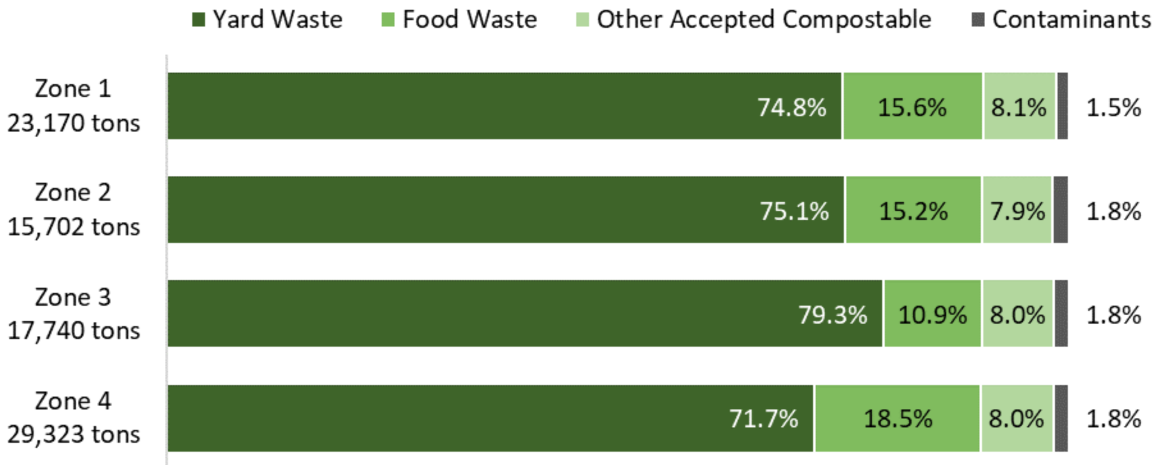


Figure 14. Compostability Group Composition by Zone: Single-family



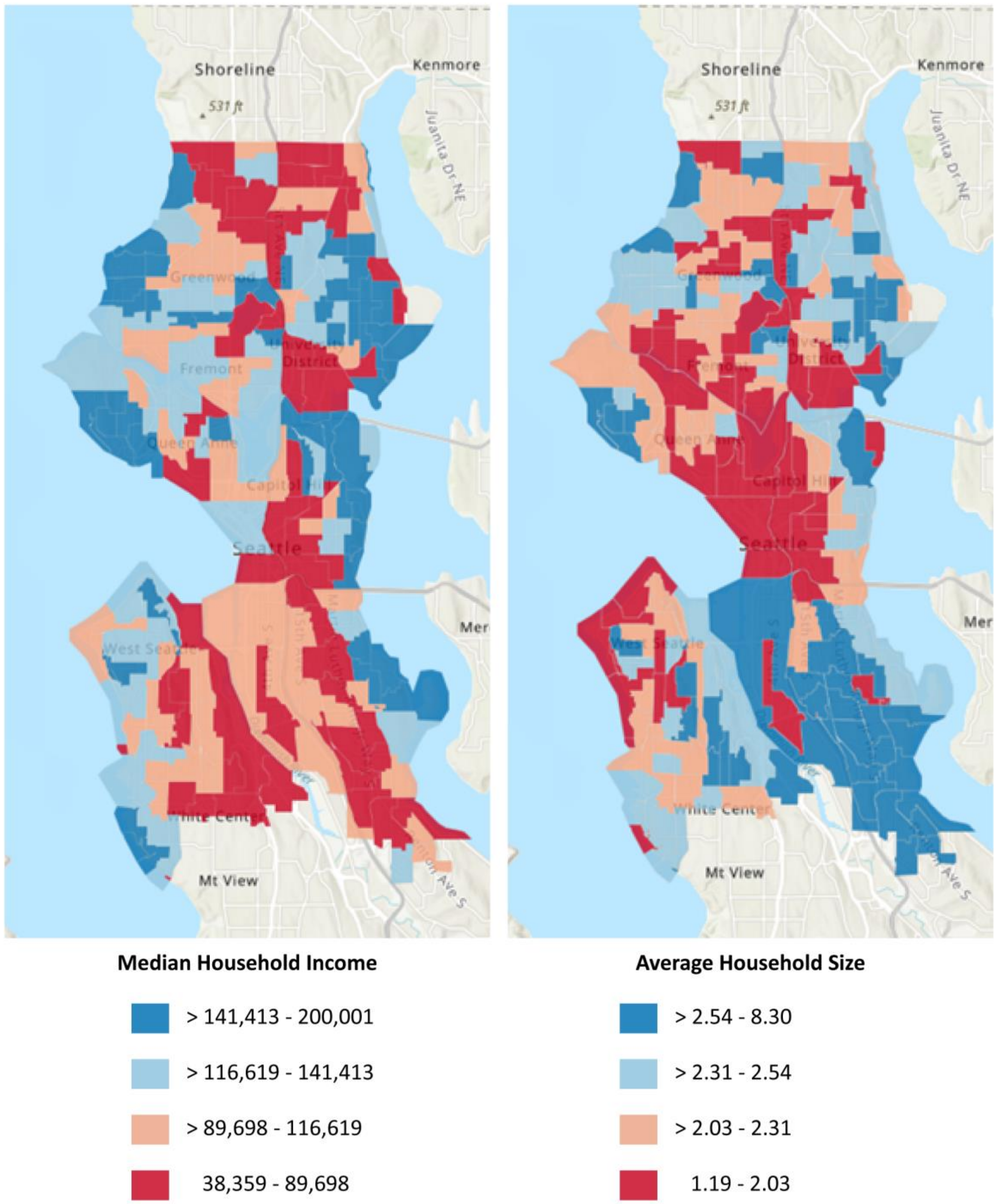
Single-family Composition by Demographics

To examine whether organics composition varies by demographic factors, Cascadia calculated separate compositions based on the median household income and average household size along collection routes. Overall, there were few meaningful differences in composition between groups based on income and household size. Please see Appendix A for more details on the demographic analysis.

Demographic Analysis Approach

For income, the list of all single-family organics collection routes in Seattle was divided into four groups, called quartiles, based on median household income along the route (Figure 15).Median incomes ranged from ranged from about $38,359 per year to about $200,001 per year. High-income routes are the 25% of routes with the highest median income ($141,413 and above), and low-income routes are the 25% of routes with the lowest median income ($89,698 and below). Cascadia used the same quartile process with average household size, which ranged from 1.2 to 8.3 people per household. Large-household routes were those with 2.54 or more people per household, and small-household routes had 2.03 or fewer. While each route includes a mix of household incomes and sizes, on average the high-income routes will have a higher proportion of households with high incomes than the low-income routes.

Figure 15. Single-family Residential Routes by Household Income and Size



Cascadia then calculated composition percentages using only samples from routes identified as high-income, low-income, large household, and small household. Table 13 shows the number of single-family samples included in each demographic group. Tonnage data was not available at the demographic quartile level; therefore, the composition is expressed in percentages only. See Appendix A for more details on demographic calculations.

Table 13. Number of Samples Included in Demographic Quartiles

Demographic feature	Highest Quartile	Lowest Quartile
Median Household Income	30	18
Average Household Size	40	44

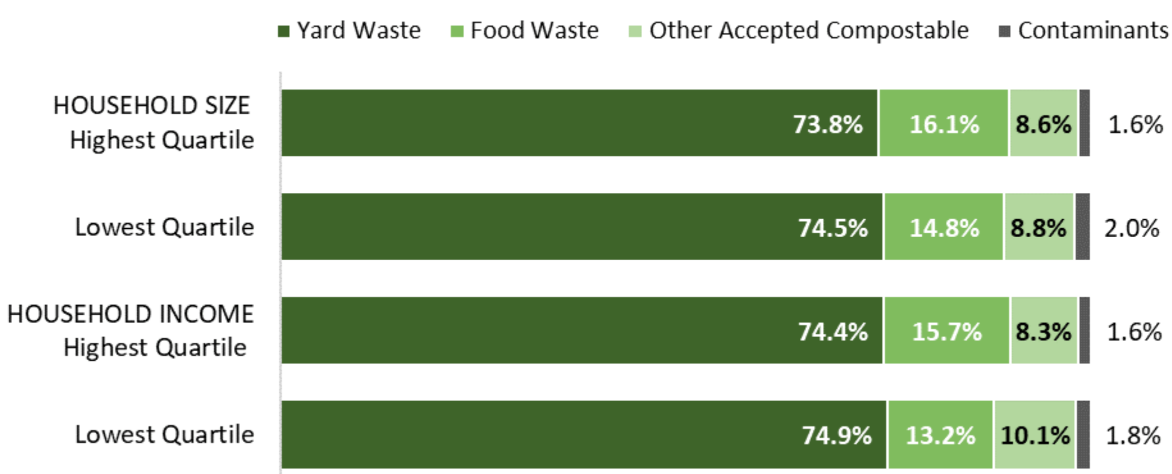
Demographic Analysis Results

There were few meaningful differences in composition between groups based on median income and average household size (see Appendix D for detailed results). For most material types, error ranges around the estimated percentages were greater than the differences between percentages, so the differences may not be statistically significant.

- **Average Household Size.** Large households had a lower percentage of one material than small households: potentially compostable paper (0.5% ±0.1 versus 0.7% ±0.1).
- **Median Household Income.** There were no meaningful differences between high- and low-income households.

Figure 16 shows percentages of yard waste, food waste, other accepted compostables, and contaminants by demographic factors. For both income and household size, differences in Figure 16 are smaller than the error ranges around those estimated percentages. Because data on total tons collected from areas representing the different demographic groups are not available, Cascadia could not estimate tons by material type or compostability group for the different demographic groups.

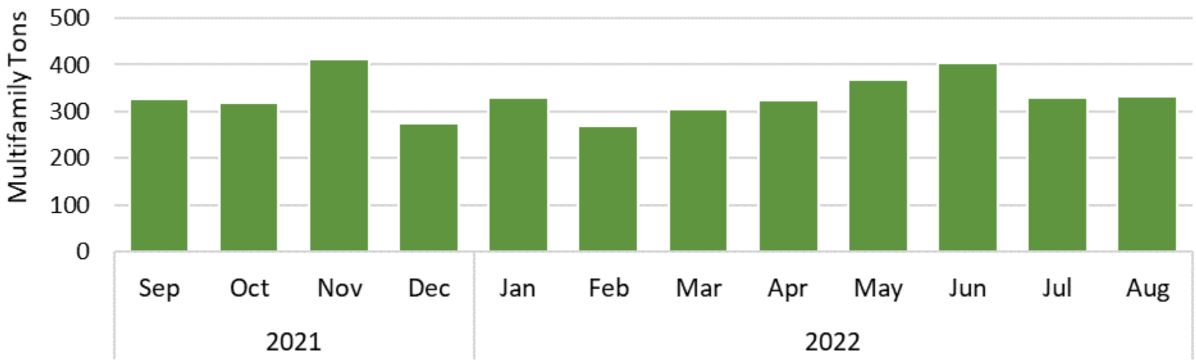
Figure 16. Compostability Group Composition by Demographics: Single-family



Multifamily Results

This section summarizes the composition findings and analysis of 210 samples characterized from multifamily customers during the study period. SPU's contractors collected 3,986 tons of organic material from the multifamily residential sector between September 2021 and August 2022. Figure 17 shows tons by month during this period.

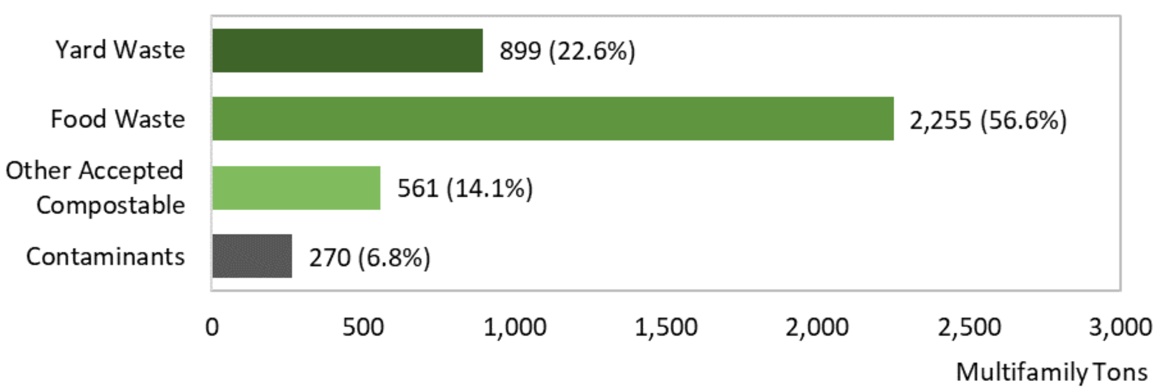
Figure 17. Monthly Contractor Collected Multifamily Organics Tons



Multifamily Composition Overall

Overall, 93.2% (3,715 tons) of multifamily organics were compostable. Food waste was the greatest share of multifamily organics 56.6% (2,255 tons), shown in Figure 18. Yard waste was another 22.6% (899 tons). Other accepted compostable items, which include uncoated paper and certified compostable paper and plastic products, made up 14.1% (561 tons) of multifamily organics.

Figure 18. Compostable Category Composition: Multifamily



Food made up 56.6% (2,255.3 tons) of multifamily organics (Table 14). Inedible vegetative food was the most common food material type (33.4%; 1,330.0 tons). Edible food made up an estimated 20.5% (817.5 tons), including both packaged and non-packaged food. Non-edible food made up 36.1% (1,437.8 tons). Like the single-family sector, edible food waste was more often not packaged (18.5%) than packaged (2.0%).

Table 14. Ranked Food Waste Material Types: Multifamily

Material	Est. %	+ / -	Est. Tons
Edible Food	**20.5%**		817.5
Non-packaged Edible Other Food	10.3%	1.7%	410.6
Non-packaged Edible Vegetative Food	8.2%	0.9%	325.7
Packaged Edible Other Food	1.6%	0.5%	62.6
Packaged Edible Vegetative Food	0.5%	0.3%	18.6
Non-edible Food	**36.1%**		1,437.8
Inedible Vegetative Food	33.4%	2.4%	1,330.0
Inedible Other Food	2.7%	0.6%	106.4
Fats, Oils, & Grease	0.0%	0.0%	1.4
Total Multifamily Food	**56.6%**	**3.0%**	**2,255.3**

Contaminants made up 6.8% (270.1 tons) of multifamily organics (Table 15). Contaminants included potentially compostable materials (1.6%, 63.4 tons) and non-compostable materials (5.2%, 206.7 tons). The most common contaminant material types by weight were other non-recoverable waste (1.6%), pet waste (1.4%), and potentially compostable paper (1.3%).

Table 15. Ranked Contaminants in Organics Stream: Multifamily

Material	Est. %	+ / -	Est. Tons
Other Non-recoverable Waste	1.6%	0.6%	61.9
Pet Waste	1.4%	0.7%	55.1
Potentially Compostable Paper	1.3%	0.2%	53.6
Non-compostable Film	0.7%	0.3%	28.2
Recyclable Plastic Containers	0.5%	0.1%	21.2
Other Non-recoverable Plastic	0.3%	0.1%	10.4
Potentially Compostable Plastic	0.2%	0.0%	9.9
Other Non-compostable Paper	0.2%	0.1%	8.6
Recyclable Glass	0.2%	0.2%	7.4
Polycoated Paper	0.2%	0.0%	7.1
Recyclable Metal	0.2%	0.1%	6.9
Total Multifamily Contaminants	**6.8%**	**1.3%**	**270.1**

Table 16 presents the detailed composition results for the multifamily organics stream. The largest material class was organics (79.4%; 3,166.3 tons). Paper made up 13.2% (526.7 tons) and plastic made up 4.0% (161.4 tons) of multifamily organics.

The two most common material types were inedible vegetative food (33.4%) and grass/leaves (21.5%). The rest of the five most common material types were non-packaged edible other food (10.3%), non-packaged edible vegetative food (8.2%), and universally compostable paper (8.0%).

Table 16. Organics Composition: Multifamily

Material	Est. %	+ / -	Est. Tons	Material	Est. %	+ / -	Est. Tons
Organics	**79.4%**	**1.7%**	**3,166.3**	**Plastic**	**4.0%**	**0.5%**	**161.4**
Grass/Leaves	21.5%	3.4%	858.4	Universally Compostable Plastic	1.0%	0.1%	38.3
Prunings	1.0%	0.5%	40.8	Compostable Film	1.3%	0.1%	53.4
Packaged Edible Vegetative Food	0.5%	0.3%	18.6	Potentially Compostable Plastic	0.2%	0.0%	9.9
Non-packaged Edible Vegetative Food	8.2%	0.9%	325.7	Non-compostable Film	0.7%	0.3%	28.2
Packaged Edible Other Food	1.6%	0.5%	62.6	Recyclable Plastic Containers	0.5%	0.1%	21.2
Non-packaged Edible Other Food	10.3%	1.7%	410.6	Other Non-recoverable Plastic	0.3%	0.1%	10.4
Inedible Vegetative Food	33.4%	2.4%	1,330.0	**Other**	**3.3%**	**1.0%**	**131.2**
Inedible Other Food	2.7%	0.6%	106.4	Recyclable Glass	0.2%	0.2%	7.4
Fats, Oils, & Grease	0.0%	0.0%	1.4	Recyclable Metal	0.2%	0.1%	6.9
Other Compostable Organics	0.3%	0.2%	11.8	Pet Waste	1.4%	0.7%	55.1
Paper	**13.2%**	**0.9%**	**526.7**	Other Non-recoverable Waste	1.6%	0.6%	61.9
Universally Compostable Paper	8.0%	0.7%	319.5				
Mixed Recyclable Paper	3.4%	0.3%	134.4	**Compostable**	**93.2%**	1.3%	**3,715.4**
Approved Single-use Food Packaging	0.1%	0.0%	3.6	**Potentially Compostable**	**1.6%**	0.2%	**63.4**
Potentially Compostable Paper	1.3%	0.2%	53.6	**Non-compostable**	**5.2%**	1.3%	**206.7**
Polycoated Paper	0.2%	0.0%	7.1	**Estimated Total**	**100%**		**3,985.5**
Other Non-compostable Paper	0.2%	0.1%	8.6	Sample Count			210

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

Multifamily Composition by Season and Zone

Tonnages collected from multifamily customers by contracted haulers varied across seasons from 874 tons in winter up to 1,067 tons in summer (Figure 20). Per household per week, this equates to an average of 0.8 pounds in winter and 1.0 pounds in summer, using SPU data on the total number of multifamily units in Seattle (Figure 19). The estimated percentage of food waste was greatest in summer (62.5%) and lowest in fall (46%), shown in Figure 20. Contaminants ranged from 4.5% in winter up to 8.0% in spring. Inedible vegetative food was the most common material type in winter (31.0%), spring (37.0%), and summer (37.4%) and the second most common material type in fall (27.9%). Grass/leaves was the most common material type in fall (33.7%) and the second most common material type in the other three seasons.

Figure 19. Overall Average Pounds per Unit by Season: Multifamily

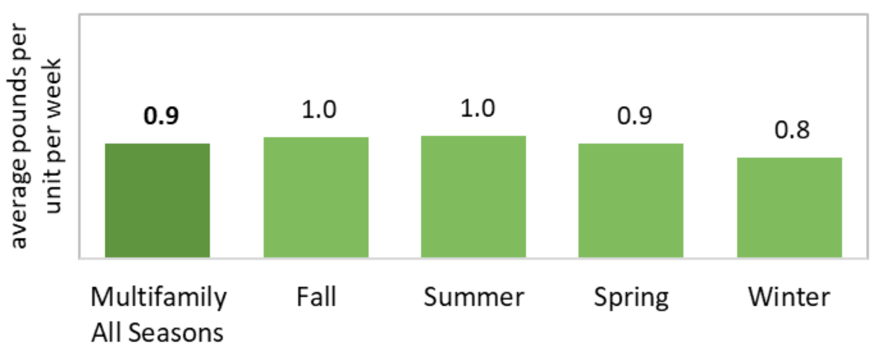
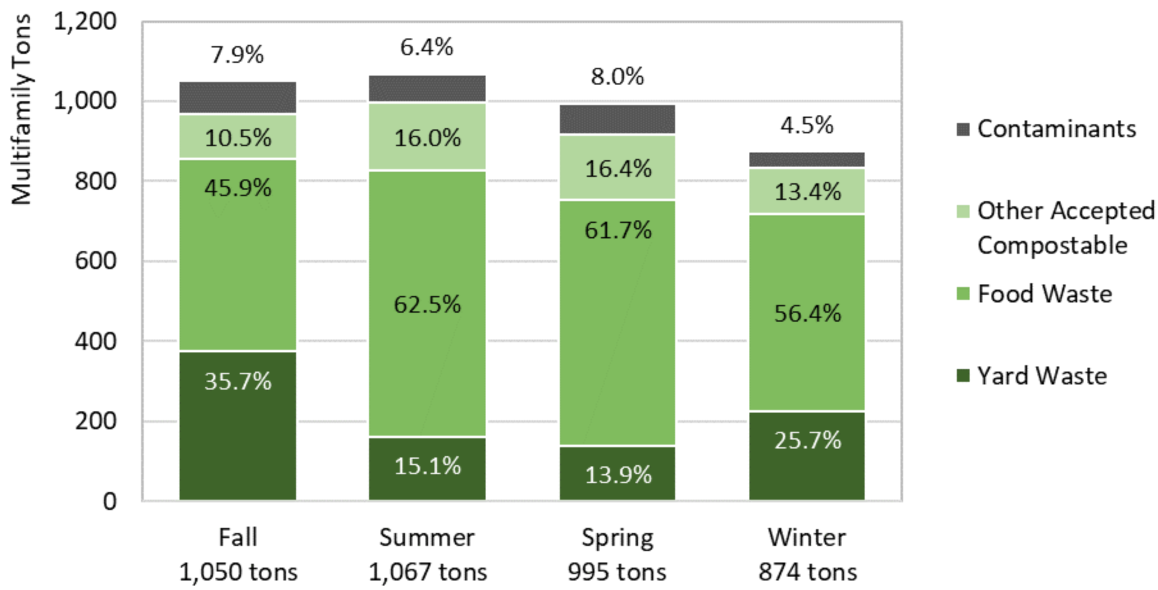


Figure 20. Compostability Group Composition by Season: Multifamily



Tonnages collected from multifamily customers varied across geographic collection zones from 794 tons in zone 4 to 1,245 tons in zone 2 (Figure 22). Average pounds per unit per week ranged from 0.5 pounds in zone 3 up to 1.8 pounds in zone 2 (Figure 21). The estimated percentage of food waste was greatest in zone 4 (62.7%), and lowest in zone 3 (50.3%), shown in Figure 22. Contaminants ranged from 4.2% in zone 1 to 11.0% in zone 4. Across all four zones, the most common material type by weight was inedible vegetative food, making up 28.8% to 37.6% of multifamily organics.

Figure 21. Overall Average Pounds per Unit by Zone: Multifamily

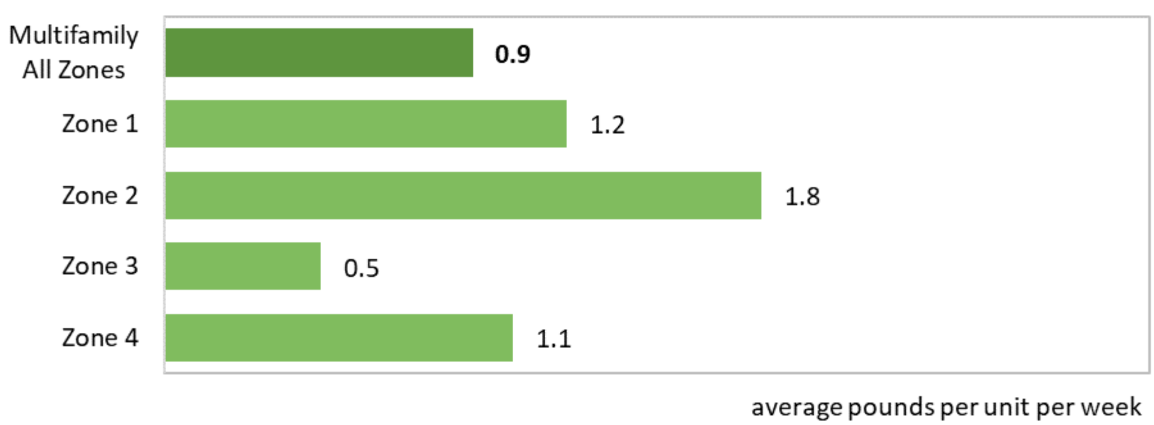
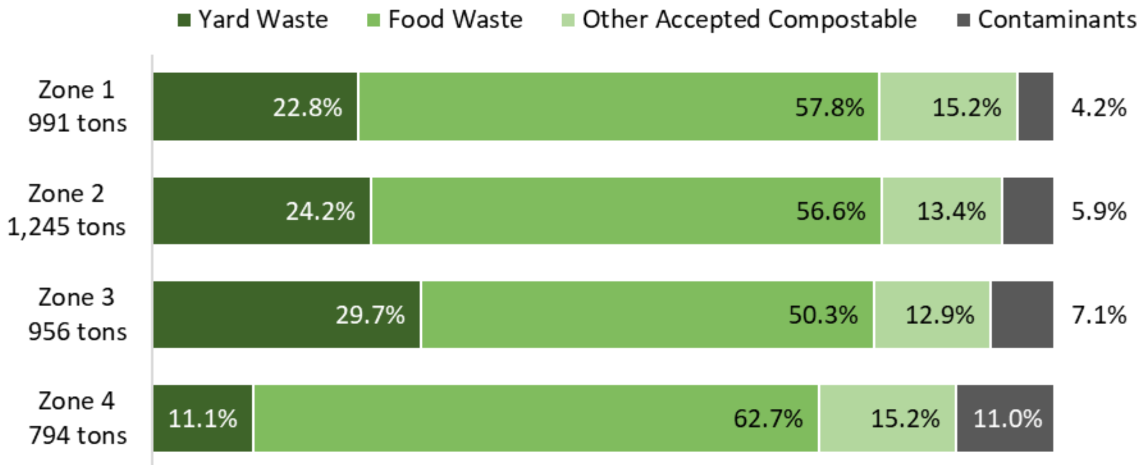


Figure 22. Compostability Group Composition by Zone: Multifamily

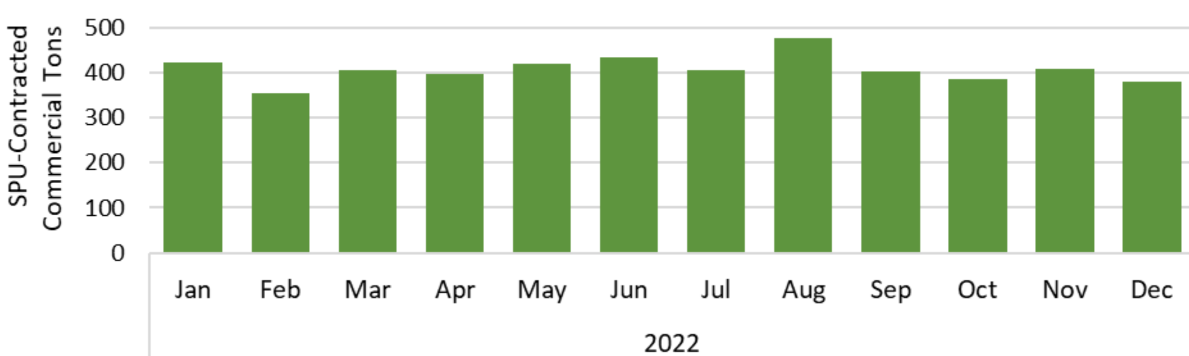


Commercial Results

This section summarizes the composition findings and analysis of the 203 samples characterized from SPU's commercial customers during that period. It does not address commercial organics collected by third-party haulers outside of SPU's contracts. SPU's contracted haulers collected 4,893 tons of organic material from commercial sector cart-based customers between January and December 2022. Figure 23 shows tons by month during this period.

Based on SPU estimates, another 53,778 tons of organics from the commercial sector are collected through private contracts between businesses and haulers. Therefore, this study characterized approximately 8% of Seattle's commercial organics generated during 2022.

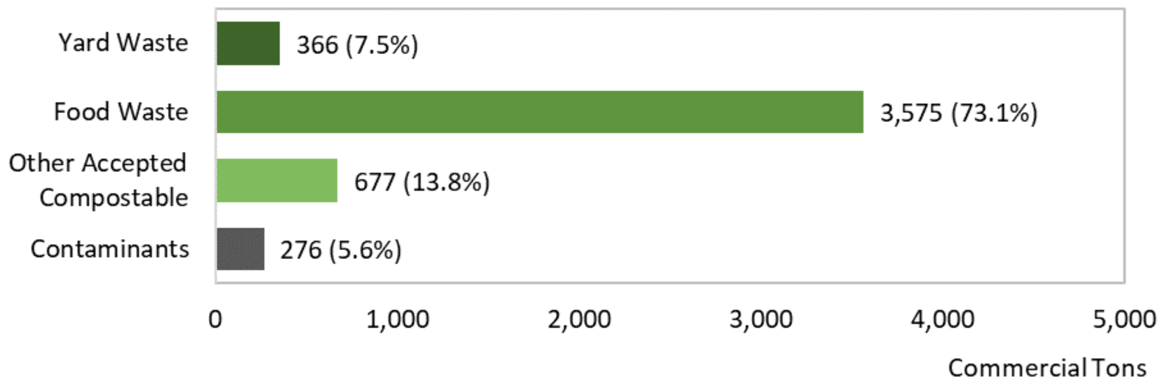
Figure 23. Monthly SPU-Contracted Commercial Organics Tons



Commercial Composition Overall

Overall, 94.4% (4,618 tons) of commercial organics were compostable. Food waste was the largest share of commercial organics 73.1% (3,575 tons), shown in Figure 24. Other accepted compostable items, which include uncoated paper and certified compostable products, made up 13.8% (677 tons) of commercial organics. Yard waste composed another 7.5% (366 tons).

Figure 24. Compostability Group Composition: Commercial



Food made up 73.1% (3,575.1 tons) of commercial organics (Table 17). Consistent with single-family and multifamily sectors, inedible vegetive food was the most common food material type (32.5%; 1,591.4). Edible food made up an estimated 35.4% (1,732.2 tons), including both packaged and non-packaged food. There was more non-packaged edible food (33.8%) than packaged edible food (1.6%). Non-edible food made up 37.7% (1,842.9 tons). Non-edible food waste was not divided into packaged or non-packaged.

Table 17. Ranked Food Waste Material Types: Commercial

Material	Est. %	+ / -	Est. Tons
Edible Food	**35.4%**		1,732.2
Non-packaged Edible Other Food	26.4%	3.5%	1,289.8
Non-packaged Edible Vegetative Food	7.4%	1.8%	363.3
Packaged Edible Other Food	1.5%	0.8%	71.5
Packaged Edible Vegetative Food	0.2%	0.1%	7.6
Non-edible Food	**37.7%**		1,842.9
Inedible Vegetative Food	32.5%	3.6%	1,591.4
Inedible Other Food	5.1%	1.4%	250.6
Fats, Oils, & Grease	0.0%	0.0%	0.9
Total Commercial Food	**73.1%**	**2.8%**	**3,575.1**

Contaminants made up 5.6% (275.7 tons) of commercial organics (Table 18). Contaminants included potentially compostable materials (1.4%; 66.3 tons) and non-compostable materials (4.3%; 209.4 tons). The most common contaminant material types by weight were potentially compostable paper (1.1%), pet waste (0.8%), and non-compostable film (0.8%).

Table 18. Ranked Contaminants in Organics Stream: Commercial

Material	Est. %	+ / -	Est. Tons
Potentially Compostable Paper	1.1%	0.3%	51.4
Pet Waste	0.8%	0.8%	37.5
Non-compostable Film	0.8%	0.2%	37.3
Polycoated Paper	0.6%	0.3%	29.9
Other Non-recoverable Waste	0.6%	0.3%	27.2
Other Non-recoverable Plastic	0.4%	0.2%	21.7
Recyclable Plastic Containers	0.4%	0.1%	21.1
Recyclable Metal	0.3%	0.1%	16.1
Potentially Compostable Plastic	0.3%	0.1%	14.9
Recyclable Glass	0.3%	0.1%	13.0
Other Non-compostable Paper	0.1%	0.1%	5.5
Total Commercial Contaminants	**5.6%**	**1.3%**	**275.7**

Table 19 presents the detailed composition results for the commercial organics stream. The largest material class was organics (80.8%; 3,955.0 tons). Paper made up 13.4% (654.0 tons) and plastic made up 3.9% (190.4 tons) of commercial organics.

The two most common material types were inedible vegetative food (32.5%) and non-packaged edible other food (26.4%). The rest of the five most common material types were universally compostable paper (9.9%), non-packaged edible vegetative food (7.4%), and grass/leaves (5.4%).

Table 19. Organics Composition: Commercial

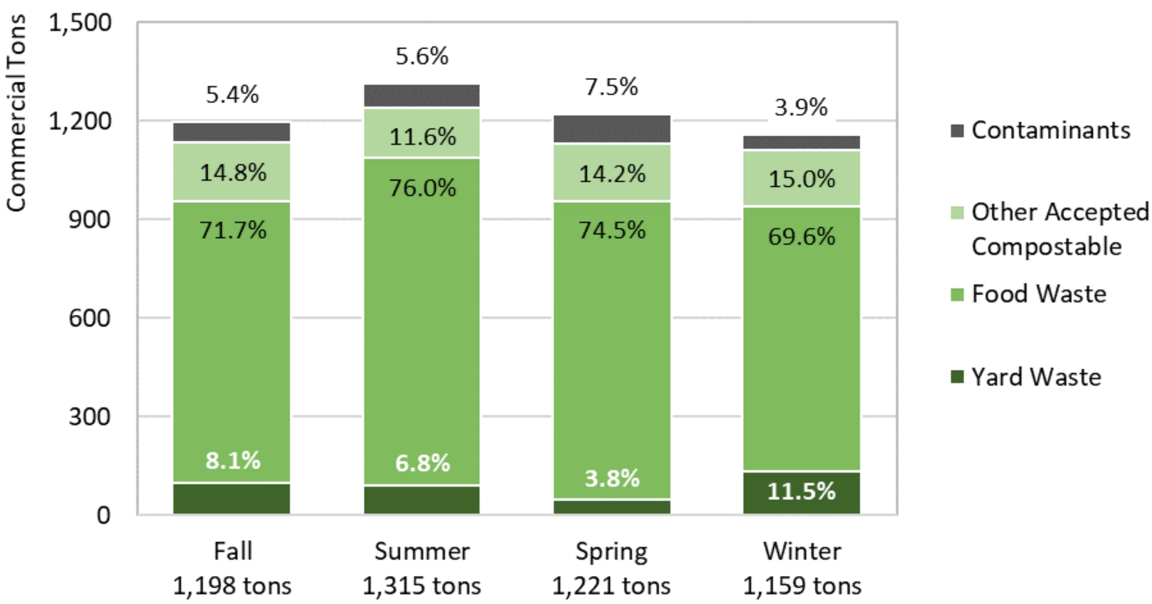
Material	Est. %	+ / -	Est. Tons	Material	Est. %	+ / -	Est. Tons
Organics	**80.8%**	**2.0%**	**3,955.0**	**Plastic**	**3.9%**	**0.5%**	**190.4**
Grass/Leaves	5.4%	2.5%	265.8	Approved Single-use Plastic Packaging	0.3%	0.1%	17.0
Prunings	2.0%	1.9%	99.8	Compostable Film	1.6%	0.2%	78.4
Packaged Edible Vegetative Food	0.2%	0.1%	7.6	Potentially Compostable Plastic	0.3%	0.1%	14.9
Non-packaged Edible Vegetative Food	7.4%	1.8%	363.3	Non-compostable Film	0.8%	0.2%	37.3
Packaged Edible Other Food	1.5%	0.8%	71.5	Recyclable Plastic Containers	0.4%	0.1%	21.1
Non-packaged Edible Other Food	26.4%	3.5%	1,289.8	Other Non-recoverable Plastic	0.4%	0.2%	21.7
Inedible Vegetative Food	32.5%	3.6%	1,591.4	**Other**	**1.9%**	**0.9%**	**93.9**
Inedible Other Food	5.1%	1.4%	250.6	Recyclable Glass	0.3%	0.1%	13.0
Fats, Oils, & Grease	0.0%	0.0%	0.9	Recyclable Metal	0.3%	0.1%	16.1
Other Compostable Organics	0.3%	0.2%	14.3	Pet Waste	0.8%	0.8%	37.5
Paper	**13.4%**	**1.4%**	**654.0**	Other Non-recoverable Waste	0.6%	0.3%	27.2
Universally Compostable Paper	9.9%	1.1%	486.1				
Mixed Recyclable Paper	1.3%	0.2%	62.8	**Compostable**	**94.4%**	1.3%	**4,617.5**
Approved Single-use Paper Packaging	0.4%	0.5%	18.3	**Potentially Compostable**	**1.4%**	0.4%	**66.3**
Potentially Compostable Paper	1.1%	0.3%	51.4	**Non-compostable**	**4.3%**	1.2%	**209.4**
Polycoated Paper	0.6%	0.3%	29.9	**Estimated Total**	**100%**		**4,893.2**
Other Non-compostable Paper	0.1%	0.1%	5.5	Sample Count			203

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

Commercial Composition by Season and Zone

Tonnages from commercial customers varied across seasons from 1,159 tons in winter to 1,315 tons in summer (Figure 25). The estimated percentage of food waste was greatest in summer (76.0%), and lowest in winter (69.6%). Contaminants ranged from 3.9% in winter up to 7.5% in spring. Across all four seasons, the most common material types in order were inedible vegetative food (28.0% to 38.1%) and non-packaged edible other food (24.4% to 27.6%).

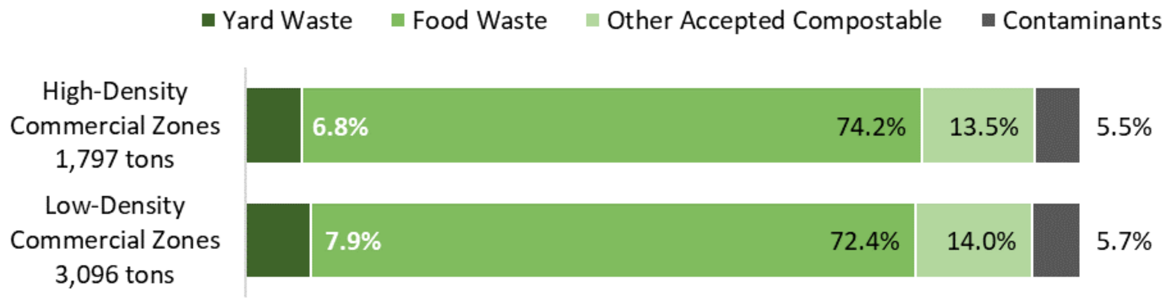
Figure 25. Compostability Group Composition by Season: Commercial



For the commercial sector, Seattle's four geographic collection zones are combined into two based on the density of commercial businesses: zones 1 and 4 are low-density and zones 2 and 3 are high-density (see map in Figure 5). During the study period, contracted organics haulers collected 3,096 tons from low-density zones and 1,797 tons from high-density zones (Figure 26). The estimated percentage of food waste was 72.4% in low-density zones and 74.2% in high-density zones.

Contaminants were estimated to be 5.7% in low-density zones and 5.5% in high-density zones. Across both density zones, the most common material types were inedible vegetative food (31.8% to 33.0%), non-packaged edible other food (25.3% to 28.2%), and universally compostable paper (9.2% to 10.4%).

Figure 26. Compostability Group Composition by Zone: Commercial



Comparison with Previous Study

This section compares the percentage compositions from the current study with the previous study to identify changes in the composition of Seattle's organics stream over time. The 2016 organics study followed the same basic methodology as the present study.

The material list for the 2021–2022 study has three more material types than the 2016 study and classified some materials into different compostability groups. Before analyzing the data, Cascadia aligned material lists from both studies into comparable compostability groups to ensure a fair comparison. For example, the comparable compostability group for contaminants includes both potentially compostable items and non-compostable items. In the following section, other compostables were previously grouped into one category but are now broken out into three categories: compostable paper, compostable plastic, and other compostables. This allows for more granular analysis. Please see Appendix B for more details on the material list and changes over time and see Table 30 in Appendix A for the aligned material lists.

Cascadia examined statistical differences, using t-tests, between the two studies to determine if changes in the composition were statistically significant. The analytical methodology is discussed in Appendix A.

Changes in Single-family Organics Composition

Since 2010, the annual tons collected in the organics stream from single-family residences has fluctuated around 80,000 tons with a low of 77,611 tons in 2014 to a high of 96,028 tons in 2020 (Figure 27).

Figure 27. Single-family Organics Tons: 2010 to 2022

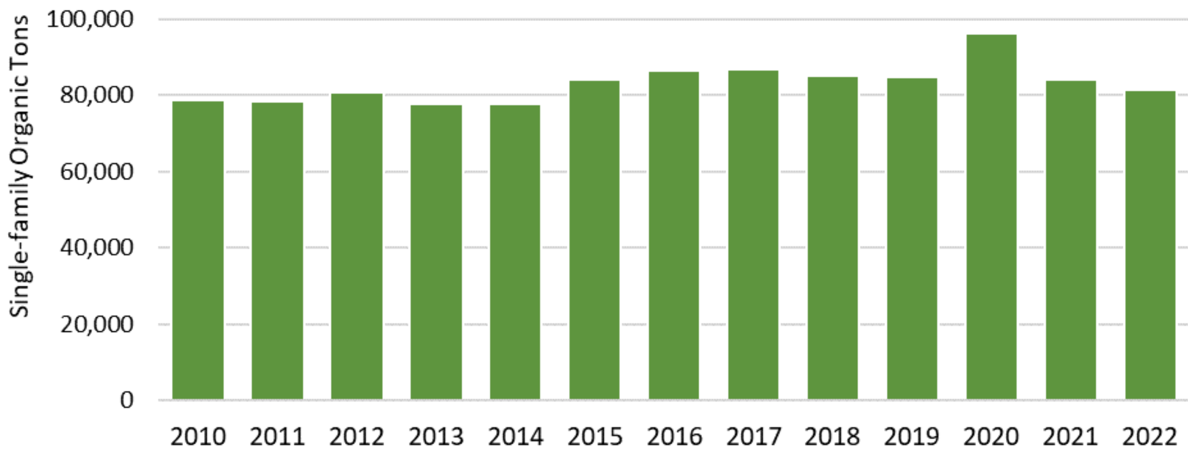


Table 20 compares weighted composition percentages for single-family organics between the 2016 and 2021–22 studies, identifying which changes are statistically significant. Percentage composition changes were statistically significant for the following materials:

- Yard waste decreased from 78.6% to 74.7%
- Food waste increased from 12.7% to 15.6%
- Contaminants increased from 1.0% to 1.7%.

Table 20. Single-family Organics Composition Changes: 2016 and 2021-22

	Composition		Change in Composition			Statistical Significance		
Compostability Group	2016	2022		Absolute	Relative	t-statistic	p-value	Strength of Results*
Yard Waste	**78.6%**	**74.7%**	▼	**-3.9%**	**-5.0%**	**2.69**	**0.008**	**stat. significant**
Food Waste	**12.7%**	**15.6%**	▲	**2.8%**	**22.2%**	**2.52**	**0.012**	**stat. significant**
Compostable Paper	6.1%	6.0%	▼	-0.1%	-1.9%	0.32	0.748	not significant
Compostable Plastic	0.8%	0.8%	▲	0.0%	2.7%	0.26	0.796	not significant
Other Compostables	0.8%	1.2%	▲	0.5%	60.9%	1.88	0.061	not significant
Contaminants	**1.0%**	**1.7%**	▲	**0.7%**	**68.7%**	**5.29**	**0.000**	**stat. significant**
Total	**100.0%**	**100.0%**						
Sample Count	197	202				**Statistically significant difference <= 0.0167*		

Weighted results are used to report change in composition and in the t-test significance testing.

Changes in Multifamily Organics Composition

Since 2010, the annual quantity of multifamily organics has ranged from 1,129 tons in 2010 to 5,452 tons in 2016 (Figure 28). Since 2013, annual tons collected from multifamily residences has hovered around 4,000 tons.

Figure 28. Multifamily Organics Tons: 2010 to 2022

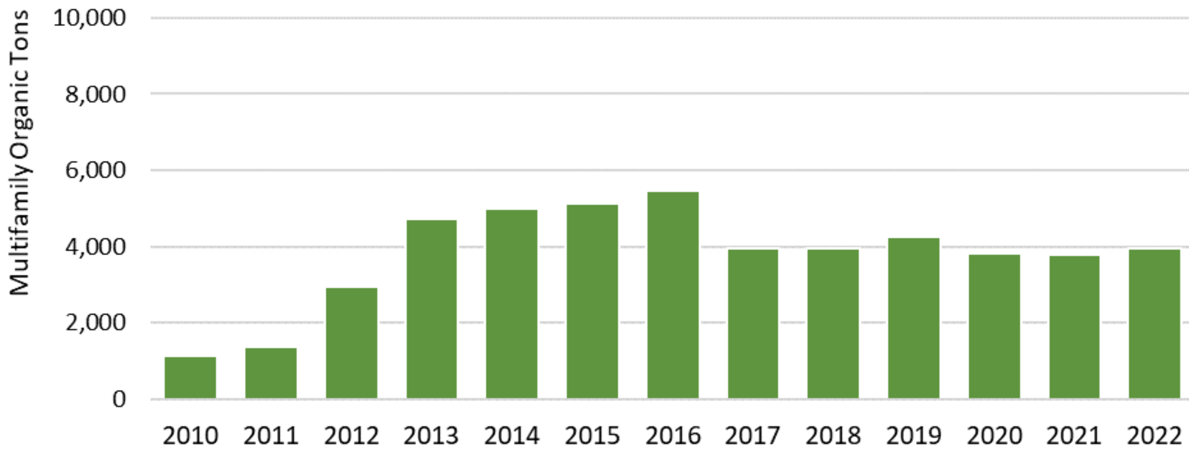


Table 21 compares weighted composition percentages for multifamily organics between the 2016 and 2021–22 studies. No significant differences between study years were identified.

Table 21. Multifamily Organics Composition Changes: 2016 and 2021-22

	Composition		**Change in Composition**			**Statistical Significance**		
Compostability Group	2016	2022		Absolute	Relative	t-statistic	p-value	Strength of Results*
Yard Waste	29.5%	22.6%	▼	-7.0%	-23.6%	1.18	0.240	not significant
Food Waste	52.0%	56.6%	▲	4.6%	8.8%	0.93	0.353	not significant
Compostable Paper	11.2%	11.5%	▲	0.3%	2.9%	0.23	0.816	not significant
Compostable Plastic	2.3%	2.3%	▲	0.0%	1.1%	0.07	0.941	not significant
Other Compostables	0.2%	0.3%	▲	0.1%	79.8%	1.15	0.251	not significant
Contaminants	4.9%	6.8%	▲	1.9%	39.3%	1.79	0.074	not significant
Total	**100.0%**	**100.0%**						
Sample Count	209	210				**Statistically significant difference <= 0.0167*		

Weighted results are used to report change in composition and in the t-test significance testing.

Changes in Commercial Organics Composition

Since 2010, the annual quantity of commercial organics collected in Seattle, including privately collected organics, ranged from 37,101 tons in 2010 to 86,271 tons in 2019 (Figure 29). The share of commercial organics collected through SPU's contract was 4,650 tons in 2016 (7% of the total) and 4,893 tons in 2022 (8% of the total).

Figure 29. Commercial Organics Tons: 2010 and 2022

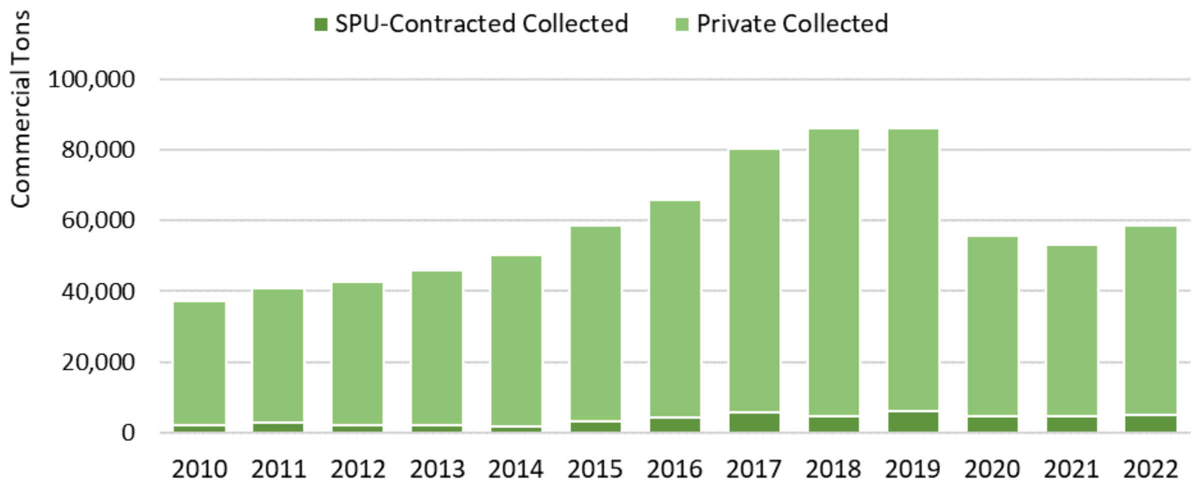


Table 22 compares weighted composition percentages for commercial organics collected under SPU's contract between the 2016 and 2021–22 studies, identifying which changes are statistically significant. No percentage composition changes were statistically significant for commercial organics.

Table 22. Commercial Organics Composition Changes: 2016 vs. 2022

	Composition		Change in Composition			Statistical Significance		
Compostability Group	2016	2022		Absolute	Relative	t-statistic	p-value	Strength of Results*
Yard Waste	5.7%	7.5%	▲	1.8%	31.1%	0.69	0.488	not significant
Food Waste	75.2%	73.1%	▼	-2.1%	-2.9%	0.77	0.440	not significant
Compostable Paper	12.3%	11.6%	▼	-0.7%	-6.1%	0.53	0.596	not significant
Compostable Plastic	1.6%	2.0%	▲	0.4%	25.8%	1.92	0.055	not significant
Other Compostables	0.3%	0.3%	▼	0.0%	-9.2%	0.15	0.878	not significant
Contaminants	4.9%	5.6%	▲	0.7%	15.4%	0.74	0.461	not significant
Total	**100.0%**	**100.0%**						
Sample Count	198	203				**Statistically significant difference <= 0.0167*		

Weighted results are used to report change in composition and in the t-test significance testing.

APPENDIX A. STUDY METHODOLOGY

The objective of the 2021–22 Seattle Organics Composition Study was to provide statistically robust data on the composition of material that was set out in carts for curbside organics collection by single-family residences, multifamily residences, and commercial businesses using SPU-contracted haulers. The organic stream was last sampled in 2016. This project followed the same basic methodology as the 2016 study.

Study Design and Sampling Plan

Substream Definitions

The organics stream is composed of various substreams. A "substream" is determined by the particular generation, collection, or composition characteristics that make it a unique portion of the total organics stream. For this study, the three substreams are defined as follows:

- **Single-family residential:** Single-unit houses and duplex, triplex, and four-plex homes. These customers have cart-based organics collection service and typically also have their garbage collected in carts.[8]
- **Multifamily residential:** Apartment or condominium buildings with five or more units. These customers have cart-based organics collection service but typically have their garbage collected in dumpsters.[9]
- **Commercial:** Businesses and institutions with cart-based organics collection service through the SPU's contracted collection service. Self-haul and other private organic subscription collection services were not included in this study.[10]

This study included only organics placed in plastic carts, including carts collected both at the curb and from locations inside the property. Organics placed in metal containers were excluded. This study did not sample any organics collected by private organics composting firms or otherwise outside SPU's collection contract.

These three organics substreams are collected by two contracted haulers, each serving two of four distinct geographic "zones" in the City of Seattle (Figure 30). WM is contracted with SPU to haul organic material from zones 1 and 4. Recology is contracted with SPU to haul organics from zones 2 and 3. The organics targeted by this study are typically hauled to either of the two City-owned transfer stations, after which they are transported to Cedar Grove Composting or Lenz Enterprises composting facilities for processing into finished compost.

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[8] https://www.seattle.gov/utilities/your-services/collection-and-disposal/food-and-yard
[9] https://www.seattle.gov/utilities/your-services/collection-and-disposal/multi-family-properties/for-managers-and-owners/food-and-yard-services
[10] https://www.seattle.gov/utilities/your-services/collection-and-disposal/food-and-yard/business-and-commercial-compostables

Figure 30. Seattle's Collection Zones

(Adapted from https://www.seattle.gov/utilities/your-services/collection-and-disposal/garbage/business-and-commercial-collection)

Sample Allocation

Cascadia collected and sorted 615 samples during six sampling events, including 202 single-family samples, 210 multifamily samples, and 203 commercial samples.

Samples were collected seasonally, so that data is representative of the types of organics collected throughout the year. The four seasons are spring (March to May), summer (June to August), fall (September to November), and winter (December to February). Samples were allocated equally across Seattle's four collection zones. The study design set quotas to allocate samples proportionally across the three sectors and four collection zones (50 samples for each sector-zone combination). Table 23 shows the sample allocation across three substreams, four collection zones, and four seasons.

Table 23. Sample Allocation

	Single-family				Mulitfamily				Commercial		Overall
City Zone	1	2	3	4	1	2	3	4	1/4	2/3	Citywide
Winter	13	11	11	13	13	13	18	14	24	27	**157**
Spring	12	14	14	11	13	13	13	13	27	26	**156**
Summer	11	15	11	13	15	15	15	13	27	23	**158**
Fall	14	14	12	13	12	13	5	12	24	25	**144**
Total Samples	**50**	**54**	**48**	**50**	**53**	**54**	**51**	**52**	**102**	**101**	**615**

Sampling Calendar

Composition estimates for single-family and multifamily are based on a 12-month sampling period from September 2021 through August 2022. SPU delayed commercial organics sampling to January through December 2022 to allow businesses more time to recover from economic disruptions due to the COVID-19 pandemic. Table 24 shows samples collected by sampling event.

Table 24. Sampling Calendar

Season	Sample Dates	Single-family	Mulitfamily	Commercial	Overall
Fall	9/20/21 - 9/23/21	53	42	-	**95**
Winter	12/6/21 - 12/9/21	48	58	-	**106**
Spring	4/5/22 - 4/8/22	51	52	-	**103**
	4/11/22 - 4/14/22	-	-	53	**53**
Summer	8/8/22 - 8/10/22	50	58	-	**108**
	8/15/22 - 8/18/22	-	-	50	**50**
Winter	10/10/22 - 10/13/22	-	-	50	**50**
	12/5/22 - 12/7/22	-	-	50	**50**
Total Samples		**202**	**210**	**203**	**615**

Schedule and Load Collection

For this study, Cascadia collected single-family residential samples at the South Transfer Station from incoming trucks. For multifamily residential and commercial samples, Cascadia obtained samples directly from organics carts set out for pick-up. For single-family samples, Cascadia randomly pre-selected collection routes so contracted haulers could deliver those loads for sampling, including extra routes in case the originally selected routes could not be sampled. Cascadia also identified randomly pre-selected multifamily and commercial customers to collect samples from.

Hauler and Transfer Station Planning and Communication

Before starting sampling events, Cascadia worked with Seattle Public Utilities (SPU) and participating haulers, facilities, and subcontractors to develop a plan for the study that provided a framework for all sampling, data collection, and analysis strategies. Cascadia held meetings with the haulers and SPU's South Transfer Station staff to communicate objectives and sampling procedures. Furthermore, Cascadia communicated the schedule of fieldwork events and confirmed each event in advance with South Transfer Station personnel to ensure all staff were aware of and prepared for the sampling fieldwork. In addition, haulers were reminded to notify the drivers of selected vehicles that they were expected to participate in the sampling activities, including delivering their load to the South Transfer Station. A day or two before each fieldwork event, Cascadia sent out final reminders to everyone involved to ensure that the haulers and the station staff were prepared and ready to help resolve any last-minute issues.

Route and Load Selection

Route and load selection differed between the single-family sector and the multifamily and commercial sectors.

Single-family Route and Load Selection

Before each fieldwork season, Cascadia asked haulers for an updated list of single-family routes that included the collection zone, route number, collection day, and customer type. From the lists of single-family routes, the target number of routes were randomly selected to correspond to the number of samples required from each and zone on each sampling day (example tracking sheet in Table 25). This study was designed to sample "pure" loads of single-family organics material only (pure versus loads mixed with multifamily and/or commercially collected organics).

Cascadia added extra single-family routes to the list of routes scheduled on each sampling day. The extra routes provided contingency samples that were obtained and sorted if one of the vehicles for the regularly planned collection route failed to arrive on time or was not intercepted in time to obtain a sample. Prior to sampling, Cascadia forwarded this route list to the haulers for verification and confirmation. The haulers verified that route numbers were correct, added truck numbers and vehicle arrival times, and returned the list.

Table 25. Example Route Selection

Route #	Date	Day	Zone	Residential Type	# Loads / Day	Disposal Site	Start Time	ETA	Notes
A1	11/9/20	Mon	1	SF	1	STS	6:00am	UNK	
A3	11/9/20	Mon	2	SF	1	STS	6:30am	UNK	
A4	11/9/20	Mon	4	SF	1	STS	6:30am	UNK	
B1	11/9/20	Mon	1	SF	3	STS	3:00am	UNK	Contingency
B2	11/9/20	Mon	3	SF	1	STS	5:00am	UNK	
B3	11/9/20	Mon	2	SF	3	STS	4:00am	UNK	
B4	11/9/20	Mon	4	SF	1	STS	3:00am	UNK	

The field supervisors consistently communicated with the hauler contacts each morning and throughout the day to receive updated information about the selected routes' estimated times of arrival to the facility. If trucks from the selected routes were scheduled to arrive late in the evening, Cascadia developed contingency plans to meet sampling targets. This included double sampling selected routes that arrived at the facility earlier if they met zone specifications. If multiple selected routes were scheduled to arrive outside of sampling hours, the field supervisor also surveyed vehicles arriving at the facility that were not pre-selected by Cascadia to identify potential replacement routes. The field supervisor asked the drivers for their route number, collection zone, and customer type then compared this information to the list of targeted samples for that day. If the route met specifications, it was recorded and selected for sampling.

Multifamily and Commercial Route and Load Selection

For multifamily and commercial organics sampling, Cascadia requested an updated list of addresses of multifamily properties and commercial businesses that subscribe to the organics collection service from the haulers. The list of addresses included the property or business address, collection zone, route number, collection day, and other relevant information (number and type of carts, collection frequency, day of collection, etc.). From the lists of routes, Cascadia randomly selected multifamily properties or commercial businesses to meet the number of samples required from each sector and zone on each sampling day. Samples were collected from carts only. Cascadia sampling crew did not collect samples from dumpsters or compactors. Additional addresses were added to the list scheduled on each sampling day for contingency.

Field Procedures

The field supervisor coordinated all logistics involving truck selection, sample extraction, sorting area, and disposal of sorted materials with transfer station staff.

Sample Selection

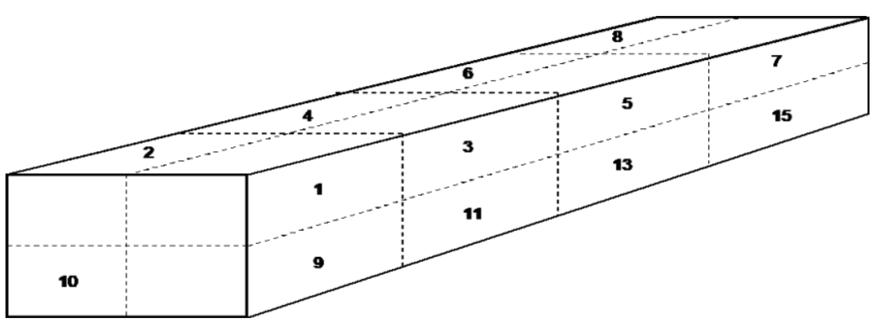
The field supervisor used specific procedures to obtain organics samples. Procedures differed between the single-family sector and the multifamily and commercial sectors.

Single-family Sample Selection

The route managers instructed the drivers to place the provided sample placard in the windshield so that the brightly colored paper alerted the field supervisor and sorting crew that a sample had arrived. When a selected truck arrived at the facility, the field supervisor confirmed the route details with the driver, including route number, zone, and residential type.

The field supervisor instructed the driver of the vehicle to dump the selected load in an elongated pile. The field supervisor chose a sample for extraction using an imaginary 16-cell grid (Figure 31) superimposed over the tipped material. The field supervisor identified a random pre-selected "cell" from the tipped load, representing a cross-section of material from top to bottom. If site constraints blocked the designated cell, then the field supervisor randomly selected an alternate cell.

Figure 31. 16-Cell Grid Applied to Selected Loads



The field supervisor then instructed the loader operator at the facility to extract the sample from the chosen cell. Approximately 200 lbs. of material were extracted for organics samples.

The extracted material was placed onto a large tarp placed near the sorting area. The field supervisor performed a tug test to estimate the weight of the sample. If judged to be too light, the sorting team manually pulled more material from the same cell area and put it on the tarp until the desired weight was achieved. Samples judged to be excessively heavy were reduced by removing a random, homogenous slice of material.

Multifamily and Commercial Sample Selection

For multifamily and commercial sampling, Cascadia sampling crew collected organics material on collection day at the pre-selected multifamily property or commercial business from carts. The crew emptied the contents of the cart onto a tarp, and tied and labelled the sample before moving on to the next sampling location. The crew collected about 12-13 samples per sampling day and brought the samples to the South Transfer Station for sorting.

Figure 32. Sample – Multifamily organics

Sorting Procedures

This section describes the process for hand-sorting all samples, which was the same for all sectors. The field supervisor pulled the cart or the tarp into the sorting area, assisted by the field crew. The field supervisor placed the sample placard that identified each sample so it was visible in each photograph. The field supervisor then photographed the sample using a digital camera (Figure 33).

Figure 33. Sampled Material with Sample Placard

The field crew hand sorted all materials in each sample into the defined material types and placed each material type into individual plastic laundry baskets or barrels (Figure 34). Individual members of the sorting crew specialized in groups of materials, such as materials in the paper or the organics material classes, to ensure consistent and accurate sorting methods. A detailed material list is in Appendix B.

Figure 34. Sample Sorting in Progress

As sorting proceeded, the field supervisor continually checked the contents of each basket and re-sorted any materials that were improperly classified. The field supervisor then verified the purity of each material as it was weighed in its basket, using a pre-calibrated scale, and recorded each material weight (excluding the weight of the basket) on a digital sampling form on Cascadia's cloud-based database management system customized for this study.

At the end of each sorting day, the field supervisor conducted a quality control review of the data recorded for each sample. The field crew also thoroughly cleaned up the sorting area to reduce the risk of litter, particularly in open-air environments.

Training

At the start of each season, the field supervisor and sorting crew reviewed the materials list, field forms, and any unique sorting protocols used during the season. Onsite, the field supervisor provided continual support and supervision. Training for this study also addressed:

- General facility overviews
- Facility-specific health and safety requirements
- Personal protective equipment (PPE) requirements
- Organics material handling techniques
- Productivity strategies and daily sorting quotas

The field supervisor evaluated each individual sample to ensure that the sorting crew understood and uniformly interpreted each material type.

Health and Safety

The field supervisor ensured that each sorting crew followed the health and safety protocols and requirements. Cascadia's team followed a strict health and safety plan that meets Occupational Safety and Health Administration (OSHA) standards. The COVID-19 pandemic affected hauler operations, capacity, and times trucks arrived at receiving facilities. The field crew adapted to these changes to meet sampling targets. Cascadia assessed and reviewed relevant regulations and adjusted the sampling calendar and protocol to reflect health and safety regulations from local and state public health officials.

Data Management and Analysis

Preparing Data Forms

Cascadia developed field forms specific to the sampling strategy and information needed for this study.

Vehicle selection forms were created for each day and each location of sampling activity. This form listed the sample quotas specific to each day, by sector, and was used to keep track of pre-selected vehicles entering the facility in a random manner for sampling (Figure 35).

Figure 35. Example Vehicle Selection Sheet

Vehicle Selection Sheet Sampling Date: **Monday, December 6, 2021**

Seattle Residential Organics Composition Study Facility: **STS**

Instructions

1. When you see a truck with our selected truck number arrive at the station (the truck should have a placard on their dashboard), safely approach the driver.
2. Confirm route information with the driver (SF, route #, zone)
   If we are collecting a MF sample, confirm with the driver that their current load is from MF accounts. If they are bringing in a COM load, confirm their next load will be MF.
3. If we are selecting the truck's second load, which means that we will collect a sample from the truck the second time they arrive at the transfer station, confirm with the driver that they will be making a second trip to this transfer station. If they are not, collect a sample from their first load.
4. Collect the truck's sample placard (Unless Sky Valley will collect the placard. Coordinate with Sky Valley.)
5. Work with the load operator and Sky Valley to collect a sample from the truck's load by collecting a sample form the load's random cell #.

Sampled? (Y or N)	Sorted?	Sample ID	Double sampled?	Double Sample ID	Sorted Double Sample?	Hauler	Route	Truck No.	Zone	Stream	Estimated Time of Arrival	Notes
		SFO2101				[redacted]	[redacted]		3	SFO		
		SFO2102				[redacted]	[redacted]		3	SFO		
		SFO2103				[redacted]	[redacted]		3	SFO		
		SFO2104				[redacted]	[redacted]		3	SFO		contingency
		SFO2105				[redacted]	[redacted]		2	SFO		
		SFO2106				[redacted]	[redacted]		2	SFO		
		SFO2107				[redacted]	[redacted]		2	SFO		
		SFO2108				[redacted]	[redacted]		2	SFO		contingency
		SFO2109				[redacted]	[redacted]		1	SFO		
		SFO2110				[redacted]	[redacted]		1	SFO		
		SFO2111				[redacted]	[redacted]		1	SFO		
		SFO2112				[redacted]	[redacted]		1	SFO		contingency
		SFO2113				[redacted]	[redacted]		1	SFO		
		SFO2114				[redacted]	[redacted]		4	SFO		
		SFO2115				[redacted]	[redacted]		4	SFO		
		SFO2116				[redacted]	[redacted]		4	SFO		
		SFO2117				[redacted]	[redacted]		4	SFO		contingency

Today's Sampling Plan 17 SFO

Cascadia created sample placards to identify vehicles selected for sampling and document sample information along with sample photos. The sample placard is a brightly colored paper sign that the collection truck driver placed on the windshield of every vehicle that was chosen for sampling. The sample placard had pre-printed information about the sample, including the sample ID, collection zone, route number, collection day, and sector (Figure 36).

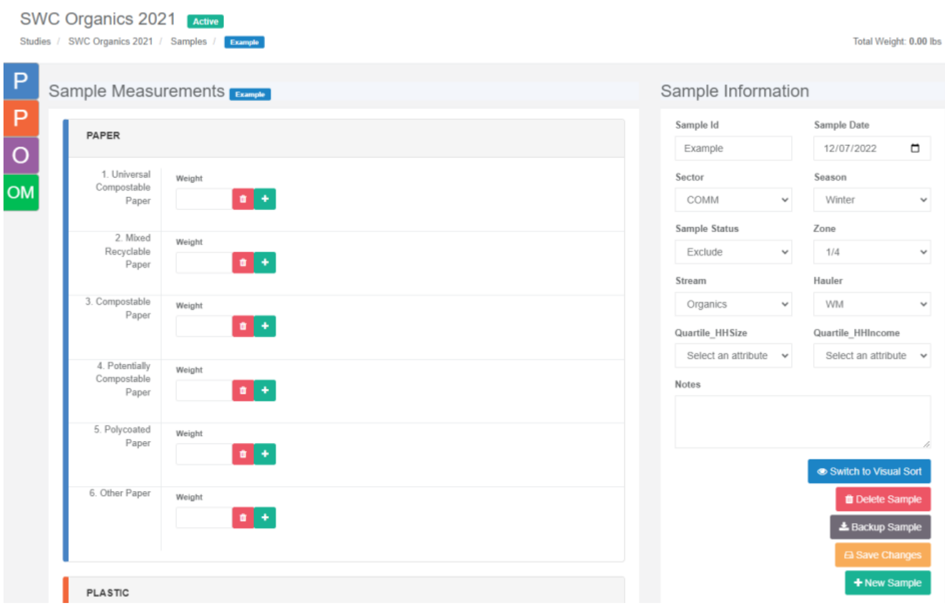
Figure 36. Sample Placard

Managing Data

The field supervisor continually conducted quality control review of entered data, flagged and reviewed any anomalies, and ensured completeness of all information for each sample. For study integrity, all samples collected were included in the analysis unless Cascadia determined that the underlying sample data was incorrect. Following each fieldwork sampling event, the field supervisor recorded all data into a cloud-based database management system customized for this study.

Electronic tally sheets included a list of all materials and cells to record the weights of each material type. The field supervisor recorded the weight on a digital sampling form in Cascadia's cloud-based database management system customized for this study (Figure 37).

Figure 37. Electronic Tally Sheet



Cascadia's cloud-based database management system contains built-in logic and error checking to prevent data entry errors. It also sums sample weights so that the field supervisor can confirm weight targets were achieved. The data is automatically synchronized to a cloud-based database, reducing data loss and transcription errors.

The Data Manager verified that all required data were recorded properly and supervised the data entry and data quality control process. As an additional quality control step, randomly selected sampling records were inspected in detail to monitor the accuracy of the data entry process.

Standard Calculations for Waste Composition

This section describes the methodology used to:

- Quantify the disposed organics material
- Estimate the composition and its associated confidence interval (error range)

Tonnage Data

SPU provided tonnage data by sector, zone, and by season (Table 26 and Table 28). Single-family and multifamily sampling occurred in 2021 and 2022. Therefore, tonnage data from summer 2021 through summer 2022 (a 12-month period) was used for calculations. Sampling for the commercial organics stream occurred in 2022, so tonnages from January through December 2022 were used for calculations for commercial organics stream. Cascadia used this data to convert percent composition into estimated tonnages. Composition percentages for all sectors combined were developed using the same tons reported for individual sectors, but tons are not reported in tables for all sectors because the time periods do not align.

Table 26. Residential Organics Stream Weight by Sector (in Tons): 2022

	Winter	Spring	Summer	Fall	Total
Single-family	15,267	22,169	23,355	25,143	**85,935**
Zone 1	4,133	6,065	6,341	6,630	**23,170**
Zone 2	2,688	4,065	4,149	4,800	**15,702**
Zone 3	3,416	4,227	4,580	5,517	**17,740**
Zone 4	5,030	7,812	8,285	8,196	**29,323**
Multifamily	874	995	1,067	1,050	**3,986**
Zone 1	201	256	253	281	**991**
Zone 2	300	310	322	314	**1,245**
Zone 3	215	237	269	234	**956**
Zone 4	157	192	223	222	**794**
Total Residential	**16,141**	**23,164**	**24,421**	**26,194**	**89,920**

To calculate average pounds collected per household or unit per week, SPU also provided data on the number of single-family households and multifamily units in Seattle (Table 27).

Table 27. Single-family Household and Multifamily Units

	Single-family		Multifamily	
	Households	% total	Units	% total
Zone 1	47,390	14%	31,085	9%
Zone 2	32,510	10%	26,310	8%
Zone 3	37,489	11%	77,197	23%
Zone 4	56,751	17%	28,766	9%
All Zones	**174,140**	**52%**	**163,358**	**48%**

For the commercial sector, Seattle's four zones were combined into two based on the density of commercial businesses: low-density are zones 1 and 4 and high-density are zones 2 and 3. These grouped zones were used in composition calculations for the commercial organics stream.

Table 28. Commercial Organics Collection by Contracted Haulers from Carts Only: 2022

	Winter	Spring	Summer	Fall	Total
Contracted Commercial	1,159	1,221	1,315	1,198	**4,893**
Zone 1 and 4	737	778	822	759	**3,096**
Zone 2 and 3	422	443	493	439	**1,797**

Estimating Composition Ratios for an Individual Stratum

For a given stratum (for example, spring season sampling of single-family organics from Zone 1), the composition estimate (denoted by r_j) represents the ratio of the material type weight (*c*) to the total weight of all the samples in the stratum (*w*). This estimate was derived by summing the weight of each material type across all the selected samples (*i*) belonging to a given stratum and dividing by the sum of the total weight of organics material for all the samples in that stratum, as shown in the following equation:

$$r_j = \frac{\sum_i c_{ij}}{\sum_i w_i} \quad (1)$$

where:

- r_j = composition estimate for material *j* (*r* stands for *ratio*)
- *c* = weight of particular material type
- *w* = sum of all material type weights
- for *i* = 1 to *n*, where *n* = number of selected samples
- for *j* = 1 to *m*, where *m* = number of material types

EXAMPLE

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

	SAMPLE 1	SAMPLE 2	SAMPLE 3
Weight (c) of prunings	5	3	4
Total sample weight (w)	80	70	90

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

To find the composition estimate for the prunings material type, the weights for that material are added for all selected samples and divided by the total sample weights of those samples. The resulting composition is 0.05, or 5 percent. In other words, 5 percent of the sampled material, by weight, is prunings.

Confidence Intervals for Composition Ratios in an Individual Stratum

The confidence interval for this estimate was derived in two steps. First, the variance around the estimate, Var(r_j) was calculated, accounting for the fact that the ratio included two random variables (the material type and total sample weights). The variance of the ratio estimator equation follows, using the same letter notation meanings as above:

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

where:

The mean sample weight is $$\overline{w} = \frac{\sum_i w_i}{n} \tag{3}$$

Second, using the variance calculated in Equation 3, the error range around r_j at the 90 percent confidence level was calculated for a material type as follows:

the variance is $\left(z\sqrt{\mathrm{Var}(r_j)}\right)$

and the ratio and error range are shown in tables as $r_j \pm \left(z\sqrt{\mathrm{Var}(r_j)}\right)$ (4)

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

Estimating Weighted Composition Ratios Across Strata

Composition results for all strata were combined using a weighted averaging method, to estimate the composition of larger portions of the organics stream. The relative tonnages associated with each stratum (for example, proportions of tonnage associated with spring, summer, fall, and winter seasons from each of the four zones) served as the weighting factors. The calculation was performed as follows:

$$O_j = \left(p_1 * r_{j1}\right) + (p_2 * r_{j2}) + (p_3 * r_{j3}) + \ldots \tag{5}$$

where:

- *O* = composition of the larger portions of the organics stream, combining multiple strata using a weighted averaging method
- *p* = proportion of tonnage contributed by the noted organics stratum (weighting factor)
- *r* = ratio of material type weight to total organics weight in the noted organics stratum (the composition percent for the given material type, as described above)
- for j = 1 to m, where m = number of material types (as described above)

For detail, please refer to Chapter 6 “Ratio, Regression and Difference Estimation” of Elementary Survey Sampling by R.L. Scheaffer, W. Mendenhall and L. Ott (PWS Publishers, 1986).

EXAMPLE

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

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

The composition results for the three strata were combined as follows.

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

Therefore, 9.3% of this examined portion of the waste stream is prunings.

Confidence Intervals for Weighted Composition Ratios Across Strata

The variance of the weighted average was calculated as follows:

$$\mathrm{Var}(O_j) = \left(p_1^2\ \mathrm{Var}(r_{j1})\right) + \left(p_2^2\ \mathrm{Var}(r_{j2})\right) + \left(p_3^2\ \mathrm{Var}(r_{j3})\right) + \ldots \quad (6)$$

EXAMPLE

For example, the amount of prunings present in the overall organics is 2.9 percent. The 1.6 percent figure reflects the precision of the estimate. When calculations are performed at the 90 percent confidence level, we are 90 percent certain that the true mean for prunings is between 4.5 percent (2.9% plus 1.6%) and 1.3 percent (2.9% minus 1.6%).

MATERIAL	EST. %	+ / -
Prunings	2.9%	1.6%

Calculations for Single-family Demographic Subgroups

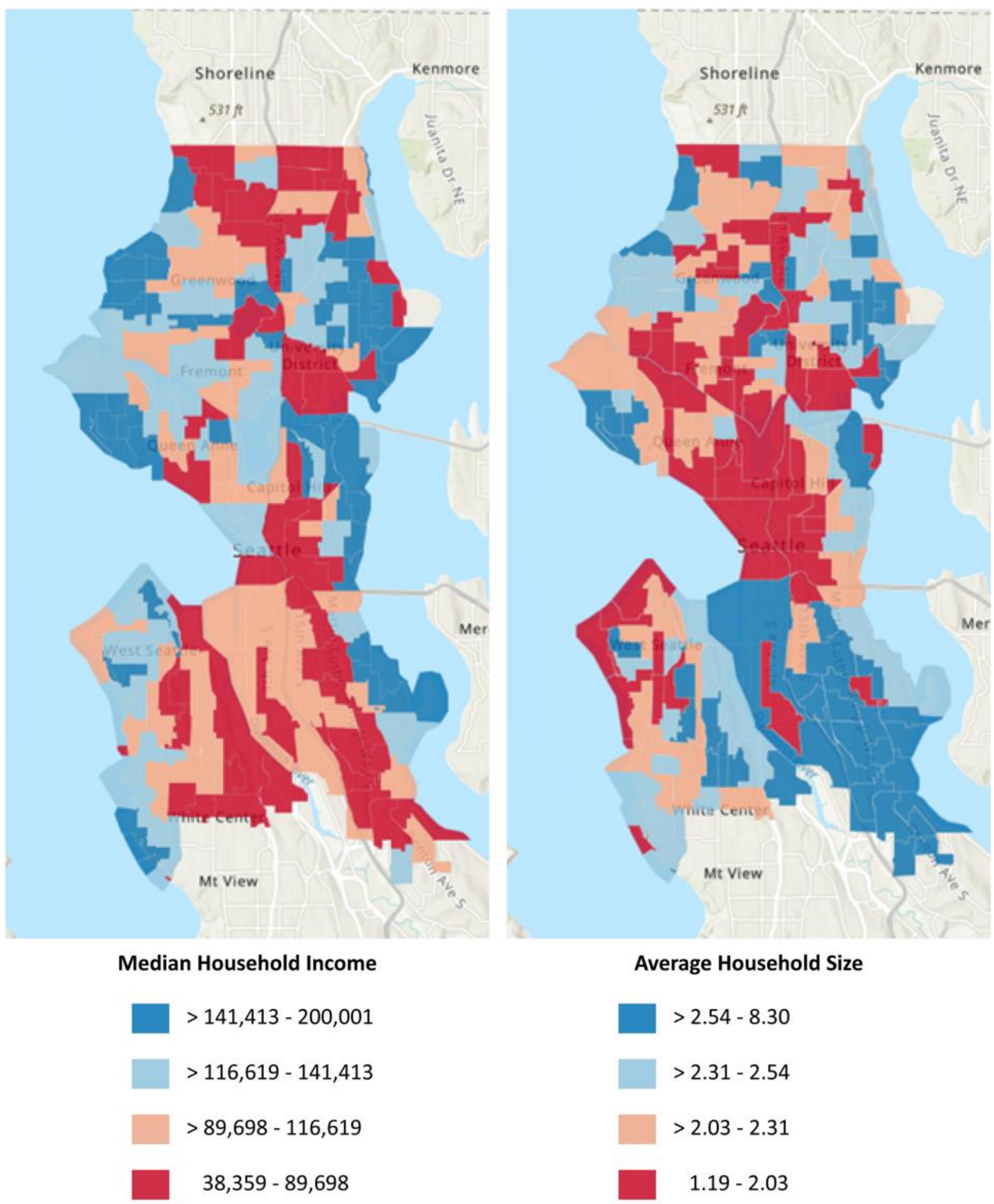
Cascadia calculated the composition of Seattle's single-family organics stream for sub-sectors based on two demographic characteristics: median household income and average household size. Cascadia used ArcGIS Online to retrieve and process data from the American Community Survey for household size and median household income data for the single-family residential routes.[11,12]

[11] Enrich feature: https://doc.arcgis.com/en/arcgis-online/analyze/enrich-layer.htm

[12] ESRI Demographics: https://doc.arcgis.com/en/esri-demographics/data/us-data-fact-sheet.htm

For income, the list of all single-family organics collection routes in Seattle was divided into four groups, called quartiles, based on median household income along the route (Figure 38). Median incomes ranged from about $38,359 per year to about $200,001 per year. High-income routes are the 25% of routes with the highest median income ($141,413 and above), and low-income routes are the 25% of routes with the lowest median income ($89,698 and below). Cascadia used the same quartile process with average household size, which ranged from 1.2 to 8.4 people per household. Large-household routes were those with 2.54 or more people per household, and small-household routes had 2.03 or fewer. While each route includes a mix of household incomes and sizes, on average the high-income routes will have a higher proportion of households with high incomes than the low-income routes.

Figure 38. Single-family Residential Routes by Household Income and Size



After estimating the demographic information for single-family organics routes, Cascadia divided the sampled routes into quartiles based on the median income and mean household size of each route. Organics samples from the first (0 - 25%) quartile of routes were used to calculate “low median income” or “low mean household size” while organics compositions and samples from the top quartile (75% - 100%) of routes were used to calculate “high median income” or “high mean household size” organics compositions. Table 29 shows the number of single-family samples included in each demographic group.

Table 29. Number of Samples Included in Demographic Quartiles

Demographic feature	Highest Quartile	Lowest Quartile
Median Household Income	30	18
Average Household Size	40	44

Once the organics samples were identified as belonging to one of these four demographic groups, Cascadia performed organics composition calculations using our standard procedures using only samples from routes identified as high-income, low-income, large household, and small household. Tonnage data was not available at the demographic quartile level; therefore, the composition is expressed in percentages only.

Calculations for Statistical Comparisons to Previous Study

Cascadia compared the findings from 2021–22 organics study with findings from the 2016 study. This comparison examined whether the composition of Seattle’s organics substreams had changed over time. Cascadia examined statistical differences, using t-tests, between the studies to determine if changes in the composition were statistically significant.

Introduction

Cascadia compared percentage estimates of broad material classes in organics substreams to identify statistically significant changes, if any. The study compared weighted percentage estimates. The reasons why or how these changes occurred were not investigated. The changes may be due to a variety of factors, such as sustained weather conditions, population changes, relative increase or decrease in percentage of other material types, and extremely rare events such as a pandemic.

Calculations

The t-test examines the following hypothesis about each of the material groups studied for each of the sectors. As an example, the hypothesis for yard waste is “There is no statistically significant difference, between the 2016 and 2021–22 study periods, in the percentage of single-family organics made up of yard waste.” The t-tests (modified for ratio estimation) were used to examine the variation between study years. 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.

Identifying statistically significant differences requires a two-step calculation. First, assuming that the two groups to be compared have the same variance, a **pooled sample variance** was calculated:

$$S_{pool}^{2} = \frac{\left[(n1-1)\cdot\left(n1\cdot\hat{V}_{r_j 1}\right)\right]+\left[(n2-1)\cdot\left(n2\cdot\hat{V}_{r_j 2}\right)\right]}{n1+n2-2}$$

Next, the **t-statistic** was constructed:

$$t = \frac{(r1-r2)}{\sqrt{\frac{S_{pool}^{2}}{n1}+\frac{S_{pool}^{2}}{n2}}}$$

Statistical Considerations

The t-test was based on an assumption of normality, with adjustments for conducting multiple t-tests. It was assumed that the material types followed normal distribution, given the large sample sizes (over 200 samples for each of the organics substreams). Also, most of the selected categories are sums of several individual material types, which improves our ability to meet the assumptions of normality.

The year-to-year comparison required conducting multiple t-tests (one for each material type), each of which carries that risk of type I error (getting false-positive results). SPU accepted only 10% chance overall 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).[13]

Interpreting the Calculation Results

The larger the absolute value of the t-statistic, the less likely it is 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. This report does not attempt an in-depth examination of potential causes of the changes in material composition over time.

The statistical tests used assumed that there has been no change. For example, “There is no statistically significant difference between the current and previous study periods in the percentage of the organics stream made up of yard waste.” Statistics were then used to look for evidence against the no-change hypothesis. A “significant” result meant that there was enough evidence to in favor of the alternative hypothesis and that Cascadia could conclude that there is a true difference in composition over time. “Insignificant” results showed that either 1) there was no true difference, or 2) even though there may have appeared to be a difference, there was not enough evidence to support concluding a difference because the findings were limited by sample size and variability. It is also possible that changes occurred in material types that

[13] For more detail about 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)

were not considered in this part of the analysis. For the purposes of this study, only those results with a p-value of less than 1.25% were considered statistically significant.

Material list crosswalk

Cascadia reclassified the material types included in the 2021-22 organics study into the 2016 material glass groupings to enable comparison between the two studies (Table 30).

Table 30. Cross-study Material Group Crosswalk

Material Group	2016 Material Type	2022 Material Type
Yard Waste	Grass/Leaves	Grass/Leaves
	Prunings	Prunings
Food Waste	Vegetative Food	Non-packaged Edible Vegetative Food
		Inedible Vegetative Food
	Vegetative Food, Packaged	Packaged Edible Vegetative Food
	Other Food	Non-packaged Edible Other Food
		Inedible Other Food
		Fats, Oils, & Grease
	Other Food, Packaged	Packaged Edible Other Food
Compostable Paper	Compostable Paper	Universally Compostable Paper
	Mixed Recyclable Paper	Mixed Recyclable Paper
	Commercially Compostable Paper	Approved Single-use Paper Packaging
Compostable Plastic	Compostable Plastic	Compostable Film
		Approved Single-use Plastic Packaging
	Commercially Compostable Plastic	
Other Compostables	Other Compostable Organics	Other Compostable Organics
Contaminants	Potentially Compostable Paper	Potentially Compostable Paper
	Recyclable Polycoated Paper	Polycoated Paper
	Other Paper	Other Non-compostable Paper
	Potentially Compostable Plastic	Potentially Compostable Plastic
	Non-compostable Plastic Film	Non-compostable Film
	Non-compostable Plastic Containers	Recyclable Plastic Containers
	Other Plastic	Other Non-recoverable Plastic
	Recyclable Glass	Recyclable Glass
	Recyclable Metal	Recyclable Metal
	Pet Waste	Pet Waste
	Disposable Diapers	Other Non-recoverable Waste
	Hazardous	
	Other Materials	

Reported Numbers and Rounding

Each composition table presents overall estimated percent composition of each material class and type by weight, including the 90 percent confidence interval for each material type. Cascadia calculated the composition and the confidence intervals according to the study's composition calculations and statistical procedures.

Except where noted, composition tables also present estimated tons of each material in the relevant organics stream, calculated by applying estimated composition percentages to the estimated total tons of materials collected from each sector during the relevant study period, provided by SPU.

To keep figures readable, estimated tonnages are rounded to the nearest ton, and estimated percentages are rounded to the nearest percent or tenth of a percent. In tables, estimated tonnages are rounded to the nearest tenth of a ton. Numbers in the text use the same rounding as the figure or table being referenced. Percentages less than 0.05% are shown as 0.0%. True zeros in tables are displayed as a dash ("–"). As a result, using the rounded percentages to calculate tonnages or sums may yield results that differ from the numbers shown in the report. Similarly, the percentages, when added together, may not exactly match the totals shown. Percentages less than 0.05% are shown as 0.0%. Each number reported in the text is accurate and has been rounded only after finishing all calculations using more precise percentages in the data workbooks. Using the rounded percentages to calculate tonnages or sums may yield results that differ from the numbers shown in the report.

APPENDIX B. MATERIAL LIST AND DEFINITIONS

The 2021-22 organics study used a list of 26 material types organized into four material classes and three recoverability classes. The material classes were organics, paper, plastic, and other.

Table 31 defines the three recoverability classes: compostable, potentially compostable, and non-compostable. Contaminants include both potentially compostable and non-compostable materials.

Table 31. Recoverability Class Definitions

Compostable	A recoverability class that includes materials currently accepted in SPU's residential and commercial sector compost collection programs. For example, food waste and yard waste materials fall into this category.
Potentially Compostable	A recoverability class that includes materials labeled as compostable or biodegradable but are not currently City-approved compostable serviceware.
Non-compostable	A recoverability class that includes materials that are not currently accepted by the SPU's contracted organics processors. This includes materials that are recyclable through SPU's curbside recycling program, as well as materials that are not recoverable and should be disposed as garbage (not compostable or recyclable).

Compostable materials in the organics class are further categorized by whether they are food, yard waste, or other compostables. A summary of changes made to the 2022 material list compared to the 2016 list follows the current material definitions.

Organics

Material	Definition	Recoverability
Packaged Edible Vegetative Food	The components of fruits and vegetables that, in a particular food supply chain, are intended to be consumed by humans. Includes edible vegetative food that is enclosed in plastic, paper, glass, or other packaging, regardless of whether it is in its original packaging. Examples include packaged salad, packaged frozen vegetables, and bags of coffee beans.	Compostable (Food)
Non-packaged Edible Vegetative Food	The components of fruits and vegetables that, in a particular food supply chain, are intended to be consumed by humans. Includes edible vegetative food that is not enclosed in plastic, paper, glass, or other packaging. Examples include loose vegetables and fruits.	Compostable (Food)

Material	Definition	Recoverability
Packaged Edible Other Food	Non-vegetative food, such as breads, meats, pastas, dairy products, etc. The components of food that, in a particular food supply chain, are intended to be consumed by humans. Includes edible food that is enclosed in plastic, paper, glass, or other packaging, regardless of whether it is in its original packaging.	Compostable (Food)
Non-packaged Edible Other Food	Non-vegetative food, such as breads, meats, pastas, dairy products, etc. The components of food that, in a particular food supply chain, are intended to be consumed by humans. Includes edible food that is not enclosed in plastic, paper, glass, or other packaging.	Compostable (Food)
Inedible Vegetative Food	The non-edible portions of food material. Examples include fruit peels, vegetable peelings and potato skins, pits, cores, juiced oranges. Includes non-edible food whether it is packaged or non-packaged.	Compostable (Food)
Inedible Other Food	The non-edible portions of food material. Examples include eggshells, bones, gristle and meat trimmings, fish skins, and seafood shells. Includes non-edible food whether it is packaged or non-packaged.	Compostable (Food)
Fats, Oils, & Grease	Fatty by-products of food preparation. Includes cooking oil, butter, lard, and gravy. Can be in liquid or solid form. Can be packaged or non-packaged. Can be edible or non-edible.	Compostable (Food)
Grass/Leaves	Grass, leaves, small herbaceous plants, inedible garden fruits and vegetables (e.g., pumpkins, pest-ridden apples, etc.), evergreen needles.	Compostable (Yard)
Prunings	Prunings that are up to 2 inches in diameter at their largest point.	Compostable (Yard)
Other Compostable Organics	Toothpicks, chop sticks, untreated wood (including dimensional lumber), and indoor florals. Includes pruning's larger than 2 inches.	Compostable (Other)

Paper

Material	Definition	Recoverability
Universally Compostable Paper	Cedar Grove-labeled cups and other clearly compostable paper, such as pizza boxes, paper towels, napkins, egg and berry cartons, shredded paper, uncoated paper plates, coffee filters, drink carriers, coffee sleeves, and take-out paper bags (e.g., fast food type bags).	Compostable

Material	Definition	Recoverability
Mixed Recyclable Paper	Office paper, newspaper, boxboard, uncoated paper bags (e.g., grocery store type bags), and other recyclable papers not listed in other categories.	Compostable
Approved Single-use Paper Packaging	BPI and/or CMA-labeled compostable paper clamshells and waxed cups.	Compostable
Potentially Compostable Paper	Bakery boxes, deli sheets, plates, bowls, wax-coated portion cups, non-BPI labeled clamshells, food trays, hot cups, deli containers, paper, or bagasse meat trays. This category also includes items that are marked compostable or biodegradable but are not Cedar Grove-approved. Examples include compostable-labeled bags or coffee cups that are not Cedar Grove/Lenz/CMA approved.	Potentially Compostable
Polycoated Paper	Milk cartons, juice cartons, and ice cream cartons; Starbucks or other non-compostable hot cups, TetraPak containers.	Non-compostable
Other Non-compostable Paper	Photographs, carbon copy paper, hardcover books, waxed cardboard, and other predominantly paper items with other attached materials, such as spiral notebooks.	Non-compostable

Plastics

Material	Definition	Recoverability
Approved Single-use Plastic Packaging	BPI or CMA-labeled food service ware, tan-colored compostable meat trays, and BPI or CMA-labeled kitchen compost bags currently on accepted list.	Compostable
Compostable Film	Bags appropriately labelled compostable (e.g., by BPI, CMA, or CG), that should be approved by Cedar Grove.	Compostable
Potentially Compostable Plastic	Utensils, straws, cups, food-handling gloves, cold cups, deli containers, and meat trays. This category includes items thought to be in a compostable format, that are unmarked, or marked compostable, but are not Cedar Grove-approved.	Potentially Compostable
Non-compostable Film	Bags not approved by Cedar Grove and other film. Includes all merchandise and take-out bags that are non-compostable. Includes bags that are not compostable that are made up of either clear, tinted green, and/or brown plastic film.	Non-compostable

Material	Definition	Recoverability
Recyclable Plastic Containers	Plastic bottles, jars, tubs, cups, and other rigid containers not marked as compostable. Includes lids 3 inches in diameter or larger.	Non-compostable
Other Non-recoverable Plastic	All other items that are entirely or predominantly composed of plastic.	Non-compostable

Other

Material	Definition	Recoverability
Recyclable Glass	Glass containers. Includes broken glass and cullet.	Non-compostable
Recyclable Metal	Aluminum cans, aluminum foil/containers, steel food cans, and other ferrous metal.	Non-compostable
Pet Waste	Bagged or unbagged pet waste. Includes kitty litter and animal bedding.	Non-compostable
Other Non-recoverable Waste	All other items not included in the categories above, such as mirrors. Includes hazardous waste such as light bulbs, paint, motor oil, etc. Includes disposable diapers.	Non-compostable

Changes to the 2021–22 Material List

The material types in this study are based on those used in Seattle's 2016 and 2012 organics studies. In consultation with SPU, Cascadia moved several materials to different broad material classes to better reflect new policies in composting. Cascadia also updated the material list to provide more detail about specific materials in the organics stream. Key changes were:

- Food categories were sub-divided into edible and non-edible food.
- A new category was created for "Fats, Oils, and Grease".
- "Disposable diapers" and "Hazardous" items from 2016 material list were merged with "Other Non-compostable, non-recyclable Items".

APPENDIX C. SAMPLING PROGRESS REPORTS

Cascadia sent progress reports to SPU throughout the project period. When feasible, sampling events were scheduled contiguously to maximize field coordination and data management efficiencies. Sampling events occurred either concurrently or in consecutive weeks.

Each summary presents dates of sampling, the total number of samples sorted compared to the goal for that sampling event, and whether any samples were missed or replaced by a different zone or sector. Each section also includes a table detailing the number of samples that were sorted versus the number planned, by sector and zone.

Fieldwork Season 1 (September 2021)

Single-family (SF)	Multifamily (MF)	Commercial (COM)
September 20, 2021-September 23, 2021	September 20, 2021-September 23, 2021	N/A

Reason for difference between planned and actual sample counts, if any:

In total, 53 single-family samples and 42 multifamily samples were sorted. Cascadia collected 8 samples fewer from zone 3 because the collection trucks had collected organics material from pre-selected routes before the multifamily sample collection crew arrived at selected properties. Correspondingly, Cascadia collected 3 extra single-family samples to adjust fieldwork efficiency for the future seasons.

Zone	SF Target	SF Actual	MF Target	MF Actual	COM Target	COM Actual
Zone 1	12	14	12	12	-	-
Zone 2	13	14	13	13	-	-
Zone 3	13	12	13	5	-	-
Zone 4	12	13	12	12	-	-
Total	**50**	**53**	**50**	**42**	**-**	**-**

Fieldwork Season 2 (December 2021)

Single-family (SF)	Multifamily (MF)	Commercial (COM)
December 6, 2021-December 9, 2021	December 6, 2021-December 9, 2021	N/A

Reason for difference between planned and actual sample counts, if any:

In total, 48 single-family samples and 58 multifamily samples were captured and sorted. Cascadia sorted 8 additional multifamily samples to make up the fall season where Cascadia sorted 42 samples. Correspondingly, Cascadia sorted 2 fewer single-family samples to adjust fieldwork efficiency.

Zone	SF Target	SF Actual	MF Target	MF Actual	COM Target	COM Actual
Zone 1	13	13	13	13	-	-
Zone 2	12	11	12	13	-	-
Zone 3	12	11	12	18	-	-
Zone 4	13	13	13	14	-	-
Total	**50**	**48**	**50**	**58**	**-**	**-**

Fieldwork Season 3 (April 2022)

Single-family (SF)	Multifamily (MF)	Commercial (COM)
April 5, 2022-April 8, 2022	April 5, 2022-April 8, 2022	April 11, 2022-April 14, 2022

Reason for difference between planned and actual sample counts, if any:

Overall, Cascadia collected all samples that were planned for the season, plus some additional organics samples. There were some alterations in how many samples were collected from each zone, as seen in the table below, due to changes in vehicle arrivals on-site. Zones that were altered during this sampling event will be taken into consideration during subsequent sampling events to ensure that samples taken continue to meet or exceed sampling goals.

Zone	SF Target	SF Actual	MF Target	MF Actual	COM Target	COM Actual
Zone 1	12	12	12	13	12	14
Zone 2	13	14	13	13	13	13
Zone 3	13	14	13	13	13	13
Zone 4	12	11	12	13	12	13
Total	**50**	**51**	**50**	**52**	**50**	**53**

Fieldwork Season 4 (August 2022)

Single-family (SF)	Multifamily (MF)	Commercial (COM)
August 8, 2022-August 10, 2022	August 8, 2022-August 10, 2022	August 15, 2022-August 18, 2022

Reason for difference between planned and actual sample counts, if any:

The number of samples completed differed from the targets due to the variation in which trucks arrived at the facility during the crew's working hours. Overall, samples taken continue to meet or exceed sampling goals.

Zone	SF Target	SF Actual	MF Target	MF Actual	COM Target	COM Actual
Zone 1	12	11	12	15	12	13
Zone 2	13	15	13	15	13	13
Zone 3	13	11	13	15	13	10
Zone 4	12	13	12	13	12	14
Total	**50**	**50**	**50**	**58**	**50**	**50**

Fieldwork Season 5 (October 2022)

Single-family (SF)	Multifamily (MF)	Commercial (COM)
N/A	N/A	October 10, 2022-October 13, 2022

Reason for difference between planned and actual sample counts, if any:

Overall, Cascadia collected all 50 samples that were planned for the season. There were some alterations in how many samples were collected from each zone, as seen in the table below, due to changes in vehicle arrivals on-site. Overall, samples taken continue to meet or exceed sampling goals.

Zone	SF Target	SF Actual	MF Target	MF Actual	COM Target	COM Actual
Zone 1	-	-	-	-	12	11
Zone 2	-	-	-	-	13	13
Zone 3	-	-	-	-	13	13
Zone 4	-	-	-	-	12	13
Total	**-**	**-**	**-**	**-**	**50**	**50**

Fieldwork Season 6 (December 2022)

Single-family (SF)	Multifamily (MF)	Commercial (COM)
N/A	N/A	December 5, 2022-December 8, 2022

Reason for difference between planned and actual sample counts, if any:

Overall, Cascadia collected all 50 samples that were planned for the season. There were some alterations in how many samples were collected from each zone in previous seasons, as seen in the table below. Overall, samples taken continue to meet sampling goals.

Zone	SF Target	SF Actual	MF Target	MF Actual	COM Target	COM Actual
Zone 1	-	-	-	-	13	13
Zone 2	-	-	-	-	13	13
Zone 3	-	-	-	-	12	12
Zone 4	-	-	-	-	12	12
Total	**-**	**-**	**-**	**-**	**50**	**50**

APPENDIX D. DETAILED COMPOSITION TABLES

This section shows detailed composition tables for the organics stream:

- All sectors (overall only)
- Single-family residential (by season, zone, household size, and household income)
- Multifamily residential (by season and zone)
- Commercial (by season and zone)

Each composition table presents overall estimated percent composition of each material class and type by weight, including the 90 percent confidence interval for each material type. Cascadia calculated the composition and the confidence intervals according to the study's composition calculations and statistical procedures.

Most composition tables also present estimated tons of each material in the organics stream, calculated by applying estimated composition percentages to the estimated total tons of materials disposed in the organics stream from the relevant sector during the relevant study period, provided by SPU.

Because data for individual sectors represent different time periods, tables for all sectors combined do not show tons. Because data on total tons collected from areas representing the different demographic groups are not available, Cascadia could not estimate tons by material type for single-family residential results by household size or household income.

Table 32. Organics Stream Composition: All Sectors

Material	Est. %	+ / -	Material	Est. %	+ / -
Organics	**90.4%**	**0.5%**	**Plastic**	**1.5%**	**0.1%**
Grass/Leaves	65.0%	1.7%	Approved Single-use Plastic Packaging	0.4%	0.0%
Prunings	4.0%	0.8%	Compostable Film	0.6%	0.1%
Packaged Edible Vegetative Food	0.1%	0.0%	Potentially Compostable Plastic	0.1%	0.0%
Non-packaged Edible Vegetative Food	3.3%	0.3%	Non-compostable Film	0.2%	0.0%
Packaged Edible Other Food	0.3%	0.1%	Recyclable Plastic Containers	0.2%	0.0%
Non-packaged Edible Other Food	4.1%	0.4%	Other Non-recoverable Plastic	0.1%	0.0%
Inedible Vegetative Food	11.6%	0.9%	**Other**	**0.7%**	**0.1%**
Inedible Other Food	0.9%	0.1%	Recyclable Glass	0.1%	0.0%
Fats, Oils, & Grease	0.0%	0.0%	Recyclable Metal	0.1%	0.0%
Other Compostable Organics	1.1%	0.3%	Pet Waste	0.2%	0.1%
Paper	**7.3%**	**0.4%**	Other Non-recoverable Waste	0.3%	0.1%
Universally Compostable Paper	4.3%	0.2%			
Mixed Recyclable Paper	2.1%	0.2%	**Compostable**	**97.9%**	0.2%
Approved Single-use Paper Packaging	0.1%	0.0%	**Potentially Compostable**	**0.7%**	0.1%
Potentially Compostable Paper	0.6%	0.1%	**Non-compostable**	**1.4%**	0.1%
Polycoated Paper	0.2%	0.0%	**Estimated Total**	**100%**	
Other Non-compostable Paper	0.1%	0.0%	Sample Count	615	

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

Table 33. Organics Composition: Single-family 2021-22

Material	Est. %	+ / -	Est. Tons
Organics	**91.5%**	**0.5%**	**78,619.1**
Grass/Leaves	70.4%	1.8%	60,521.3
Prunings	4.3%	0.8%	3,685.5
Packaged Edible Vegetative Food	0.1%	0.0%	54.8
Non-packaged Edible Vegetative Food	2.8%	0.3%	2,396.6
Packaged Edible Other Food	0.2%	0.1%	155.8
Non-packaged Edible Other Food	2.6%	0.4%	2,215.8
Inedible Vegetative Food	9.4%	0.9%	8,067.4
Inedible Other Food	0.6%	0.1%	479.9
Fats, Oils, & Grease	0.0%	0.0%	3.5
Other Compostable Organics	1.2%	0.3%	1,038.6
Paper	**6.7%**	**0.4%**	**5,783.1**
Universally Compostable Paper	3.9%	0.3%	3,318.6
Mixed Recyclable Paper	2.1%	0.2%	1,774.2
Approved Single-use Paper Packaging	0.0%	0.0%	29.8
Potentially Compostable Paper	0.6%	0.1%	500.6
Polycoated Paper	0.1%	0.0%	109.8
Other Non-compostable Paper	0.1%	0.0%	50.1

Material	Est. %	+ / -	Est. Tons
Plastic	**1.3%**	**0.1%**	**1,117.2**
Approved Single-use Plastic Packaging	0.4%	0.0%	311.0
Compostable Film	0.5%	0.1%	402.3
Potentially Compostable Plastic	0.1%	0.0%	68.5
Non-compostable Film	0.2%	0.0%	137.1
Recyclable Plastic Containers	0.2%	0.0%	144.8
Other Non-recoverable Plastic	0.1%	0.0%	53.5
Other	**0.5%**	**0.1%**	**415.3**
Recyclable Glass	0.0%	0.0%	33.4
Recyclable Metal	0.0%	0.0%	40.2
Pet Waste	0.2%	0.1%	135.7
Other Non-recoverable Waste	0.2%	0.1%	206.0
Compostable	**98.3%**	0.2%	**84,455.0**
Potentially Compostable	**0.7%**	0.1%	**569.2**
Non-compostable	**1.1%**	0.1%	**910.6**
Estimated Total	**100%**		**85,934.8**
Sample Count			202

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

Table 34. Organics Stream Composition by Season: Single-family Sector 2021-22

	FALL			WINTER			SPRING			SUMMER		
Material	**Est. %**	**+ / -**	**Est. Tons**	**Est. %**	**+ / -**	**Est. Tons**	**Est. %**	**+ / -**	**Est. Tons**	**Est. %**	**+ / -**	**Est. Tons**
Compostable	**98.5%**	0.3%	**24,755**	**98.2%**	0.3%	**14,992**	**97.8%**	0.3%	**21,685**	**98.6%**	0.4%	**23,023**
Potentially Compostable	**0.7%**	0.1%	**182**	**0.9%**	0.1%	**132**	**0.8%**	0.1%	**184**	**0.3%**	0.1%	**71**
Non-compostable	**0.8%**	0.2%	**206**	**0.9%**	0.2%	**143**	**1.4%**	0.2%	**301**	**1.1%**	0.3%	**262**
Organics	**91.6%**	**1.1%**	**23,037.7**	**91.9%**	**0.9%**	**14,029.1**	**91.5%**	**0.9%**	**20,278.4**	**91.1%**	**1.1%**	**21,273.9**
Grass/Leaves	67.9%	3.5%	17,080.7	72.6%	3.7%	11,083.1	72.8%	3.5%	16,134.2	69.5%	3.6%	16,223.3
Prunings	3.8%	1.0%	950.1	1.6%	1.1%	237.4	2.6%	1.1%	569.4	8.3%	2.7%	1,928.6
Packaged Edible Vegetative Food	0.0%	0.0%	7.4	0.0%	0.0%	1.9	0.1%	0.1%	29.5	0.1%	0.1%	16.0
Non-packaged Edible Vegetative Food	3.7%	0.7%	937.3	2.5%	0.9%	382.0	2.3%	0.5%	517.4	2.4%	0.4%	559.9
Packaged Edible Other Food	0.3%	0.2%	68.4	0.1%	0.1%	11.4	0.3%	0.2%	56.0	0.1%	0.1%	20.0
Non-packaged Edible Other Food	2.3%	0.6%	574.0	4.3%	1.9%	649.3	2.5%	0.5%	560.9	1.8%	0.4%	431.6
Inedible Vegetative Food	11.6%	2.1%	2,920.3	9.7%	1.7%	1,476.0	9.7%	2.0%	2,140.3	6.6%	1.5%	1,530.8
Inedible Other Food	0.4%	0.1%	108.0	0.8%	0.3%	120.9	0.5%	0.1%	103.6	0.6%	0.3%	147.3
Fats, Oils, & Grease	0.0%	0.0%	0.1	0.0%	0.0%	1.3	0.0%	0.0%	2.0	0.0%	0.0%	-
Other Compostable Organics	1.6%	1.0%	391.4	0.4%	0.2%	65.9	0.7%	0.3%	165.0	1.8%	0.6%	416.4
Paper	**6.7%**	**0.9%**	**1,687.2**	**6.4%**	**0.8%**	**982.4**	**6.3%**	**0.7%**	**1,403.5**	**7.3%**	**1.0%**	**1,710.0**
Universally Compostable Paper	3.9%	0.6%	988.6	3.7%	0.5%	561.1	3.5%	0.4%	765.6	4.3%	0.5%	1,003.3
Mixed Recyclable Paper	1.9%	0.3%	487.3	1.7%	0.2%	253.7	2.0%	0.4%	434.4	2.6%	0.7%	598.8
Approved Single-use Paper Packaging	0.0%	0.0%	7.1	0.1%	0.0%	12.4	0.0%	0.0%	10.1	0.0%	0.0%	0.3
Potentially Compostable Paper	0.7%	0.1%	165.0	0.7%	0.1%	113.6	0.7%	0.1%	160.5	0.3%	0.0%	61.6
Polycoated Paper	0.1%	0.0%	33.4	0.2%	0.1%	31.7	0.1%	0.0%	20.3	0.1%	0.0%	24.4
Other Non-compostable Paper	0.0%	0.0%	5.8	0.1%	0.0%	10.0	0.1%	0.0%	12.8	0.1%	0.0%	21.6
Plastic	**1.3%**	**0.3%**	**327.5**	**1.4%**	**0.2%**	**211.2**	**1.6%**	**0.2%**	**358.7**	**0.9%**	**0.2%**	**219.9**
Approved Single-use Plastic Packaging	0.3%	0.1%	87.0	0.2%	0.0%	29.9	0.4%	0.1%	94.8	0.4%	0.1%	99.3
Compostable Film	0.6%	0.2%	147.6	0.7%	0.1%	106.3	0.5%	0.1%	101.5	0.2%	0.1%	46.9
Potentially Compostable Plastic	0.1%	0.0%	17.2	0.1%	0.0%	18.7	0.1%	0.0%	23.5	0.0%	0.0%	9.1
Non-compostable Film	0.1%	0.1%	34.4	0.1%	0.0%	17.1	0.3%	0.1%	58.4	0.1%	0.0%	27.1
Recyclable Plastic Containers	0.1%	0.0%	30.9	0.2%	0.0%	27.0	0.2%	0.0%	55.0	0.1%	0.0%	31.9
Other Non-recoverable Plastic	0.0%	0.0%	10.3	0.1%	0.0%	12.2	0.1%	0.0%	25.5	0.0%	0.0%	5.5
Other	**0.4%**	**0.1%**	**90.9**	**0.3%**	**0.1%**	**44.6**	**0.6%**	**0.1%**	**128.7**	**0.6%**	**0.3%**	**151.1**
Recyclable Glass	0.0%	0.0%	0.1	0.1%	0.1%	10.7	0.0%	0.0%	9.1	0.1%	0.1%	13.5
Recyclable Metal	0.0%	0.0%	3.3	0.0%	0.0%	4.0	0.1%	0.0%	22.5	0.0%	0.0%	10.4
Pet Waste	0.1%	0.1%	21.1	0.0%	0.0%	4.7	0.3%	0.1%	58.7	0.2%	0.2%	51.2
Other Non-recoverable Waste	0.3%	0.1%	66.4	0.2%	0.1%	25.2	0.2%	0.1%	38.3	0.3%	0.2%	76.0
TOTAL	**100%**		**25,143.2**	**100%**		**15,267.3**	**100%**		**22,169.4**	**100%**		**23,354.9**
Sample Count			53			48			51			50

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

Table 35. Organics Stream Composition by Zone: Single-family Sector 2021-22

	ZONE 1			ZONE 2			ZONE 3			ZONE 4		
Material	**Est. %**	**+ / -**	**Est. Tons**	**Est. %**	**+ / -**	**Est. Tons**	**Est. %**	**+ / -**	**Est. Tons**	**Est. %**	**+ / -**	**Est. Tons**
Compostable	**98.5%**	0.2%	**22,820.8**	**98.2%**	0.4%	**15,413.0**	**98.2%**	0.4%	**17,426.7**	**98.2%**	0.2%	**28,794.4**
Potentially Compostable	**0.7%**	0.1%	**159.3**	**0.6%**	0.1%	**92.3**	**0.7%**	0.1%	**115.6**	**0.7%**	0.1%	**201.9**
Non-compostable	**0.8%**	0.2%	**189.7**	**1.3%**	0.4%	**196.5**	**1.1%**	0.4%	**197.9**	**1.1%**	0.2%	**326.5**
Organics	**92.0%**	**0.9%**	**21,307.6**	**91.4%**	**1.2%**	**14,350.6**	**91.3%**	**1.1%**	**16,200.2**	**91.3%**	**1.0%**	**26,760.8**
Grass/Leaves	69.8%	3.6%	16,172.9	72.0%	4.1%	11,311.4	75.2%	2.9%	13,340.2	67.2%	3.5%	19,696.9
Prunings	5.0%	1.6%	1,155.1	3.0%	0.9%	474.5	4.2%	1.9%	736.5	4.5%	1.7%	1,319.5
Packaged Edible Vegetative Food	0.1%	0.1%	16.4	0.1%	0.1%	7.9	0.1%	0.1%	11.9	0.1%	0.1%	18.7
Non-packaged Edible Vegetative Food	3.1%	0.5%	711.4	2.2%	0.7%	351.3	1.7%	0.3%	293.0	3.5%	0.7%	1,040.8
Packaged Edible Other Food	0.3%	0.2%	60.0	0.1%	0.1%	13.8	0.1%	0.1%	17.5	0.2%	0.1%	64.4
Non-packaged Edible Other Food	2.2%	0.4%	514.8	3.4%	1.8%	533.2	1.6%	0.5%	289.2	3.0%	0.5%	878.7
Inedible Vegetative Food	9.4%	2.0%	2,182.6	9.0%	2.3%	1,416.8	7.0%	1.1%	1,245.4	11.0%	1.7%	3,222.6
Inedible Other Food	0.5%	0.2%	127.1	0.4%	0.1%	66.5	0.4%	0.1%	74.4	0.7%	0.2%	211.8
Fats, Oils, & Grease	0.0%	0.0%	0.1	0.0%	0.0%	1.3	0.0%	0.0%	2.0	0.0%	0.0%	-
Other Compostable Organics	1.6%	0.7%	367.3	1.1%	0.5%	173.7	1.1%	0.6%	190.0	1.0%	0.8%	307.5
Paper	**6.5%**	**0.7%**	**1,504.3**	**6.6%**	**0.9%**	**1,038.0**	**6.9%**	**0.9%**	**1,225.4**	**6.9%**	**0.8%**	**2,015.4**
Universally Compostable Paper	3.8%	0.5%	888.2	4.1%	0.6%	645.4	3.9%	0.6%	684.8	3.8%	0.5%	1,100.1
Mixed Recyclable Paper	1.9%	0.4%	432.5	1.7%	0.2%	270.6	2.3%	0.4%	400.1	2.3%	0.5%	671.0
Approved Single-use Paper Packaging	0.0%	0.0%	9.0	0.0%	0.0%	5.5	0.0%	0.0%	3.8	0.0%	0.0%	11.5
Potentially Compostable Paper	0.6%	0.1%	138.5	0.5%	0.1%	80.6	0.6%	0.1%	101.3	0.6%	0.1%	180.2
Polycoated Paper	0.1%	0.0%	26.8	0.2%	0.0%	25.8	0.2%	0.1%	26.7	0.1%	0.0%	30.4
Other Non-compostable Paper	0.0%	0.0%	9.3	0.1%	0.0%	10.1	0.0%	0.0%	8.6	0.1%	0.0%	22.2
Plastic	**1.2%**	**0.2%**	**282.2**	**1.4%**	**0.3%**	**221.8**	**1.2%**	**0.2%**	**213.6**	**1.4%**	**0.2%**	**399.7**
Approved Single-use Plastic Packaging	0.3%	0.1%	78.0	0.3%	0.1%	47.1	0.3%	0.1%	53.2	0.5%	0.1%	132.8
Compostable Film	0.5%	0.1%	105.6	0.6%	0.3%	93.9	0.5%	0.1%	84.6	0.4%	0.1%	118.2
Potentially Compostable Plastic	0.1%	0.0%	20.8	0.1%	0.0%	11.7	0.1%	0.0%	14.3	0.1%	0.0%	21.7
Non-compostable Film	0.1%	0.1%	30.9	0.2%	0.1%	32.4	0.1%	0.0%	23.2	0.2%	0.0%	50.6
Recyclable Plastic Containers	0.1%	0.0%	32.1	0.2%	0.0%	27.7	0.2%	0.0%	30.6	0.2%	0.0%	54.3
Other Non-recoverable Plastic	0.1%	0.0%	14.8	0.1%	0.0%	9.0	0.0%	0.0%	7.7	0.1%	0.0%	22.1
Other	**0.3%**	**0.1%**	**75.8**	**0.6%**	**0.3%**	**91.5**	**0.6%**	**0.3%**	**101.1**	**0.5%**	**0.1%**	**146.9**
Recyclable Glass	0.0%	0.0%	2.3	0.0%	0.0%	1.3	0.0%	0.0%	3.9	0.1%	0.1%	25.9
Recyclable Metal	0.0%	0.0%	8.9	0.1%	0.0%	10.2	0.1%	0.0%	9.0	0.0%	0.0%	12.2
Pet Waste	0.1%	0.0%	14.8	0.1%	0.0%	9.0	0.3%	0.2%	48.7	0.2%	0.1%	63.3
Other Non-recoverable Waste	0.2%	0.1%	49.8	0.5%	0.3%	71.0	0.2%	0.1%	39.6	0.2%	0.1%	45.6
Estimated Total	**100%**		**23,169.9**	**100%**		**15,701.9**	**100%**		**17,740.2**	**100%**		**29,322.7**
Sample Count			50			54			48			50

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

Table 36. Organics Stream Composition by Average Single-family Household Size

	HOUSEHOLD SIZE			
	Highest Quartile		Lowest Quartile	
Material	Est. %	+ / -	Est. %	+ / -
Compostable	**98.4%**	0.3%	**98.0%**	0.4%
Potentially Compostable	**0.5%**	0.1%	**0.8%**	0.2%
Non-compostable	**1.0%**	0.2%	**1.1%**	0.3%
Organics	**91.4%**	**1.3%**	**90.1%**	**1.2%**
Grass/Leaves	68.1%	4.8%	71.1%	3.5%
Prunings	5.7%	2.4%	3.3%	1.5%
Packaged Edible Vegetative Food	0.2%	0.2%	0.0%	0.0%
Non-packaged Edible Vegetative Food	2.5%	0.6%	2.3%	0.5%
Packaged Edible Other Food	0.2%	0.2%	0.2%	0.2%
Non-packaged Edible Other Food	2.4%	0.7%	2.6%	0.6%
Inedible Vegetative Food	10.3%	3.3%	8.9%	1.4%
Inedible Other Food	0.5%	0.1%	0.7%	0.4%
Fats, Oils, & Grease	0.0%	0.0%	0.0%	0.0%
Other Compostable Organics	1.5%	0.9%	0.9%	0.5%
Paper	**6.7%**	**1.0%**	**7.8%**	**1.0%**
Universally Compostable Paper	4.3%	0.7%	4.4%	0.6%
Mixed Recyclable Paper	1.8%	0.4%	2.4%	0.5%
Approved Single-use Paper Packaging	0.0%	0.0%	0.0%	0.0%
Potentially Compostable Paper	0.5%	0.1%	0.7%	0.1%
Polycoated Paper	0.1%	0.0%	0.2%	0.2%
Other Non-compostable Paper	0.0%	0.0%	0.1%	0.0%
Plastic	**1.4%**	**0.4%**	**1.6%**	**0.2%**
Approved Single-use Plastic Packaging	0.3%	0.1%	0.4%	0.1%
Compostable Film	0.7%	0.3%	0.6%	0.2%
Potentially Compostable Plastic	0.1%	0.0%	0.1%	0.0%
Non-compostable Film	0.2%	0.1%	0.2%	0.0%
Recyclable Plastic Containers	0.2%	0.0%	0.2%	0.0%
Other Non-recoverable Plastic	0.0%	0.0%	0.0%	0.0%
Other	**0.5%**	**0.2%**	**0.4%**	**0.1%**
Recyclable Glass	0.0%	0.0%	0.0%	0.0%
Recyclable Metal	0.1%	0.0%	0.1%	0.0%
Pet Waste	0.1%	0.1%	0.1%	0.1%
Other Non-recoverable Waste	0.3%	0.1%	0.2%	0.1%
TOTAL	**100%**		**100%**	
Sample Count		40		44

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

Table 37. Organics Stream Composition by Median Single-family Household Income

	HOUSEHOLD INCOME			
	Highest Quartile		Lowest Quartile	
Material	Est. %	+ / -	Est. %	+ / -
Compostable	**98.4%**	0.3%	**98.2%**	0.7%
Potentially Compostable	**0.5%**	0.1%	**0.8%**	0.3%
Non-compostable	**1.1%**	0.3%	**1.0%**	0.5%
Organics	**91.0%**	**1.7%**	**90.7%**	**1.9%**
Grass/Leaves	68.3%	6.2%	72.4%	5.2%
Prunings	6.1%	3.0%	2.5%	2.0%
Packaged Edible Vegetative Food	0.2%	0.2%	0.0%	0.0%
Non-packaged Edible Vegetative Food	1.9%	0.5%	2.1%	1.0%
Packaged Edible Other Food	0.2%	0.3%	0.2%	0.2%
Non-packaged Edible Other Food	2.0%	0.7%	2.6%	1.3%
Inedible Vegetative Food	10.8%	4.4%	7.9%	1.4%
Inedible Other Food	0.4%	0.1%	0.4%	0.1%
Fats, Oils, & Grease	0.0%	0.0%	0.0%	0.0%
Other Compostable Organics	0.9%	0.4%	2.6%	2.0%
Paper	**7.0%**	**1.3%**	**7.6%**	**1.6%**
Universally Compostable Paper	4.5%	0.9%	4.2%	1.0%
Mixed Recyclable Paper	1.9%	0.5%	2.3%	0.7%
Approved Single-use Paper Packaging	0.0%	0.0%	0.0%	0.0%
Potentially Compostable Paper	0.4%	0.1%	0.7%	0.3%
Polycoated Paper	0.1%	0.0%	0.4%	0.4%
Other Non-compostable Paper	0.0%	0.0%	0.0%	0.0%
Plastic	**1.5%**	**0.5%**	**1.5%**	**0.3%**
Approved Single-use Plastic Packaging	0.3%	0.1%	0.3%	0.1%
Compostable Film	0.7%	0.4%	0.7%	0.2%
Potentially Compostable Plastic	0.1%	0.0%	0.1%	0.0%
Non-compostable Film	0.2%	0.1%	0.2%	0.1%
Recyclable Plastic Containers	0.2%	0.0%	0.1%	0.1%
Other Non-recoverable Plastic	0.0%	0.0%	0.0%	0.0%
Other	**0.5%**	**0.2%**	**0.3%**	**0.1%**
Recyclable Glass	0.0%	0.0%	0.0%	0.0%
Recyclable Metal	0.1%	0.0%	0.0%	0.0%
Pet Waste	0.1%	0.1%	0.1%	0.1%
Other Non-recoverable Waste	0.3%	0.2%	0.1%	0.1%
TOTAL	**100%**		**100%**	
Sample Count		30		18

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

Table 38. Organics Composition: Multifamily 2021-22

Material	Est. %	+ / -	Est. Tons	Material	Est. %	+ / -	Est. Tons
Organics	**79.4%**	**1.7%**	**3,166.3**	**Plastic**	**4.0%**	**0.5%**	**161.4**
Grass/Leaves	21.5%	3.4%	858.4	Universally Compostable Plastic	1.0%	0.1%	38.3
Prunings	1.0%	0.5%	40.8	Compostable Film	1.3%	0.1%	53.4
Packaged Edible Vegetative Food	0.5%	0.3%	18.6	Potentially Compostable Plastic	0.2%	0.0%	9.9
Non-packaged Edible Vegetative Food	8.2%	0.9%	325.7	Non-compostable Film	0.7%	0.3%	28.2
Packaged Edible Other Food	1.6%	0.5%	62.6	Recyclable Plastic Containers	0.5%	0.1%	21.2
Non-packaged Edible Other Food	10.3%	1.7%	410.6	Other Non-recoverable Plastic	0.3%	0.1%	10.4
Inedible Vegetative Food	33.4%	2.4%	1,330.0	**Other**	**3.3%**	**1.0%**	**131.2**
Inedible Other Food	2.7%	0.6%	106.4	Recyclable Glass	0.2%	0.2%	7.4
Fats, Oils, & Grease	0.0%	0.0%	1.4	Recyclable Metal	0.2%	0.1%	6.9
Other Compostable Organics	0.3%	0.2%	11.8	Pet Waste	1.4%	0.7%	55.1
Paper	**13.2%**	**0.9%**	**526.7**	Other Non-recoverable Waste	1.6%	0.6%	61.9
Universally Compostable Paper	8.0%	0.7%	319.5				
Mixed Recyclable Paper	3.4%	0.3%	134.4	**Compostable**	**93.2%**	1.3%	**3,715.4**
Approved Single-use Food Packaging	0.1%	0.0%	3.6	**Potentially Compostable**	**1.6%**	0.2%	**63.4**
Potentially Compostable Paper	1.3%	0.2%	53.6	**Non-compostable**	**5.2%**	1.3%	**206.7**
Polycoated Paper	0.2%	0.0%	7.1	**Estimated Total**	**100%**		**3,985.5**
Other Non-compostable Paper	0.2%	0.1%	8.6	Sample Count			210

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

Table 39. Organics Stream Composition by Season: Multifamily Sector 2021-22

Material	FALL			WINTER			SPRING			SUMMER		
	Est. %	+ / -	Est. Tons	Est. %	+ / -	Est. Tons	Est. %	+ / -	Est. Tons	Est. %	+ / -	Est. Tons
Compostable	**92.1%**	3.6%	**967**	**95.5%**	0.9%	**835**	**92.0%**	2.5%	**916**	**93.6%**	2.6%	**998**
Potentially Compostable	**1.5%**	0.4%	**15**	**1.6%**	0.2%	**14**	**1.9%**	0.3%	**18**	**1.5%**	0.5%	**16**
Non-compostable	**6.5%**	3.3%	**68**	**2.9%**	0.8%	**25**	**6.1%**	2.4%	**61**	**4.9%**	2.5%	**53**
Organics	**81.6%**	**4.8%**	**857.4**	**82.3%**	**2.3%**	**718.9**	**75.9%**	**2.7%**	**755.4**	**78.2%**	**2.7%**	**834.5**
Grass/Leaves	33.7%	8.3%	354.4	25.7%	8.8%	224.7	12.2%	4.9%	121.3	14.8%	4.8%	157.9
Prunings	1.9%	0.6%	20.1	0.0%	0.0%	0.2	1.7%	1.9%	17.1	0.3%	0.3%	3.3
Packaged Edible Vegetative Food	0.7%	0.7%	7.8	0.2%	0.2%	1.7	0.5%	0.6%	5.0	0.4%	0.4%	4.0
Non-packaged Edible Vegetative Food	7.4%	1.9%	77.4	7.2%	1.4%	62.8	8.1%	1.4%	80.3	9.9%	2.0%	105.2
Packaged Edible Other Food	1.3%	0.9%	13.1	1.1%	1.0%	9.8	3.0%	1.3%	30.0	0.9%	0.6%	9.7
Non-packaged Edible Other Food	7.2%	1.8%	75.7	13.4%	5.8%	117.1	10.1%	1.7%	100.6	11.0%	3.6%	117.2
Inedible Vegetative Food	27.9%	4.8%	292.7	31.0%	5.2%	270.8	37.0%	4.5%	367.7	37.4%	4.3%	398.9
Inedible Other Food	1.5%	0.5%	15.6	3.4%	2.3%	29.5	3.0%	0.6%	29.8	2.9%	1.1%	31.5
Fats, Oils, & Grease	0.0%	0.0%	-	0.1%	0.1%	0.9	0.0%	0.1%	0.5	0.0%	0.0%	-
Other Compostable Organics	0.1%	0.0%	0.5	0.2%	0.1%	1.4	0.3%	0.1%	3.2	0.6%	0.6%	6.7
Paper	**10.6%**	**2.1%**	**111.4**	**12.1%**	**1.7%**	**105.8**	**15.6%**	**1.7%**	**155.4**	**14.4%**	**1.5%**	**154.1**
Universally Compostable Paper	5.8%	1.2%	61.2	7.3%	1.3%	63.6	9.9%	1.6%	98.2	9.0%	1.2%	96.5
Mixed Recyclable Paper	3.0%	0.8%	31.6	3.1%	0.5%	27.5	3.6%	0.6%	35.9	3.7%	0.7%	39.5
Approved Single-use Paper Packaging	0.0%	0.0%	0.4	0.2%	0.1%	1.6	0.2%	0.1%	1.6	0.0%	0.0%	0.0
Potentially Compostable Paper	1.3%	0.4%	14.1	1.3%	0.2%	11.5	1.5%	0.3%	15.1	1.2%	0.4%	12.9
Polycoated Paper	0.3%	0.1%	2.9	0.1%	0.0%	0.9	0.2%	0.1%	1.6	0.2%	0.1%	1.7
Other Non-compostable Paper	0.1%	0.1%	1.4	0.1%	0.0%	0.7	0.3%	0.1%	3.1	0.3%	0.4%	3.5
Plastic	**3.6%**	**1.6%**	**37.3**	**3.8%**	**0.5%**	**33.1**	**5.1%**	**0.6%**	**50.6**	**3.8%**	**0.6%**	**40.3**
Approved Single-use Plastic Packaging	0.6%	0.2%	6.4	0.5%	0.1%	4.0	0.5%	0.2%	5.0	2.1%	0.3%	22.9
Compostable Film	0.9%	0.2%	10.0	2.2%	0.3%	19.1	2.0%	0.3%	19.7	0.4%	0.2%	4.7
Potentially Compostable Plastic	0.1%	0.0%	1.3	0.3%	0.0%	2.2	0.3%	0.1%	3.3	0.3%	0.1%	3.0
Non-compostable Film	1.1%	1.0%	12.1	0.4%	0.1%	3.5	0.8%	0.3%	8.2	0.4%	0.2%	4.4
Recyclable Plastic Containers	0.6%	0.4%	5.9	0.4%	0.1%	3.2	0.8%	0.4%	8.1	0.4%	0.1%	4.1
Other Non-recoverable Plastic	0.2%	0.1%	1.6	0.1%	0.0%	1.2	0.6%	0.2%	6.3	0.1%	0.0%	1.3
Other	**4.2%**	**2.1%**	**44.1**	**1.8%**	**0.7%**	**15.9**	**3.4%**	**1.9%**	**33.5**	**3.5%**	**2.4%**	**37.7**
Recyclable Glass	0.4%	0.6%	4.0	0.0%	0.0%	0.2	0.1%	0.2%	1.2	0.2%	0.2%	2.0
Recyclable Metal	0.1%	0.1%	1.2	0.2%	0.1%	1.9	0.3%	0.1%	3.0	0.1%	0.0%	0.8
Pet Waste	0.6%	0.5%	6.4	0.7%	0.4%	6.5	1.5%	1.2%	14.8	2.6%	2.2%	27.4
Other Non-recoverable Waste	3.1%	1.9%	32.5	0.8%	0.6%	7.3	1.5%	1.4%	14.5	0.7%	0.6%	7.5
TOTAL	**100%**		**1,050.3**	**100%**		**873.7**	**100%**		**994.9**	**100%**		**1,066.6**
Sample Count			42			58			52			58

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

Table 40. Organics Stream Composition by Zone: Multifamily Sector 2021-22

	ZONE 1			ZONE 2			ZONE 3			ZONE 4		
Material	**Est. %**	**+ / -**	**Est. Tons**	**Est. %**	**+ / -**	**Est. Tons**	**Est. %**	**+ / -**	**Est. Tons**	**Est. %**	**+ / -**	**Est. Tons**
Compostable	**95.8%**	1.0%	**949.5**	**94.1%**	2.2%	**1,172.0**	**92.9%**	3.0%	**887.7**	**89.0%**	4.5%	**706.3**
Potentially Compostable	**1.7%**	0.3%	**17.3**	**1.1%**	0.2%	**13.3**	**2.0%**	0.6%	**18.7**	**1.8%**	0.3%	**14.1**
Non-compostable	**2.4%**	0.9%	**24.3**	**4.8%**	2.1%	**59.8**	**5.2%**	2.8%	**49.3**	**9.2%**	4.3%	**73.4**
Organics	**80.8%**	**2.5%**	**800.5**	**80.9%**	**2.8%**	**1,007.5**	**80.5%**	**3.3%**	**769.2**	**74.2%**	**5.1%**	**589.1**
Grass/Leaves	22.4%	7.1%	222.0	23.4%	7.1%	291.4	27.1%	6.1%	259.0	10.8%	6.1%	85.9
Prunings	0.4%	0.3%	4.2	0.8%	0.4%	9.5	2.6%	2.0%	24.8	0.3%	0.2%	2.4
Packaged Edible Vegetative Food	0.1%	0.2%	1.3	0.8%	0.6%	9.4	0.0%	0.0%	0.3	0.9%	0.9%	7.5
Non-packaged Edible Vegetative Food	7.0%	1.3%	69.1	8.0%	1.3%	99.1	8.4%	1.9%	80.5	9.7%	2.5%	77.1
Packaged Edible Other Food	0.4%	0.4%	4.1	1.3%	0.8%	16.6	1.1%	1.0%	10.8	3.9%	1.6%	31.1
Non-packaged Edible Other Food	10.5%	3.7%	104.4	9.9%	3.8%	123.0	9.0%	2.9%	85.9	12.3%	2.2%	97.3
Inedible Vegetative Food	37.6%	4.8%	372.6	33.9%	4.9%	422.7	28.8%	4.4%	274.8	32.7%	4.1%	259.9
Inedible Other Food	2.1%	0.5%	20.7	2.6%	1.7%	32.7	3.0%	1.2%	28.3	3.1%	0.9%	24.7
Fats, Oils, & Grease	0.0%	0.0%	0.1	0.1%	0.1%	1.2	0.0%	0.0%	0.0	0.0%	0.0%	-
Other Compostable Organics	0.2%	0.1%	1.9	0.2%	0.1%	2.0	0.5%	0.5%	4.6	0.4%	0.6%	3.3
Paper	**14.1%**	**2.2%**	**139.6**	**12.4%**	**1.6%**	**154.4**	**12.0%**	**1.6%**	**115.0**	**14.8%**	**1.7%**	**117.7**
Universally Compostable Paper	9.0%	1.6%	89.3	8.1%	1.4%	100.7	6.8%	0.8%	64.5	8.2%	1.2%	65.0
Mixed Recyclable Paper	3.1%	0.6%	31.1	3.0%	0.6%	37.4	3.4%	0.8%	32.3	4.2%	0.8%	33.6
Approved Single-use Paper Packaging	0.1%	0.1%	1.2	0.1%	0.1%	1.5	0.0%	0.0%	0.3	0.1%	0.1%	0.6
Potentially Compostable Paper	1.5%	0.3%	14.7	0.9%	0.2%	11.5	1.7%	0.6%	16.2	1.4%	0.3%	11.3
Polycoated Paper	0.2%	0.1%	1.8	0.1%	0.0%	1.7	0.1%	0.0%	1.0	0.3%	0.1%	2.6
Other Non-compostable Paper	0.2%	0.1%	1.5	0.1%	0.1%	1.6	0.1%	0.1%	0.8	0.6%	0.5%	4.7
Plastic	**3.8%**	**0.5%**	**37.5**	**3.8%**	**0.6%**	**47.9**	**3.3%**	**0.5%**	**31.3**	**5.6%**	**2.1%**	**44.6**
Approved Single-use Plastic Packaging	0.7%	0.2%	7.3	0.9%	0.2%	11.3	1.2%	0.3%	11.8	1.0%	0.2%	7.9
Compostable Film	2.0%	0.3%	20.1	1.1%	0.2%	13.7	1.0%	0.2%	9.5	1.3%	0.3%	10.1
Potentially Compostable Plastic	0.3%	0.1%	2.7	0.1%	0.0%	1.8	0.3%	0.2%	2.6	0.4%	0.1%	2.8
Non-compostable Film	0.4%	0.1%	4.0	0.9%	0.3%	11.1	0.3%	0.1%	3.1	1.3%	1.3%	10.1
Recyclable Plastic Containers	0.3%	0.1%	2.7	0.5%	0.2%	6.8	0.3%	0.1%	3.3	1.1%	0.6%	8.5
Other Non-recoverable Plastic	0.1%	0.0%	0.8	0.3%	0.1%	3.3	0.1%	0.0%	1.0	0.7%	0.3%	5.2
Other	**1.4%**	**0.7%**	**13.5**	**2.8%**	**1.7%**	**35.3**	**4.2%**	**2.7%**	**40.1**	**5.3%**	**2.3%**	**42.3**
Recyclable Glass	0.1%	0.2%	1.4	0.1%	0.1%	1.2	0.0%	0.0%	0.4	0.6%	0.8%	4.4
Recyclable Metal	0.0%	0.0%	0.4	0.2%	0.1%	2.9	0.1%	0.0%	1.0	0.3%	0.2%	2.6
Pet Waste	0.9%	0.7%	8.5	0.8%	0.7%	10.5	3.3%	2.6%	31.1	0.6%	0.4%	5.0
Other Non-recoverable Waste	0.3%	0.3%	3.1	1.7%	1.4%	20.7	0.8%	0.8%	7.7	3.8%	2.1%	30.3
Estimated Total	**100%**		**991.1**	**100%**		**1,245.0**	**100%**		**955.7**	**100%**		**793.8**
Sample Count			53			54			51			52

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

Table 41. Organics Composition: Commercial 2022

Material	Est. %	+ / -	Est. Tons
Organics	**80.8%**	**2.0%**	**3,955.0**
Grass/Leaves	5.4%	2.5%	265.8
Prunings	2.0%	1.9%	99.8
Packaged Edible Vegetative Food	0.2%	0.1%	7.6
Non-packaged Edible Vegetative Food	7.4%	1.8%	363.3
Packaged Edible Other Food	1.5%	0.8%	71.5
Non-packaged Edible Other Food	26.4%	3.5%	1,289.8
Inedible Vegetative Food	32.5%	3.6%	1,591.4
Inedible Other Food	5.1%	1.4%	250.6
Fats, Oils, & Grease	0.0%	0.0%	0.9
Other Compostable Organics	0.3%	0.2%	14.3
Paper	**13.4%**	**1.4%**	**654.0**
Universally Compostable Paper	9.9%	1.1%	486.1
Mixed Recyclable Paper	1.3%	0.2%	62.8
Approved Single-use Paper Packaging	0.4%	0.5%	18.3
Potentially Compostable Paper	1.1%	0.3%	51.4
Polycoated Paper	0.6%	0.3%	29.9
Other Non-compostable Paper	0.1%	0.1%	5.5

Material	Est. %	+ / -	Est. Tons
Plastic	**3.9%**	**0.5%**	**190.4**
Approved Single-use Plastic Packaging	0.3%	0.1%	17.0
Compostable Film	1.6%	0.2%	78.4
Potentially Compostable Plastic	0.3%	0.1%	14.9
Non-compostable Film	0.8%	0.2%	37.3
Recyclable Plastic Containers	0.4%	0.1%	21.1
Other Non-recoverable Plastic	0.4%	0.2%	21.7
Other	**1.9%**	**0.9%**	**93.9**
Recyclable Glass	0.3%	0.1%	13.0
Recyclable Metal	0.3%	0.1%	16.1
Pet Waste	0.8%	0.8%	37.5
Other Non-recoverable Waste	0.6%	0.3%	27.2
Compostable	**94.4%**	1.3%	**4,617.5**
Potentially Compostable	**1.4%**	0.4%	**66.3**
Non-compostable	**4.3%**	1.2%	**209.4**
Estimated Total	**100%**		**4,893.2**
Sample Count			203

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

Table 42. Organics Stream Composition by Season: Commercial Sector 2022

	SPRING			SUMMER			FALL			WINTER		
Material	Est. %	+/-	Est. Tons	Est. %	+/-	Est. Tons	Est. %	+/-	Est. Tons	Est. %	+/-	Est. Tons
Compostable	**92.5%**	2.8%	**1,130**	**94.4%**	2.1%	**1,240**	**94.6%**	3.7%	**1,133**	**96.1%**	1.5%	**1,114**
Potentially Compostable	**1.6%**	0.7%	**20**	**1.6%**	1.0%	**21**	**1.1%**	0.5%	**13**	**1.1%**	0.7%	**13**
Non-compostable	**5.9%**	2.6%	**72**	**4.0%**	1.7%	**53**	**4.4%**	3.5%	**52**	**2.8%**	1.2%	**32**
Organics	**78.4%**	**4.5%**	**957.3**	**82.9%**	**3.4%**	**1,089.4**	**80.6%**	**4.8%**	**965.3**	**81.3%**	**3.6%**	**942.9**
Grass/Leaves	3.8%	3.1%	46.3	6.5%	4.4%	84.9	7.2%	6.6%	86.3	4.2%	5.8%	48.4
Prunings	0.0%	0.0%	-	0.3%	0.5%	4.6	0.9%	0.8%	10.5	7.3%	8.0%	84.7
Packaged Edible Vegetative Food	0.4%	0.4%	5.0	0.2%	0.2%	2.3	0.0%	0.0%	0.4	0.0%	0.0%	-
Non-packaged Edible Vegetative Food	9.7%	3.7%	117.9	8.1%	5.2%	106.8	6.1%	2.3%	73.1	5.6%	1.9%	65.5
Packaged Edible Other Food	1.8%	1.6%	21.4	2.3%	2.3%	30.5	0.3%	0.3%	4.0	1.3%	1.6%	15.6
Non-packaged Edible Other Food	26.6%	6.1%	325.2	24.4%	7.2%	320.3	27.1%	7.6%	324.9	27.6%	7.0%	319.5
Inedible Vegetative Food	28.0%	6.2%	342.0	38.1%	7.6%	501.2	33.7%	7.4%	404.0	29.7%	7.4%	344.0
Inedible Other Food	8.1%	4.4%	98.5	2.9%	1.1%	37.5	4.4%	2.1%	53.1	5.3%	2.9%	61.5
Fats, Oils, & Grease	0.0%	0.0%	-	0.0%	0.0%	0.0	0.0%	0.0%	0.2	0.1%	0.1%	0.7
Other Compostable Organics	0.1%	0.0%	1.1	0.1%	0.1%	1.3	0.7%	0.9%	8.8	0.3%	0.2%	3.1
Paper	**13.9%**	**3.1%**	**169.3**	**12.0%**	**2.6%**	**157.2**	**13.7%**	**2.8%**	**164.6**	**14.1%**	**2.8%**	**162.9**
Universally Compostable Paper	9.3%	2.0%	113.4	8.8%	1.9%	115.9	10.3%	2.3%	123.7	11.5%	2.5%	133.0
Mixed Recyclable Paper	1.6%	0.6%	19.1	1.1%	0.4%	14.1	1.4%	0.4%	17.3	1.1%	0.3%	12.4
Approved Single-use Paper Packaging	1.2%	1.9%	14.8	0.1%	0.1%	0.9	0.2%	0.3%	2.6	0.0%	0.0%	-
Potentially Compostable Paper	1.5%	0.7%	18.0	1.2%	1.0%	15.3	0.8%	0.4%	9.4	0.7%	0.5%	8.7
Polycoated Paper	0.3%	0.2%	3.1	0.7%	0.6%	9.3	0.9%	0.6%	11.0	0.6%	0.4%	6.6
Other Non-compostable Paper	0.1%	0.1%	0.9	0.1%	0.1%	1.8	0.1%	0.1%	0.7	0.2%	0.2%	2.1
Plastic	**4.7%**	**1.2%**	**56.9**	**4.0%**	**1.1%**	**53.0**	**3.3%**	**0.6%**	**39.6**	**3.5%**	**0.9%**	**41.0**
Approved Single-use Plastic Packaging	0.1%	0.0%	0.9	0.6%	0.2%	8.1	0.3%	0.2%	3.5	0.4%	0.1%	4.5
Compostable Film	2.0%	0.6%	24.2	0.9%	0.2%	12.2	1.7%	0.4%	21.0	1.8%	0.4%	21.0
Potentially Compostable Plastic	0.1%	0.1%	1.8	0.4%	0.3%	5.8	0.3%	0.2%	3.2	0.4%	0.3%	4.2
Non-compostable Film	1.3%	0.8%	16.5	1.0%	0.6%	12.8	0.4%	0.1%	5.1	0.3%	0.1%	2.9
Recyclable Plastic Containers	0.7%	0.3%	8.5	0.5%	0.3%	6.7	0.3%	0.1%	3.3	0.2%	0.1%	2.7
Other Non-recoverable Plastic	0.4%	0.4%	5.0	0.6%	0.4%	7.5	0.3%	0.2%	3.5	0.5%	0.3%	5.7
Other	**3.1%**	**1.8%**	**37.6**	**1.1%**	**0.7%**	**15.1**	**2.4%**	**3.1%**	**28.8**	**1.1%**	**0.9%**	**12.4**
Recyclable Glass	0.6%	0.3%	7.9	0.3%	0.2%	3.5	0.1%	0.1%	1.6	0.0%	0.0%	-
Recyclable Metal	0.6%	0.4%	7.0	0.3%	0.3%	4.5	0.2%	0.1%	1.9	0.2%	0.2%	2.8
Pet Waste	0.5%	0.7%	6.1	0.0%	0.0%	0.2	2.0%	3.1%	23.8	0.6%	0.9%	7.3
Other Non-recoverable Waste	1.4%	1.1%	16.6	0.5%	0.4%	6.9	0.1%	0.1%	1.5	0.2%	0.2%	2.3
TOTAL	**100%**		**1,221.1**	**100%**		**1,314.6**	**100%**		**1,198.4**	**100%**		**1,159.1**
Sample Count			53			50			49			51

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

Table 43. Organics Stream Composition by Zone: Commercial Sector 2022

	Low-Density Commercial Zones			High-Density Commercial Zones		
Material	**Est. %**	**+ / -**	**Est. Tons**	**Est. %**	**+ / -**	**Est. Tons**
Compostable	**94.3%**	1.9%	**2,919.7**	**94.5%**	1.3%	**1,697.9**
Potentially Compostable	**1.2%**	0.4%	**35.8**	**1.7%**	0.8%	**30.4**
Non-compostable	**4.5%**	1.8%	**140.8**	**3.8%**	1.1%	**68.6**
Organics	**80.7%**	**2.7%**	**2,497.6**	**81.1%**	**2.9%**	**1,457.4**
Grass/Leaves	5.9%	3.8%	183.0	4.6%	2.5%	82.7
Prunings	2.0%	2.8%	60.4	2.2%	1.9%	39.4
Packaged Edible Vegetative Food	0.2%	0.2%	5.0	0.1%	0.1%	2.5
Non-packaged Edible Vegetative Food	7.2%	2.6%	221.7	7.9%	2.3%	141.6
Packaged Edible Other Food	2.0%	1.3%	61.4	0.6%	0.3%	10.1
Non-packaged Edible Other Food	25.3%	4.9%	783.3	28.2%	4.6%	506.5
Inedible Vegetative Food	33.0%	4.9%	1,020.8	31.8%	4.8%	570.5
Inedible Other Food	4.8%	1.8%	149.4	5.6%	2.3%	101.2
Fats, Oils, & Grease	0.0%	0.0%	0.6	0.0%	0.0%	0.3
Other Compostable Organics	0.4%	0.3%	11.8	0.1%	0.1%	2.5
Paper	**13.4%**	**1.7%**	**415.1**	**13.3%**	**2.4%**	**238.8**
Universally Compostable Paper	10.4%	1.4%	321.1	9.2%	1.7%	165.0
Mixed Recyclable Paper	1.3%	0.3%	39.1	1.3%	0.3%	23.7
Approved Single-use Paper Packaging	0.1%	0.1%	3.7	0.8%	1.3%	14.6
Potentially Compostable Paper	0.8%	0.3%	24.6	1.5%	0.8%	26.8
Polycoated Paper	0.8%	0.4%	24.4	0.3%	0.2%	5.6
Other Non-compostable Paper	0.1%	0.0%	2.3	0.2%	0.1%	3.1
Plastic	**3.7%**	**0.7%**	**114.2**	**4.2%**	**0.7%**	**76.3**
Approved Single-use Plastic Packaging	0.4%	0.1%	12.1	0.3%	0.1%	4.9
Compostable Film	1.5%	0.3%	46.1	1.8%	0.3%	32.3
Potentially Compostable Plastic	0.4%	0.2%	11.3	0.2%	0.1%	3.6
Non-compostable Film	0.7%	0.3%	20.2	1.0%	0.5%	17.1
Recyclable Plastic Containers	0.3%	0.1%	9.0	0.7%	0.2%	12.2
Other Non-recoverable Plastic	0.5%	0.3%	15.5	0.3%	0.1%	6.2
Other	**2.2%**	**1.4%**	**69.4**	**1.4%**	**0.7%**	**24.5**
Recyclable Glass	0.3%	0.1%	7.9	0.3%	0.2%	5.1
Recyclable Metal	0.3%	0.2%	8.9	0.4%	0.2%	7.2
Pet Waste	1.0%	1.2%	30.2	0.4%	0.6%	7.3
Other Non-recoverable Waste	0.7%	0.5%	22.4	0.3%	0.1%	4.8
Estimated Total	**100%**		**3,096.3**	**100%**		**1,796.9**
Sample Count			102			101

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

APPENDIX E. EXAMPLE CONTAMINATION PHOTOS

To provide context for contamination levels, this section shows photos of example samples that show varying levels of contamination: 0%, 1%, 2%, 5% and 10% or more. Tarps, red and yellow sorting tubs, and sample placards are study equipment and not part of the sample.

Figure 39. Example Samples with 0% Contamination

Figure 40. Example Samples with 1% Contamination

Figure 41. Example Samples with 2% Contamination

Figure 42. Example Samples with 5% Contamination

Figure 43. Example Samples with 10%+ Contamination

APPENDIX F. WEATHER ANALYSIS

Temperature and precipitation affect plant growth and gardening activities, and likely affect tonnages of yard waste collected. This study focuses on single-family organics bins because 98% of yard waste collected during this study period came from the single-family sector. Cascadia analyzed temperature and precipitation during sampling months to assess whether the weather conditions leading to sampling were representative of the typical weather conditions for the study period. The analysis found that that weather in each week before sampling was within one standard deviation from the average weather for each month selected for sampling. As a result, weather during the week that residents generated organics can be considered representative of average weather conditions for the month.

Weather Conditions Data

Table 44 shows a summary of average temperature for the month of each sampling event and the week prior to each sampling event. Most weeks before sampling events were within one standard deviation of the mean for the month.

Table 44. Average Temperature During Study Period

Sampling Dates	Average Monthly Temperature (F)	Prior Week Average Temperature (F)	Standard Deviation	Within One Standard Deviation of Mean?
9/20/2021	61.9	58.6	2.7	**No**
9/21/2021	61.9	58.8	2.7	**No**
9/22/2021	61.9	59.3	2.7	**Yes**
9/23/2021	61.9	59.9	2.7	**Yes**
12/6/2021	38.0	44.9	4.6	**No**
12/7/2021	38.0	43.0	4.6	**No**
12/8/2021	38.0	41.6	4.6	**Yes**
12/9/2021	38.0	41.1	4.6	**Yes**
4/5/2022	47.1	47.4	5.9	**Yes**
4/6/2022	47.1	46.8	5.9	**Yes**
4/7/2022	47.1	46.7	5.9	**Yes**
4/8/2022	47.1	48.5	5.9	**Yes**
8/8/2022	70.0	67.7	5.3	**Yes**
8/9/2022	70.0	69.1	5.3	**Yes**
8/10/2022	70.0	70.0	5.3	**Yes**
8/11/2022	70.0	70.1	5.3	**Yes**

Table 45 shows a summary of precipitation conditions for the month of each sampling event and the week prior to each sampling event. Except for fall 2021, most weeks before sampling events were within one standard deviation of the mean for the month.

Table 45. Average Precipitation During Study Period

Sampling Dates	Average Monthly Precipitation (inches)	Prior Week Average Daily Precipitation (inches)	Standard Deviation	Within One Standard Deviation of Mean?
9/20/2021	0.116	0.380	0.092	**No**
9/21/2021	0.116	0.304	0.092	**No**
9/22/2021	0.116	0.278	0.092	**No**
9/23/2021	0.116	0.280	0.092	**No**
12/6/2021	0.163	0.140	0.191	**Yes**
12/7/2021	0.163	0.136	0.191	**Yes**
12/8/2021	0.163	0.150	0.191	**Yes**
12/9/2021	0.163	0.134	0.191	**Yes**
4/5/2022	0.100	0.168	0.089	**Yes**
4/6/2022	0.100	0.142	0.089	**Yes**
4/7/2022	0.100	0.140	0.089	**Yes**
4/8/2022	0.100	0.132	0.089	**Yes**
8/8/2022	0.002	0.000	0.024	**Yes**
8/9/2022	0.002	0.000	0.024	**Yes**
8/10/2022	0.002	0.000	0.024	**Yes**
8/11/2022	0.002	0.006	0.024	**Yes**

Analysis of Weather by Sampling Event

Overall, this analysis indicates that weather leading up to sampling, in terms of temperature and precipitation, was representative of the month that sampling took place for the majority of sampling days. Sampling events are adjusted typically only under extreme weather conditions, and not for daily or weekly changes in weather. Also, the deviation is measured for one week prior to sampling with respect to one standard deviation from the mean for a given month, and this deviation may not represent extreme or sustained weather conditions (such as a heat wave) that may have medium- to long-term impact on vegetation growth.

Fall 2021. Weather leading up to the fall 2021 sampling event was comparable to those for the sampling month in terms of temperature, and wetter in terms of precipitation. For sampling events in September 2021, the average temperature for two out of four sampling days (9/22 and 9/23) for the week prior to each sampling event were within one standard deviation of the mean for the month. The precipitation for the week prior to each sampling event was outside one standard deviation of the mean for the month (0.116 inches).

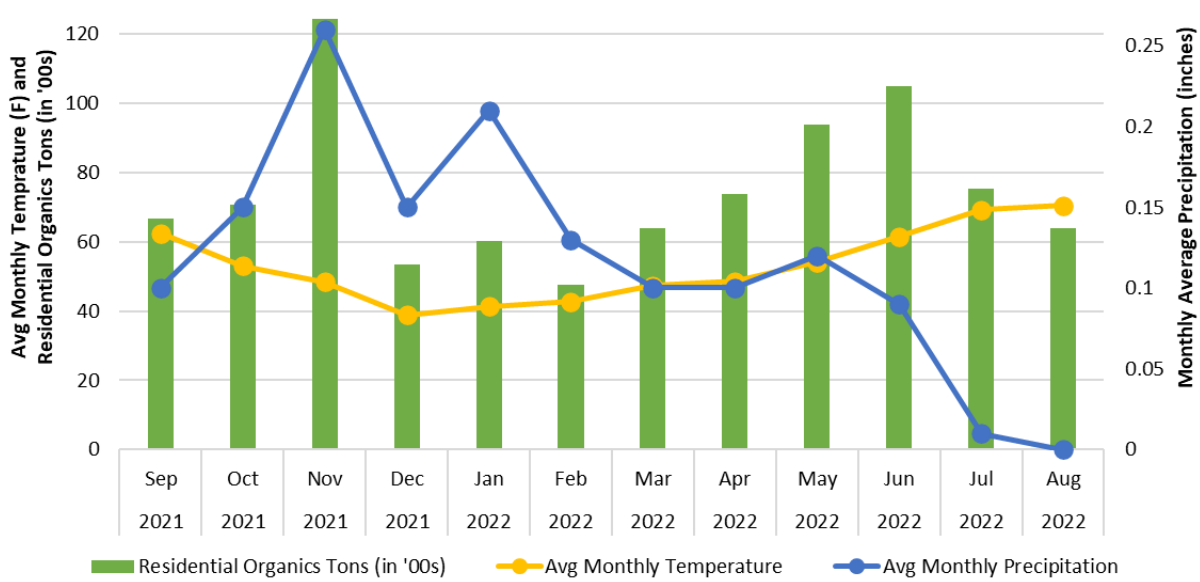
Winter 2021. Weather leading up to the winter 2021 sampling event, in terms of temperature and precipitation, was comparable in terms of temperature and precipitation to those for the sampling month. For sampling events in December 2021, the average temperature for two out of four sampling days (12/8 and 12/9) for the week prior to each sampling event were within one standard deviation of the mean for the month. The precipitation for the week prior to each sampling event was within one standard deviation of the mean for the month (0.163 inches).

Spring and summer 2022. For sampling events in April and August of 2022, both the average temperature and precipitation for the week prior to each sampling event are within one standard deviation of the mean for the month.

Relationship Between Weather Conditions and Tonnages

Figure 44 shows weather conditions relative to single-family organics tonnages collected during the study period (September 2021 through August 2022). Precipitation peaked in November 2021 (average monthly precipitation = 0.26 inches), while no precipitation was recorded during August 2022. The lowest average monthly temperatures were in December 2021 (38.9 °F) and the highest average monthly temperatures were in August 2022 (70.5 °F). The greatest single-family organics tonnages were in November 2021 (12,442.9 tons), while the lowest single-family organics tonnages were in February 2022 (4,766.3 tons).

Figure 44. Weather Conditions Relative to Single-family Organics Tonnage



The November 2021 peak in organics tonnages coincided with the peak in average monthly precipitation, also the highest for the entire study period in that month. A second peak in precipitation was in January 2022 (0.21 inches), and an uptick in organics tonnage was in that month (6,017.6 tons). High precipitation could be adding moisture to the yard waste collected, increasing the weight. During low precipitation months the tonnages may be driven primarily by the plant growth and minimally from the moisture added by precipitation.