

2019 City of Saskatoon Waste Characterization Study

Summary Report

Prepared for

City of Saskatoon

Prepared by

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TABLE OF CONTENTS

EXECUTIVE SUMMARY	1
1.0 INTRODUCTION.....	4
1.1 Definitions.....	4
1.2 Study Background	6
2.0 METHODOLOGY	7
2.1 Waste Sampling Process	7
2.1.1 Curbside Residential	7
2.1.2 Multi-Unit Residential.....	7
2.1.3 Self-Haul.....	7
2.1.4 Civic Facilities	7
2.1.5 ICI	7
2.2 Material Sorting Process.....	8
2.3 Assumptions	8
3.0 RESULTS AND DISCUSSION: Curbside Residential	8
3.1 Curbside Residential Results.....	8
3.2 Overall Curbside Residential Waste Composition Profile.....	9
3.3 Curbside Residential Garbage Sample Results	11
3.4 Curbside Residential Recycling Results.....	13
3.5 Curbside Residential Food & Yard Waste Results.....	15
3.6 Capture Rates for Curbside Residential Recycling	16
4.0 RESULTS AND DISCUSSION: Multi-Unit Residential.....	18
4.1 Overall Multi-Unit Residential Waste Profile and Composition	18
4.2 Multi-Unit Residential Garbage Results.....	20
4.3 Multi-Unit Residential Recycling Results	22
4.4 Capture Rates for Multi-Unit Residential Recycle	25
5.0 RESULTS AND DISCUSSION: Self-Haul.....	27
6.0 RESULTS AND DISCUSSION: Civic Facilities	28
7.0 RESULTS AND DISCUSSION: ICI Audit.....	31

LIST OF TABLES

Table 3.1 Curbside Residential Collection Survey Results.....	9
Table 3.2 Curbside Residential Set-out Profile	9
Table 3.3 Single Family Residential Curbside Garbage Stream Composition by Season.....	12
Table 3.4 Curbside Residential Recycling Composition by Season.....	14
Table 3.5 Curbside Residential Food & Yard Waste Composition by Season.....	16
Table 3.6 Curbside Residential Recycling Capture Rates.....	17
Table 4.1 Multi-Unit Residential Waste Profile	18
Table 4.2 Multi-Unit Residential Seasonal Garbage Composition	22
Table 4.3 Multi-Unit Residential Seasonal Recycling Composition	24
Table 4.4 Multi-unit Residential Recycling Capture Rates	26
Table 5.1 Self Haul Overall Waste Composition	28
Table 6.1 Civic Facilities Audited	29
Table 7.1 Accommodation/Food Service Recycling Composition	32
Table 7.2 Retail Recycling Composition.....	33

Table 7.3 Health Services Recycling Composition	34
Table 7.4 Other Services Recycling Composition	35

LIST OF FIGURES

Figure 3.1 Curbside Residential Waste Collection Profile (kg/hh/wk)	10
Figure 3.2 Annual Curbside Residential Waste Collection Profile (kg/hh/wk)	11
Figure 3.3 Single Family Residential Curbside Garbage Composition	12
Figure 3.4 Curbside Residential Recycling Composition.....	13
Figure 3.5 Durable Products in the Curbside Residential Recycling.....	14
Figure 3.6 Plastic Films in the Curbside Residential Recycling	14
Figure 3.7 Other Materials in the Curbside Residential Recycling	15
Figure 4.1 Multi-Unit Residential Waste Profile (kg/hh/wk).....	19
Figure 4.2 Multi-Unit Residential Waste Profile (kg/hh/wk).....	20
Figure 4.3 Multi-Unit Residential Garbage Composition	21
Figure 4.4 Multi-Unit Residential Recycling Composition	23
Figure 4.5 Shoes in Multi-unit Residential Recycling.....	25
Figure 4.6 Plastics in Multi-unit Residential Recycling	25
Figure 4.7 Other Materials in Multi-unit Residential Recycling	25
Figure 5.1 Self-Haul Waste Composition.....	27
Figure 6.1 Civic Facilities Garbage Profile.....	30
Figure 6.2 Civic Facilities Recycling Profile	31
Figure 7.1 Accommodation/Food Service Waste Composition.....	32
Figure 7.2 Retail Waste Composition	33
Figure 7.3 Health Services Waste Composition.....	34
Figure 7.4 Other Services Waste Composition.....	35

EXECUTIVE SUMMARY

CURBSIDE RESIDENTIAL

AET Group Inc. conducted a curbside residential waste characterization study in Saskatoon between May 27th, 2019 and December 6th, 2019. This study included collecting and sorting materials from garbage, recycling, and food and yard waste from 100 households selected by the City over a two-week period.

The following is a summary of the 2019 results:

- Participation rates for curbside garbage, recycling and subscription food & yard waste (organics) were 79%, 67% and 7%, respectively.
- An average of 18.19 kilograms of waste was collected per household per week. Of that, a total of 21% of the waste was diverted from landfill through the City's curbside recycling programs in place.
- Curbside garbage samples contained 65% divertible material (57% food waste/yard waste/compostable paper, and 8% recyclable material).
- Curbside recycling samples had an overall contamination rate of 12%.
- Food & Yard (Organics) Waste samples had an overall contamination rate of 0.01%.

The following table provides an overview of the key results obtained throughout the study.

Overview of Key Results

	Spring 2019	Summer 2019	Fall 2019	Winter 2019	Annual Average
Participation Rates					
Participation Rate - Garbage	79.44%	74.50%	81.82%	85.00%	79.10%
Participation Rate - Recycling	75.00%	63.00%	64.00%	65.56%	66.92%
Participation Rate - Organics	8.89%	4.00%	9.00%	N/A	7.24%
Diversion and Capture Rates					
Diversion Rate	18.89%	17.79%	21.84%	19.73%	21.20%
Capture Rate	67.25%	59.88%	69.07%	68.05%	65.93%
Contamination Rates					
Recycling Contamination Rate	16.16%	9.35%	13.17%	8.73%	11.98%
Organics Contamination Rate	0.08%	0.02%	0.00%	N/A	0.01%

MULTI-UNIT RESIDENTIAL

AET Group Inc. conducted a multi-unit residential waste characterization study in Saskatoon in August and November 2019. This study included sorting materials collected in the garbage and recycling programs by category from five buildings over a one-week period during each audit.

The following is a summary of the results:

- An average of 7.9 kilograms of waste (garbage and recycling) was collected per household per week. Of that, a total of 9% of the waste was diverted from landfill through the multi-unit recycling program.
- Multi-unit garbage samples consisted of 14% recyclable material.

- Multi-unit recycling samples had a contamination rate of 17%.

The following table provides an overview of the key results obtained throughout the study.

Overview of Key Results

	Summer 2019	Winter 2019	Average
Diversion and Capture Rates			
Diversion Rate	10.29%	8.14%	9.16%
Capture Rate	49.82%	37.05%	42.95%
Contamination Rates			
Recycling Contamination Rate	8.82%	25.17%	17.24%

SELF-HAUL

AET Group Inc. conducted a self-haul waste characterization study of inbound material at the City of Saskatoon landfill in May and October 2019. This study included auditing material from 38 randomly selected vehicles.

The following is a summary of the results:

- The average mass per load was 142.63 kg.
- The three largest contributors were construction and demolition waste, Bulky items and other materials at 30%, 27% and 14%, respectively.
- The samples contained an average of 6% recyclable material, and 10% organics (food waste, yard waste, and compostable paper).

CIVIC FACILITIES

AET Group Inc. conducted a civic facility waste characterization study in August and December 2019. This study involved auditing materials in garbage and recycling containers of 18 civic facilities (ten in summer and eight in winter) during the two audit periods.

The following is a summary of the results:

- Garbage samples contained an average of 21% recyclable material and 39% organics (food waste, yard waste, and compostable paper).
- Recycling samples had an average contamination rate of 6%.

INDUSTRIAL, COMMERCIAL & INSTITUTIONAL (ICI)

AET Group Inc. conducted an ICI waste characterization study in Saskatoon during June and October 2019. This study included auditing materials in garbage and recycling containers over a two week period in both the spring and fall. A total of 21 IC&I samples were audited, including seven accommodation/food services, three retail services, three health care services, and eight other services.

The following is a summary of the results:

- Accommodation/food services garbage samples contained an average of 11% recyclable material, and 63% organics.
- Accommodation/food services recycling samples average contamination rate was 1%.
- Retail services garbage samples contained an average of 26% recyclable material, and 41% organics.
- Retail services recycling samples average contamination rate was 2%.
- Health services garbage samples contained an average of 18% recyclable material, and 38% organics.
- Health services recycling samples average contamination rate was 0.06%.
- Other services garbage samples contained an average of 13% recyclable material, and 36% organics.
- Other services recycling samples average contamination rate was 5%.

1.0 INTRODUCTION

1.1 Definitions

Accepted: Material allowed in the City's diversion programs.

Bulky Items Refers to large household items such as furniture, appliances and carpeting.

Capture Rate: The capture rate is the percentage of a specified material collected in a diversion program, in relation to the total amount of that material generated.

$$\left(\frac{\text{weight of specified material diverted}}{\text{total weight of specified material generated}} \right) \times 100\%$$

C&D Construction and demolition wastes including wood, gypsum wallboard, shingles, metals, concrete, etc.

Contamination Rate: Percentage of total material that is not accepted in the identified stream.

$$\left(\frac{\text{unsuitable materials in the diversion stream}}{\text{total weight of material in the diversion stream}} \right) \times 100\%$$

Curbside Collection The collection of solid waste set-out in an approved Roll-out Cart for Garbage, Recycling, or Organics Waste, for Curbside Household occupants. Includes Curbside Households and any other residential buildings approved by the City for Curbside Collection.

Curbside Household Generally, a Curbside Household is an individual household that receives an individual Garbage, Recycling and/or Leaf & Yard (Organics) Waste Collection service. For services that are tied to an individual customer with a Roll-out Cart, the customer is considered a Curbside Household.

Curbside Recycling Recycling collected from blue Roll-out Carts as part of Curbside Household Collection.

Diversion Rate: Percentage of total material that is diverted from landfill through programs such as Recycling or Food & Yard Waste programs.

$$\left(\frac{\text{weight of material diverted}}{\text{total weight of all material generated}} \right) \times 100\%$$

Divertible Material: Material that is accepted by the City of Saskatoon Recycling programs. This includes accepted recycling and food & yard waste.

Food & Yard Waste	Also known as Organic Waste . Carbon-based Solid Waste that is readily capable of being biologically degraded, including paper, food residuals, wood wastes, yard debris and plant wastes but not metals and glass or plastic ³ . Please see the “Accepted items” list from the City’s Green Cart Program webpage ⁴ for material that is currently accepted in the optional fee-for-service program. The acceptable list of materials is subject to change with updates to the Food & Yard Waste programs.
Garbage	Solid Waste that is permitted to be discarded at the Saskatoon Regional Waste Management Center (i.e. the City of Saskatoon Landfill). Does not include Recyclable Material, Organic Waste, Hazardous Waste, and any other material that could be reused, repurposed, or recycled. Please refer to Schedule “C”: Unacceptable Waste of Bylaw 8310 for material that is not accepted at the Saskatoon Regional Waste Management Center.
HHW	Household hazardous waste such as paint, oil, pesticides and batteries.
ICI	Refers to the Industrial, Commercial and Institutional sector comprised of businesses and organizations operating in Saskatoon.
Multi-Unit Household	Generally, per the waste bylaw ⁷ , a building or portion thereof designed for or occupied as three or more residences, but does not include an institutional premise. For services that are tied to multiple customers sharing a Communal/Metal Bin, the customers are considered Multi-Unit Household.
Multi-unit Recycling	Recycling collected from designated Metal/Communal Waste Bins or carts as part of the Multi-Unit Household Collection.
Multi-Unit Residential Collection	The collection of Solid Waste set out in an approved Container, generally a Metal/Communal Waste Bin, for Multi-unit Household occupants, separate from Curbside Collection and all ICI waste. Includes Multi-Unit Households and other residential buildings approved by the City for Multi-unit Residential Collection.
Organics:	Materials accepted in this program include food waste, leaf & yard waste, tissue/towelling, and soiled paper.
Other Material	Refers to garbage such as diapers and sanitary products, pet waste, textiles, tires and materials not classified elsewhere (ex. Wooden fruit basket, vacuum bags, wax candles, furnace filters, etc.).

Participation Rate: The percentage of the total curbside residential households that placed a cart of material out for curbside collection on their regularly scheduled collection day. The term can apply to garbage, recycling and subscription green cart participants.

$$\left(\frac{\text{number of households that set out material}}{\text{total number of households sampled}} \right) \times 100\%$$

Recyclable Material Solid Waste material accepted for the purpose of recycling or reuse through Curbside Recycling, Multi-unit Recycling, and other City Recycling programs (e.g. Recycling Depots). Please see Schedule “E”: Permitted Recyclable Material of Bylaw 8310 for material accepted through City Recycling programs.

Set-out Rate: The percentage of sample locations who set out material in a given stream each week during the two-week sample period. The information on each households waste is recorded during curbside collection. This information is expressed as the total number of carts per household per week (items/hh/wk) and the total full container equivalents per household per week (FCE/hh/wk). The number of households sampled includes all houses included in the sample size regardless of them setting out material or not.

$$\text{Items/hh/wk: } \left(\frac{\text{Total number of items}}{\text{Total number of households sampled}} \right) \div 2 \text{ weeks}$$

$$\text{FCE/hh/wk: } \left(\frac{\text{Total number of full container equivalents}}{\text{Total number of households sampled}} \right) \div 2 \text{ weeks}$$

WEEE Waste Electrical and Electronic Equipment such as computers, cables and small appliances.

1.2 Study Background

The City of Saskatoon contracted AET Group Inc. (AET) to undertake a waste characterization study over four seasonal audit periods. Objectives of the study were to identify trends and changes in Saskatoon’s waste profile and provide benchmarks as new programs (city-wide green cart) are introduced. The study was undertaken to help improve understanding of current program use, identify areas for improvement and build public communication campaigns. Data collected through seasonal waste audits will also help in the development of future waste diversion programs for curbside residential, multi-unit residential and Industrial Commercial and Institutional (ICI) sectors. This report summarizes the findings from all seasonal audits, which included sampling from single family residential curbside households, multi-unit residential buildings, IC&I sources, civic facilities, and inbound self-hauled loads at the City’s landfill.

2.0 METHODOLOGY

2.1 Waste Sampling Process

2.1.1 Curbside Residential

City of Saskatoon staff provided AET with a list of 100 households to be sampled from ten areas representing various demographics within the city. Areas were sampled in groups of ten houses, with two areas being sampled a day (Monday to Friday). Curbside garbage, recycling and subscription food & yard waste was collected from the selected households on their regularly scheduled pickup day.

Addresses of sampled households were recorded along with:

- The number of carts set out;
- The approximate fullness of carts; and,
- Any issues that occurred during collection.

2.1.2 Multi-Unit Residential

City of Saskatoon staff provided AET with a list of ten multi-unit residential buildings to be sampled. Five buildings were sampled in the summer and five in the winter. Garbage and recycling material collected from these buildings were delivered to AET at the City of Saskatoon Landfill located off Valley Road, South of 11th Street in City of Saskatoon.

2.1.3 Self-Haul

AET conducted a physical audit of inbound self-haul material from 38 different loads at the City's landfill. If loads were less than 100 kg, then 100% of the load was sorted for the audit. If loads were greater than 100 kg, then minimum 100 kg sub-sample was extracted for detailed composition analysis.

2.1.4 Civic Facilities

The City of Saskatoon provided AET with a list of 18 civic facilities to be sampled. Garbage and recycling material collected from the civic facilities were delivered to AET at the City of Saskatoon Landfill.

2.1.5 ICI

The City of Saskatoon provided AET with a list of 21 ICI facilities to be sampled. Garbage and recycling material collected from the ICI facilities were delivered to AET at the City of Saskatoon Landfill.

2.2 Material Sorting Process

All collected materials were sorted and weighed separately (into individually tared bins) into six primary (paper, plastic, metal, glass, organics, and other) and 112 secondary categories (e.g. newsprint, recyclable glass containers, clean wood, textiles, etc.) at the City of Saskatoon Landfill. The full list of sort categories can be found in Appended. AET made every reasonable effort to separate multi-material items and to separate food waste from their packaging.

Prior to weighing the sorted material, AET took photos of any substantial or unusual material categories and items found in the samples. All sorted material was weighed for each sample using a digital scale (0.01 kg precision up to 40 kg +/- 1% of true weight). Tare weights of the bins used for sorting were verified prior to the audit and checked regularly throughout the study to maintain accuracy. Light materials were weighed directly on the scale. The weight of each individual material category was recorded on a waste sort worksheet. Any unusual materials/items which may have not been representative, or which may have significantly affected the overall composition of the sample was also noted on the worksheet. Additional notes were also made on the worksheet describing the contents of categories labeled “other” (e.g. other plastic would be identified – blister packaging, toothpaste tubes, etc.).

Once all the waste material was classified and weighed, non-divertible material was placed in a large roll-off bin that was emptied of by City of Saskatoon Facility staff when needed. Likewise, post-audited recyclable material was placed in a 4-yard bin that was picked up by Loraas daily. Organic material collected as part of the waste characterization study was disposed of together with garbage waste.

2.3 Assumptions

The 2019 waste characterization study assumed that the selected curbside households, multi-unit households, self-haul loads, civic facilities, and ICI buildings were representative of the composition of waste generated in Saskatoon.

3.0 RESULTS AND DISCUSSION: CURBSIDE RESIDENTIAL

This section details a summary of waste material from the sampled curbside households in Saskatoon during the spring, summer, fall and winter seasons and includes an overview of the waste collection results. Participation rates and waste set-out rates are presented for each stream.

3.1 Curbside Residential Results

The average full container equivalents per set out (i.e. when a cart is set out, how full it is) per week for recycling, garbage, and organics are 0.75, 0.67, and 0.77. Finally, participation rates for recycling, garbage, and organics are 66.92%, 79.10%, and 7.24%, respectively.

The curbside collection surveying results can be found in Table 3.1. The results show averages for recycling and garbage for all households sampled.

Table 3.1 Curbside Residential Collection Survey Results

Total (Two Week Period)	4 Season Average		
	Recycling	Garbage	Organics
Total number of households sampled	390	579	290
Total number of household set-outs	261	458	21
Total number of items	262	457	22
Total number of full container equivalents	194.57	308.75	16.25
Average number of items/hh/wk ¹	0.67	0.79	0.08
Average number of full container equivalents/hh/wk ²	0.50	0.53	0.06
Average number of full container equivalents/set out	0.75	0.67	0.77
Participation Rate	66.92%	79.10%	7.24%

¹ Averaged across all sampled households (including those with no setouts). This does not represent the average per household.
² Averaged across just the subset of households that had something set out (i.e. avg. # of full container equivalents per household with something set out).

3.2 Overall Curbside Residential Waste Composition Profile

Curbside garbage, recycling and food & yard waste collected for this study is shown in Table 3.2. The data displays the total mass of material set-out at the curb. As shown in Table 3.2, across all four seasons single family households generated an annual average of 18.2 kg/hh/wk of curbside waste. Of this, 2.6 kg/hh/wk was set-out in recycling carts, 1.6 kg/hh/wk was set-out in food & yard waste carts, and the remaining 14.0 kg/hh/wk was set out in garbage carts. The spring audit had the highest amount of material collected at the curb with 21.9 kg/hh/wk and winter had the lowest with 12.4 kg/hh/wk.

Table 3.2 Curbside Residential Set-out Profile

Material Stream	Set-Out Generation Rates									
	Spring		Summer		Fall		Winter		Average	
	Weight (kg/hh/wk)	Percent of Total Material Generated (%)	Weight (kg/hh/wk)	Percent of Total Material Generated (%)	Weight (kg/hh/wk)	Percent of Total Material Generated (%)	Weight (kg/hh/wk)	Percent of Total Material Generated (%)	Weight (kg/hh/wk)	Percent of Total Material Generated (%)
Garbage	17.25	78.95%	16.22	81.11%	12.91	76.34%	9.71	78.38%	14.02	77.10%
Recycling	2.89	13.22%	2.35	11.75%	2.34	13.81%	2.68	21.62%	2.56	14.09%
Organics	1.71	7.83%	1.43	7.13%	1.67	9.85%	0.00	0.00%	1.60	8.80%
Total	21.85	100.00%	20.00	100.00%	16.91	100.00%	12.38	100.00%	18.19	100.00%

Bi-weekly set-outs were adjusted to weekly generation equivalents.

Figure 3.1 illustrates the profile of all curbside waste sampled across all four seasons as well as an annual average.

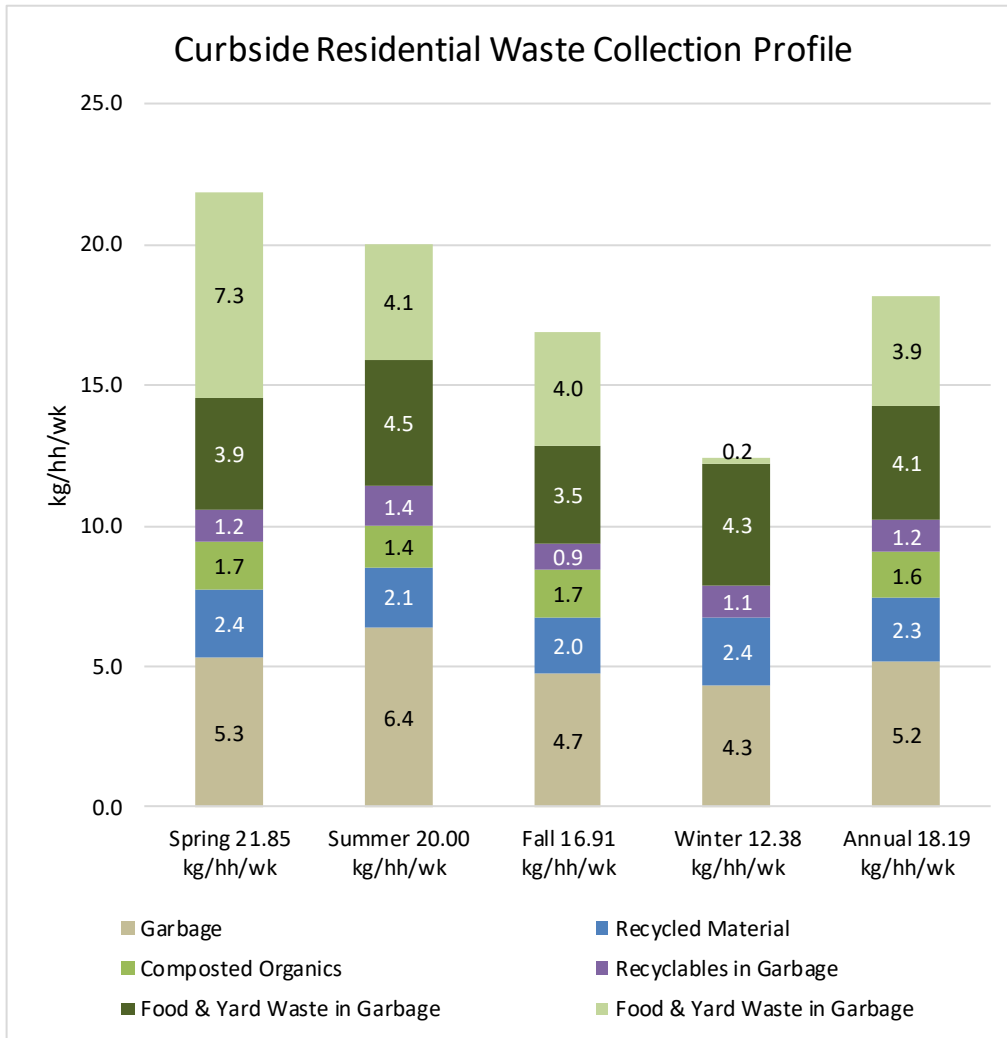


Figure 3.1 Curbside Residential Waste Collection Profile (kg/hh/wk)

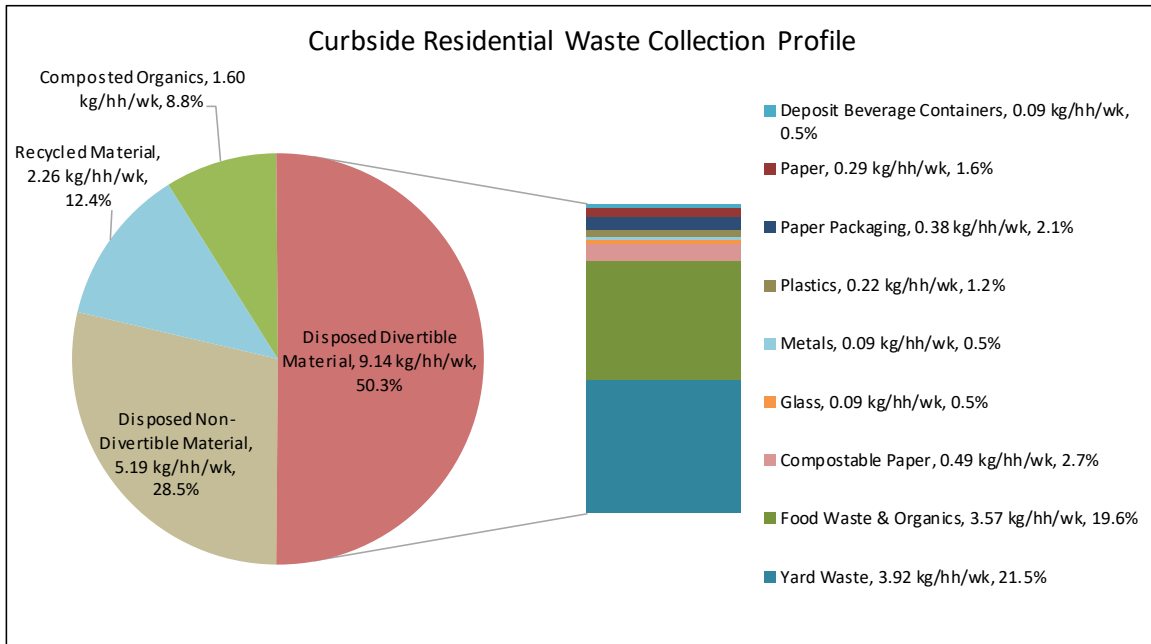


Figure 3.2 Annual Curbside Residential Waste Collection Profile (kg/hh/wk)

Figure 3.2 illustrates the annual waste composition breakdown for garbage, recycling and food & yard waste programs combined. A total of 12% of material was diverted through the Recycling program and 9% of the material through the Food & Yard Waste program. The remaining 79% consisted of a mix of non-divertible and divertible material placed in the garbage. This includes all material in the garbage stream plus contamination in the recycling stream. 29% of material was actual garbage while 50% was divertible. Divertible material consisted largely of yard waste (22%) and food waste & organics (20%). Recyclables accounted for 6% of the garbage collected.

3.3 Curbside Residential Garbage Sample Results

Figure 3.3 illustrates the average garbage sample composition from curbside households in Saskatoon. An average of 14 kg/hh/wk of material was collected in the garbage through all four seasons. The largest material categories in the garbage were Yard Waste at 28% Food Waste & Organics at 25%. The next largest material category was Other Materials at 19%. Approximately 8% of the collected garbage consisted of divertible recyclable material. Table 3.3 summarizes the percentage composition of the garbage samples throughout all four seasons. Disposed organic compatible materials are highlighted in green and disposed recyclables are highlighted in blue.

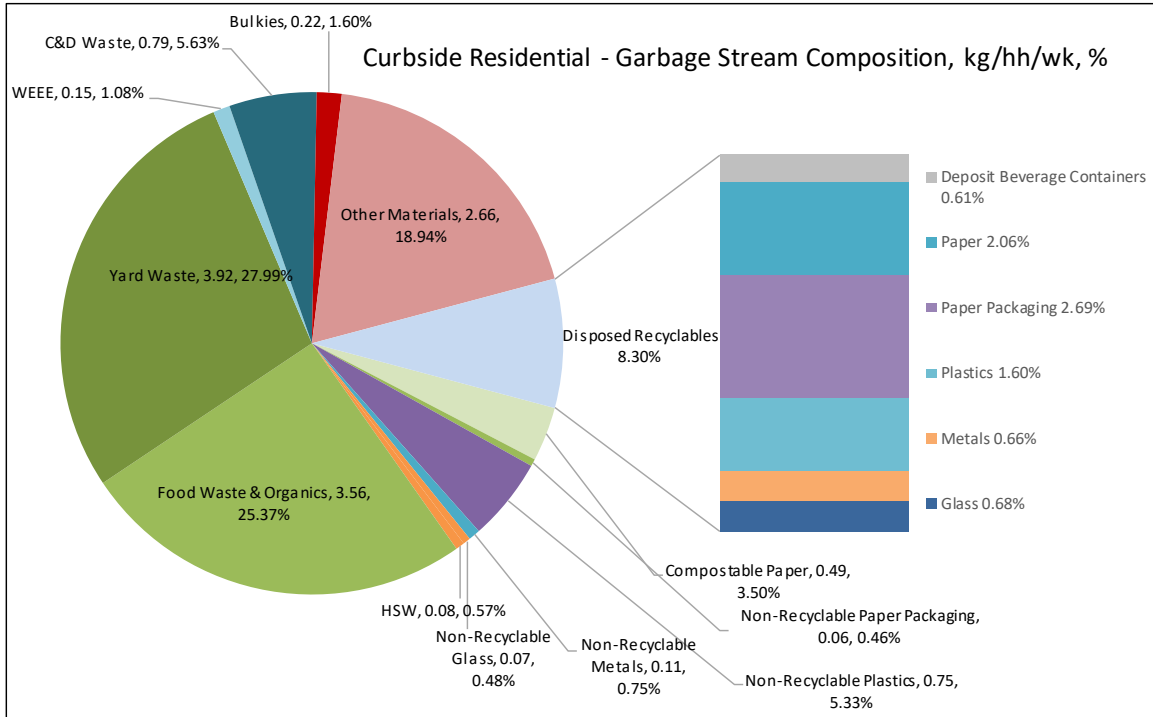


Figure 3.3 Single Family Residential Curbside Garbage Composition

Table 3.3 Single Family Residential Curbside Garbage Stream Composition by Season

Garbage Stream	Spring	Summer	Fall	Winter	Annual
Material Type	%	%	%	%	%
Compostable Paper	3.2%	3.2%	2.8%	5.4%	3.5%
Non-Recyclable Paper Packaging	0.5%	0.3%	0.4%	0.8%	0.5%
Non-Recyclable Plastics	5.1%	5.3%	4.5%	6.9%	5.3%
Non-Recyclable Metals	0.5%	0.9%	1.1%	0.5%	0.8%
Non-Recyclable Glass	0.4%	0.4%	0.7%	0.5%	0.5%
HHW	0.3%	1.0%	0.5%	0.3%	0.6%
Food Waste & Organics	19.5%	24.4%	24.4%	38.7%	25.4%
Yard Waste	42.3%	25.3%	31.3%	2.4%	28.0%
Waste Electrical and Electronic Equipment	0.9%	1.5%	0.9%	1.0%	1.1%
C&D Waste	2.9%	5.8%	7.5%	7.7%	5.6%
Bulky Items	0.9%	1.9%	3.2%	0.1%	1.6%
Other Materials	16.6%	21.1%	15.6%	23.9%	18.9%
Deposit Beverage Containers	0.4%	0.8%	0.3%	1.2%	0.6%
Paper	1.4%	2.9%	1.7%	2.2%	2.1%
Paper Packaging	2.3%	2.7%	2.7%	3.5%	2.7%
Plastics	1.6%	1.4%	1.3%	2.3%	1.6%
Metals	0.6%	0.6%	0.6%	1.1%	0.7%
Glass	0.6%	0.5%	0.4%	1.6%	0.7%
	100.00%	100.00%	100.00%	100.00%	100.00%

3.4 Curbside Residential Recycling Results

Figure 3.4 illustrates the average composition of recycling collected from curbside households in Saskatoon during the study. 2.6 kg/hh/wk of material was collected and 12% of this was contamination. The top contaminating materials include non-recyclable plastics (largely durable plastic products, other rigid plastic packaging and plastic film), other materials (largely other waste and textiles) and non-recyclable metals. Table 3.4 summarizes the composition of recycling across all four seasons.

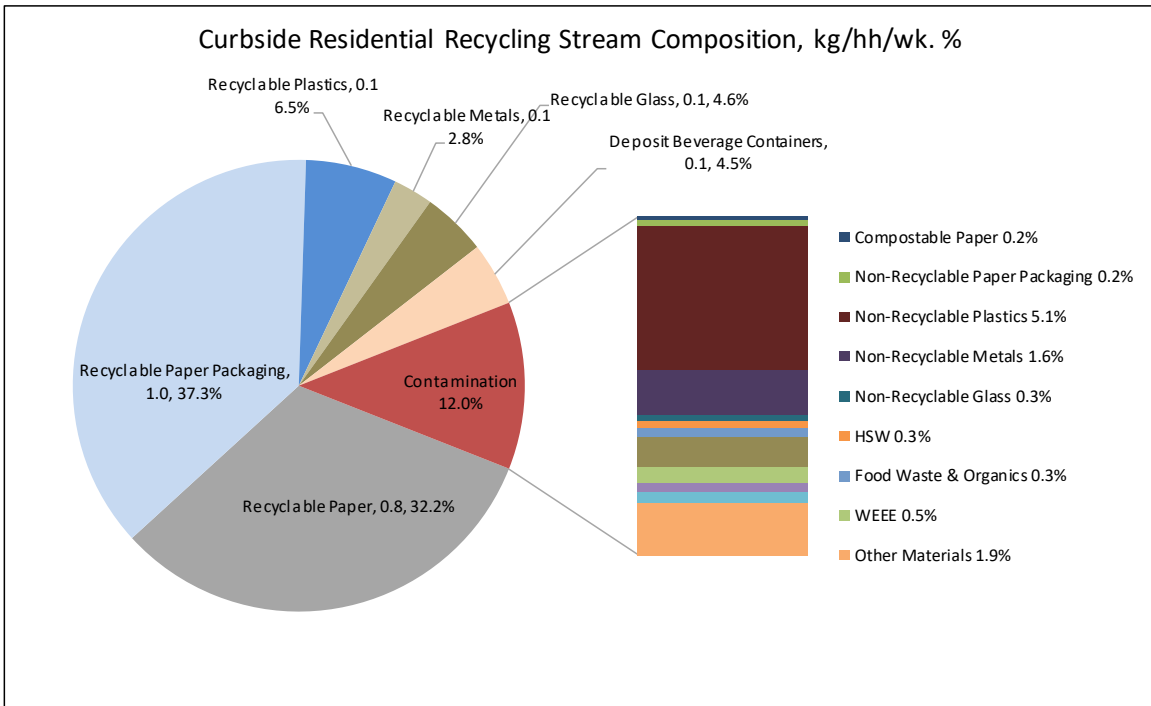


Figure 3.4 Curbside Residential Recycling Composition

Table 3.4 Curbside Residential Recycling Composition by Season

Recycling Stream	Spring	Summer	Fall	Winter	Annual
Material Type	%	%	%	%	%
Recyclable Paper	31.7%	31.5%	27.6%	37.6%	32.2%
Recyclable Paper Packaging	35.2%	38.4%	40.2%	36.1%	37.3%
Recyclable Plastics	6.5%	7.4%	6.6%	5.7%	6.5%
Recyclable Metals	2.4%	2.4%	3.3%	3.3%	2.8%
Recyclable Glass	4.1%	4.7%	5.5%	4.4%	4.6%
Deposit Beverage Containers	4.0%	6.3%	3.7%	4.3%	4.5%
Compostable Paper	0.1%	0.1%	0.2%	0.1%	0.1%
Non-Recyclable Paper Packaging	0.2%	0.3%	0.2%	0.2%	0.2%
Non-Recyclable Plastics	5.4%	4.6%	6.8%	3.6%	5.1%
Non-Recyclable Metals	0.9%	0.7%	4.1%	0.9%	1.6%
Non-Recyclable Glass	0.5%	0.0%	0.1%	0.3%	0.2%
HHW	0.1%	0.4%	0.2%	0.3%	0.3%
Food Waste & Organics	0.5%	0.5%	0.0%	0.2%	0.3%
Yard Waste	3.6%	0.3%	0.0%	0.0%	1.1%
Waste Electrical and Electronic Equipment	1.0%	0.3%	0.6%	0.1%	0.5%
C&D Waste	0.7%	0.0%	0.0%	0.5%	0.3%
Bulky Items	1.3%	0.0%	0.0%	0.0%	0.4%
Other Materials	1.8%	2.2%	0.9%	2.4%	1.9%
Total	100%	100%	100%	100%	100%
Contamination	16.2%	9.3%	13.2%	8.7%	12.0%

Photographs of contaminating materials within the recycling stream can be viewed in Figures 3.5 through 3.7.



Figure 3.5 Durable Products in the Curbside Residential Recycling



Figure 3.6 Plastic Films in the Curbside Residential Recycling



Figure 3.7 Other Materials in the Curbside Residential Recycling

3.5 Curbside Residential Food & Yard Waste Results

Table 3.5 summarizes seasonal composition of the subscription Food & Yard Waste program from curbside households in Saskatoon. This is an optional program for curbside collection customers and in 2019 XX% of curbside household subscribed to the program. In the waste characterization study 9 of the 100 households sampled were green cart subscribers. 97% of Food & Yard Waste material collected for the study was yard waste.

Table 3.5 Curbside Residential Food & Yard Waste Composition by Season

Organics Stream	Spring	Summer	Fall	Annual
Material Type	%	%	%	%
Avoidable Food Waste	0.4%	0.0%	0.8%	0.4%
Unavoidable Food Waste	1.2%	0.6%	5.9%	2.7%
Compostable Paper & Paper Packaging	0.1%	0.0%	0.2%	0.1%
Yard Waste	98.1%	99.3%	93.1%	96.8%
Paper	0.0%	0.0%	0.0%	0.0%
Paper Packaging	0.0%	0.0%	0.0%	0.0%
Plastics	0.0%	0.0%	0.0%	0.0%
Metals	0.0%	0.0%	0.0%	0.0%
Glass	0.0%	0.0%	0.0%	0.0%
HHW	0.0%	0.0%	0.0%	0.0%
Waste Electrical and Electronic Equipment	0.0%	0.0%	0.0%	0.0%
C&D Waste	0.0%	0.0%	0.0%	0.0%
Bulkies	0.0%	0.0%	0.0%	0.0%
Other Materials	0.0%	0.0%	0.0%	0.0%
Total	100%	100%	100%	100%
Contamination	0.1%	0.0%	0.0%	0.0%

Note: Green Cart collection is not offered in the winter months. The 4-season average was calculated off of the Spring, Summer and Fall seasonal audit results.

3.6 Capture Rates for Curbside Residential Recycling

Capture rates presented below have been calculated and displayed in terms of kilograms per household per week. Capture rate is defined as the amount of each divertible material captured within the recycling stream compared to the overall amount of that specific material generated.

The overall capture rate for recyclable material was 66%, which includes all materials accepted in the curbside recycling program in the City of Saskatoon at the time of the study. Additional material diverted through other means, such as recycling depots, are not included in this calculation.

Among the highest capture rates were newspaper – dailys and weeklys (95%), newsprint – other (91%), telephone books/directories (90%), corrugated cardboard (86%), and magazines & bound materials (84%).

Materials with the lowest capture rates include aluminum foil & foil trays (4%), polycoat cold beverage cups (9%) and steel beverage cans (10%).

Table 3.6 Curbside Residential Recycling Capture Rates

Material Category	Recycled	Generated	Capture Rate
	kg/hh/wk	kg/hh/wk	%
Newspaper – Dailys and Weeklys	0.12	0.13	95%
Newsprint - Other	0.41	0.45	91%
Telephone Books / Directories	0.02	0.03	90%
Magazines & Bound Materials	0.11	0.13	84%
Mixed Fine Paper	0.14	0.32	43%
Shredded Paper	0.00	0.01	66%
Other Paper - Non-obligated	0.02	0.05	35%
Corrugated Cardboard	0.56	0.65	86%
Boxboard / Cores	0.32	0.48	67%
Kraft Paper	0.02	0.07	34%
Molded Pulp	0.03	0.06	55%
Polycoat Hot Beverage Cups	0.005	0.02	21%
Polycoat Cold Beverage Cups	0.002	0.02	9%
Ice Cream Containers and Other Bleached Long Polycoat Fibre	0.002	0.01	12%
Spiral Wound Containers	0.01	0.02	49%
Gable Top Containers - Beverage	0.01	0.01	57%
Gable-top Containers - Non-Beverage	0.001	0.002	34%
Aseptic Containers Beverage	0.003	0.01	34%
Aseptic Containers - non beverages	0.003	0.005	63%
#1 PET Bottles - Beverage	0.01	0.03	52%
#1 PET Bottles, Jugs and Jars - Non beverage	0.03	0.07	38%
#1 PET Thermoform	0.05	0.09	49%
#2 HDPE Beverage	0.01	0.02	58%
#2 HDPE Non beverage (Bottles,Jugs and Jars)	0.04	0.07	53%
#2 Other HDPE Containers	0.005	0.02	30%
#3 PVC	0.000	0.001	42%
#5 PP	0.04	0.11	38%
#6 PS - Non-expanded - all other	0.01	0.03	32%
Aluminum- Beverage Cans	0.01	0.02	39%
Aluminum- Non Beverage	0.01	0.01	56%
Aluminum Foil & Foil Trays	0.001	0.04	4%
Steel Beverage Cans	0.000	0.003	10%
Steel Food Cans	0.06	0.11	56%
Glass Beverage Containers	0.07	0.11	65%
Glass- non beverage	0.12	0.21	55%
Overall Capture Rate - All Recyclables	2.26	3.42	66%

4.0 RESULTS AND DISCUSSION: MULTI-UNIT RESIDENTIAL

The multi-unit residential waste characterization study was completed over the course of two seasons (summer and winter of 2019). Results shown in this section are summarized into primary and secondary categories. Please note that for the purposes of this study, materials have been classified as ‘recyclable’, ‘organic’, ‘garbage’ or ‘no collection’ based on their acceptance into the multi-unit diversion programs. The two material streams involved in this study are the mixed recycling stream, and the garbage stream.

For illustrative purposes, some of the results have been extrapolated to estimated generation rates of kilograms per household per week (kg/hh/wk).

4.1 Overall Multi-Unit Residential Waste Profile and Composition

The waste profile for the multi-unit residential households included in this study is shown in Table 4.1. The data does not take into account contamination (i.e. recyclables in the garbage stream, contamination in the recycling stream). Multi-unit households are generating an average of 7.9 kg/hh/wk of waste. Of this, 0.9 kg/hh/wk is collected through the recycling program, and the remaining 7.0 kg/hh/wk is collected in the garbage program.

Table 4.1 Multi-Unit Residential Waste Profile

Material Stream	Summer		Winter		Annual	
	Mass (kg/hh/wk)	Percent of Total Material Generated (%)	Mass (kg/hh/wk)	Percent of Total Material Generated (%)	Mass (kg/hh/wk)	Percent of Total Material Generated (%)
Garbage	6.6	89%	7.3	89%	7.0	89%
Recycling	0.8	11%	0.9	11%	0.9	11%
Total	7.5	100%	8.2	100%	7.8	100%

Bi-weekly set-outs were adjusted to weekly generation equivalents.

Figure 4.1 illustrates the profile of all multi-unit residential waste sampled across two seasons as well as an annual average. Figure 4.2 illustrates the composition of multi-unit residential waste collected for this study. The waste composition profile includes the sampled garbage and recycling combined.

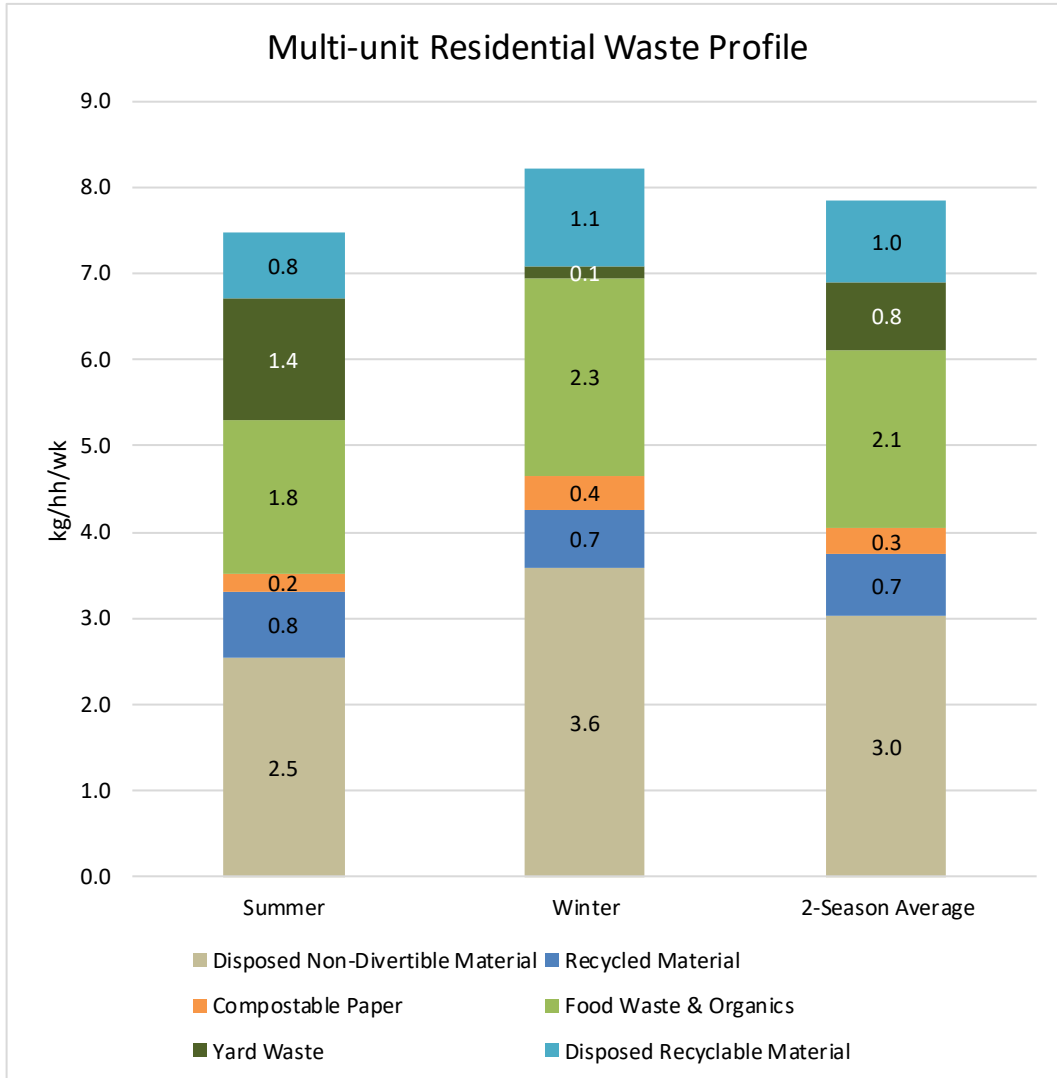


Figure 4.1 Multi-Unit Residential Waste Profile (kg/hh/wk)

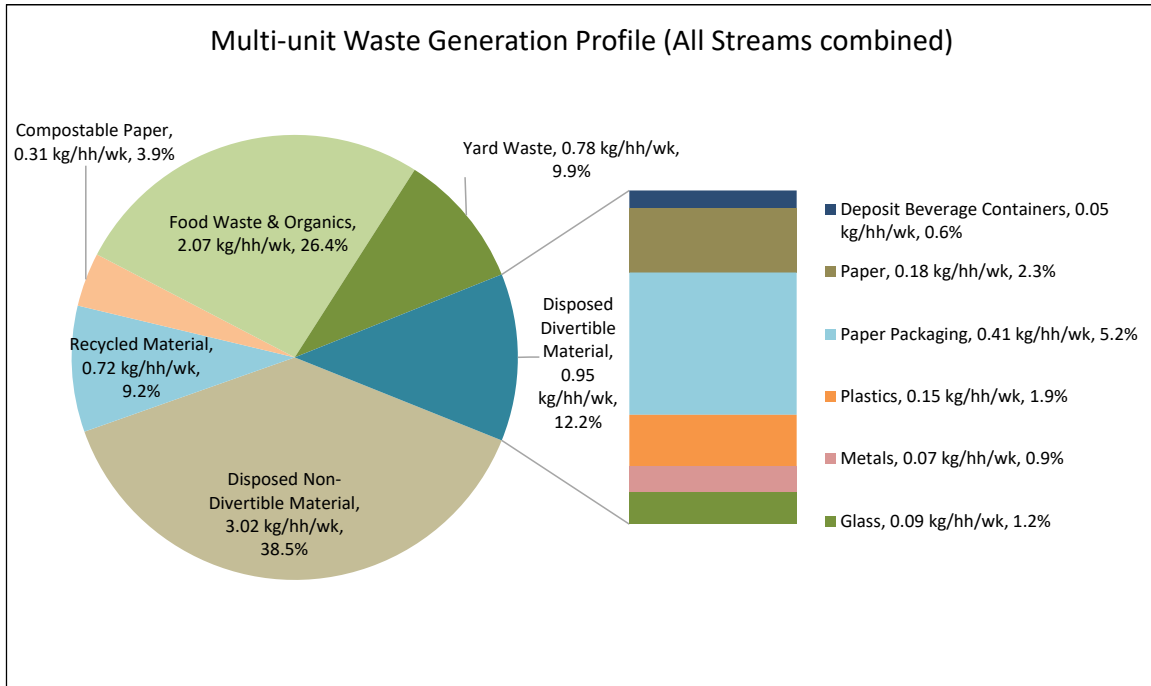


Figure 4.2 Multi-Unit Residential Waste Profile (kg/hh/wk)

A total of 9% of material was diverted through the Multi-Unit Recycling program. The remaining 91% consisted of garbage, food waste & organics, yard waste, compostable paper and divertible material. On average 40% was disposed organic materials (food waste, compostable paper & yard waste), 39% was garbage and 12% was recyclable material. Recyclable material placed in the garbage was made up of mostly recyclable paper packaging (5%), recyclable paper (2%) and recyclable plastics (2%).

4.2 Multi-Unit Residential Garbage Results

The largest material category in the garbage stream was food waste & organics at 29%, followed by other materials at 16%. Approximately 14% of the garbage consisted of divertible recyclable material. See Figure 4.3 for a more detailed breakdown. Table 4.2 summarizes the seasonal composition of the garbage stream for multi-unit residential buildings.

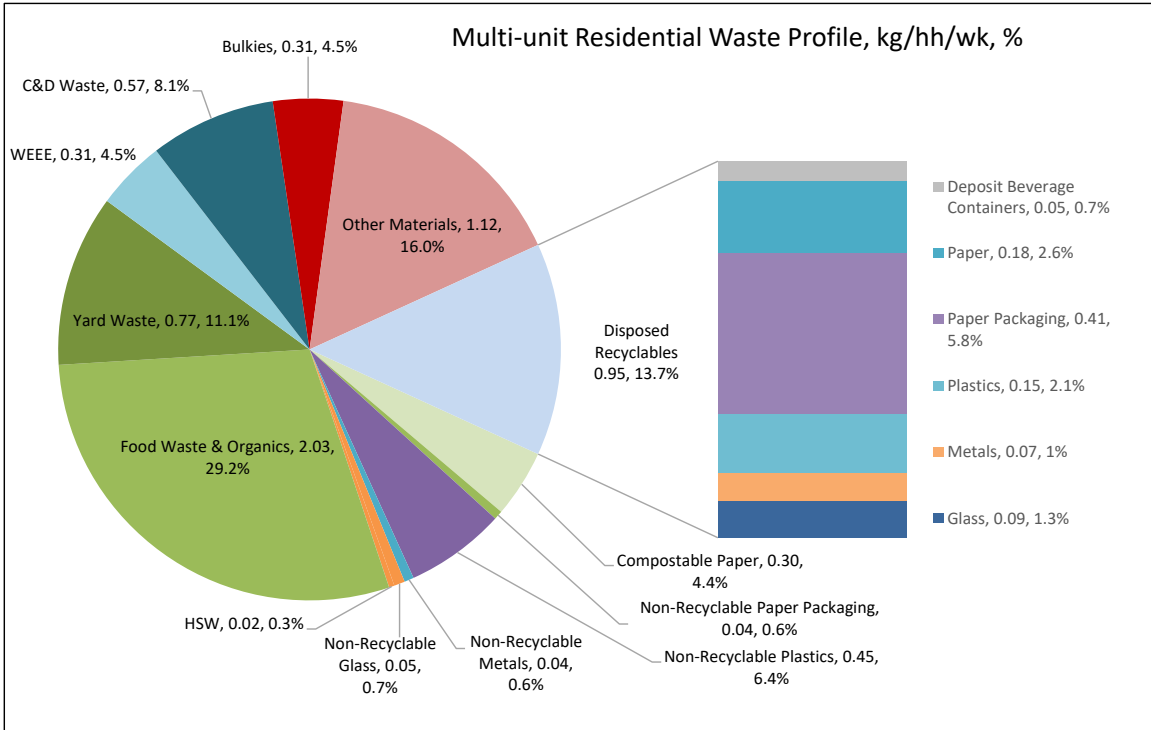


Figure 4.3 Multi-Unit Residential Garbage Composition

Table 4.2 Multi-Unit Residential Seasonal Garbage Composition

Garbage Stream	Summer	Winter	Annual
Material Type	%	%	%
Non-Recyclable Paper	0.0%	0.0%	0.0%
Compostable Paper	3.1%	5.5%	4.4%
Non-Recyclable Paper Packaging	0.3%	0.8%	0.6%
Non-Recyclable Plastics	5.2%	7.5%	6.4%
Non-Recyclable Metals	0.8%	0.4%	0.6%
Non-Recyclable Glass	0.5%	0.9%	0.7%
HHW	0.5%	0.2%	0.3%
Food Waste & Organics	26.9%	31.2%	29.2%
Yard Waste	21.2%	1.9%	11.1%
Waste Electrical and Electronic Equipment	0.8%	7.8%	4.5%
C&D Waste	4.7%	11.2%	8.1%
Bulky Items	8.6%	0.8%	4.5%
Other Materials	15.6%	16.4%	16.0%
Deposit Beverage Containers	0.8%	0.7%	0.7%
Paper	1.6%	3.5%	2.6%
Paper Packaging	5.4%	6.2%	5.8%
Plastics	1.8%	2.4%	2.1%
Metals	0.8%	1.3%	1.1%
Glass	1.3%	1.3%	1.3%
Total	100%	100%	100%

4.3 Multi-Unit Residential Recycling Results

Figure 4.4 illustrates the average composition of the recycling stream from multi-unit residential households in Saskatoon. The study found a 17% contamination rate for multi-unit recycling. The most common contaminate was non-recyclable plastic (largely plastic packaging with no number, plastic films, and durable plastic products), at 5%. Other materials, at 5% also made a notable contribution to the contamination. Materials that fall into this category include diapers and sanitary products, textiles, and other waste. Another notable contaminate was food waste and organics, at 4%. Table 4.4 summarizes the composition of the recycling stream.

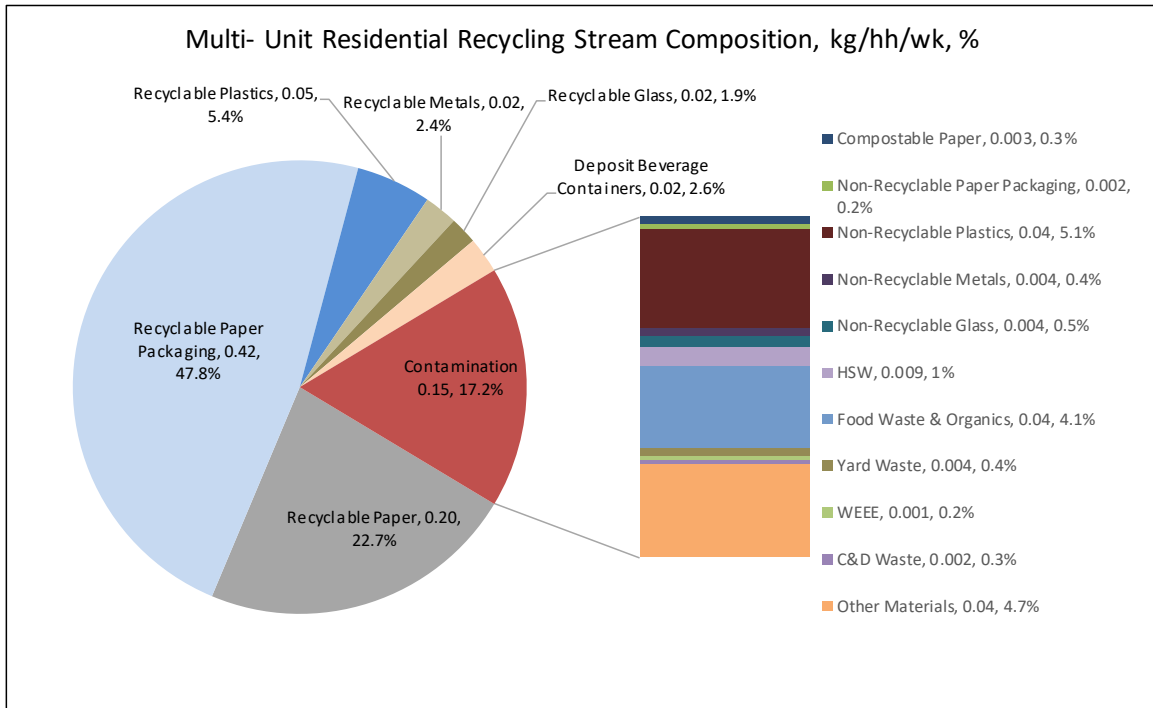


Figure 4.4 Multi-Unit Residential Recycling Composition

Table 4.3 Multi-Unit Residential Seasonal Recycling Composition

Recycling Stream	Summer	Winter	Annual
Material Type	%	%	%
Recyclable Paper	36.2%	9.9%	22.7%
Recyclable Paper Packaging	40.2%	55.1%	47.8%
Recyclable Plastics	6.1%	4.7%	5.4%
Recyclable Metals	2.8%	1.9%	2.4%
Recyclable Glass	1.7%	2.2%	1.9%
Deposit Beverage Containers	4.1%	1.0%	2.6%
Compostable Paper	0.1%	0.6%	0.3%
Non-Recyclable Paper Packaging	0.1%	0.3%	0.2%
Non-Recyclable Plastics	3.3%	6.7%	5.1%
Non-Recyclable Metals	0.5%	0.5%	0.4%
Non-Recyclable Glass	0.9%	0.1%	0.5%
HHW	0.2%	1.8%	1.0%
Food Waste & Organics	1.5%	6.6%	4.1%
Yard Waste	0.6%	0.2%	0.4%
Waste Electrical and Electronic Equipment	0.0%	0.3%	0.2%
C&D Waste	0.0%	0.5%	0.3%
Bulky Items	0.0%	0.0%	0.0%
Other Materials	1.7%	7.4%	4.7%
Total	100%	100%	100%
Contamination	8.8%	25.2%	17.2%

Photographs of contaminating materials within the recycling stream are shown in Figures 4.5 through 4.7.



Figure 4.5 Shoes in Multi-unit Residential Recycling



Figure 4.6 Plastics in Multi-unit Residential Recycling



Figure 4.7 Other Materials in Multi-unit Residential Recycling

4.4 Capture Rates for Multi-Unit Residential Recycle

Capture rate is defined as the amount of each divertible material captured within the recycling stream compared to the overall amount of that specific material generated.

Table 4.4 outlines the capture rates for the multi-unit residential recycling. The overall capture rate for recyclable material was 43%, which includes all materials accepted in the recycling program at the time of the study.

Among the highest capture rates were newspaper – daily's and weekly's (80%), newsprint other (62%) and corrugated cardboard (58%).

Materials with the lowest capture rates were steel beverage cans (0%), aluminum non-beverage (0.5%), aluminum foil & foil trays (4%) and gable top containers – non beverage (6%).

Table 4.4 Multi-unit Residential Recycling Capture Rates

Material Category	Recycled	Generated	Capture Rate
	kg/hh/wk	kg/hh/wk	%
Newspaper – Dailys and Weeklys	0.03	0.03	80%
Newsprint - Other	0.09	0.14	62%
Telephone Books / Directories	0.000	0.003	0%
Magazines & Bound Materials	0.02	0.04	55%
Mixed Fine Paper	0.06	0.15	39%
Shredded Paper	0.003	0.01	43%
Other Paper - Non-obligated	0.003	0.01	24%
Corrugated Cardboard	0.28	0.48	58%
Boxboard / Cores	0.11	0.24	46%
Kraft Paper	0.01	0.03	26%
Molded Pulp	0.01	0.03	33%
Polycoat Hot Beverage Cups	0.002	0.01	14%
Polycoat Cold Beverage Cups	0.001	0.01	8%
Ice Cream Containers and Other Bleached Long Polycoat Fibre	0.001	0.01	12%
Spiral Wound Containers	0.003	0.01	56%
Gable Top Containers - Beverage	0.002	0.01	30%
Gable-top Containers - Non-Beverage	0.000	0.001	6%
Aseptic Containers Beverage	0.001	0.003	32%
Aseptic Containers - non beverages	0.001	0.002	36%
#1 PET Bottles - Beverage	0.004	0.01	32%
#1 PET Bottles, Jugs and Jars - Non beverage	0.01	0.04	19%
#1 PET Thermoform	0.01	0.05	29%
#2 HDPE Beverage	0.004	0.01	38%
#2 HDPE Non beverage (Bottles,Jugs and Jars)	0.01	0.03	37%
#2 Other HDPE Containers	0.001	0.002	27%
#3 PVC	0.0001	0.0003	18%
#5 PP	0.01	0.06	19%
#6 PS - Non-expanded - all other	0.002	0.01	12%
Aluminum- Beverage Cans	0.003	0.01	58%
Aluminum- Non Beverage	0.000	0.01	0%
Aluminum Foil & Foil Trays	0.001	0.02	4%
Steel Beverage Cans	0.000	0.004	0%
Steel Food Cans	0.02	0.07	29%
Glass Beverage Containers	0.01	0.03	26%
Glass- non beverage	0.02	0.11	16%
Overall Capture Rate - All Recyclables	0.72	1.67	43%

5.0 RESULTS AND DISCUSSION: SELF-HAUL

During the study, 38 inbound self-haul loads were physically audited to determine composition by material category.

The waste composition profile for the self-haul waste is shown in Figure 5.1 and Table 5.1. The average self-haul load size over spring a fall was 142.6 kg.

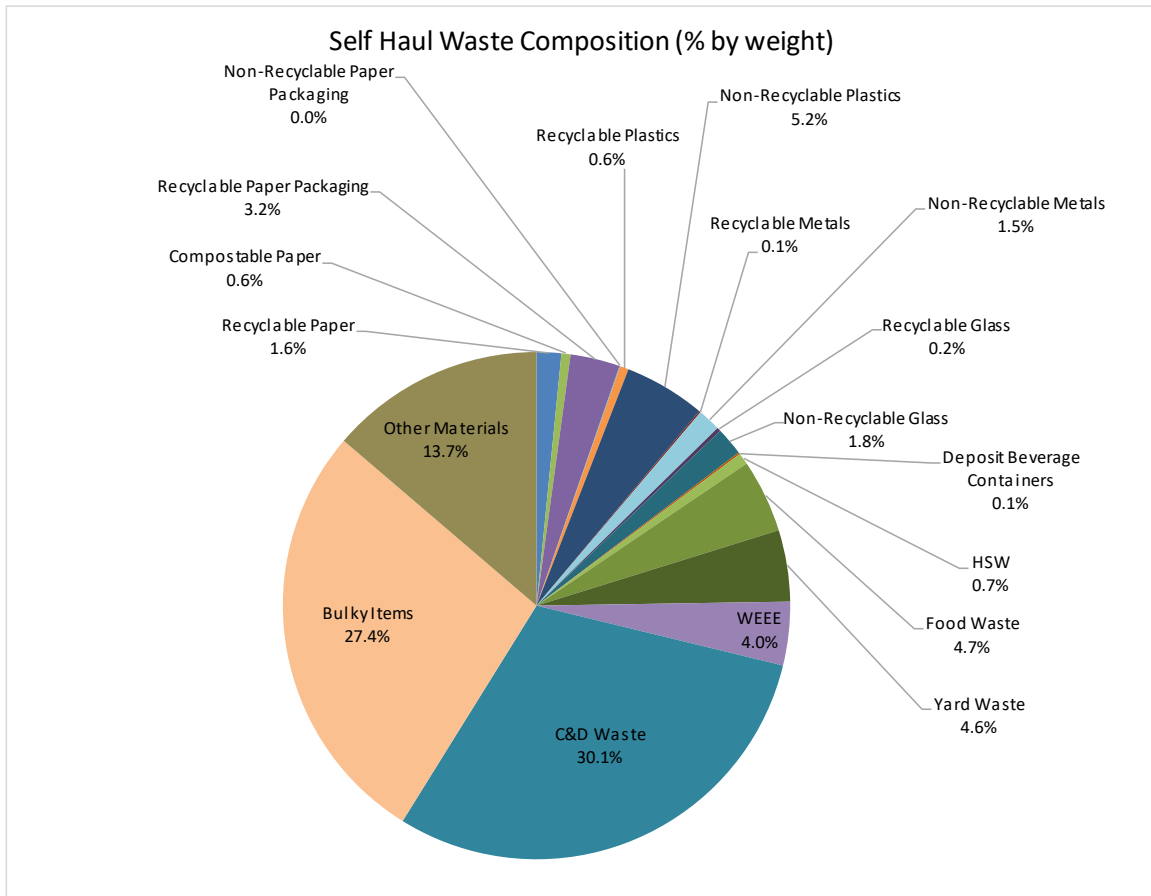


Figure 5.1 Self-Haul Waste Composition

The largest material category was C&D waste, at 30% and bulky waste (mainly furniture), at 27%.

Table 5.1 shows the breakdown of the waste material audited from inbound self-haul loads during 2019.

Table 5.1 Self Haul Overall Waste Composition

Material Type	Overall (kg)	Average kg/load	Percentage (%)
Recyclable Paper	78.36	2.24	1.6%
Non-Recyclable Paper	0.00	0.00	0.0%
Compostable Paper	28.98	0.83	0.6%
Recyclable Paper Packaging	157.56	4.50	3.2%
Non-Recyclable Paper Packaging	2.34	0.07	0.0%
Recyclable Plastics	27.49	0.79	0.6%
Non-Recyclable Plastics	258.61	7.39	5.2%
Recyclable Metals	5.39	0.15	0.1%
Non-Recyclable Metals	72.74	2.08	1.5%
Recyclable Glass	12.16	0.35	0.2%
Non-Recyclable Glass	89.02	2.54	1.8%
Deposit Beverage Containers	6.10	0.17	0.1%
HSW	36.72	1.05	0.7%
Food Waste	232.76	6.65	4.7%
Yard Waste	227.25	6.49	4.6%
WEEE	202.12	5.77	4.0%
C&D Waste	1500.24	42.86	30.1%
Bulky Items	1368.62	39.10	27.4%
Other Materials	685.70	19.59	13.7%
Total	4,992.16	142.63	100.0%

6.0 RESULTS AND DISCUSSION: CIVIC FACILITIES

In 2019, 18 samples from civic facility were physically audited to determine composition. Issues with sample collection during the audit resulted in some facilities missing either a garbage or recycling sample. Additionally, some facilities do not have recycling collection. In total, 17 facilities had garbage samples collected and 11 had recycling samples collected. Table 6.1 outlines the civic facilities audited and the associated weights of garbage and recycling generated.

Table 6.1 Civic Facilities Audited

Civic Facilities	Garbage	Recycling
	Weight (kg)	Weight (kg)
Police Services - Head Quarters	289.19	270.00
Civic Square East	126.24	60.00
Cosmo Civic Centre (Carlyle King Library) & Arena	90.00	N/A
Saskatoon Light and Power	100.76	36.42
Transit - Access Bus Storage Building	2.95	16.98
Alice Turner Library	118.00	77.01
Fire Station #3	180.00	12.48
Riversdale Pool	63.61	10.33
Kinsmen park - Nurien Playland - Workshop	100.00	N/A
River Landing Spray park	440.00	N/A
Field House	319.98	24.71
Lakewood CC	250.00	N/A
BID's	185.00	4.78
Carpentry Shop	140.00	N/A
Water Treatment Plant	80.00	30.00
Archibald Arena	238.16	N/A
Sign Shop	30.00	N/A
John Deere	N/A	11.18
Total	2753.89	553.89

Figure 6.1 illustrates the collected garbage sample composition from civic facilities in terms of garbage, recyclable material and organic material. As shown in Figure 6.1 the average amount of recyclable material in the garbage sample was 21%, and the average amount of organic material (Food Waste, yard waste and compostable paper) was 39%.

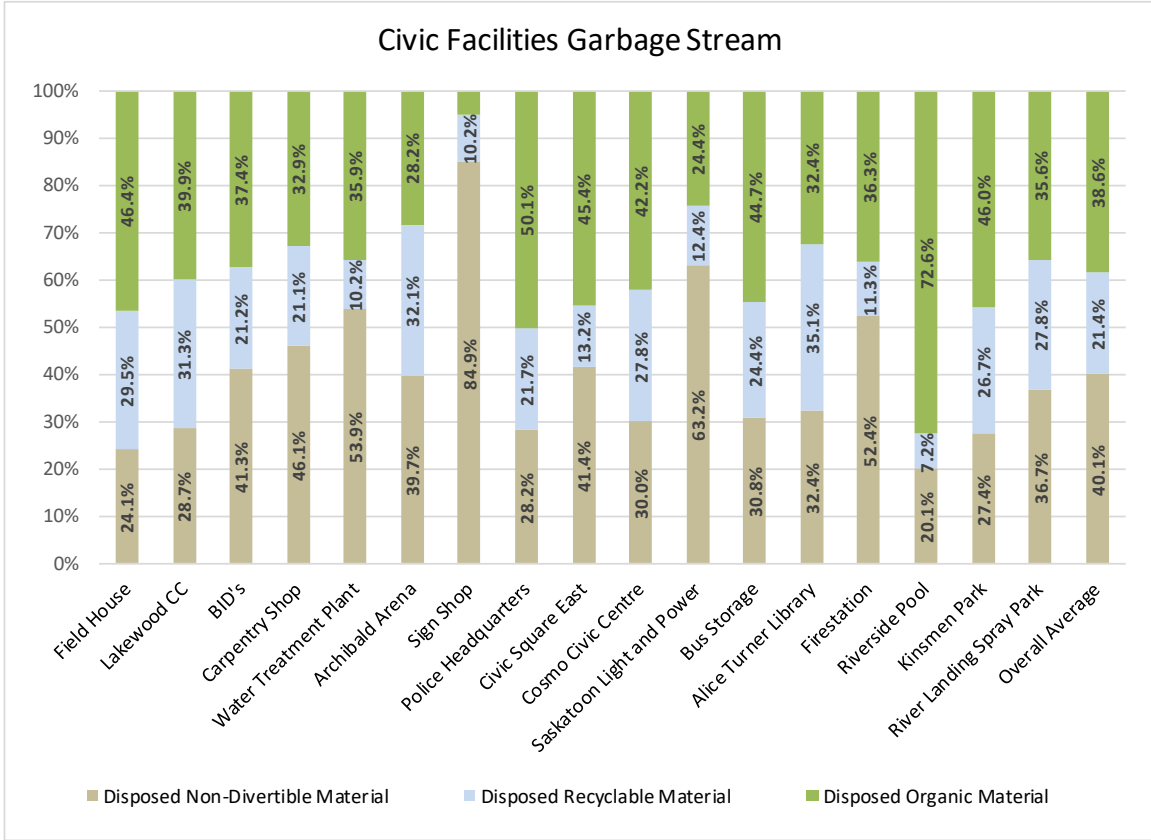


Figure 6.1 Civic Facilities Garbage Profile

Figure 6.2 illustrates the composition of the recycling samples from civic facilities. The average contamination rate in the recycling stream was 6%. Facilities with the highest contamination rates include public bins in Business improvement district's (15%) and the Police Headquarters (14%).

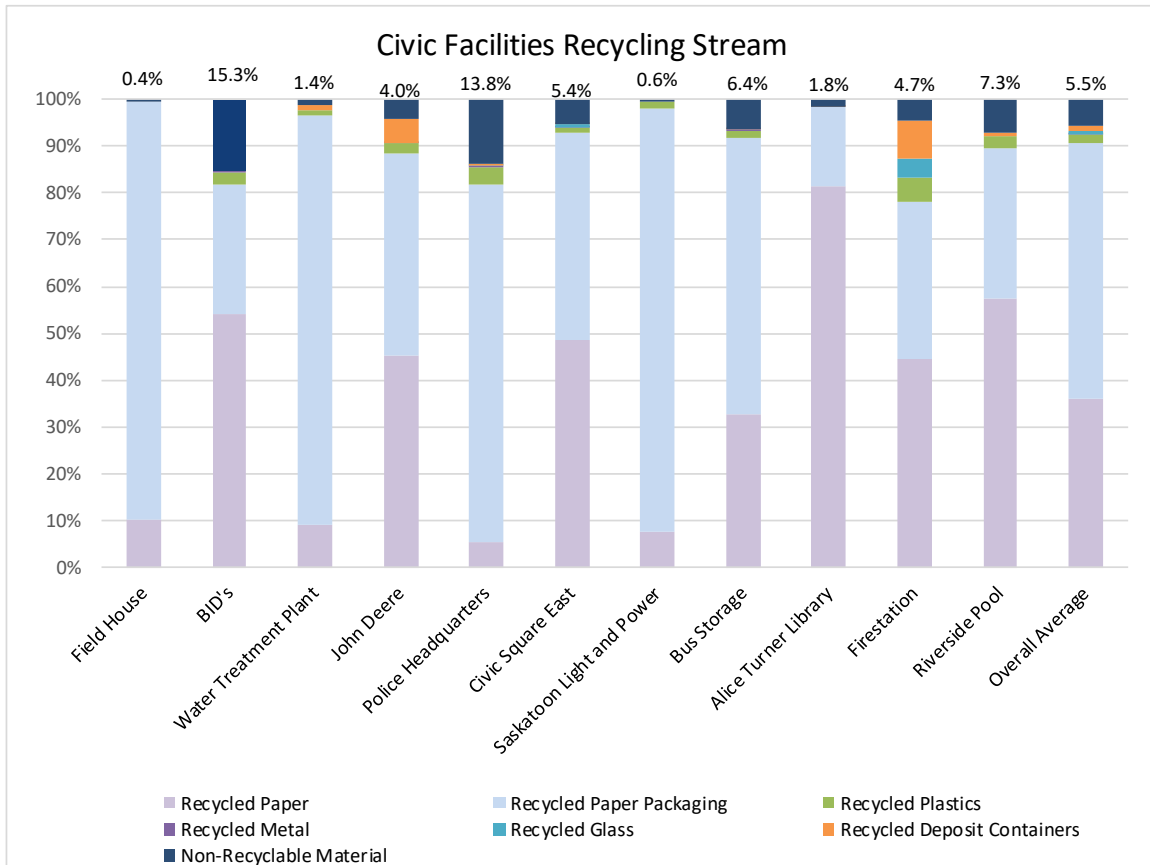


Figure 6.2 Civic Facilities Recycling Profile

7.0 RESULTS AND DISCUSSION: ICI AUDIT

The City arranged for collection and transport of samples from 21 ICI locations. The selected ICI locations represented a variety of facility types, including: retail trade, accommodation/food service, health care, and other services.

The summary below broadly classifies materials found in the ICI waste as garbage, drop-off, recyclable, food & organic, yard waste, or deposit beverage. Garbage refers to materials for which there is generally no readily available diversion opportunity (either curbside or depot). Drop-off refers to materials which would not be accepted in a curbside recycling program, but for which there may be other diversion opportunities (e.g. recycling depot). Recyclable refers to materials accepted in Saskatoon’s curbside recycling program.

As shown in Figure 7.1 the average amount of recyclables in the accommodation/food service garbage was 11%, and the average amount of organic material (Food Waste, yard waste and compostable paper) was 62%.

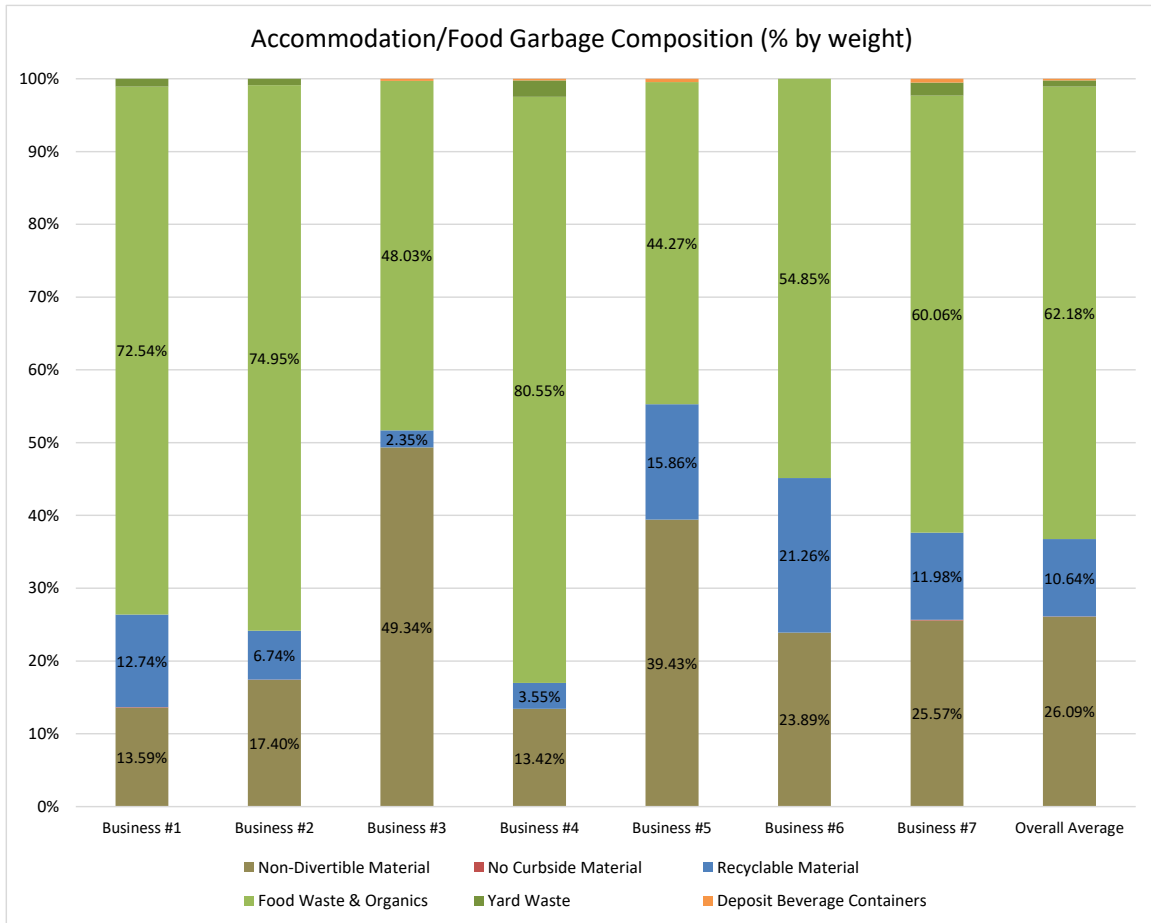


Figure 7.1 Accommodation/Food Service Waste Composition

Table 7.1 summarizes the composition of the recycling stream from two ICI accommodation/food service facilities. The majority of recycling was found to be recyclable paper packaging (largely corrugated cardboard and mixed fine paper). The overall contamination was low for both ICI facilities.

Table 7.1 Accommodation/Food Service Recycling Composition

IC&I Facility:	Recyclable Material	Organic Material	Non-Divertible Material	Total Contamination
Business #5	99.3%	0.1%	0.6%	0.7%
Business #6	98.7%	0.0%	1.3%	1.3%

As shown in Figure 7.2 the average amount of recyclable material across all the retail services garbage was 26%, and the average amount of organic material (food waste, yard waste and compostable paper) was 41%.

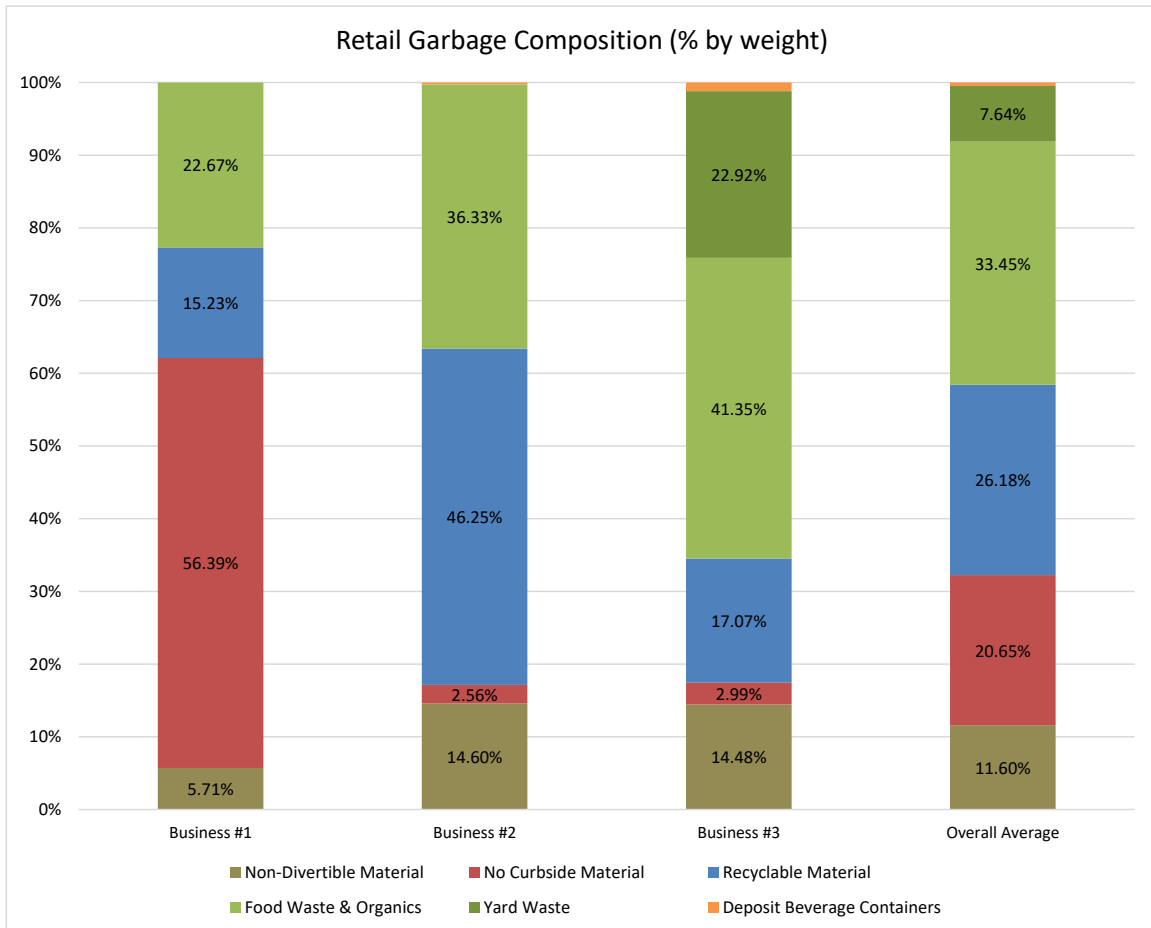


Figure 7.2 Retail Waste Composition

Table 7.2 summarizes the composition of the recycling stream from two ICI retail facilities. The majority of the recycling sample consisted of recyclable paper packaging (largely corrugated cardboard and mixed fine paper). The overall contamination was low for both ICI facilities.

Table 7.2 Retail Recycling Composition

IC&I Facility:	Recyclable Material	Organic Material	Non-Divertible Material	Total Contamination
Business #2	96.2%	0.0%	3.8%	3.8%
Business #3	98.8%	0.0%	1.2%	1.2%

As shown in Figure 7.3 Garbage across all health services contained 18% recyclable material and 38% organic material (food waste, yard waste and compostable paper).

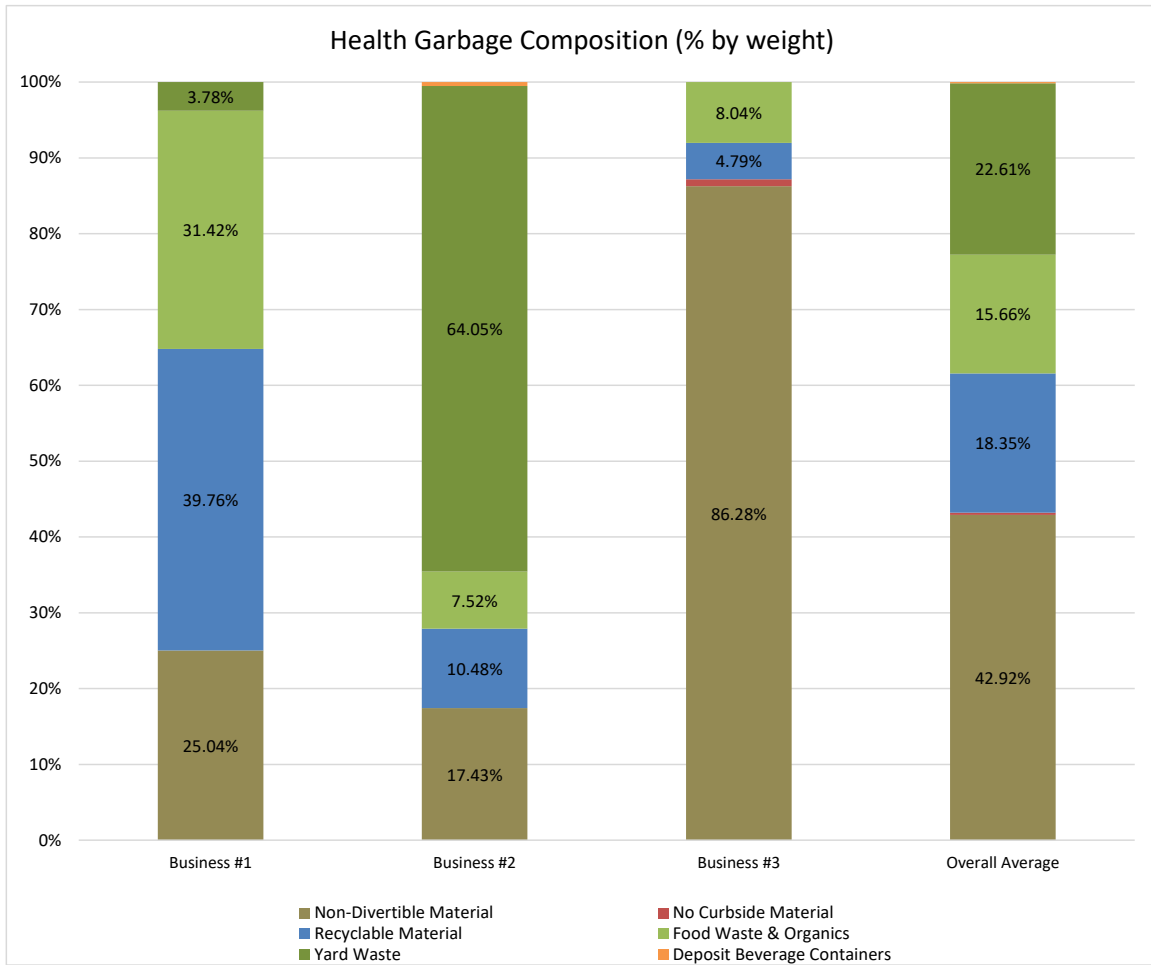


Figure 7.3 Health Services Waste Composition

Table 7.3 summarizes the composition of the recycling stream from one ICI health services facility. The majority of the recycling was made up of recyclable paper packaging (largely corrugated cardboard and boxboard). The overall contamination was low, at 0.06%.

Table 7.3 Health Services Recycling Composition

IC&I Facility:	Recyclable Material	Organic Material	Non-Divertible Material	Total Contamination
Business #3	99.9%	0.0%	0.1%	0.1%

As shown in Figure 7.4 Garbage across the other services ICI sectors included 13% recyclable material and 36% organic material (food waste, yard waste and compostable paper).

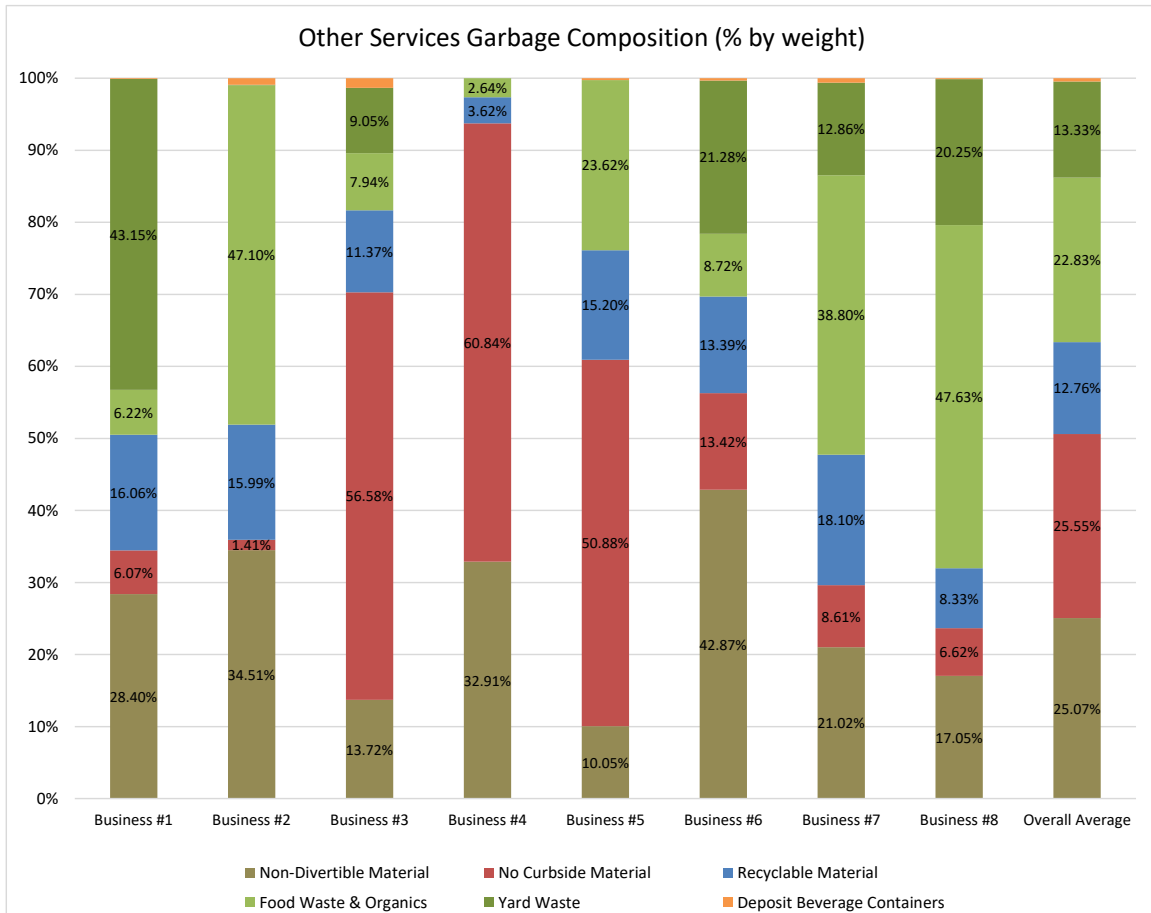


Figure 7.4 Other Services Waste Composition

Table 7.4 summarizes the composition of the recycling stream from three ICI other services facilities. A majority of the recycling was made up of recyclable paper packaging (largely corrugated cardboard, boxboard and mixed fine paper).

Table 7.4 Other Services Recycling Composition

IC&I Facility:	Recyclable Material	Organic Material	Non-Divertible Material	Total Contamination
Business #4	96.7%	0.0%	3.2%	3.3%
Business #5	89.2%	0.0%	10.8%	10.8%
Business #6	98.0%	0.0%	2.0%	2.0%

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Disclaimer

AET Group Inc. makes no warranty and assumes no liability for the information contained in this report outlining the waste audit study results. These results reflect measurements made over the two-week study period as described in the methodology. As such, waste generation measurements should be considered snapshots and may not reflect accurately conditions across City of Saskatoon over time. These reported generation, capture, diversion, and contamination rates more accurately reflect the quantity of each material generated over the study period.