

# Kent County Department of Public Works

## 2021 Municipal Solid Waste Characterization Study

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March 2022

**GERSHMAN, BRICKNER & BRATTON, INC.**

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1	Executive Summary.....	1
2	Preparing for the MCW Study.....	7
2.1	Methodology.....	7
2.2	Schedule.....	9
3	MCW Sampling.....	10
3.1	Study Preparation.....	10
3.2	Sort Categories.....	10
3.3	Project Staffing.....	11
3.4	Physical Planning.....	11
3.4.1	WTE Facility.....	11
3.4.2	NKTS.....	12
3.4.3	SKL.....	13
3.5	Crew Training.....	13
3.6	Material Collection and Sorting and Weighing.....	13
3.7	Data Collection.....	14
4	Results of MCW Characterization Study.....	15
4.1	Overall MCW Study Results.....	15
5	Results by Generator Type.....	20
5.1	Residential:.....	20
5.2	Commercial.....	21
5.3	Comparison to 2017 Data.....	23
5.4	Sizing Results.....	24
5.5	RRS Kent County MRF November 2021 Sort Results.....	25
6	Generation Estimates.....	27
6.1	Residential Waste Generation – Alternative Estimates.....	30
6.2	Commercial Waste Generation – Alternative Estimates.....	31
6.3	Generated Amounts by Commodity.....	33
7	Growth.....	34
8	C&D Generation.....	35
9	Definitions.....	39
9.1	Common Acronyms.....	39
9.3	Material Categories.....	47



9.3.1	Sort Categories .....	47
10	Appendices.....	51
10.1	Data Sheets .....	52
10.1.1	Front Page .....	52
10.1.2	Back Page.....	53
10.2	Blank Sizing Sheet.....	54
10.3	Full Results by Generator Type.....	55
10.4	Full Results by Truck Type .....	57
10.5	Comparison to 2017 WTE Waste Sort Study .....	63
10.6	Sizing Data .....	65
10.7	Results of November 2021 MRF Sort by RRS.....	66
10.8	Generation Tables for In-County Estimates from County Dataset .....	67
10.9	Cascadia Group Number Definitions by NAICS Code.....	68
10.10	2021 County Tonnage Data .....	69
10.11	Category Generation Estimate by Generator Type .....	70
10.12	Raw MCW Study Data with Tares Removed .....	71
	Figure 1 - Sort Area at the WTE Facility.....	2
	Figure 2 - Results for All Generators (non-weighted) for Category Groups.....	3
	Figure 3 - Top 10 Items (All Generators) .....	4
	Figure 4 - Population of Kent County vs. Tons of Waste Generated by Kent County .....	5
	Figure 5 - A Sample of MCW at the WTE Facility.....	7
	Figure 6 - Types of Trucks for Sampling.....	8
	Figure 7 - Schedule of Waste Characterization Sort .....	9
	Figure 8 - Example of Bins with Category Labels .....	10
	Figure 9 - Waste Sort Area at WTE Facility .....	12
	Figure 10 - Waste Sort Area at NKTS .....	12
	Figure 11 - Waste Sort Area at SKL .....	13
	Figure 12 - Results for All Generators (non-weighted) for Category Groups .....	18
	Figure 13 - Top 10 Items (All Generators) .....	19
	Figure 14 - Top 10 Items - Residential Generators .....	20



Figure 15 - Top 10 Items - Commercial Generators .....	21
Figure 16 - Top 10 materials from Other generator trucks (Self-Haul and Roll-Off).....	22
Figure 17 - Percentage of Material Group by Generator Type .....	22
Figure 18 - Top 10 results for 2021 Residential composition vs. 2017 Residential composition.....	23
Figure 19 - Top 10 materials in MRF incoming materials .....	26
Figure 20 - Top 10 materials in MRF Residue .....	26
Figure 21 - Population of Kent County vs. Tons of Waste Generated by Kent County .....	34
Figure 22 - All Combined Generators (No Weighting) .....	59
Figure 23 - Residential Generators (Side- and Rear-Load).....	60
Figure 24 - Commercial Generators (Front-Load and Compactors) .....	61
Figure 25 - Other Generators (Roll-offs and Self-Haul) .....	62
Table 1 - Overall Generation of Residential and Commercial Waste from Within Kent County.....	5
Table 2 - Trucks Sampled.....	15
Table 3 - Overall Unweighted Material Composition Kent County MCW .....	16
Table 4 - Sizing Results .....	24
Table 5 - Sort Categories for Characterization Study at Recycling MRF .....	25
Table 6 - Yearly In-County Estimates for Kent County Waste Generated and Received at Kent County Facilities based on 2021 Scalehouse Data .....	27
Table 7 - Yearly Disposal Estimates for Generators Outside of Kent County Disposed at Kent Solid Waste Facilities.....	28
Table 8 - EGLE Report of Kent County Generated Tonnages for 2021 Disposed at Out-of-County Landfills (Converted from YD <sup>3</sup> ) .....	28
Table 9 - Estimate of Commercial Kent Generated MSW Disposed Tons Outside of Kent County not Counting Materials Transferred from North Kent Transfer Station.....	29
Table 10 - Overall Generation of Residential and Commercial Waste from Within Kent County.....	30
Table 11 - Generation of MCW for the City of Grand Rapids, MI .....	30
Table 12 - County TPY Based on Kent County Households up to 4 Units .....	31
Table 13 - Waste Generation by Commercial Group Type and Number of Employees .....	32
Table 14 - Comparison of Generation Estimated from Scalehouse Data and Number of Employees..	33
Table 15 - Generation of Materials by Category Group for Residential and Commercial Waste Generated in Kent County.....	33
Table 16 - Rate of Kent County Population and Waste Growth .....	35



Table 17 – Top 10 Materials from Lancaster, PA C&D Characterization Study .....	35
Table 18 – Estimate of C&D In-County Generation Yearly Tonnage Estimate.....	37
Table 19 – Estimate of Out-of-County C&D Disposed at Kent Facilities .....	37
Table 20 – 2021 EGLE Report in Tons for Kent Generated C&D.....	37
Table 21 – Total C&D Tonnages .....	38

# 1 Executive Summary

The Kent County Department of Public Works (DPW) has set an ambitious goal of diverting the amount of waste it manages via landfill disposal by 90% by 2030. A critical element in achieving that goal is the development of a Sustainable Business Park (SBP) on land Kent County (County) owns adjacent to its South Kent Landfill. Prospective tenants of the SBP will have a focus on the recovery, reuse, and recycling of waste materials into high value products and renewable energy creating a circular economy for Western Michigan.

Gershman, Brickner & Bratton (GBB) was commissioned by the DPW to analyze the material characteristics and quantities of the municipal solid waste (MSW) generated in Kent County. This study provides the results of our analysis.

The first prospective SBP tenant, referred herein as the Kent County BioEnergy Facility LLC (KCBF), is a joint venture between Anergia Services LLC and ContinuumMaterials LLC. The facility proposed by KCBF will accept and process 400,000 tons per year (TPY) of MSW from residential and commercial sources which is currently disposed at the County's South Kent Landfill, or at regional landfills outside the County, or is combusted at the County's waste to Energy facility. This SBP facility will recover traditional recyclable materials such as metal and plastic bottles, old corrugated cardboard (OCC), high value fiber, and other valuable commodity materials. The high value recovered material will be baled and shipped to intermediate processors for eventual conversion into new products. The facility will recover organic material such as food waste and convert it into renewable natural gas and organic fertilizer via an anaerobic digestion process. Finally, low to no value paper and plastic materials will be recovered, processed, and made into roof cover boards and other construction materials through an integrated manufacturing facility operated by ContinuumMaterials.

While the design of our study, and the results presented herein, are tailored to fill the needs of the KCBF, the report may be useful for secondary tenants of the SBP. It is envisioned that such secondary tenants may process additional volumes of MSW, recovered recyclable materials from the KCBF, or other waste streams from the region such as construction and demolition (C&D) waste. According to the records of the Michigan Department of the Environment, Great Lakes, and Energy (EGLE) in 2021 Kent County residents and businesses disposed of over 612,000 tons of municipal and commercial waste (MCW) at facilities managed by the DPW and other regional facilities. MCW is a term defined and used in EGLE regulations and is equivalent to the generic waste industry term, MSW.

The rate of MCW generation is influenced by many factors, but it is highly sensitive to changes in population and economic activity. A review of EGLE's records for the reporting periods 2012 through 2021<sup>1</sup>, indicate the rate of MCW generated in Kent County has consistently grown at a compound rate of 2.32% per year. The growth rate was interrupted in 2020 and 2021 due to the impacts of the COVID-19 pandemic when MCW generation declined by 9.0%. This is illustrated in Figure 4 on Page 5.

Going forward, GBB believes it is reasonable to assume that MCW generation will once again increase in proportion to the growth in population and economic activity in the county. Using the pre-pandemic historical MCW growth rate, by the SBP's first full year of operation, the volume of MCW generated in

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<sup>1</sup> The EGLE 2021 reporting period runs from Q4 of 2020 through Q3 of 2021



Kent County is projected to increase almost 12%, reaching 685,000 tons per year from the pandemic low point.

It is estimated that over 1.0 million tons per year of non-hazardous solid waste is generated in Kent County. In 2019 reports filed with EGLE, a total of 897,000 tons of total Kent County generated solid waste was disposed of at Michigan landfills and the DPW's WTE facility. In addition to MCW, EGLE reported volumes include C&D waste and industrial waste disposed of at an EGLE regulated waste management facility. Waste volumes not captured in the 2019 EGLE reported volume may include industrial waste such as wood-waste which was used in a biomass power plant, yard waste, food waste managed at a non-landfill facility, and waste materials exported to out of state management facilities.

Not all the 612,000 tons of MCW generated in Kent County is suitable for processing at the KCBF. Within this report GBB uses the term Processable Waste to mean that portion of the MCW stream which it believes can be efficiently managed at the KCBF. Using our judgement and reasonable assumptions, we believe there is a minimum of 466,000 tons per year of Processable Waste generated within Kent County. Examples of MCW which may not be Processable Waste include some construction and demolition debris, bulky wastes, household hazardous waste (HHW) not taken to the HHW drop-off, and electronic waste. In Section 6 we discuss alternative generation estimation techniques which indicate the volume of Processable Waste originating out of the commercial waste sector could be as much as 100,000 tons per more than what is included in our 466,000 ton per year estimate.

## Sort Process

The field data collection effort of this study took place over two weeks in October and November 2021 at three different collection locations: the Kent County Waste to Energy Plant (WTE), the North Kent Transfer Station (NKTS), and the South Kent Landfill (SKL). An additional, separate characterization study occurred over three days to analyze the single-stream recycling at the County material recovery facility (MRF). Both studies were based on the ASTM D5231 Waste Sort Test Methodology with modifications necessary for safe and effective sample gathering.

The waste characterization study sorted the waste into a list of fifty material categories in ten (10) major groupings. The ten (10) major grouping utilized were Fiber, Plastics, Glass, Metals, Organics, Liquids, Textiles, Household Hazardous Waste, Electronics, Construction and Demolition (C&D) waste, and Other Residue. The GBB Site Supervisor identified appropriate trucks for sampling, and a front-end loader took a sample from that load and dumped it next to the sorting area into totes. Samples were identified by the type of hauling truck that would designate the waste as residential or commercial (with most multifamily waste being considered Commercial waste). Industrial waste and C&D waste were not studied.

The sample contents were placed on the tables, separated, and sorted into individual categories using specially marked receptacles surrounding the

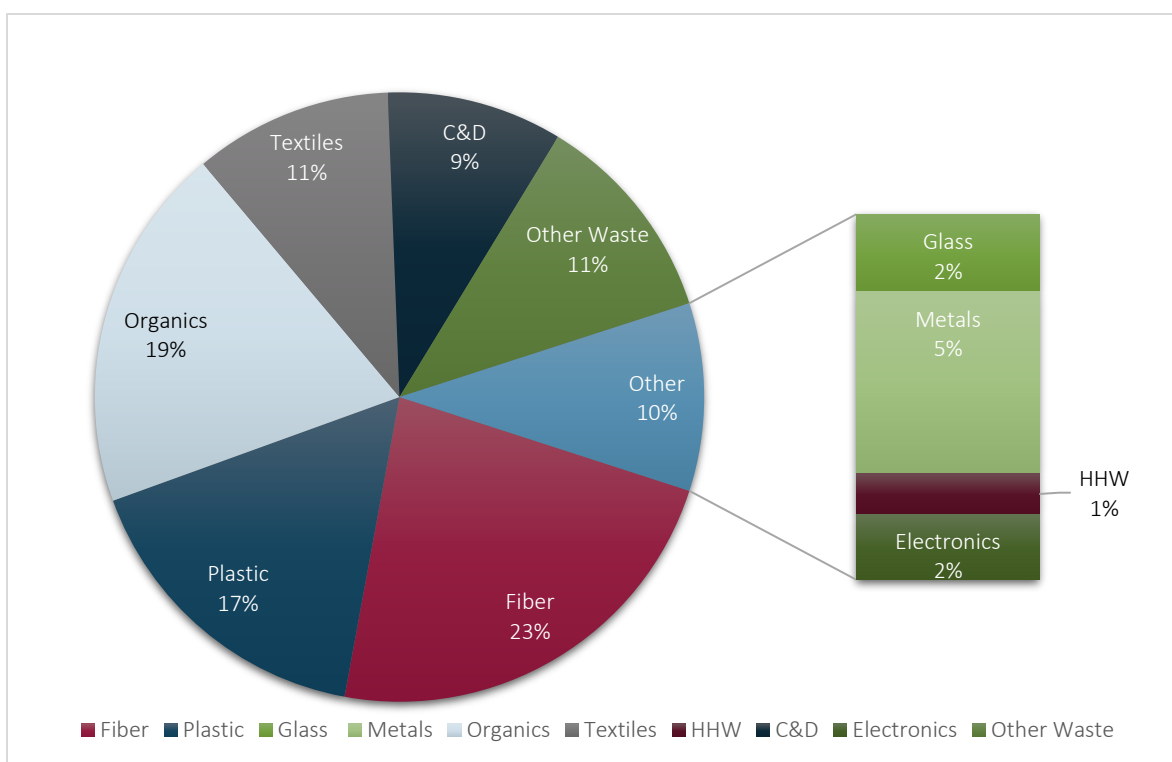


*Figure 1 - Sort Area at the WTE Facility*

sorting area. Once a sample was fully sorted, all containers with contents were weighed and recorded. These weights for each category form the basis of the percentages of that material in the overall waste stream. Once the sample was weighed, the material was discarded, and a new sample was taken for sorting. All results include a 90% confidence interval to help show the possible variance of the results.

## Results

*Figure 2 - Results for All Generators (non-weighted) for Category Groups*

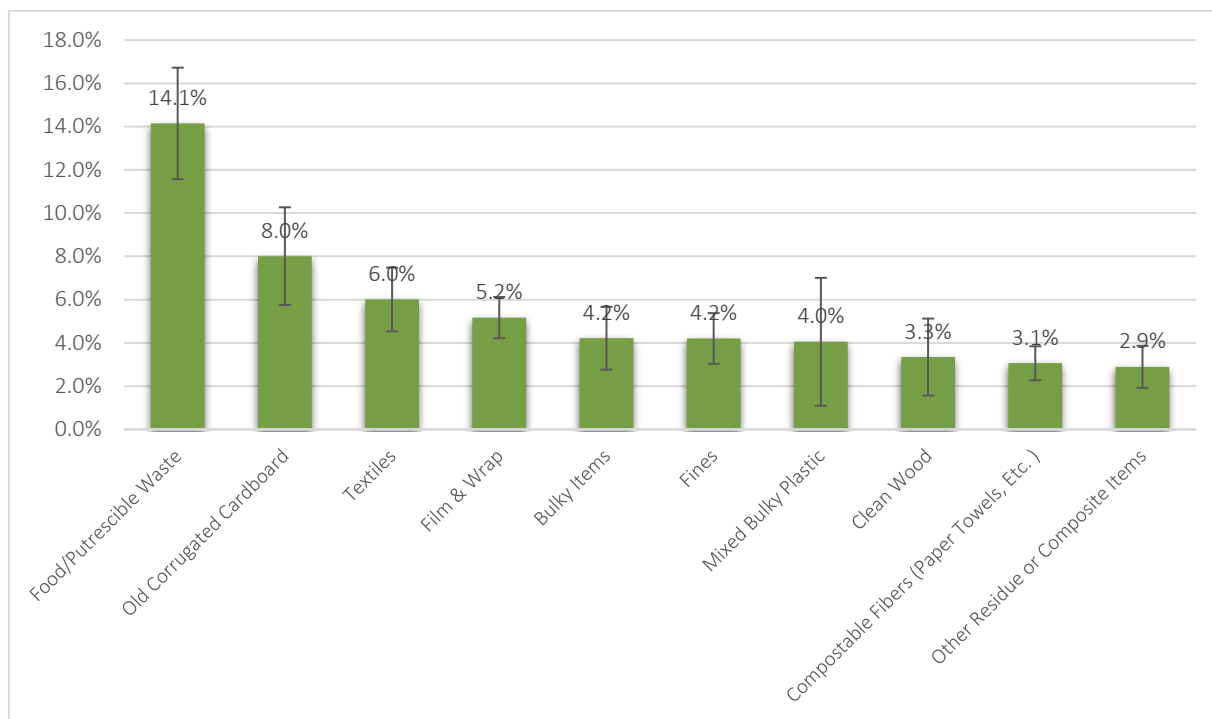


- (1) Fiber consists of all paper products, including wet and non-recyclable paper
- (2) Plastics include all types of recyclable and non-recyclable plastic materials
- (3) Metals include UBCs, steel cans, other ferrous and non-ferrous metals, and small appliances
- (4) Organics include food waste, yard waste, and other organics (frequently feces)
- (5) Textiles include clothing and other cloth, leather and rubber, and diapers
- (6) Other Waste includes Bulky or Composite items and Fines

The three (3) largest combined category groups (as seen in Figure 2) in the MCW Study are fiber, organics, and plastics, which total nearly 60% of the total waste composition. The textiles group (which includes textiles, leather, rubber, and diapers) was the second-most prevalent category with 11% of the total composition, similar to the “Other Waste” category which includes bulky and composite items. The processing system aims to recover much of the organics, plastics, and fiber for recycling or alternative uses, and most of the metals can be recovered for recycling as well. If all of the materials from these four (4) groups could be recovered, this would be a nearly 65% recovery rate of material from the waste. However, a full recovery of all materials is not practical, but the composition indicates that a recovery rate of greater than 50% is possible and even likely.

The results for all 50 categories are shown in the main report, but it is interesting to note the top ten (10) items from the sorting by individual category, shown below in Figure 3. The top ten (10) materials included organics with Food Waste, fiber with Cardboard (OCC) and Compostable Fiber (napkins), and plastics with Film and Mixed Bulky Plastics. The SBP tenants will need to show how their system will process and recover these materials and the other remaining materials.

*Figure 3 - Top 10 Items (All Generators)*



Throughout the sampling, the top three (3) categories (Food/Putrible Waste, Old Corrugated Cardboard, and Textiles) were present in almost all loads. The red bars indicate the 90% confidence interval for that material which indicates the likely range of the actual average value for that material. A larger error bar for Bulky Plastics indicates that material had more variability in how much material was present per load.

## Waste Generation and Growth

To estimate the generation of waste, several methods were utilized. First, the County used the scale houses at all three disposal locations to record the type of truck, county of origin, and weight of the materials for disposal for five (5) months from October to through February.<sup>2</sup> This data was used to extrapolate the in-county disposal of residential and commercial waste generated from Kent County.

EGLE data was utilized to estimate the amount of residential and commercial waste generated within Kent County but disposed at locations outside of the County. The total estimated generation from the scale data and EGLE calculations (shown in Table 1) indicate that approximately 466,000 TPY of

<sup>2</sup> This detailed recording is continuing and will be used for more accurate yearly estimates once a full year has been recorded

residential and commercial waste is generated in the County and could be processed by the proposed SBP system.

*Table 1 - Overall Generation of Residential and Commercial Waste from Within Kent County*

In County Generator	TPY
Est. 2020 in-county Residential Disposal TPY <sup>1</sup>	162,602
Est. 2020 in-county Commercial Disposal TPY <sup>1</sup>	181,371
Est. 2020 out-of-county Commercial Disposal TPY <sup>2</sup>	110,974
Est. in-County "Other" Disposal TPY <sup>1</sup>	10,993
<b>Total</b>	<b>465,940</b>

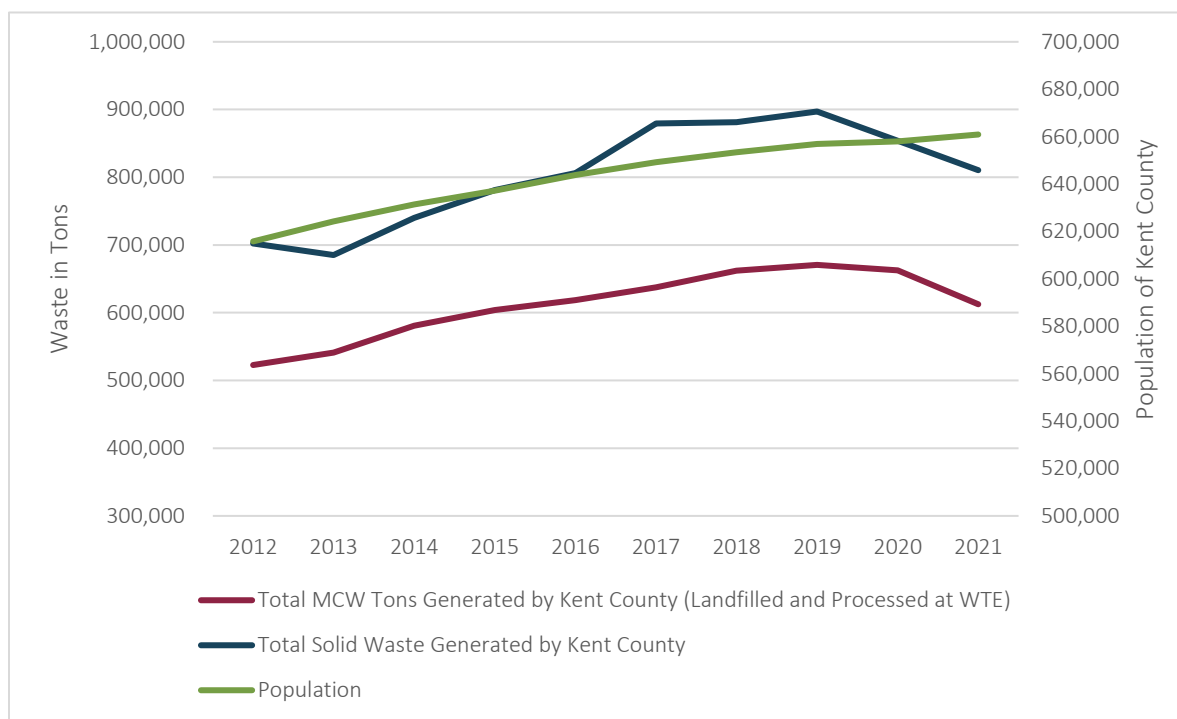
(1) Estimated from truck data collected at scale houses in Oct. 2021 (Table 6)

(2) Estimated from EGLE data reported in 2021 (See Table 9)

Other methods of generation estimates utilizing employee numbers and population generation were also used to compare the above results. All the other generation estimates indicated even more waste generation than was estimated from the scale data. GBB concludes that the estimated waste in Table 1 is likely a conservative estimate of residential and commercial Processable Waste generated in Kent County.

## Growth

Kent County has experienced steady growth in population over the last decade, and as a central business hub, this growth is projected to continue for some time.



*Figure 4 - Population of Kent County vs. Tons of Waste Generated by Kent County*

The population of Kent County has grown from 615,789 in 2012 to 657,974 in 2020. The population of Kent County was estimated for 2021 using the average rate of population growth between 2017 and 2020, 0.45%, and is 660,900. The amount of waste disposed of in the South Kent Landfill by the County mirrored the population, however, unlike the population, the amount of waste did not increase every year and has varied more between individual years. The average growth rate of the population was 0.83% and this average reflects the trend of small, consistent yearly growth. The average rate of change of waste disposed at South Kent was 2.33%. While the waste was influenced by the onset of the pandemic in 2020, the rate of change has varied more severely than the population growth since 2012 and has not consistently increased (as seen in Figure 4). The population data used in Figure 4 was retrieved from the U.S. Census Bureau, and the waste disposal data was from the EGLE yearly reports. The change in waste and population was calculated by dividing the yearly total by the previous year's total and converting the difference into a percentage.

## Conclusion

The MCW Study gives a solid understanding of the composition and type of waste the new facility would process. The generation study and the EGLE landfilled data indicates there should be a minimum of 466,000 TPY of processable waste generated within Kent County, especially given the growth of the County that is projected to continue.

## 2 Preparing for the MCW Study

An objective of this study is to better understand the composition and amount of material available within the County (with assumed flow control) that can be processed in the new mixed waste processing facility (MWPF) as proposed by KCBF. The composition is critical to understanding the operations and efficiencies of the equipment to provide optimal recovery and throughput efficiency. The total amounts of waste and recyclables available are critical to estimating the system outputs (and total revenue from these outputs). The study took place at all three County waste locations. These facilities include the Waste to Energy plant (WTE), the North Kent Transfer Station (NKTS), and the South Kent Landfill (SKL).

This data is also critical to understanding the current system and may be used as a benchmark for future changes or adaptations within the County. An initial goal of this study was to include samples from both residential, commercial, and C&D loads, but unfortunately, the lack of staffing and space constraints limited the amount of C&D that could be sampled, but adequate samples were collected for both residential and commercial wastes for accurate results.

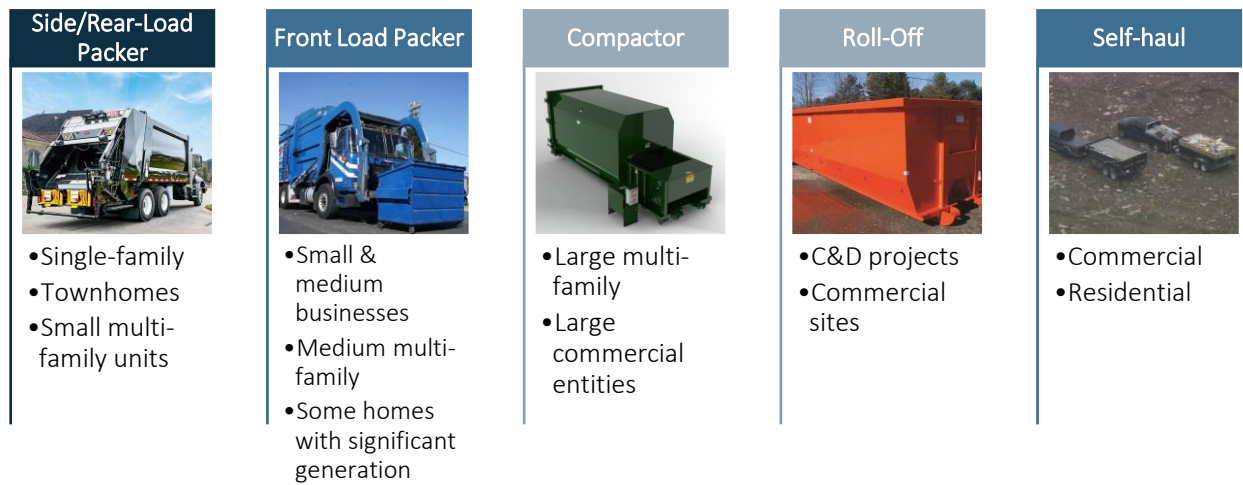
### 2.1 Methodology

Most of the MCW in the County comes to the three (3) aforementioned locations: SKL, the WTE facility, and the NKTS. The waste stream stems from various generators and can be classified as Commercial Waste, Residential Waste, and Construction and Demolition (C&D) Waste. The waste was differentiated by the types of trucks that brought the waste into the waste management facility. It was assumed that rear or side loader trucks were primarily residential MCW, front-loaders, and direct haul compactors were from commercial sources and that most roll-off boxes were C&D waste. The self-haul waste was evaluated on a sample-by-sample basis if it was more C&D or MCW loads.



*Figure 5 - A Sample of MCW at the WTE Facility*





*Figure 6 - Types of Trucks for Sampling*

GBB bases all its waste characterizations on ASTM D5231 standards, although the collection details are adapted to allow for different operational coordination at different sites. Care is taken to ensure statistically relevant and random sampling from each load. The Site Supervisor indicated to the loader operators the truck from which a sample should be taken at all three locations. The Site Supervisor decided which trucks to target based on availability and the overall number of trucks expected to arrive at each location.

Once the Site Supervisor identified a sample truck, the loader operator used the front loader to collect a sample from the tipped pile. The operator tried to collect a representative sample, although this was sometimes difficult as loads varied in composition throughout the stack of materials. Therefore, it was vital to collect enough samples from each location over the two weeks to account for these variabilities.

In addition to material composition, it is crucial to understand the size of collected materials to understand how they will behave in a processing system. A sorting table was designed with squares of tape of varying sizes to estimate how a material would fall through these squares as if they were screens in a processing system. This sizing sort was used on waste categories that had enough material in a particular sample to have representative size variations and materials whose size would vary significantly. The Site Supervisor trained one of the temporary workers to perform the sizing sampling throughout the entirety of the MCW Study. The Site Supervisor periodically checked the resulting sizing designations and agreed with the worker's assessment in each instance. The GBB team is confident in the results of the sizing sampling.

In addition to the MCW study, a separate waste characterization study (MRF Study) from a solid waste engineering firm, RRS, took place at the Kent County Recycling and Education Center (MRF) directly after the MCW sorting event. The County's SBP will also process single-stream materials adjacent to the mixed waste processing equipment. The composition of the single-stream recycling is critical to the overall functionality of the new single stream processing system at the facility. Though the number of samples collected from the MRF study was fewer than the MCW study, the MRF samples were taken from the pre-mixed recyclables on the tip floor. This pre-mixed material has a lower variability than

materials from an MCW truck, allowing for smaller sample sizes that are still representative of the overall composition. The results from the MRF Study are also included in this report.

The final aspect of this study was to estimate the availability of processable materials within the County. The County directed the employees at the scale houses to record additional details on the incoming trucks and tonnages over a month of transactions at each of the three scale houses. This information can be extrapolated to estimate tonnages over the entire year with certain assumptions. The remaining tonnages disposed of external to the County are estimated by Michigan's EGLE data. It should be noted that this can only be an estimate, and alternative generation data may be needed to validate or compare these generation amounts.

## 2.2 Schedule

GBB personnel arrived in Grand Rapids for the MCW Study on Sunday, October 24, 2021. GBB personnel purchased study materials and set up the sort site at the WTE facility upon arrival. The sampling and sorting at the WTE facility began on Monday, October 25, 2021, and lasted four (4) days until Thursday, October 28, 2021. The Study team had the goal of sorting six (6) total samples of commercial and residential waste per day at the WTE facility, which was accomplished except for days where time was spent setting up or packing the sorting equipment. On Friday, October 29, 2021, the sort materials were set up at the NKTS, where residential and C&D were sorted for three (3) days until Monday, November 1, 2021. The sorting team maintained the goal of six (6) samples per day; however, more samples were taken on Saturday as the loads were self-haul and slightly smaller. The sort materials were then transferred to SKL on Tuesday, November 2, 2021, where the waste was sorted for five (5) days until Saturday, November 6, 2021, to acquire six (6) samples per day. When the sort finished, the site was cleaned, and some of the project materials were disposed of in the SKL, while others were transported to the Kent MRF in case they could be used in the single-stream sampling event.

October/November 2021						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
24	25	26	27	28	29	30
Arrival, Material purchasing and site set-up at WTE	WTE Sort Day 1	WTE Sort Day 2	WTE Sort Day 3	WTE Sort Day 4, move to NKTS	NKTS Sort Day 1 (MSW and C&D)	NKTS Sort Day 2 (MSW and C&D)
31	Nov. 1	2	3	4	5	6
	NKTS Sort Day 3 (MSW and C&D) Move to SKL	SKL Sort Day 1 (C&D and MSW)	SKL Sort Day 2 (C&D and MSW)	SKL Sort Day 3 (C&D and MSW)	SKL Sort Day 4 (C&D and MSW)	SKL Sort Day 5 (half day) and Clean-up
		MSW Sort at WTE Location				
		Combined C&D and MSW Sort at North Kent Transfer Station				
		Combined MSW and C&D Sort at SKL				

Figure 7 - Schedule of Waste Characterization Sort



## 3 MCW Sampling

### 3.1 Study Preparation

Before the arrival of the GBB personnel, a total of three 4-foot by 8-foot tables were constructed by SKL personnel. Two (2) of the tables were used for sorting, and one (1) was used for sizing specific categories of material. After arrival, GBB personnel purchased bins, buckets, and totes for sorting material into fifty (50) different material designations and categories. A large tent and portable toilet were rented for the sorting at SKL to accommodate the MCW Study being outside. At the other facilities, sorting took place indoors, and there were restrooms available for use by sorting staff. Finally, a handwashing station and coolers for water, Gatorade, and snacks were provided to ensure sanitary conditions and maintain staff hydration and energy levels.

The GBB Site Supervisor established standard safety protocols. These protocols included a health and safety plan and details on Personal Protective Equipment (PPE) to be used during the sort. The PPE included Tyvek suits, Tyvek sleeves, eye protection, nitrile gloves (worn directly over hands), protective outer gloves (worn over the nitrile gloves), and masks. Finally, tarps were placed on the ground to lay samples before sorting.

### 3.2 Sort Categories

The team developed a list of fifty material categories with ten (10) major groups for the MCW Study (See Sort Categories on page 47 of this report for the full list of material categories with definitions). The ten (10) major groupings were:

1. Fiber
2. Plastics
3. Glass
4. Metals
5. Organics
6. Textiles
7. Household Hazardous Waste
8. Electronics
9. C&D waste
10. Other Wastes



*Figure 8 - Example of Bins with Category Labels*

### 3.3 Project Staffing

The MCW Study was staffed with the support of a GBB Site Supervisor, a GBB field supervisor, and six (6) sorting laborers provided by a local temporary staffing agency, Snelling. The sort labor varied somewhat during the course of the event, with six (6) regulars that stayed throughout the duration of the waste sort. Staffing was an issue for this particular study due to high demand for workers throughout the region; the Snelling staff agency successfully aimed to find employees willing to stay throughout the two weeks of the sorting.

The sort crew was asked to show up on-site at 8:30 for safety training and to get PPE equipment properly donned. The waste sort daily activities began at approximately 9:00 AM and finished around 3:30-4:00 PM. There was a 30-minute break for lunch and staggered 5–15-minute breaks were taken on an as needed basis based on the availability of a sample.

GBB would like to thank the labor team from the staffing agency Snelling that stuck with the sorting and sampling throughout most of two weeks of the study: Carolyn Morris, Dajalon Lyons, Keonna Lee, Atlas Marlatt, Jenna Good, and Sophia Sheets. The study was dependent on their hard work.

GBB would also like to thank the operators at each of the County waste locations for accommodating the team at their site and for procuring appropriate samples when needed. Their assistance and hard work were also essential to the safety and success of the waste characterization study.

### 3.4 Physical Planning

#### 3.4.1 WTE Facility

At the WTE facility, all incoming waste is tipped in the receiving hall. Most of the waste is pushed into the WTE storage pit where it is collected by the WTE crane and either sent to one of the two WTE boilers or to the by-pass compactor which sent excess materials to the SKL. Bulky or C&D materials were tipped near the rear of the tip floor to be placed in an open top transfer trailer for disposal at SKL or other regional landfills.

The sorting area for the MCW Study was established at an end of the receiving hall, blocked off by large barriers that protected the crew from the vehicles on the tip floor. Behind the blocks the sorting tables were arranged in a line and were surrounded by the containers labeled with the material category names, arranged in order of group type. The digital scale was behind the tables and after weighing the sample was disposed of in a pile behind the scale on the other side of the barriers to be pushed into the pit for disposal. Figure 9 shows the sorting layout at the WTE tip floor.



*Figure 9 - Waste Sort Area at WTE Facility*



### 3.4.2 NKTS

At the NKTS, the incoming trucks come into the receiving hall through six (6) large doors and then dump the waste onto the tip floor; a grapple excavator takes the waste and fills a compactor which is then diverted to Central Sanitary Landfill in Pierson, Michigan. The sorting area for the MCW Study was established on a side of the receiving hall away from the tip floor and was denoted by cones denoting where the sorters would be working. Totes were placed on the other side of the cones, where a front-end loader took samples and dumped them into the totes. The tables were placed side by side in the center of the area and the containers were arranged around the table.



*Figure 10 - Waste Sort Area at NKTS*

The sizing table was separated from the sorting tables to allow greater mobility for the sorters. The digital scale was just inside of the cones and after weighing the sample was dumped into a pile on the other side of the cones to be removed by the staff. The sampling site was located at the NKTS electronics drop-off and care was taken to not interrupt the citizen drop-off.

### 3.4.3 SKL

At the SKL, the portable tent and porter potty were placed just inside the portable fencing on the top of the landfill a safe distance away from landfill working face. This location allowed an optimal observation of incoming trucks and other loads. Once a desirable sample was found, a wheel loader would collect a sample and dump into totes on a tarp outside of the tent. Inside the tent, the two (2) sorting tables were placed parallel to each other in the center and were surrounded by the sorting containers. The sizing table was placed in a corner of the tent and was covered with a tarp to prevent water contamination from wet conditions. The scale was placed outside the tent on a wooden board for stability, and, after weighing, the sample was dumped in a pile outside the tarp with the totes on it for the landfill operators to remove later in the day.



*Figure 11 - Waste Sort Area at SKL*

## 3.5 Crew Training

On Monday the 25<sup>th</sup> of October, the Site Supervisor trained the sorters on the overall safety required at the site, discussed the overall objectives of the projects, and reviewed how to use the equipment required for the sort. The Project Manager reviewed both the sort procedures and the Health and Safety Plan specifically to sort safety. Expectations were established through the labor firm regarding the requirement to wear work boots and long pants to the site each day. Hard hats, reflective vests, and other PPE were distributed to the sorters at the end of the briefing and remained available for whenever necessary. New sorters that joined during the later days received the same training and demonstration procedure. Safety protocols specific to each individual site were re-iterated at the new locations.

## 3.6 Material Collection and Sorting and Weighing

Before each sort in the MCW Study, the Site Supervisor identified appropriate trucks for sampling and a front-end loader took a sample from that load and dumped it next to the sorting area into totes. The totes were emptied onto the tables and any bags or other containers in the sample were opened. The contents and other waste on the tables were separated and sorted into individual category marked receptacles surrounding the sorting tables. The receptacles were marked using paper labels by GBB and separated into different groupings. The sorters became knowledgeable in a brief period of time as they learned the characteristics of the material categories.

The Field Supervisor and the Site Supervisor monitored the quality of the category material containers as the sample was sorted and before weighing out the containers. Improperly classified materials were placed in the correct container and pointed out to the sorters. Open containers allowed the Field Supervisor to always see the material and monitor the sort as it happened. The materials in the sample



were sorted until a mixed remainder of two-inch or smaller “Fines” material is left on the table. The fines were swept into its own respective category bin labeled “Fines.”

When an appropriate category for sizing was selected by the Site Supervisor, the selected categories of material would be diverted after weighing and then sized. Sizing squares were taped onto the sizing table in sizes of the following dimensions: 0”-2”, 2”-6”, 6”-11”, and 11”-18”. One (1) of the sorters was trained by Site Supervisor on how to identify and sort material using the sizing squares and they performed the sizing study throughout the two-week sorting period.

### 3.7 Data Collection

After the sample was completely sorted, the containers were brought to the scale where they were weighed, which was called the weigh-out. The sorters and the Field Supervisor were responsible for bringing containers that became too full to add materials or too heavy to safely carry to be weighed on the digital scale prior to the weigh-out. The container was then return to accept more material from the sample. The method of recording weights in the data sheet ensured that the weights and tares for all bins (including multiple filled bins) were properly recorded and calculated.

The weights of each sample were recorded on a Composition Data Recording Sheet (shown in Appendix 10.1) by the Project manager or the Field Supervisor. The weights of the assorted sizes of material in the sizing were recorded in a separate Sizing Data Recording Sheet (shown in Appendix 10.2) was kept by the Site Supervisor. Additional notes of interest such as composition of a sample which may affect the variability of the data or material that may be a problem with a front-end processing system was noted at the bottom of the two (2) Recording Sheets. After sorting and sizing, the sample was disposed of in a pile outside of the sorting area and taken away by the front-end loaders operating at the respective waste management facilities.

The composition Data Recording Sheet remained within a water-resistant folder to ensure they remained out of any adverse weather conditions. At the end of the sort, scans were made of the data sheets and all data was tabulated and compiled in excel.

## 4 Results of MCW Characterization Study

During the twelve (12) days of sorting, a total of fifty-seven (57) total samples were taken, 12,935.7 lbs. of waste was sorted, and the average sample size was 269.4 lbs. This is larger than the recommended sort size from the ASTM standard but was used to accommodate the significant variability of materials within the loads and the larger samples gathered by the loaders. This does not adversely affect the overall statistical validity of the sampling and likely makes it better.

The number and types of trucks sampled at all three locations in the MCW Study are shown below in Table 2. An effort was made to select trucks based on their frequency and overall tonnages, but the selection also depended on availability and timing. Rear-Loaders and Side-Loaders were considered to hold residential waste, while Front-Loaders and Compactors were considered to hold commercial waste. Self-haul and Roll-offs were considered to hold “Other Waste” and were sampled when they were more residential waste instead of C&D materials.

*Table 2 - Trucks Sampled*

Truck Type	Count (Samples)
Rear-Load (B)	6
Front-Load (F)	12
Side-Load (S)	15
Self-Haul (H)	7
Compactor (C)	10
Roll-off (R)	7
<b>Total</b>	<b>57</b>

### 4.1 Overall MCW Study Results

The overall results of the percentage of the different materials in the Kent County waste from the MCW Study are shown in Table 3. This is the combined averages from each of the types of generators without weighting as the generation totals by type is similar within the County and would not change the results drastically from the results below. Figure 12 following the table shows the distribution of the category groups.

Table 3 - Overall Unweighted<sup>3</sup> Material Composition Kent County MCW

Number	Group	Category	Average %: All Generators <sup>1</sup>	Error +/- (90%)
1	Fiber	Old Corrugated Cardboard	8.0%	2.3%
2		Old Newsprint (ONP)	0.3%	0.2%
3		Office Paper	2.3%	0.6%
4		Magazines and Catalogs	1.3%	0.4%
5		Gable Top/Aseptic Containers	0.1%	0.0%
6		Compostable Fibers (Paper Towels, etc.)	3.1%	0.8%
7		Other Mixed Recyclable Paper/Kraft	2.6%	0.8%
8		Wet or Soiled Fiber	2.4%	0.6%
9		Non-recyclable Paper Products	2.7%	1.0%
10	Plastic	PET Bottles (#1)	1.5%	0.3%
11		PET Containers/Packaging (#1)	0.1%	0.0%
12		HDPE Color (#2)	0.4%	0.1%
13		HDPE Natural (#2)	0.4%	0.2%
14		HDPE Tubs and Lids/Other (#2)	0.1%	0.0%
15		Polypropylene (#5)	0.8%	0.2%
16		Mixed Containers (#3-#7)	0.7%	0.4%
17		Extruded polystyrene (EPS) Foam (#6)	0.5%	0.1%
18		Film & Wrap	5.2%	1.0%
19		Flexible Packaging	1.0%	0.3%
20		Mixed Bulky Plastic	4.0%	3.0%
21		Non-Recyclable Rigid Plastic	1.9%	0.6%
22	Glass	Recyclable Glass	1.3%	0.4%
23		Non-Recyclable Glass/Ceramic	0.8%	0.4%
24	Metals	Ferrous Metal Containers	0.7%	0.2%
25		Aluminum Cans (UBC)	0.4%	0.3%
26		Other Ferrous Metals	2.3%	1.5%
27		Other Non-Ferrous Metals	0.5%	0.3%
28		Appliances (Small)	1.0%	1.4%
29	Organics	Food/Putrescible Waste	14.1%	2.6%

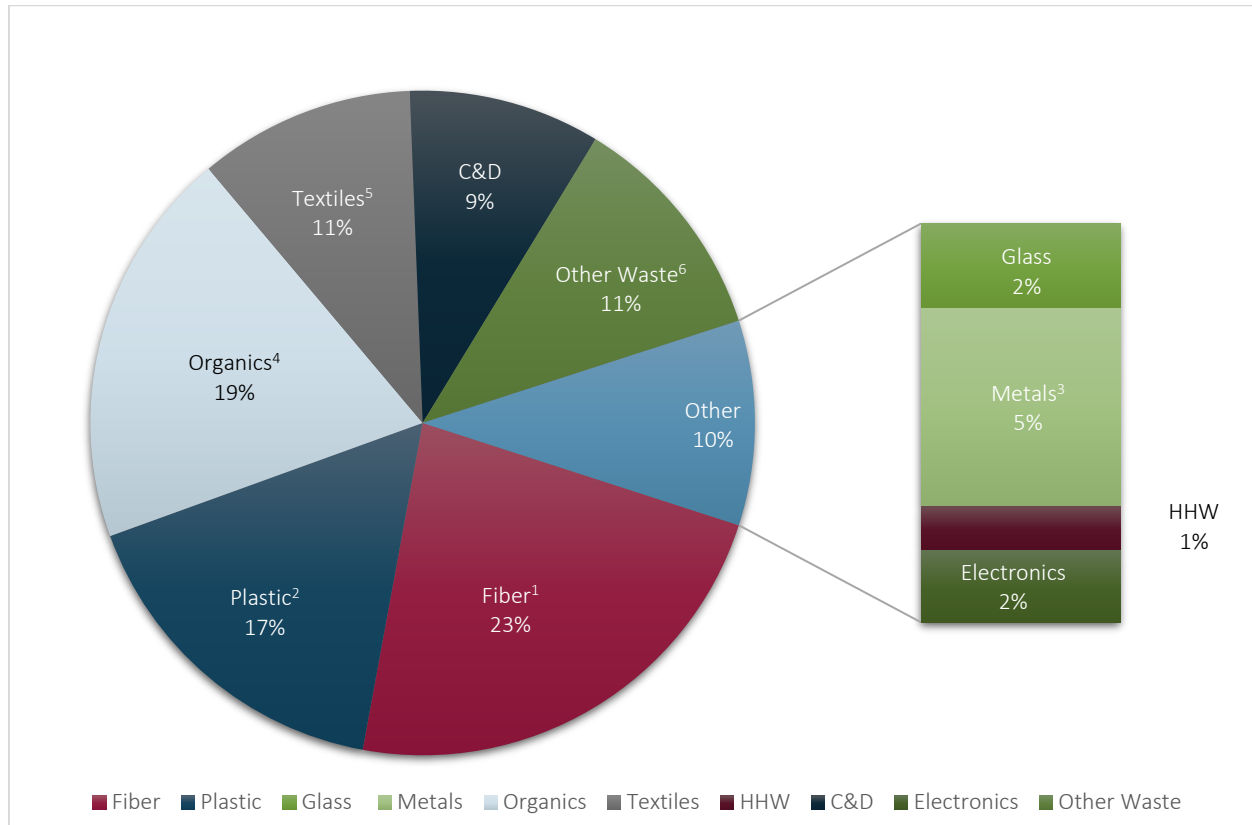
<sup>3</sup> The total generation by truck type is not well known but is estimated in the Generation section of the report. It is presumed that weighing the data to the generation results by truck type will not significantly change the shown results as the number of truck samples per type is similar to what weighing the data would achieve.

Number	Group	Category	Average %: All Generators <sup>1</sup>	Error +/- (90%)
30		Leaves and Grass	0.9%	0.7%
31		Brush, Pruning, etc.	0.9%	0.6%
32		Other Organics	2.4%	1.4%
33		Liquids	1.0%	0.3%
34	HHW	Household Hazardous Waste	0.8%	0.4%
35		Medical Waste	0.3%	0.5%
36	Electronic	Electronics (Small)	0.5%	0.1%
37		Electronics (Large)	1.2%	0.6%
38		Batteries	0.1%	0.0%
39	C&D	Clean Wood	3.3%	1.8%
40		Wood- Painted or Treated	2.8%	1.5%
41		Concrete, Brick, Asphalt, etc.	0.5%	0.5%
42		Car005pet and Padding	0.6%	0.5%
43		Other C&D	2.1%	1.0%
44	Textiles	Textiles	6.0%	1.5%
45		Leather & Rubber	2.1%	0.8%
46	Other Wastes	Diapers	2.4%	0.8%
47		Fines	4.2%	1.2%
48		Tires	0.0%	0.0%
49		Bulky Items	4.2%	1.5%
50		Other Residue or Composite Items	2.9%	1.0%
Total:			100.0%	

(1) Total percentages not weighted

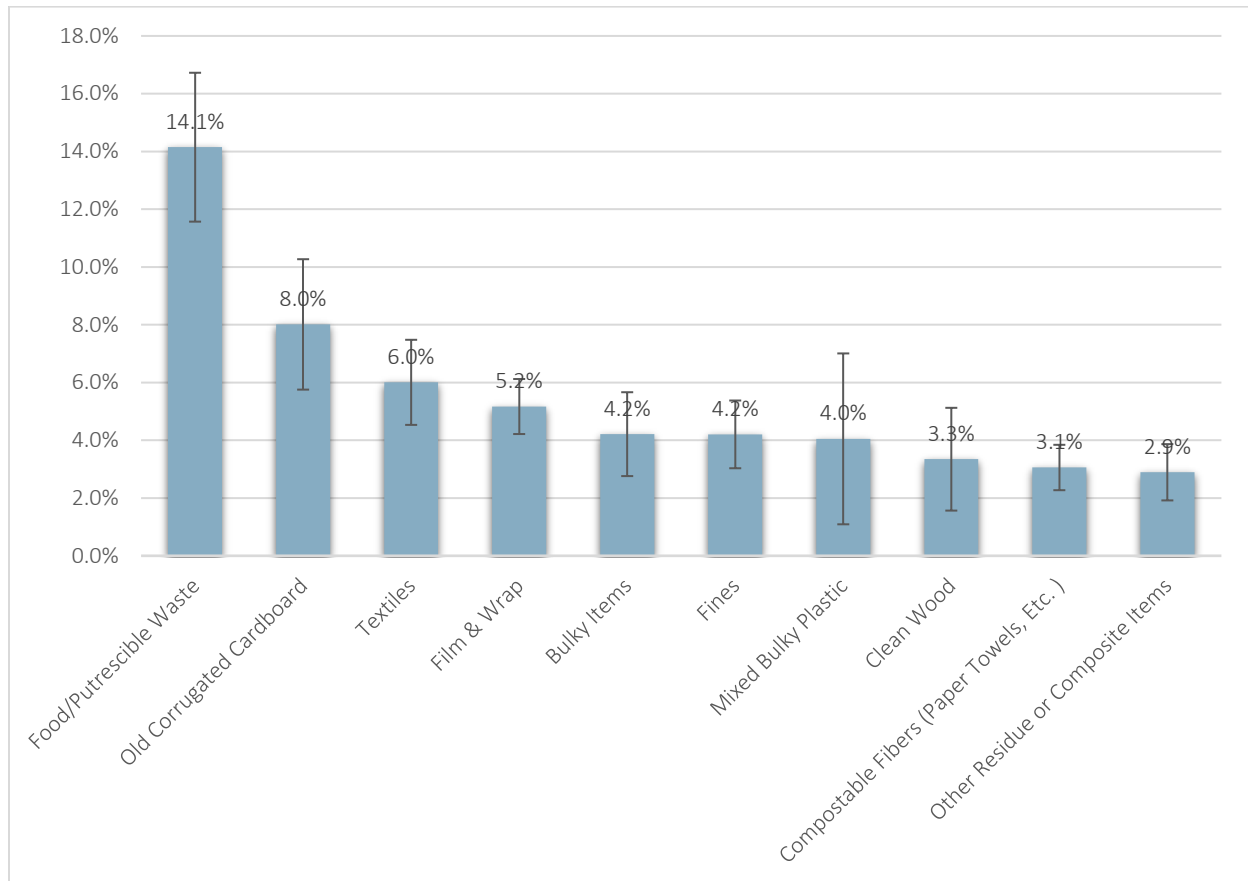


Figure 12 - Results for All Generators (non-weighted) for Category Groups



- (1) Fiber consists of all paper products including wet and non-recyclable paper
- (2) Plastics include all types of recyclable and non-recyclable plastic materials
- (3) Metals include UBCs, steel cans, other ferrous and non-ferrous metals, and small appliances
- (4) Organics includes food waste, yard waste, and other organics (frequently feces)
- (5) Textiles includes clothing and other cloth, leather and rubber, and diapers
- (6) Other Waste includes Bulky or Composite items and Fines

The three (3) largest combined category groups in the MCW Study are fiber, organics, and plastics, which total nearly to 60% of the total waste composition. The Textiles group, which includes textiles, leather and rubber, and diapers was next with 11%, similar to Other Waste which includes bulky and composite items. These results have not been weighted to the total generation by generator type as the total tonnage by truck type are not recorded by the County and can only be estimated (See Footnote 3 above). The table of results for all materials and generators is shown at the end of this document (Appendix 10.3).



*Figure 13 - Top 10 Items (All Generators)*

Throughout the sampling, the top three (3) categories (Food/Putrescible Waste, Old Corrugated Cardboard, and Textiles) were present in most loads. The top 10 items from the combined data are shown above in Figure 13. The bars in the table above indicate the 90% confidence interval for that material which indicated the likely range of the actual average value for that material. A larger error bar indicates that material had more variability in how much showed up per load.

## 5 Results by Generator Type

The distribution of materials in the MCW Study was slightly different depending on the type of generator. The following graphics show the top ten materials from each of the designated generator types. The full list of results by both generator type and by truck type are included in the appendices.

### 5.1 Residential:

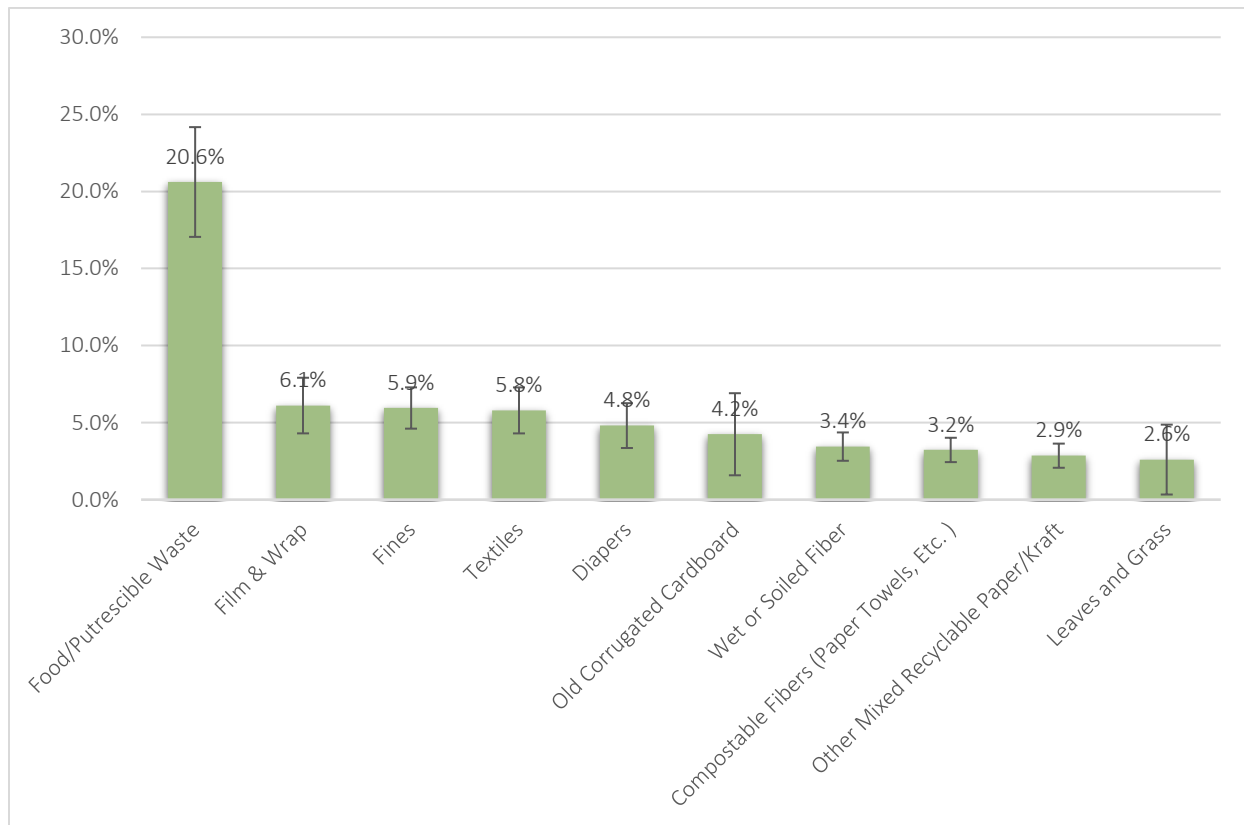


Figure 14 - Top 10 Items - Residential Generators

Residential loads (both side-loaders and rear-loaders) were relatively consistent and had the most food waste of any of the generators as shown above in Figure 14. It should be noted that 4 of the top 10 materials were fiber and that film was the second most plentiful material in the residential stream. It should be noted that some materials were fairly wet, so this may not be the bone-dry composition of the material (especially textiles, diapers and wet or soiled fiber).

## 5.2 Commercial

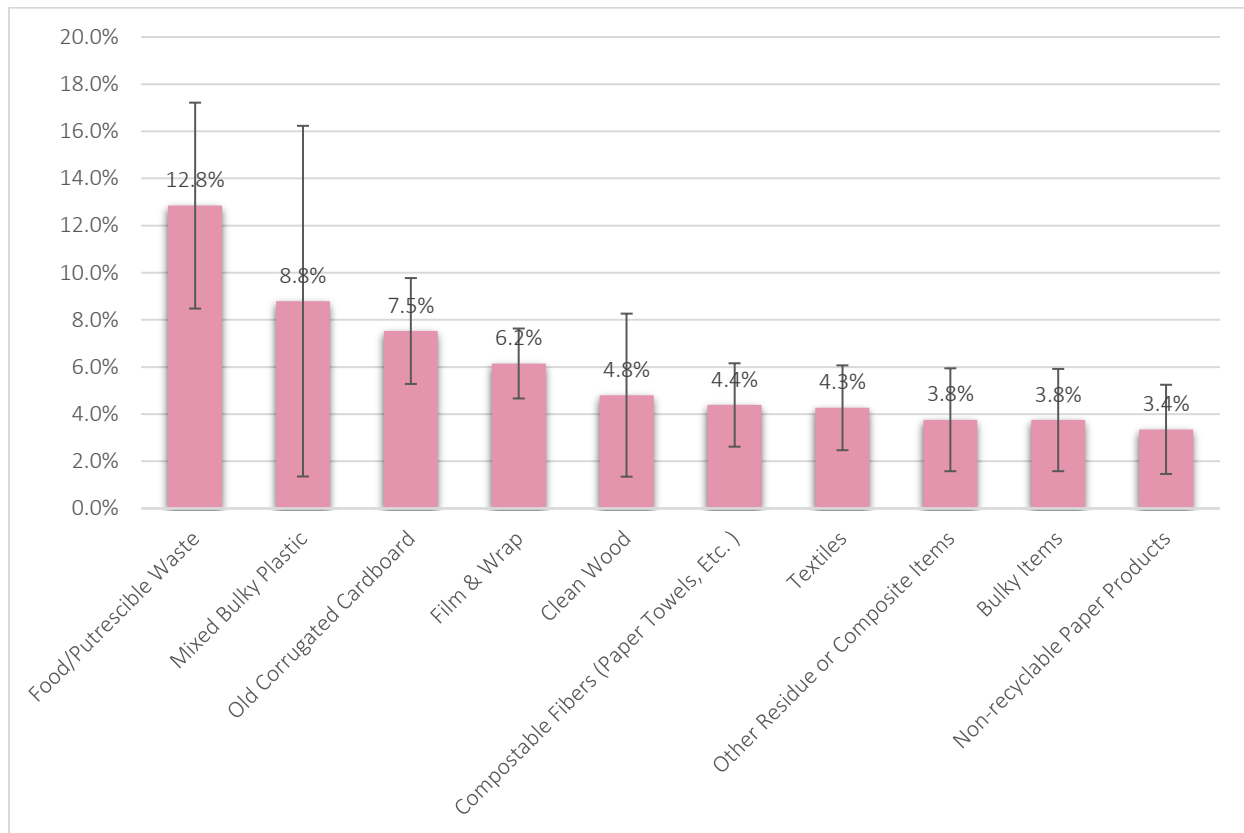


Figure 15 - Top 10 Items - Commercial Generators

Commercial generators (Front-Load and Compactors) varied significantly throughout the MCW Study depending on where the loads originated or even where in the load the sample was taken. This can be seen with the larger error bars in Figure 15 above. Food was common, especially from restaurant locations, while cardboard and film were also quite common in most loads. Bulky plastics show as the second largest material category, but the exceptionally large error bars indicate that this was highly variable depending on the load. (In Front-Load samples only, Bulky Plastics was only 1.3%, showing that the variability for this category came from the compactors). The full results by truck type are shown in Appendix 10.4.

The “Other Residue or Composite Items” category did not have consistent composition across samples but had a higher percentage of C&D type materials and a high percentage of OCC, Textiles, and Food waste. The results for the top ten items are shown in Figure 16 below.

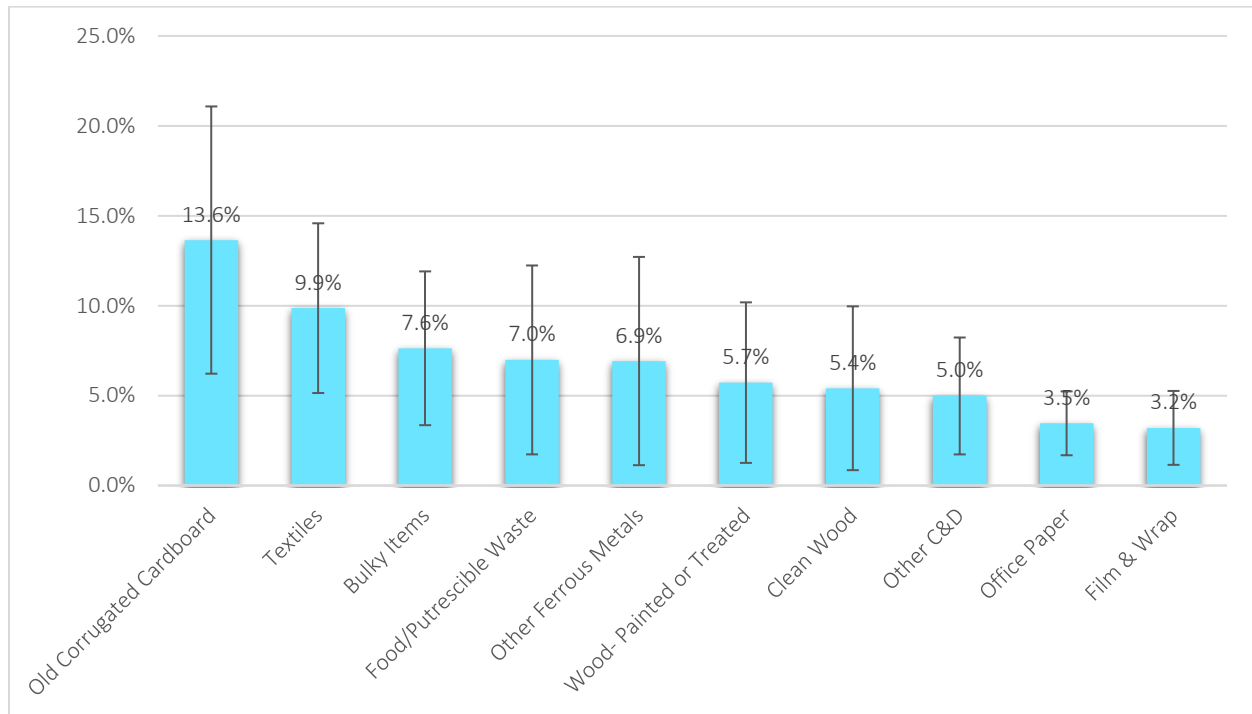


Figure 16 - Top 10 materials from Other generator trucks (Self-Haul and Roll-Off)

A comparison of each type of generator is shown in Figure 17 below. This indicates that fiber is relatively even across each of the generator types, while plastics, organics, and C&D can vary significantly depending on the generator type.

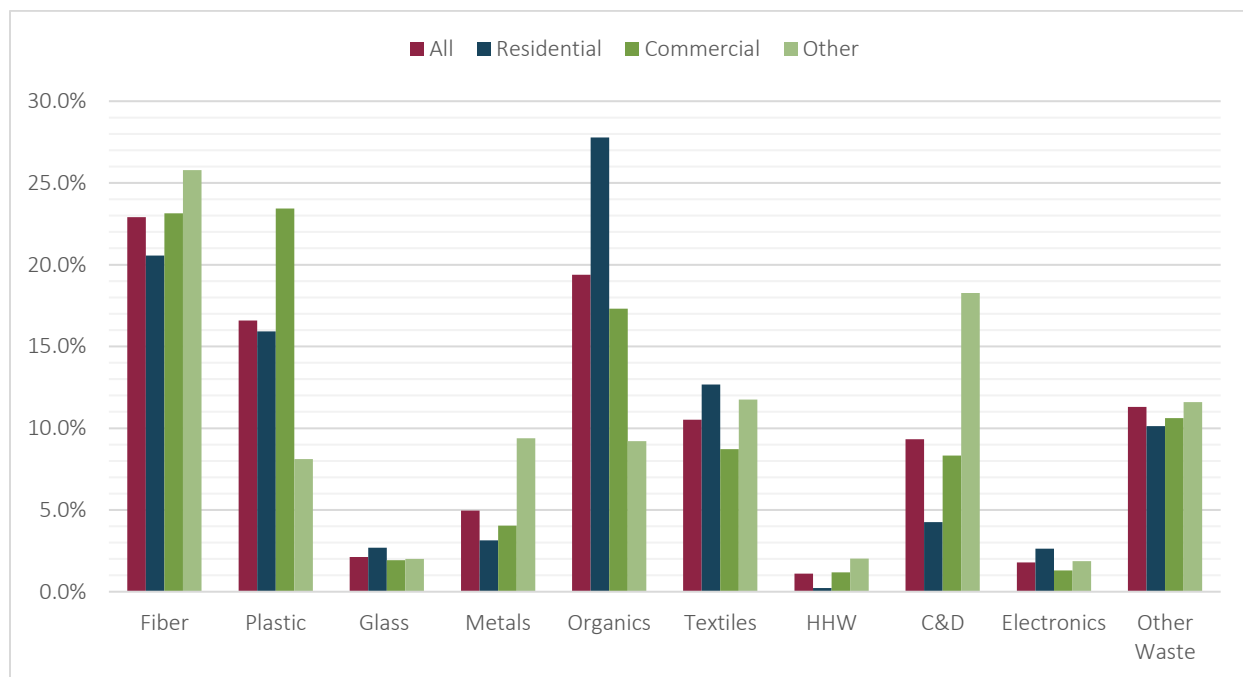


Figure 17 - Percentage of Material Group by Generator Type

### 5.3 Comparison to 2017 Data

There was curiosity whether there were significant differences in the waste stream from the 2017 waste sort that occurred at the WTE facility with the information gathered from the 2021 waste sort. As a comparison, the results from the WTE portion of this latest study were compared to the 2017 sort. Unfortunately, there were significant differences in the number and type of categories (29 in 2017 vs. 50 in this latest study). The results from the 2021 study were combined as best they could to match the categories from the 2017 data set, although there were likely outliers.

A comparison of the top 10 categories from 2021 MCW Study are compared to the results from the 2017 sort shown below in Figure 18. There are discrepancies in organics and special waste, although that may be due to differences in how the categories were set-up and defined for the two different sorts. Food Waste, Textiles and Carboard/Kraft seem to have increased in 2021, although it is difficult to say for certain as the error bars indicate that the actual percentages could be much closer. Other Paper and Plastic Film are close still or even slightly lower from 2017. A more robust statistical analysis of the results would be required to determine if there are statistical differences between the two years and there are not enough samples at the WTE in both years for definitive statistical differences in the results. The full results are shown in Appendix 10.5.

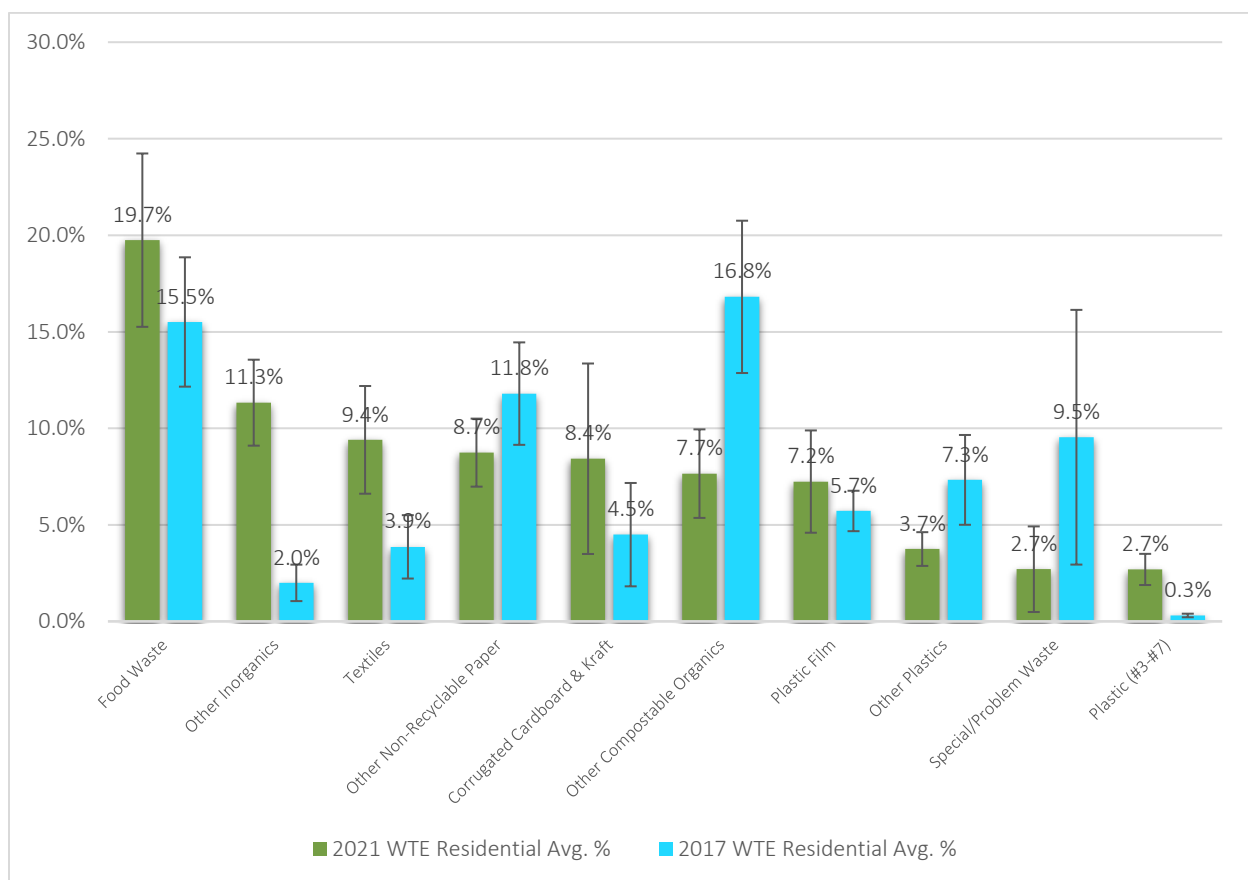


Figure 18 - Top 10 results for 2021 Residential composition vs. 2017 Residential composition

## 5.4 Sizing Results

To assist in understanding the types and sizes of equipment needed for processing the incoming waste, certain categories were chosen for to be sized based on what screen opening the items would fall through. Not all categories were sized as most were standard for their category, but certain groups had a variety of sizes so were chosen to be classified after being sorted. Table 4 shows the results of the size sorting for ten (10) distinct categories that tended to show a wide variation in sizes. A category was chosen for sizing if that particular sample had a large enough amount of material in that category to allow for representative sizing weights.

Table 4 - Sizing Results

	Size <sup>1</sup>					
Category	0"-2"	2"-6"	6"-12"	11"-18"	18"+	# of Samples
Old Corrugated Cardboard	0.0%	4.7%	9.9%	25.1%	60.3%	3
Office Paper	0.8%	30.4%	66.9%	1.9%	0.0%	4
Other Mixed Recyclable Paper/Kraft	0.0%	11.4%	43.7%	45.0%	0.0%	3
Non-recyclable Paper Products	1.4%	26.3%	69.1%	3.2%	0.0%	3
PET Non-Bottles (#1)	0.0%	0.0%	68.1%	31.9%	0.0%	2
HDPE Bottles (#2)	0.0%	12.3%	87.7%	0.0%	0.0%	1
Polypropylene (#5)	3.2%	51.4%	41.3%	4.1%	0.0%	4
Mixed Containers (#3-#7)	3.2%	41.9%	54.8%	0.0%	0.0%	1
Extruded polystyrene (EPS) Foam (#6)	0.0%	13.2%	86.8%	0.0%	0.0%	1
Non-Recyclable Rigid Plastic	13.5%	38.5%	21.9%	26.0%	0.0%	1
Textiles	1.5%	31.3%	7.5%	59.7%	0.0%	1

(1) The darker the cell, the larger percentage of that category was in that size range

## 5.5 RRS Kent County MRF November 2021 Sort Results

The solid waste engineering firm, RRS, performed a two-day waste characterization study (MRF Study) at the Kent County Recycling and Education Center (MRF) on November 11 and 12, 2021. During the MRF Study, RRS sampled approximately 400 lbs. of MRF residue from two (2) samples and 1,750 lbs. of inbound material (single-stream recycling) from ten (10) samples taken from the materials dumped by trucks on the MRF tip floor. MRF. RRS used twenty-five (25) sort categories and five (5) groupings to categorize the materials as shown in the table below. The following information was contained within a preliminary document, *2021 Kent County Sort Memo*, dated Dec 17, 2021, and was provided by RRS to GBB and Kent County Department of Public Works via email.

*Table 5 - Sort Categories for Characterization Study at Recycling MRF*

#	Group	Category
1	Fiber	OCC
2		News (ONP)
3		Mixed Paper and paper bags
4		Paper FSP cups and clamshells
5		Cartons (Gable & Aseptic)
6		Other Fiber
7	Metals	Deposit Aluminum (UBC)
8		Aluminum Foil and Trays
9		Steel Cans
10		Other Metals
11	Plastics	Deposit PET Bottles (#1)
12		Other PET Bottles (#1)
13		PET Cups and Clamshells
14		HDPE Bottles (#2)
15		PP Tubs Cups and Clamshells (#5)
16		PS Cups & Clamshells (#6)
17		Plastics lids and closures
18		Plastic Film
19		Other Plastic
20	Glass	Glass
21	Other	Residue Textiles
22		Residue Organics and Food Waste
23		Residue Fines
24		Residue Bulky Waste
25		Residue Other



The results from the MRF Study had fewer samples than GBB's MCW Study, but the mixed materials on the tip floor were consistent and provided satisfactory results for both the sampled incoming materials and residue. In 2021, the MRF received 33,850 tons of materials for processing, and except for outlier seasons and holidays, such as Christmas. This measured composition is assumed to be normal for the current recycling collections. Much of the incoming material was Cardboard (OCC) and mixed paper (See Figure 19 below for the top ten materials), while the residue was mostly mixed paper and polypropylene mixed plastics (See Figure 20 for top ten residue materials). The full table for the MRF composition results are shown in Appendix 10.7.

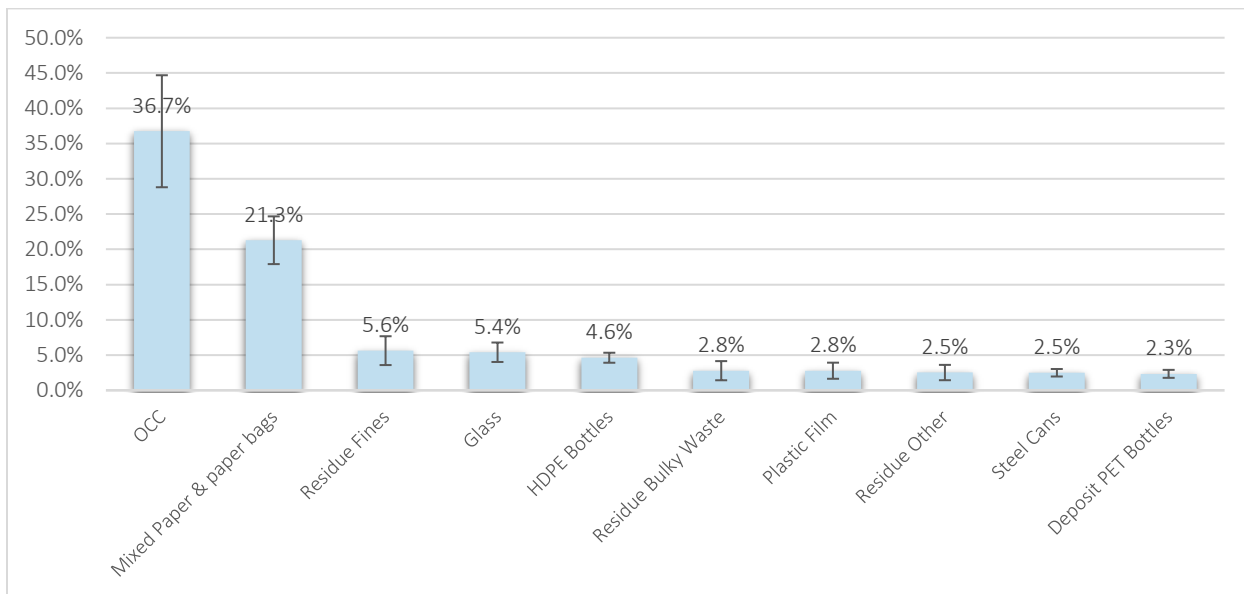


Figure 19 - Top 10 materials in MRF incoming materials

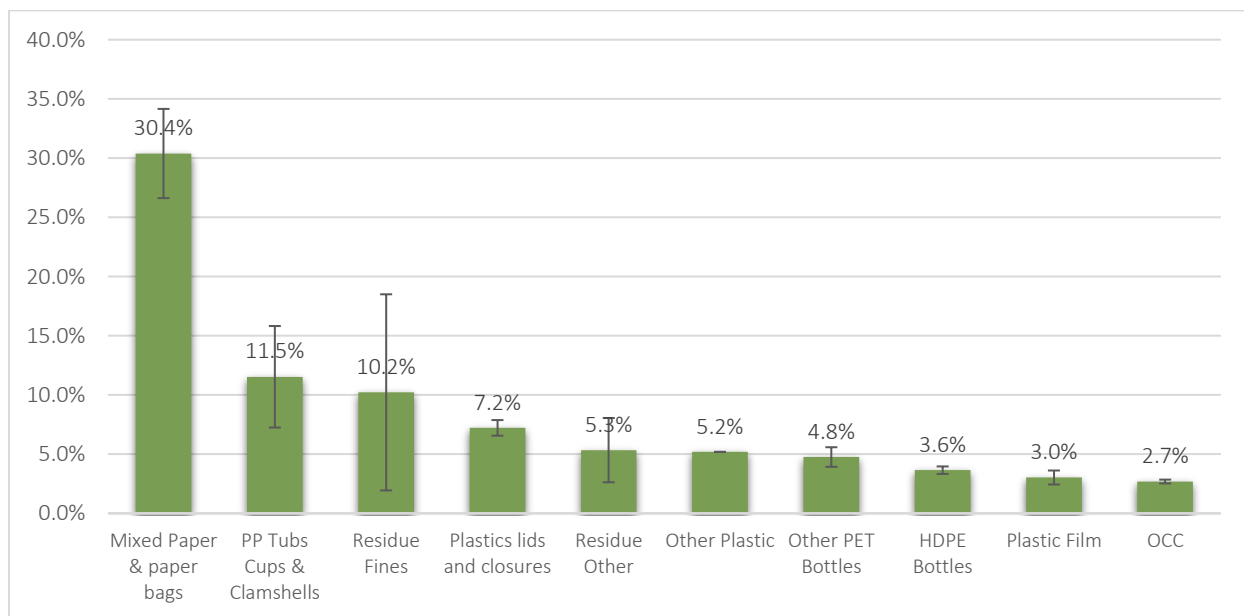


Figure 20 - Top 10 materials in MRF Residue

## 6 Generation Estimates

Kent County does not currently have granular data for the tonnages received in the County based on truck type or generator type, including tonnage data reported to EGLE. To better understand the full breadth of the types of materials brought to the three solid waste locations, additional data was collected at the County scalehouses. The County recorded individual vehicle data for five months of transactions at each of the three receiving locations to allow for estimating the overall tonnages by truck (and generator) type. The residential and commercial waste generated and received in Kent County are estimated from the data collected by the scale houses around the same time of the waste composition study. To date, five (5) months of scalehouse transactional information was collected that included the type of material, tonnage, and County of origin.<sup>4</sup>

To extrapolate the generation by type, the data from the scalehouse was averaged on a monthly basis and then multiplied by twelve to estimate the yearly generation. Since the data for January and February were significantly lower than the other recorded months, only the data for October through December was used to estimate the yearly generation. Once data is collected throughout the year, a more accurate estimate can be made on the total tonnages and expected fluctuations.

The total estimated Kent County waste generated in the County and received at the three Kent waste locations is shown in Table 6, with Front-Load and Compactor trucks for commercial generation being shown separately since they were recorded separately in the data collection. A large majority of this MCW waste is first brought to the WTE tip hall. Much of this waste is utilized to create electricity at the facility while some is transferred to the SKL for disposal.<sup>5</sup> It should be noted that the “other” generator type below may or may not correlate to the “Other” truck-type categories shown in the composition tables, but it is assumed to be similar in nature.

*Table 6 - Yearly In-County Estimates for Kent County Waste Generated and Received at Kent County Facilities based on 2021 Scalehouse Data*

Type	SKL	WTE	NKTS	Total TPY
Residential – <i>(Side and Rear Loaders)</i>	24,891	97,508	40,202	<b>162,602</b>
Commercial - <i>Front-Loaders</i>	19,275	108,753	10,675	<b>138,703</b>
Commercial – <i>Compactor</i>	8,351	33,791	525	<b>42,667</b>
Other	3,151	2,808	5,034	<b>10,993</b>
<b>Total</b>	<b>55,668</b>	<b>242,860</b>	<b>56,437</b>	<b>354,966</b>

This estimate indicates that there are approximately 355,000 tons of processable residential and commercial waste generated in Kent County is already received and disposed within the County

<sup>4</sup> The dataset for each scale transaction is too large to provide in an appendix (over 81,000 lines), so GBB will provide an Excel sheet with an interactive Pivot table to the County and to vendors as requested for additional data on the materials coming to the Kent disposal facilities.

<sup>5</sup> This transferred waste from the WTE facility is not included in the received tonnage at SKL

system. According to the estimates from the recorded scalehouse data, an additional 31,006 tons of residential and commercial waste is disposed within the County from generators outside the County at the three disposal sites. The breakdown of these tonnages is shown in Table 7. It is unknown how much of this material will be available for processing at the MWP facility as it is not subject to flow control so it is not counted in the overall available processable totals.

*Table 7 - Yearly Disposal Estimates for Generators Outside of Kent County Disposed at Kent Solid Waste Facilities*

Type	SK	WTE	NK	Total TPY
Residential	18,419	0	2,732	21,150
Front-Load	6,901	0	86	6,987
Compactor	1,227	0	32	1,258
Other	666	0	943	1,610
<b>Total</b>	<b>27,213</b>	<b>0</b>	<b>3,793</b>	<b>31,006</b>

To estimate the tonnage of processable waste materials generated within Kent County but disposed outside of the County, the 2021 EGLE data was utilized, with most of the adjacent landfills segregating the incoming waste by type, allowing for a rough estimate of the Kent generated MCW. There are several factors to consider with the EGLE data. For instance, nearly all the North Kent Transfer Station waste is sent to the Central Sanitary Landfill in Pierson, Montcalm County north of Kent County, so this will need to be considered for calculating the total tonnages. The reported EGLE tonnages for 2021 are shown below in Table 8.

*Table 8 - EGLE Report of Kent County Generated Tonnages for 2021 Disposed at Out-of-County Landfills (Converted from YD<sup>3</sup>)*

Landfill	County	Total <sup>1</sup> (TPY)	MCW <sup>2</sup>	IW <sup>2</sup>	C&D <sup>2</sup>	ADC <sup>2</sup>	CS <sup>2</sup>
Autumn Hills Recycling and Disposal Facility	Ottawa County	43,120	27,266	10,274	2,087	0	3,493
Advanced Disposal Services Arbor Hills Landfill	Washtenaw County	1,976	41	14	1,922	0	0
Central Sanitary Landfill <sup>3</sup>	Montcalm County	162,125	153,057	4,227	123	4,640	78
Ottawa County Farms Landfill	Ottawa County	139,634	48,588	17,873	12,593	42,921	17,660
Pitsch Sanitary Landfill	Ionia County	44,802	3,618	476	40,655	0	53

(1) Tons per year (TPY) are shown in this table. Data in the EGLE report is given in Cubic Yards. To calculate the tons per year, the Cu. Yds. are multiplied by a factor of 0.33 to give the above data.

(2) MCW – municipal and commercial waste; IW – Industrial Waste; C&D – Construction and Demolition waste; ADC – Alternative Daily Cover; CS – Contaminated Soil. Only MCW is processable at the MWP facility

(3) Tonnage includes mixed waste materials transferred from NKTS (Red)

The processable residential and commercial portion of the Kent generated material sent to the Central landfill is already accounted for in the generation estimate shown in Table 7 and should not be counted in the EGLE data for waste generated in Kent and disposed elsewhere. It is assumed that the mixed materials being transferred to the Central landfill from NKTS are counted in the EGLE report as MCW materials. To calculate the remaining MCW that is disposed at the Central landfill outside of the waste coming from the NKTS, the tons transferred from NKTS must be removed from the EGLE reported MCW tons for the Central landfill.

The 2021 County tonnages report (see Appendix 10.10) shows that a total of 121,595 tons were transferred to the Central landfill from the NKTS.<sup>6</sup> To account for this transfer of materials, the reported tonnage of 153,057 of MCW at the Central landfill (Table 8) is reduced by the reported tonnage of 121,595 transferred from NKTS, resulting in 31,462 tons of additional Kent generated MCW that was disposed at the Central landfill in 2021. As stated, it is assumed this tonnage is commercial waste only. The total tons of MCW disposed outside of Kent County from waste generated in the County is shown in Table 9 below.

*Table 9 - Estimate of Commercial Kent Generated MSW Disposed Tons Outside of Kent County not Counting Materials Transferred from North Kent Transfer Station*

EGLE Estimated out-of-county Tonnages for MCW <sup>1</sup>	Total MCW (TPY) <sup>2</sup>
Autumn Hills Recycling and Disposal Facility	27,266
Advanced Disposal Services Arbor Hills Landfill	41
Central Sanitary Landfill (Pierson) <sup>3</sup>	31,462
Ottawa County Farms Landfill	48,588
Pitsch Sanitary Landfill	3,618
<b>Total TPY</b>	<b>110,974</b>

(1) 2021 EGLE Landfill Report Data (Converted from Yd<sup>3</sup>)

(2) Assumes All Kent Generated Externally Disposed Waste is Commercial

(3) With NKTS Transferred Tonnages (121,595) Removed

With the estimated tonnages generated within Kent County and disposed within the County or outside of the County now calculated, the total yearly tonnages of commercial and residential generated MCW can be estimated. Table 10 below shows the totals of these different generators and the total materials taken from the tables above including residential and commercial waste disposed within and outside of the County. The calculations estimate a total tonnage of 465,947 TPY that could be processable at the proposed MWP facility.

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<sup>6</sup> The generation calculations from the scalehouse truck measurements estimated this total tonnage at NKTS, which includes Bulky and other waste along with the MCW at a total of about 106,000 TPY. The larger measured 2021 tonnage at 121,595 assumes that the difference is mostly seasonal (summer) C&D and bulky waste and not a large uptick in residential or commercial waste during other seasons of the year. According to the estimates from the scalehouse data, approximately 60,000 tons of the NKTS tonnages was processable MCW and is included in the estimates shown in Table 6.

Table 10 - Overall Generation of Residential and Commercial Waste from Within Kent County

In County Generator	TPY
Est. In-County Residential Disposal TPY <sup>1</sup>	162,602
Est. In-County Commercial Disposal TPY <sup>2</sup>	181,371
Est. Out-of-County Commercial Disposal TPY <sup>3</sup>	110,974
Est. In-County “Other” Truck Type Disposal TPY <sup>1</sup>	10,993
<b>Total County Generated MCW</b>	<b>465,940</b>

(1) Estimated from truck data collected at scale houses (Table 6)

(2) Estimated from combining Front-Load and Compactor Data (Table 6)

(3) Estimated from EGLE data reported in 2021 (Table 9)

## 6.1 Residential Waste Generation – Alternative Estimates

To estimate the residential tons generated from Kent County as a check on the calculated tonnages from the scalehouse data, the tons collected by the City of Grand Rapids were utilized to produce a tons per household generation for the city, and this was extrapolated to estimate the residential tonnage for the County. The number of locations service by the City were provided to calculate a generation per serviced household (Table 11). The collected tons divided by the number of serviced homes gives the generation per household (HH). This generation rate is then multiplied by the one-to-four-unit households in Kent County to estimate the residential generation for the County.<sup>7</sup>

Table 11 - Generation of MCW for the City of Grand Rapids, MI

Tons Residential MSW per Year (2021) <sup>1</sup>	2021 Household <sup>2</sup>	Lbs. per HH per Year
37,110	56,014	1,325

(1) Tons of MCW to WTE Facility from City of Grand Rapids Side Load Trucks

(2) 2021 Grand Rapids Households Served (Single Family up to 4 HH Unit Locations)

These generation numbers are compared to the residential tonnage estimated from the 2021 scale data in the data below in Table 12. At just over 200,000 households in Kent County that likely would get service from a side or rear-loader truck, it is estimated that they generate approximately 136,616 tons of waste per year. In comparison to the estimated generation of 162,602 TPY from the scalehouse data, these estimates are relatively close. The difference may be that homes outside of the City may,

<sup>7</sup> The tonnage collected by the City of Grand Rapids mostly consists of single-family homes or multifamily locations of less than four dwellings. To estimate the total single-family homes or locations with less than 4 units for the County, 2019 data for Kent County from the American Communities Survey (ACS) was used.

on average, generate a bit more waste per household per year, or there may be a small amount of residential waste that is being disposed outside of the County.

*Table 12 - County TPY Based on Kent County Households up to 4 Units*

Kent County HH <sup>1</sup>	Lbs. per HH <sup>2</sup>	Total Estimated TPY
206,209	1,325	136,616
Comparison Residential Waste from Scalehouse Estimate <sup>3</sup>		162,602

(1) ACS 2019 Data for Households from 1 to 4 Units

(2) From Table 11 Data

(3) From Table 6 data

## 6.2 Commercial Waste Generation – Alternative Estimates

Most estimates of commercial generation utilize broad categories of the types of commercial entities and either the square footage of the location or the number of employees at each location. There is no data for the square footage of the commercial locations in Kent County, but the Right Place, a Western Michigan business development organization, has excellent data for the number of employees within the County by NAICS code for the type of business.

There are public studies that look at the generation of waste from commercial entities, but most are from the early 2000s and may not accurately reflect the current waste generation. One of the most comprehensive and recent studies was done by Cascadia Consulting in 2014, where waste was characterized for sixteen (16) distinct types of commercial groups and the generation per employee were also calculated. The correlation for NAICS codes and the Cascadia Group numbers is included in Appendix 10.9.

The Right Place data showed that there were 16,281 commercial entities operating in Kent County in 2020 with a total of 404,554 employees.<sup>8</sup> The Cascadia data has different generation numbers including overall generation, material recycled or composted, and remaining materials disposed. It is assumed that the disposal generation is the most accurate to what is happening in Kent County, although it is unknown how much commercial materials are currently being diverted from landfill. The tonnage estimates for Kent County commercial waste (not including multifamily locations) is shown in Table 13 below.

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<sup>8</sup> These numbers correlate closely with US Census data, which estimated 16,962 commercial entities and 372,282 employees in 2019

Table 13 - Waste Generation by Commercial Group Type and Number of Employees

Group	Group Description	Number of Employees	TPY per Emp. Disposal Only by Group <sup>1</sup>	TPY Disposal Only
1	Arts, Entertainment, & Recreation	3,897	2.56	9,976
2	Durable Wholesale & Trucking	25,671	0.6	15,402
3	Education	16,879	0.43	7,258
4	Hotels & Lodging	2,330	1.72	4,008
5	Manufacturing - Electronic Equipment	4,150	0.31	1,287
6	Manufacturing - Food & Nondurable Wholesale	15,060	1.28	19,277
7	Manufacturing - All Other	51,590	0.45	23,215
8	Medical & Health	58,404	0.67	39,131
9	Public Administration	25,275	0.32	8,088
10	Restaurants	20,824	2.4	49,977
11	Retail Trade - Food & Beverage Stores	4,465	1.21	5,402
12	Retail Trade - All Other	27,643	2.14	59,155
13	Services - Management, Administrative, Support, & Social	64,204	0.74	47,511
14	Services - Professional, Technical, & Financial	43,862	1.86	81,583
15	Services - Repair & Personal	9,063	0.94	8,519
16	Not Elsewhere Classified	9,895	0.5	4,948
Blank <sup>1</sup>		21,343	1.13	24,118
<b>Total</b>		<b>404,554</b>		<b>408,855</b>

(1) Cascadia 2014 Report for California Commercial Characterization and Generation Report

(2) Businesses that did not correlate to a Group number were assigned the average generation per employee rate

By using the California generation estimate, just over 400,000 tons of commercial waste should be created by the commercial entities in Kent County. This compares to an estimate of just over 300,000 TPY of commercial waste as estimated from the Kent scalehouse data and the EGLE reports. This comparison is shown below in Table 14.

Table 14 - Comparison of Generation Estimated from Scalehouse Data and Number of Employees

Commercial Waste Estimate from Scale Data <sup>1</sup> and EGLE Report	Commercial Waste Estimate from Generation per Employee <sup>2</sup>
303,338 TPY	408,855 TPY

(1) Includes TPY estimates from Front Load trucks, Compactors, and Other hauler categories and an estimate for tonnage disposed outside of the County from EGLE data

(2) Does not include a generation estimate from Multifamily housing

The per employee generation is certainly larger than the estimated generation from the likely more accurate scalehouse data. The discrepancy could exist because the older data is not as accurate to the tonnages of today's waste, with many changes in lightweighting of materials, going to more paperless functionality, and efficiencies in manufacturing and reducing waste. It is also likely there are still some effects of the Covid restrictions and different working environments. There has not been a generation study done since the pandemic began, so it is very difficult to know how commercial generation has changed in the last two years. The reasoning may never be fully known for this difference in the estimated tons, but the conclusion that can be gleaned from this is that the commercial waste estimated from the scale data and EGLE data is likely a conservative estimate of the available commercial waste generated within Kent County.

### 6.3 Generated Amounts by Commodity

As a function of the waste composition and waste generation studies, it is possible to estimate the total tons of each material category found in the MCW generated within Kent County. The full table breakdown is shown in Appendix 10.11, with the generation by material category shown below in Table 15.

Table 15 - Generation of Materials by Category Group for Residential and Commercial Waste Generated in Kent County

Material Group	Residential (TPY)	Commercial and Other (TPY)	Total (TPY)
Fiber <sup>1</sup>	33,421	70,494	103,915
Plastics <sup>2</sup>	25,888	69,421	95,310
Glass	4,362	5,850	10,212
Metals <sup>3</sup>	5,095	12,849	17,944
Organics <sup>4</sup>	45,184	51,632	96,816
HHW	363	3,673	4,036
Electronics	4,290	3,996	8,286
C&D	6,924	26,342	33,266
Textiles <sup>5</sup>	20,602	26,773	47,374
Other Wastes <sup>6</sup>	16,474	32,307	48,781
<b>Total</b>	<b>162,602</b>	<b>303,338</b>	<b>465,940</b>

(1) Fiber consists of all paper products including wet and non-recyclable paper



- (2) *Plastics include all types of recyclable and non-recyclable plastic materials*
- (3) *Metals include UBCs, steel cans, other ferrous and non-ferrous metals, and small appliances*
- (4) *Organics includes food waste, yard waste, and other organics (frequently feces) and Liquids*
- (5) *Textiles includes clothing and other cloth, leather and rubber, and diapers*
- (6) *Other Waste includes Bulky or Composite items and Fines*

Of note in the generation results, there is much more C&D waste generated in the County that is hauled separately, it is just that approximately 33,000 tons ends up in the MCW waste. Also, it is interesting to note that there are nearly 50,000 TPY (47,374) of textiles, diapers, leather, and rubber waste in the MCW. The processing system will need to be designed to account for this type of material to limit jamming issues that are frequently caused by textiles in this equipment.

## 7 Growth

The population of Kent County has grown from 615,789 in 2012 to 657,974 in 2020. The population of Kent County was estimated for 2021 using the average rate of population growth between 2017 and 2020, 0.45%, and is 660,900. The amount of waste disposed of in the South Kent Landfill by the County mirrored the population, however, unlike the population, the amount of waste did not increase every year and has varied more between individual years. The average growth rate of the population was 0.83% and this average reflects the trend of small, consistent yearly growth. The average rate of change of waste disposed was 2.33%. While the waste was influenced by the onset of the pandemic in 2020, the rate of change has varied more severely than the population growth since 2012 and has not consistently increased (as seen in Table 16). The population data used in Figure 21 and Table 16 was retrieved from the U.S. Census Bureau, and the waste disposal data was from the EGLE yearly reports. The change in waste and population was calculated by dividing the yearly total by the previous year's total and converting the difference into a percentage.

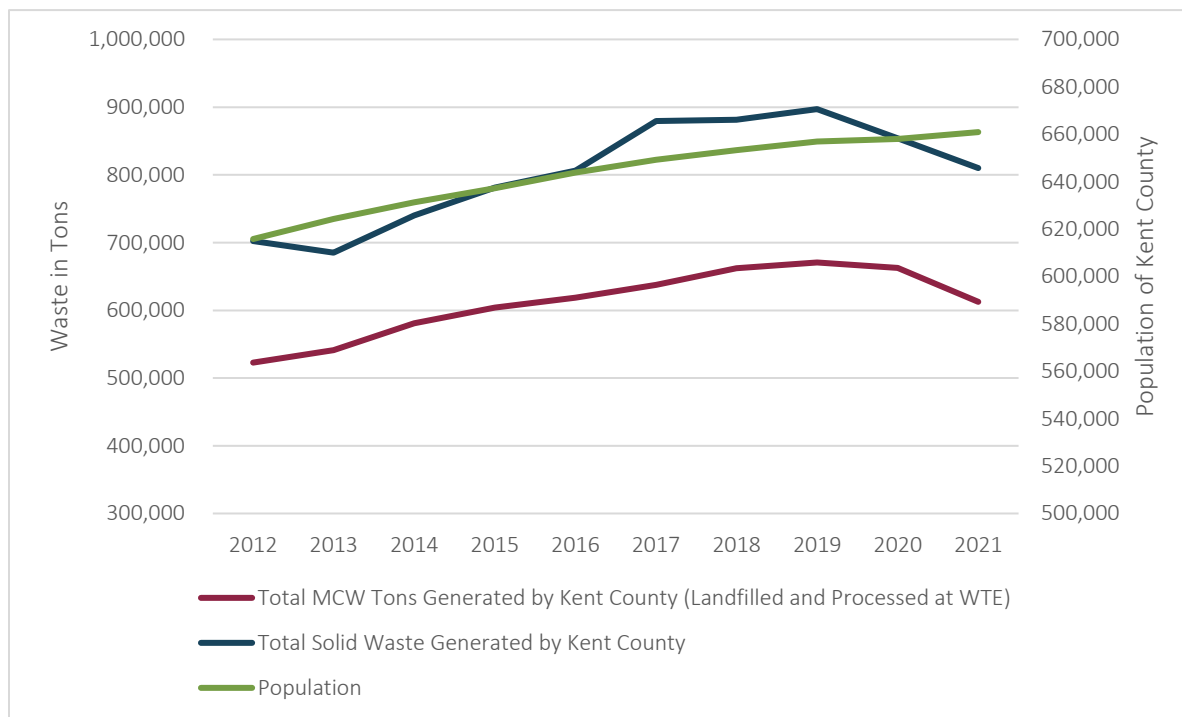


Figure 21 - Population of Kent County vs. Tons of Waste Generated by Kent County

Table 16 - Rate of Kent County Population and Waste Growth

Year	Rate of Population Growth <sup>1</sup>	Growth Rate of Total Waste Disposed <sup>2</sup>
2013	1.38%	-3.34%
2014	1.13%	11.01%
2015	0.92%	7.36%
2016	1.05%	4.24%
2017	0.84%	11.79%
2018	0.63%	0.29%
2019	0.55%	2.24%
2020	0.16%	-6.06%
2021	0.44%	-6.55%
<b>Average</b>	<b>0.83%</b>	<b>2.33%</b>

(1) From US Census Bureau Estimated Population for Kent County

(2) From EGLE Annual Landfill Reports for Kent Generated Waste

This steady population growth indicates that the amount of processable waste generated in the County will also likely keep increasing for the near future.

## 8 C&D Generation

As stated before, there is also a large tonnage of C&D materials that are hauled to the landfill. Much of this comes in roll-off boxes, as well as most of the self-haul trucks.<sup>9</sup> The composition of the Kent C&D waste is unknown, but the composition does not tend the change as drastically as MSW waste. GBB performed a comprehensive characterization study in Lancaster County, PA in 2019. The results are shown below in Table 17.

Table 17 – Top 10 Materials from Lancaster, PA C&D Characterization Study

Rank	Category	Weighted Mean - All	Error +/- (90%)
<b>1</b>	Asphalt Shingles	19.5%	5.1%
<b>2</b>	Dirt and other Fines	18.9%	2.6%
<b>3</b>	Other Bulky or Composite Items	9.9%	2.8%
<b>4</b>	Clean Lumber	8.8%	1.8%
<b>5</b>	Plywood and Pallets	8.1%	1.6%

<sup>9</sup> Some self-haul vehicles have a variety of wastes but the majority contained mostly C&D type waste that were observed during the two-week period of the waste study

<b>6</b>	Treated and Painted Wood	6.0%	1.7%
<b>7</b>	Gypsum/Drywall	5.2%	3.0%
<b>8</b>	Old Corrugated Cardboard (OCC)	4.0%	0.9%
<b>9</b>	Carpet	2.8%	2.3%
<b>10</b>	Ferrous Metals	2.6%	0.6%

The single largest category are the asphalt shingles, but four (4) of the top 10 categories are wood materials, which is common for most C&D streams and is consistent with the observations by GBB during the waste study. There seemed to be less shingles that were observed in Lancaster, but this may be due to the season of the sort (late October).

The estimated tonnage of C&D generated in Kent County can be calculated using the same method as for the MCW generation. The truck data from the scalehouse observations as well as the EGLE data for C&D disposed at other landfills can estimate the tons of C&D generated. The generation estimate may be low as the scalehouse data is from the winter months and C&D generation tends to be more active during the summer months. Table 18 below indicates that approximately 136,205 tons of C&D generated in Kent County is brought to a Kent facility for disposal every year.

*Table 18 – Estimate of C&D In-County Generation Yearly Tonnage Estimate*

Truck Type	SKL	WTE	NKTS	Total
<b>Self-Haul</b>	2,196	131	6,028	<b>8,355</b>
<b>C&amp;D (Roll-Off)</b>	92,615	9,421	25,815	<b>127,850</b>
<b>Total</b>	<b>94,810</b>	<b>9,552</b>	<b>31,843</b>	<b>136,205</b>

As with the MCW, some C&D is also brought to Kent facilities for disposal. The out-of-county estimate from the scalehouse data is shown is just over 25,000 tons per year (Table 19).

*Table 19 – Estimate of Out-of-County C&D Disposed at Kent Facilities*

Truck Type	SKL	WTE	NKTS	Total
<b>Self-Haul</b>	64	0	386	<b>450</b>
<b>C&amp;D (Roll-Off)</b>	19,962	0	5,176	<b>25,138</b>
<b>Total</b>	<b>20,026</b>	<b>0</b>	<b>5,562</b>	<b>25,588</b>

As with the MCW, C&D from Kent County is also reported by nearby landfills in the EGLE report. This total (converted to tons from the Cu. Yds given in the report) shows that an additional 62,659 tons of C&D is generated in Kent County per year, as shown in Table 20.

*Table 20 – 2021 EGLE Report in Tons for Kent Generated C&D*

Location	C&D
<b>Pitch</b>	40,655
<b>WM - Autumn Hills</b>	2,087
<b>Advanced-Arbor Hills</b>	1,922
<b>Republic-Central</b>	123
<b>Republic-Ottawa County Farms</b>	17,873
<b>Total</b>	<b>62,659</b>

The total C&D disposed in Kent County as well as the C&D generated in Kent and disposed elsewhere is nearly 225,000 tons per year (Table 21). Much of this material could be diverted with a dedicated processing system and would further reduce the amount of material being landfilled at the SKL facility.

Table 21 – Total C&D Tonnages

<b>C&amp;D Generation</b>	<b>Tons per Year</b>
<b>In-County Generation and Disposal<sup>1</sup></b>	136,205
<b>Out-of-County Generation, In-County Disposal<sup>1</sup></b>	25,588
<b>In-County Generation, Out-of-County Disposal<sup>2</sup></b>	62,659
<b>Total</b>	<b>224,452</b>

(1) Estimate from Scalehouse Data

(2) EGLE 2021 Data

GBB does not recommend flow control for C&D materials as this can adversely affect the smaller private processors and is more difficult to define than MSW, but if the tip fee for the processing of C&D can be kept similar to the current tip fee, it is likely that the above tonnages would still be brought to a Kent facility. Further study will be needed to observe the tonnages of C&D to the Kent facilities during the summer months and to identify outlets for possible materials recovered from a C&D processing facility.

## 9 Definitions

### 9.1 Common Acronyms

AD - Anaerobic Digestion

ASTM - American Society for Testing and Materials

C&D - Construction and Demolition

EGL - Michigan Department of Environment, Great Lakes, and Energy

EPA - Environmental Protection Agency

GBB – Gershman, Brickner & Bratton Solid Waste Management Consultants

H&S - Health and Safety

HASP - Healthy and Safety Plan

HDPE - High Density Polyethylene

HHW - Household Hazardous Waste

MCW – Municipal Commercial Waste

MSW - Municipal Solid Waste

MRF - Materials Recovery Facility

MSWPF – Municipal Solid Waste Processing Facility

NKTS – North Kent Transfer Station

OCC - Old Corrugated Cardboard

ONP - Old Newsprint

PET - Polyethylene Terephthalate

PP - Polypropylene

PPE - Personal Protective Equipment

SBP - Sustainable Business Park

SKL – South Kent Landfill

SWMP- Solid Waste Management Plan

TPD - Tons per Day

TPY - Tons per Year

TS – Transfer Station

UBC – Used Beverage Cans

Yd<sup>3</sup> - Cubic Yards

## 9.2 Glossary

**Anaerobic Digestion (AD):** The controlled decomposition of organic materials, such as leaves, grass, and food scraps, by microorganisms. Anaerobic digestion happens in closed spaces where there is no oxygen.

**ASTM International:** Formerly the American Society for Testing and Materials, ASTM International is a non-profit, membership-based and consensus-driven standards organization that develops and publishes voluntary consensus technical standards for a wide range of materials, products, systems, and services.

**ASTM International D 5231 – 92:** The standard test method for determination of the composition of unprocessed municipal solid waste.

**Collection:** The transfer of solid waste from the point of use and disposal to the point of treatment or landfill. Waste collection also includes the curbside collection of recyclable materials that technically are not waste, as part of a landfill diversion program.

**Commingled Material (or Commingled Loads):** Refers to mixed materials in a bin or load brought to facilities for processing.

**Composite:** A composite material is a combination of two materials with different physical and chemical properties.

**Composting:** The natural process in which microorganisms break down organic materials, such as leaves, grass, and food scraps, by microorganisms. Composting occurs when oxygen is present. The result of this decomposition process is compost, a crumbly, soil-like material.

**Construction and Demolition (C&D) Debris:** Materials resulting from the construction, remodeling, repair, or demolition of buildings, bridges, pavement, and other structures. Typically includes concrete, asphalt, wood, metals, drywall (gypsum wallboard, sheet rock, or plaster), and roofing materials. Land clearing debris such as stumps, rocks, and dirt may also be included in this category of waste.

**Contamination:** Recycling contamination is non-recyclable material or garbage that ends up in the recycling system or stream.

**Convenience Centers:** Community waste and/or recyclables drop-off sites. They typically consist of one or more bins for waste and/or recyclables and are located at spots convenient for residents, such as near major roads or at shopping centers or community centers.

**Curbside Collection:** Programs in which waste or recyclable materials are collected at the curb, often from special containers, and then taken to various processing facilities.

**Disposal:** Waste disposal includes removing and destroying or storing damaged, used, or other unwanted products, materials, and substances. In the context of this course, disposal primarily refers to burying material at landfill sites.

**Diversification:** Waste diversion is the process of diverting waste from landfills or other disposal methods through recycling and source reduction activities.

**Drop-off Collection:** A method of collecting waste, recyclable, or compostable materials in which the materials are taken by individuals to collection sites, such as convenience centers, where they deposit the materials into designated containers.

**End-Use Market:** A company or other entity that purchases recycled materials for use in manufacturing new products.

**EPA:** Environmental Protection Agency. The U.S. Environmental Protection Agency (EPA) is an independent executive agency of the United States federal government tasked with environmental protection matters. The U.S. EPA was established in 1970 after U.S. President Richard Nixon signed an executive order establishing it and was ratified by the U.S. Congress. The agency conducts environmental assessment, research, and education. It has the responsibility of maintaining and enforcing national standards under a variety of environmental laws, in consultation with state, tribal, and local governments. The agency also works with industries and all levels of government in a wide variety of voluntary pollution prevention programs and energy conservation efforts.

**Fines:** Waste materials that are small in size (usually less than 2 inches in size in two dimension) that are too small to sort or separate either mechanically or manually.

**Generator:** Any entity that produces solid waste. Generators are usually divided into the following types: residential (single or multi-family households); commercial (offices, retail, and wholesale outlets); institutional (social, educational, or charitable activities); and industrial (industrial processes or manufacturing operations).

**Generation Rate:** Amount of solid waste produced over a given period of time. For example, a community might produce 1,600 tons of waste per year. For a population of 2,000, that amounts to a generation rate of 4.4 pounds per person per day.

**Greenhouse Gas (GHG):** A greenhouse gas is a gas that absorbs and emits radiant energy within the thermal infrared range, causing the “greenhouse effect”. Common anthropogenic GHGs discussed in the solid waste management industry are carbon dioxide (CO<sub>2</sub>, see Carbon Dioxide above) emissions from combustion of fossil fuels and methane (CH<sub>4</sub>, see Methane below) from landfills. Human activities are the primary sources of anthropogenic GHG emissions since the Industrial Revolution (mid 1700s).



**Health and Safety Plan (HASP or H&S Plan):** A health and safety plan is a plan that outlines the safety measures and procedures implemented in a workplace. It is also designed in accordance with the legislative requirements covering the roles and responsibilities of the staff and the emergency action plan.

**Household Hazardous Waste (HHW):** The leftover content of consumer products used in and around the home that contain hazardous components, including certain paints, cleaners, stains and varnishes, car batteries, motor oil, and pesticides. Certain types of household hazardous waste have the potential to cause physical injury to sanitation workers, contaminate septic tanks or wastewater treatment systems if poured down drains or toilets, and present hazards to children and pets if left around the house. While households do not have to separate household hazardous waste from trash under federal law, some states, localities, and tribes, have special disposal requirements for this waste.

**Integrated Solid Waste Management:** A solid waste management system composed of the following actions, steps, methods, processes, and facilities: planning, financing, regulation, operation, and management. It also includes reduction of solid waste generation (source reduction), collection, transfer, materials recycling, composting, combustion, and disposal. EPA defines integrated solid waste management as a process for managing solid waste and materials diverted from solid waste through a combination of any of the following four methods of management: source reduction, recycling, combustion, and landfilling.

**Landfill:** A landfill (informally referred to as a tip, dump, rubbish dump, garbage dump, or dumping ground) is a site for the disposal of waste materials by method of burial. Landfill is the oldest and still most common form of waste disposal in the United States. In the context of this course, landfill refers to a sanitary landfill, which is engineered to contain and prevent leakage of waste materials into surrounding land and groundwater, as well as to contain odors and various air pollutants that may be harmful to the surrounding community.

**Lightweighting:** The process of minimizing the materials necessary in packaging or other components such as thinner plastic water bottles.

**Material Category:** In general, categories contain types of materials that are made of the same base material; for example, paper, plastic glass, or metal.

**Material Type:** Materials with the same basic attributes within a material category; examples include old corrugated cardboard (OCC), newsprint (ONP), and office paper, and aluminum cans.

**Materials Recovery Facility (MRF):** A Materials Recovery Facility (MRF, pronounced like “murf”) is a facility dedicated to the acceptance, sorting, and baling of commingled recyclables. Typically, MRFs use a combination of automatic sorting equipment and manual labor to separate and bale recyclable materials in preparation for shipment to specialized recyclers that recover a particular

material type, to commodity markets for resale, or to manufacturers who then manufacture new products using the recycled materials.

**Medical Waste:** Wastes from hospitals, clinics, or other health care facilities that contain or have come into contact with diseased tissues or infectious microorganisms. Can include human blood and blood products, pathological waste, discarded sharps (e.g., needles, lancets, scalpels, broken medical instruments), and prescription medication. Also referred to as “red bag” waste because of the red biohazard bags in which it is discarded.

**Mixed Bulky Plastics:** Mixed bulky plastics refers to large plastic items in waste. For example, a lawn chair, large plastic toys, buckets, baskets, and more.

**Mixed Waste Processing (MWP):** Processing equipment facility for mixed waste materials (usually MSW) for the recovery of specific materials for recycling and other beneficial use.

**Municipal Solid Waste (MSW):** A specific type of solid waste that primarily consists of trash comprised of various items that consumers throw away, for example, packaging, food, yard trimmings, paper, plastics, metals, glass, furniture, appliances, tires, clothing, etc. Despite the name, MSW is not limited to municipalities and comes from a variety of sources, including residences, businesses, schools, hospitals, etc. By definition, MSW does not include industrial waste (including manufacturing waste), hazardous waste (including medical waste and chemicals), or construction and demolition debris, although these items may still appear in MSW streams on occasion.

**Organics:** Organic waste is any material that is biodegradable and comes from either a plant or an animal.

**Personal Protective Equipment (PPE):** Personal protective equipment is protective clothing, helmets, goggles, or other garments or equipment designed to protect the wearer's body from injury or infection. The hazards addressed by protective equipment include physical, electrical, heat, chemicals, biohazards, and airborne particulate matter.

**Processing:** Processing is the physical treatment of waste by using physical methods, techniques, and technologies for changing the composition and character of the waste.

**Records Evaluation:** A detailed review of available waste- and recycling-related data, including waste hauling and disposal contracts, records, and receipts. A records evaluation provides insight into an organization's waste generation and removal patterns including purchasing, supply invoices, waste hauling and disposal records, and service contracts.

**Recoverable:** Recoverable materials are those that can be successfully recovered, removed, or extracted from a waste stream and that have economical value or utility for purposes such as reuse, repair, recycling, composting, or conversion to energy.

**Recyclables:** The term “Recyclables” refers to the acceptable materials that are placed into collection containers for recycling (such as bottles and cans, paper, cardboard, etc.). The term ‘recyclables’ should not be confused with the term ‘Recycling’. (See “Recycle, Recycling” below.) Also, note that the term “single-stream” may sometimes come before the term ‘recyclables’ or ‘recycling’. (See ‘Single-stream’ below”).)

**Recycling:** A series of activities that includes collecting recyclable materials that would otherwise be considered waste, sorting by either manual or mechanized methods to separate by material type, and processing these separated material types into raw materials such as fibers and plastic resins that can be used for manufacturing into new products.

**Residue:** The remaining waste material that is left over after sorting or processing either at a waste or recycling processing facility (the material that either cannot be processed or does not have economical value or utility) or during a waste sort (the material that cannot be sorted into any other defined category).

**Reuse:** Using a product more than once, either for the same purpose or for a different purpose. Reusing items by repairing them, donating them to charity or community groups, or selling them also reduces waste.

**Roll-off Container:** A large waste or recyclables container that fits onto a tractor-trailer that can be dropped off and picked up hydraulically.

**Sampling Plan:** A waste sampling plan outlines where, how, and when samples will be taken during a waste sort in order to produce a data set that both is random and representative of the larger waste stream.

**Single Stream:** The term ‘Single stream’ refers to the commingling of all types of acceptable recyclable materials (bottles and cans, paper, cardboard, etc.) into one container instead of separating the recyclables by material type. Many curbside recycling services collect “single-stream recyclables” because residents mix all types of acceptable materials into one container for pickup. (See “Recyclables” and “Recycle, Recycling” above.)

**Solid Recovered Fuel:** Solid Recovered Fuel (SRF) is a high-energy content engineered fuel product produced from solid waste. SRF is related to other waste-derived fuels in that it consists of combustible components of municipal solid waste (MSW) (e.g., MRF residues, organic wastes, textiles, and waste plastics). SRF can be used as a fossil fuel alternative in industrial boilers, such as with cement industry’s use of SRF as a replacement for coal.

**Solid Waste:** Solid waste is a general term that includes any garbage, refuse, or discarded material resulting from industrial, commercial, mining, and agricultural operations, and from community activities. Solid waste also includes sludge from a wastewater treatment plant, water

supply treatment plant, or air pollution control facility. Municipal Solid Waste (MSW, see above) is a specific type of Solid Waste.

**Sorting Plan:** A waste sorting plan outlines how samples will be physically sorted and into what specific material categories and types during a waste sort.

**Source Reduction (or Waste Prevention):** Refers to any change in the design, manufacture, purchase, or use of materials or products (including packaging) to reduce the amount, quantity, or quality of these materials or products before they become waste. Source reduction can also refer to the reuse of products or materials.

**Source Separated Material (or Source Separated Load):** When waste is sorted by material type on a job site, using several bins to store materials separately. Typically results in a higher diversion or recycling rate.

**Special Wastes:** A non-regulatory term often used by tribes to describe problem wastes typically generated by households that are not disposed in household garbage containers primarily due to their size or because of disposal restrictions. The most common special wastes include tires, furniture, bicycles, appliances and other white goods, and car batteries. Tires and lead-acid car batteries are examples of special wastes that might have disposal restrictions.

**Tare Weight:** A tare weight is the weight of an empty vehicle or container. Subtract the tare weight from the weight of the full vehicle or container to determine the weight of only the goods or materials carried or contained.

**Transfer:** The movement of waste over a specific area by trains, tankers, trucks, barges, or other vehicles.

**Transfer Station:** A site or facility where waste materials are taken from smaller collection vehicles (or private vehicles) and placed in larger vehicles, including trucks, trailers, railroad cars, or barges for transport. Recycling and some waste processing may also occur at some transfer stations.

**Visual Assessment:** A visual assessment is a direct observation and evaluation of the physical properties of waste materials that are visible to the naked eye and that can be evaluated directly in the field. A visual assessment can be completed at the point of waste generation, collection, or disposal.

**Waste Assessment:** A waste assessment is a systematic study of a community's or an area's waste stream. The three main types of waste assessments are: Records Evaluation, Visual Assessment, and Waste Characterization Study ("Waste Sort").

**Waste Characterization Study ("Waste Sort"):** A waste characterization study or "waste sort" is the process of collecting random and representative samples of a particular waste stream and

manually sorting these samples into individual waste components by material type; it is a systematic process used to identify, sort, and analyze material types in a particular waste stream. Data from such a study can be statistically analyzed to understand the detailed composition of the waste stream (the Waste Composition Profile) to help, for example, in planning how to reduce waste, set up recycling programs, and conserve money and resources.

**Waste Composition Profile:** A waste composition profile depicts the percentage of materials contained in a particular waste stream.

**Waste Reduction:** Using source reduction, recycling, or composting to prevent or reduce waste generation.

**Waste Stream:** The total flow of solid waste from generators within an area or community that must be recycled, reused, or disposed.

**Waste-to-Energy:** The conversion of non-recyclable waste materials into usable heat, electricity, and/or steam through the process of combustion, in which waste materials are heated in a controlled environment to the point of self-igniting.

**Yard Trimmings:** Leaves, grass, clippings, prunings and other natural organic matter discarded from yards or gardens. Yard trimmings may also include tree stumps and brush.

## 9.3 Material Categories

### 9.3.1 Sort Categories

The following are categories and groupings used by the solid waste engineering firm, GBB, during their Waste Characterization Sort (MSW Study) at the Covanta Waste to Energy Facility, North Kent Transfer Station, and the South Kent Landfill that was performed October 24<sup>th</sup>, 2021, through November 1<sup>st</sup>, 2021.

#	Material Type	Material Category	Definition
1	Fiber	Old Corrugated Cardboard (OCC)	Old corrugated containers (cardboard) that are clean and dry enough to be recycled. Most shipping boxes are OCC.
2		Old Newsprint (ONP)	Old newspapers that are clean and dry enough to be recycled as a commodity when separated. This shall include all newspaper inserts.
3		Office Paper	All white and Manila office paper (8 1/2 x 11)
4		Magazines and Catalogs	Glossy magazines and catalogs, books, and phonebooks
5		Other Mixed Recyclable Paper/Kraft	Paper of composite material or other paper that is clean and dry enough to be recycled as a commodity when separated, such as mailing envelopes with windows, and other flat paper items that are not office paper or news. Includes kraft paper such as cereal boxes.
6		Gable Top/Aseptic Containers	Containers made of paperboard material but with a “gable top” lid, sometimes including a “screw-on” circular plastic cap. Examples of this material include paper milk cartons and juice boxes.
7		Wet or Soiled Fiber	Paper that is heavily soiled or wet that would not survive intact as fiber in a processing plant
8		Compostable Fibers (Paper Towels, etc.)	Paper products that are contaminated by food or other putrescible products and non-traditionally recyclable (but compostable) such as paper towels.
9		Non-recyclable Paper Products	Paper that is not recyclable, including paper plates and cups, wax paper, or any other composite paper items that are not recoverable for recycling in a standard MRF
10	Plastic	PET Bottles (#1)	Narrow necked bottles or containers identified by the recycling symbol with the number #1, contents shall be emptied into the Liquids category.

11		PET Containers/Packaging (#1)	Food trays and other non-bottle PET #1 items. Contents will be emptied into appropriate categories.
12		HDPE Color (#2)	Narrow necked bottles or containers that are opaque due to coloring and can be identified by the recycling symbol with the number #2. Examples include laundry soap bottles and certain medicine bottles.
13		HDPE Natural (#2), also known as HDPE-N.	Narrow necked or other containers that are translucent in color identified by the recycling symbol with the number #2. Most milk bottles are HDPE Natural
14		HDPE Tubs and Lids/Other (#2)	Other non-bottle items identified by #2
15		Polypropylene (PP) (#5)	All items identified by #5
16		Other Mixed Plastics (#3-#7)	All rigid plastic containers or items identified by the recycling symbol with any other number but #1, #2, and #5 (except Extruded polystyrene (EPS) Foam #6).
17		Extruded polystyrene (EPS) Foam (#6)	Polystyrene foam, such as disposable coffee cups, coolers, or cushioning material in packaging, which are typically white and are made of expanded polystyrene beads.
18		Film & Wrap	All film plastic including trash bags, grocery bags, shrink wrap, plastic sheeting, etc.
19		Flexible Packaging	Includes flexible packaging such as chip bags, food pouches, and candy wrappers.
20		Mixed Rigid Bulky	Large plastic items such as crates or toys that would still be mostly recyclable.
21		Non-Recyclable Rigid Plastic	Plastic items without a number or other mostly plastic items that would be difficult to recycle.
22	Glass	Recyclable Glass	All containers made from glass (bottles, jars) of all colors, shapes, and sizes. Contents shall be emptied into Food, Liquid, or other appropriate categories.
23		Non-Recyclable Glass/Ceramic	Any non-container glass material including plate glass, windowpanes, as well as any ceramic or other similar inert material.
24	Metals	Ferrous Metal Containers	Any ferrous containers or other items including cans used to store soup, beans, or other non-perishable items. Composite materials that are a majority ferrous metals will be placed in this category.
25		Aluminum Cans (UBC)	Any non-ferrous used beverage can (UBC) containers such as soda cans.

26		Other Ferrous Metals	Any other magnetic (or stainless) metals other than Ferrous cans. Includes knives, plumbing, and iron pans.
27		Other Aluminum Metals	Any other non-ferrous metals other than UBC. Includes foil, copper, and brass fixtures.
28		Appliances (Small)	Small appliances that are mostly metal by weight (Ex: Blender, coffee maker, small motors, etc.)
29	<b>Organics</b>	Food/Putrescible Waste	Uncooked foods and cooked left-over food from homes and restaurants. This includes foodstuffs emptied from containers during the sort.
30		Leaves and Grass	Leaves and grass clippings from Yard Waste, flowers, etc.
31		Brush, Pruning, etc.	Other yard waste and woody waste
32		Other Organics	Organics that are not classified as the above, such as animal waste (not including textiles).
33		Liquids	Includes water from bottles and other foodstuff liquids such as soda. Bottles that appear to contain human waste will remain in the container.
34	<b>Textiles</b>	Textiles	All items made from fibrous materials such as clothes, cloth, blankets, pillows, stuffed animals etc.
35		Leather & Rubber	Any leather items such as shoes, or belts and rubber items such as tubes or padding, and combination item such as purses or shoes.
36		Diapers	Used diapers or any other cloth that contains human feces.
37	<b>HHW</b>	Household Hazardous Waste	Containers with contents meeting the definition of hazardous, including paint solvents, used oil, sharps, etc. Materials will remain in containers and weight includes these containers
		Medical Waste	All waste considered to be medical in nature such as catheters and tubes, prescription medicine, and needles/syringes
38	<b>C&amp;D</b>	Clean Wood	Any mostly unpainted, untreated, or bulky dimensional wood material including pallets and dunnage and plywood
39		Wood - Painted or Treated	Any wood that is chemically treated or heavily painted
40		Concrete, Brick, Asphalt, etc.	Any inert mineral building materials
41		Carpet and Padding	Any carpet or carpet padding materials



42		Other C&D	Any other construction and demolition materials such as composite building components, roofing, drywall (gypsum), vinyl siding, non-metallic plumbing, etc.
43	Electronics	Electronics (Small)	Includes cell phones/tablets, personal electronics, and other hand-held or counter size electronic waste.
44		Electronics (Large)	Includes televisions and other large electrical devices such as printers that do not contain much metal
45		Batteries	All types of batteries (except lead-acid batteries which would go under HHW)
46	Other Wastes	Fines	Any material that is less than two inches in diameter, such as the debris that is left on the sorting tables after all other material that can be separated has been sorted. Also includes dirt and fine materials such as sawdust and cat litter
47		Tires	Rubber tires of any size
48		Bulky Furniture	Includes such items as mattresses, chairs, shelving, etc.
49		Other Bulky Items	May include composite items such as luggage and other bulky items. Large metal objects (such as a sink) will fall under this category
50		Other Waste or Composite Items	Other unidentifiable or special waste including illegal substances, composite items, or any other items that do not fit into the described categories.

## 10 Appendices

- Blank Data Sheet
- Blank Sizing Sheet
- Table of Results by Generator with Error
- Table of results by Truck (no error)
- Graphics of Results
  - All
  - Residential
  - Commercial
  - Other
- 2017 and 2021 Comparison Table
- Sizing Data
- Total MRF Results Table
- Generation Table for In-County Estimates
- Group Number Explanation (Cascadia)
- PDF of 2020 Kent Tonnages
- Generation Table for all categories with tonnages
- Tareless Weights for all categories from all samples

## 10.1 Data Sheets

### 10.1.1 Front Page

MSW Material Composition					
<b>Week:</b>	<b>Sample Number:</b>	<input type="checkbox"/> Front-loader	<input type="checkbox"/> Self-haul:		
<b>Day:</b>		<input type="checkbox"/> Back-loader	<input type="checkbox"/> Other:		
<b>Time:</b>	<b>Vehicle Number:</b>	<input type="checkbox"/> Side-load	<input type="checkbox"/> Compacter:		
<b>Number of Staff:</b>		<b>Weather Conditions:</b>			
Category	Material	Bin Weight	Bucket Weight	Tote Weight	No Tare Weight
<b>Fiber</b>	Old Corrugated Cardboard (OCC)				
	Old Newsprint (ONP)				
	Office Paper				
	Magazines and Catalogs				
	Gable Top/Aseptic Containers				
	Compostable Fibers (Paper Towels, Etc.)				
	Other Recyclable Paper (Kraft)				
	Wet or Soiled Fiber				
	Non-recyclable Paper Products				
<b>Plastic</b>	PET Bottles (#1)				
	PET Containers/Packaging (#1)				
	HDPE Color (#2)				
	HDPE Natural (#2)				
	HDPE Tubs and Lids/Other (#2)				
	PolyPropelene (#5)				
	Mixed Containers (#3-#7)				
	EPS Foam (#6)				
	Film & Wrap				
	Flexible Packaging				
	Mixed Bulky Plastic				
	Non-Recyclable Rigid Plastic				
<b>Glass</b>	Recyclable Glass				
	Non-Recyclable Glass/Ceramic				

### 10.1.2 Back Page

Category	Material	Bin Weight	Bucket Weight	Tote Weight	No Tare Weight
<b>Metals</b>	Ferrous Metal Containers				
	Aluminum Cans (UBC)				
	Other Ferrous Metals				
	Other Aluminum metals				
	Appliances (Small				
<b>Organics</b>	Food/Putrescible Waste				
	Leaves and Grass				
	Brush, Prunings, etc.				
	Other Organics				
	Liquids				
<b>Haz. Waste</b>	Household Hazardous Waste				
	Medical Waste				
<b>Electronics</b>	Electronic (Small)				
	Electronics (Large				
	Batteries				
<b>C&amp;D</b>	Clean Wood				
	Wood – Painted or Treated				
	Concrete/Brick/Asphalt				
	Carpet and Padding				
	Other C&D				
<b>Textiles</b>	Textiles				
	Leather & Rubber				
	Diapers				
<b>Other</b>	Fines				
	Tires				
	Bulky Items				
	Other Residue or Composites				

## 10.2 Blank Sizing Sheet

Size Sampling Material Composition							
<b>Week:</b> <b>Day:</b> <b>Time:</b>	<b>Sample Number:</b>	<input type="checkbox"/> Front-loader			<input type="checkbox"/> Self-haul:		
	<b>Vehicle</b>	<input type="checkbox"/> Back-loader			<input type="checkbox"/> Other:		
	<b>Number:</b>	<input type="checkbox"/> Side-load			<input type="checkbox"/> Compacter:		
Category	Material	0"-2"	2-6"	6"-11"	Over 11"		Tare Type
<b>Fiber</b>	Old Corrugated Cardboard (OCC)				11"-18"	OVR 11"	
	Magazines and Catalogs						
	Non-recyclable Paper Products						
<b>Plastic</b>	HDPE Tubs and Lids/Other (#2)						
	Mixed Containers (#3-#7)						
	Non-Recyclable Rigid Plastic						
<b>Organics</b>	Food/Putrescible Waste						
<b>Other</b>	Fines						
	Other Residue						

## 10.3 Full Results by Generator Type

#	Type	Category	Average %: All Generators <sup>1</sup>	Error +/- (90%)	Average %: Residential	Error +/- (90%)	Average % Commercial	Error +/- (90%)	Average %: Other	Error +/- (90%)
1	Fiber	Old Corrugated Cardboard	8.0%	2.3%	4.2%	2.7%	7.5%	2.2%	13.6%	7.4%
2		Old Newsprint (ONP)	0.3%	0.2%	0.6%	0.6%	0.2%	0.1%	0.2%	0.2%
3		Office Paper	2.3%	0.6%	2.3%	1.2%	1.9%	0.8%	3.5%	1.8%
4		Magazines and Catalogs	1.3%	0.4%	1.6%	0.6%	0.8%	0.4%	1.8%	1.5%
5		Gable Top/Aseptic Containers	0.1%	0.0%	0.2%	0.1%	0.1%	0.1%	0.0%	0.0%
6		Compostable Fibers (Paper Towels, Etc.)	3.1%	0.8%	3.2%	0.8%	4.4%	1.8%	0.6%	0.3%
7		Other Mixed Recyclable Paper/Kraft	2.6%	0.8%	2.9%	0.8%	2.7%	1.8%	2.1%	1.5%
8		Wet or Soiled Fiber	2.4%	0.6%	3.4%	0.9%	2.1%	0.6%	1.5%	1.6%
9		Non-recyclable Paper Products	2.7%	1.0%	2.1%	0.6%	3.4%	1.9%	2.5%	2.9%
10	Plastics	PET Bottles (#1)	1.5%	0.3%	2.3%	0.8%	1.6%	0.5%	0.2%	0.1%
11		PET Containers/Packaging (#1)	0.1%	0.0%	0.1%	0.0%	0.1%	0.1%	0.0%	0.0%
12		HDPE Color (#2)	0.4%	0.1%	0.5%	0.2%	0.3%	0.1%	0.3%	0.3%
13		HDPE Natural (#2)	0.4%	0.2%	0.5%	0.2%	0.5%	0.4%	0.1%	0.1%
14		HDPE Tubs and Lids/Other (#2)	0.1%	0.0%	0.2%	0.1%	0.0%	0.0%	0.0%	0.0%
15		Polypropylene (#5)	0.8%	0.2%	1.3%	0.3%	0.9%	0.2%	0.2%	0.1%
16		Mixed Containers (#3-#7)	0.7%	0.4%	0.6%	0.4%	1.2%	1.1%	0.1%	0.1%
17		Extruded Polystyrene (EPS) Foam (#6)	0.5%	0.1%	0.6%	0.1%	0.5%	0.2%	0.5%	0.5%
18		Plastic Film and Wrap	5.2%	1.0%	6.1%	1.8%	6.2%	1.5%	3.2%	2.1%
19		Flexible Packaging	1.0%	0.3%	1.1%	0.2%	1.2%	0.6%	0.1%	0.1%
20		Mixed Bulky Plastic	4.0%	3.0%	1.1%	0.6%	8.8%	7.4%	1.2%	0.8%
21		Non-Recyclable Rigid Plastic	1.9%	0.6%	1.6%	0.4%	2.1%	1.4%	2.1%	1.2%
22	Glass	Recyclable Glass	1.3%	0.4%	2.0%	0.7%	1.3%	0.7%	0.6%	0.3%
23		Non-Recyclable Glass/Ceramic	0.8%	0.4%	0.7%	0.3%	0.6%	0.3%	1.4%	1.6%
24	Metals	Ferrous Metal Containers	0.7%	0.2%	1.4%	0.3%	0.3%	0.1%	0.4%	0.3%
25		Aluminum Cans (UBC)	0.4%	0.3%	0.2%	0.1%	0.2%	0.1%	1.0%	1.3%

#	Type	Category	Average %: All Generators <sup>1</sup>	Error +/- (90%)	Average %: Residential	Error +/- (90%)	Average % Commercial	Error +/- (90%)	Average %: Other	Error +/- (90%)
26		Other Ferrous Metals	2.3%	1.5%	0.8%	0.3%	0.8%	0.5%	6.9%	5.8%
27		Other Non-Ferrous Metals	0.5%	0.3%	0.4%	0.2%	0.3%	0.2%	1.0%	1.1%
28		Appliances (Small)	1.0%	1.4%	0.3%	0.4%	2.4%	3.7%	0.0%	0.1%
29	Organics	Food/Putrescible Waste	14.1%	2.6%	20.6%	3.6%	12.8%	4.4%	7.0%	5.3%
30		Leaves and Grass	0.9%	0.7%	2.6%	2.3%	0.4%	0.7%	0.1%	0.2%
31		Brush, Pruning, etc.	0.9%	0.6%	0.9%	0.5%	0.3%	0.3%	0.6%	0.5%
32		Other Organics	2.4%	1.4%	2.6%	0.6%	2.8%	3.4%	0.4%	0.3%
33		Liquids	1.0%	0.3%	1.1%	0.6%	0.9%	0.5%	1.1%	0.9%
34	HHW	Household Hazardous Waste	0.8%	0.4%	0.2%	0.2%	0.4%	0.3%	2.0%	1.4%
35		Medical Waste	0.3%	0.5%	0.0%	0.0%	0.8%	1.3%	0.0%	0.0%
36	Electronics	Electronics (Small)	0.5%	0.1%	0.5%	0.2%	0.5%	0.3%	0.6%	0.3%
37		Electronics (Large)	1.2%	0.6%	2.1%	1.6%	0.7%	0.6%	1.2%	1.1%
38		Batteries	0.1%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
39	C&D	Clean Wood	3.3%	1.8%	0.5%	0.3%	4.8%	3.5%	5.4%	4.6%
40		Wood- Painted or Treated	2.8%	1.5%	1.3%	1.0%	1.9%	2.2%	5.7%	4.5%
41		Concrete/Brick/Asphalt, etc.	0.5%	0.5%	1.2%	1.7%	0.0%	0.1%	0.5%	0.7%
42		Carpet and Padding	0.6%	0.5%	0.0%	0.0%	0.2%	0.3%	1.7%	1.9%
43		Other C&D	2.1%	1.0%	1.2%	1.0%	1.4%	0.9%	5.0%	3.3%
44	Textiles	Textiles	6.0%	1.5%	5.8%	1.5%	4.3%	1.8%	9.9%	4.7%
45		Leather & Rubber	2.1%	0.8%	2.1%	1.0%	2.7%	1.9%	1.7%	1.0%
46		Diapers	2.4%	0.8%	4.8%	1.5%	1.7%	1.4%	0.2%	0.2%
47	Other	Fines	4.2%	1.2%	5.9%	1.3%	3.1%	1.1%	1.5%	1.2%
48		Tires	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
49		Bulky Items	4.2%	1.5%	2.0%	1.3%	3.8%	2.2%	7.6%	4.3%
50		Other Residue or Composite Items	2.9%	1.0%	2.2%	0.9%	3.8%	2.2%	2.5%	1.7%
Total			100.0%		100.0%		100.0%		100.0%	

(1) Total Average not Weighted

## 10.4 Full Results by Truck Type

#	Type	Material Category	Back-Load (Average %)	Front-Load (Average %)	Side-Load (Average %)	Self-Haul (Average %)	Compactor (Average %)	Roll-Off (Average %)
1	Fiber	Old Corrugated Cardboard	3.0%	7.8%	5.5%	6.1%	7.1%	21.2%
2		Old Newsprint (ONP)	1.3%	0.3%	0.2%	0.3%	0.1%	0.1%
3		Office Paper	1.2%	2.7%	2.4%	4.9%	0.9%	2.0%
4		Magazines and Catalogs	1.5%	1.0%	1.6%	2.4%	0.6%	1.3%
5		Gable Top/Aseptic Containers	0.1%	0.2%	0.2%	0.0%	0.1%	0.0%
6		Compostable Fibers (Paper Towels, Etc.)	3.9%	3.8%	3.0%	0.5%	5.1%	0.7%
7		Other Mixed Recyclable Paper/Kraft	2.1%	2.1%	3.1%	3.3%	3.5%	1.0%
8		Wet or Soiled Fiber	3.3%	3.0%	3.3%	2.1%	1.1%	0.9%
9		Non-recyclable Paper Products	1.8%	2.7%	2.4%	1.0%	4.1%	4.0%
10	Plastic	PET Bottles (#1)	2.7%	1.9%	1.9%	0.3%	1.3%	0.2%
11		PET Containers/Packaging (#1)	0.1%	0.1%	0.1%	0.0%	0.1%	0.0%
12		HDPE Color (#2)	0.8%	0.5%	0.5%	0.5%	0.1%	0.2%
13		HDPE Natural (#2)	0.6%	0.4%	0.4%	0.1%	0.6%	0.1%
14		HDPE Tubs and Lids/Other (#2)	0.1%	0.0%	0.2%	0.0%	0.0%	0.1%
15		Polypropylene (#5)	1.1%	1.1%	1.3%	0.2%	0.6%	0.2%
16		Mixed Containers (#3-#7)	0.2%	0.6%	0.8%	0.1%	1.9%	0.0%
17		EPS Foam (#6)	0.5%	0.6%	0.5%	0.3%	0.5%	0.8%
18		Film & Wrap	6.1%	6.1%	5.2%	1.8%	6.2%	4.6%
19		Flexible Packaging	1.1%	0.9%	1.5%	0.1%	1.5%	0.1%
20		Mixed Bulky Plastic	1.6%	1.3%	0.7%	0.7%	17.8%	1.7%
21		Non-Recyclable Rigid Plastic	1.4%	1.5%	1.5%	3.9%	2.9%	0.3%
22	Glass	Recyclable Glass	2.6%	1.6%	1.4%	0.8%	1.0%	0.4%
23		Non-Recyclable Glass/Ceramic	0.4%	0.9%	0.7%	2.5%	0.2%	0.2%
24	Metals	Ferrous Metal Containers	1.6%	0.5%	1.2%	0.7%	0.2%	0.1%
25		Aluminum Cans (UBC)	0.4%	0.3%	0.2%	2.0%	0.1%	0.0%
26		Other Ferrous Metals	0.9%	0.9%	0.8%	7.8%	0.7%	6.0%



#	Type	Material Category	Back-Load (Average %)	Front-Load (Average %)	Side-Load (Average %)	Self-Haul (Average %)	Compactor (Average %)	Roll-Off (Average %)
27		Other Non-Ferrous Metals	0.8%	0.5%	0.3%	0.7%	0.1%	1.3%
28		Appliances (Small)	0.0%	0.1%	0.3%	0.1%	5.2%	0.0%
29	Organics	Food/Putrescible Waste	23.6%	18.7%	18.9%	8.1%	5.9%	5.9%
30		Leaves and Grass	0.9%	0.8%	2.4%	0.2%	0.0%	0.0%
31		Brush, Pruning, etc.	0.5%	0.5%	2.2%	1.1%	0.0%	0.0%
32		Other Organics	2.3%	0.9%	3.7%	0.5%	5.1%	0.4%
33		Liquids	0.7%	1.4%	1.2%	1.7%	0.3%	0.6%
34	HHW	Household Hazardous Waste	0.3%	0.7%	0.3%	3.0%	0.0%	1.0%
35		Medical Waste	0.0%	1.5%	0.1%	0.0%	0.0%	0.0%
36	Electronics	Electronics (Small)	0.2%	0.8%	0.6%	0.8%	0.2%	0.4%
37		Electronics (Large)	1.7%	1.2%	1.7%	1.5%	0.1%	0.8%
38		Batteries	0.0%	0.1%	0.1%	0.0%	0.0%	0.1%
39	C&D	Clean Wood	0.6%	3.0%	0.4%	1.5%	7.0%	9.3%
40		Wood- Painted or Treated	1.7%	3.5%	1.7%	2.2%	0.0%	9.3%
41		Concrete, Brick, Asphalt, etc.	0.0%	0.1%	1.3%	0.1%	0.0%	0.9%
42		Carpet and Padding	0.1%	0.0%	0.5%	1.3%	0.4%	2.0%
43		Other C&D	2.5%	1.9%	0.4%	0.9%	0.7%	9.1%
44	Textiles	Textiles	6.3%	5.5%	4.8%	13.5%	2.8%	6.3%
45		Leather & Rubber	2.0%	1.2%	1.7%	2.3%	4.5%	1.2%
46		Diapers	6.7%	3.0%	3.7%	0.0%	0.2%	0.3%
47	Other	Fines	5.0%	4.5%	8.0%	0.6%	1.5%	2.4%
48		Tires	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
49		Bulky Items	2.2%	4.9%	2.5%	13.7%	2.4%	1.6%
50		Other Residue or Composite Items	1.6%	2.4%	2.5%	3.8%	5.5%	1.1%
Total			100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Figure 22 - All Combined Generators (No Weighting)

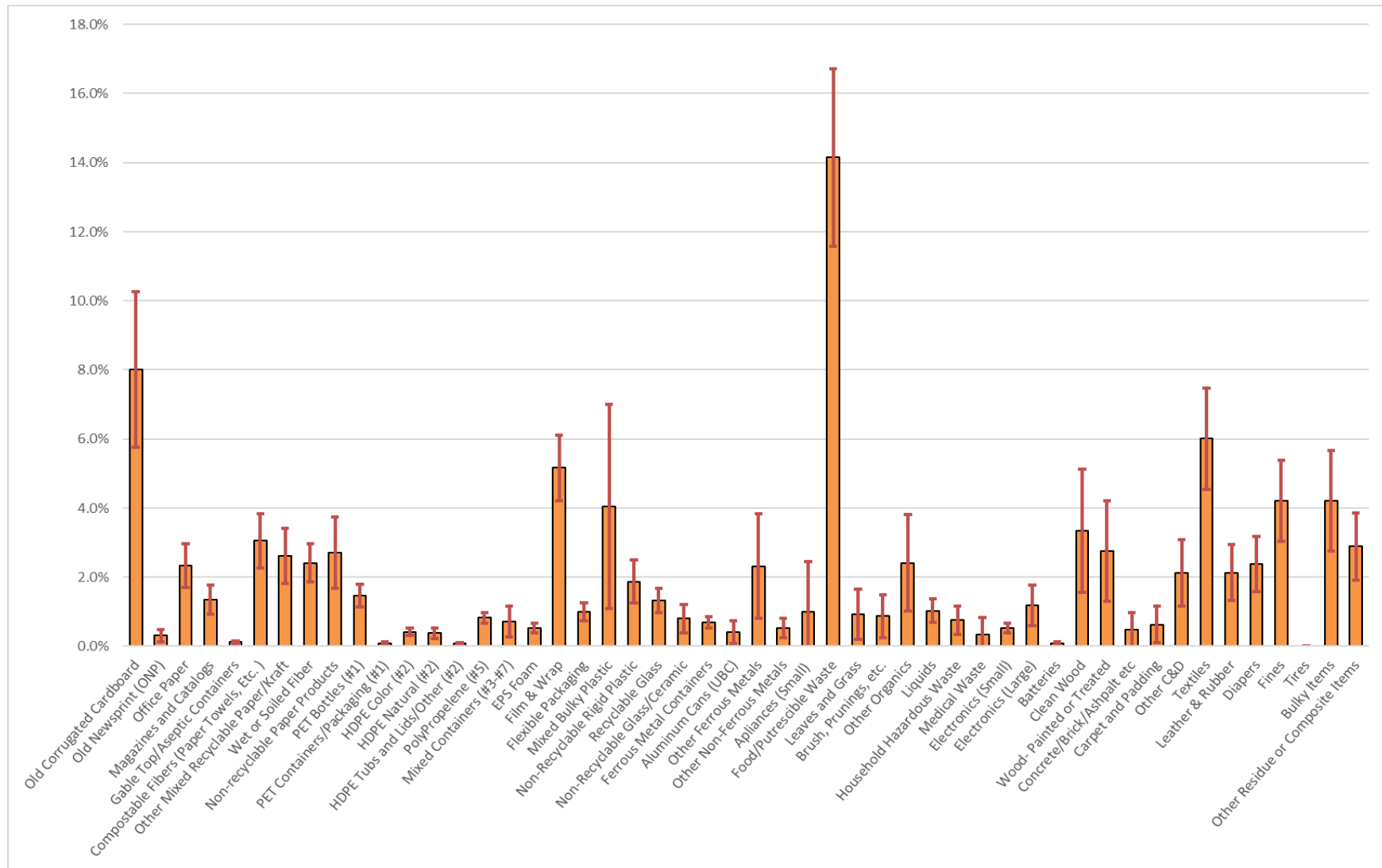


Figure 23 - Residential Generators (Side- and Rear-Load)

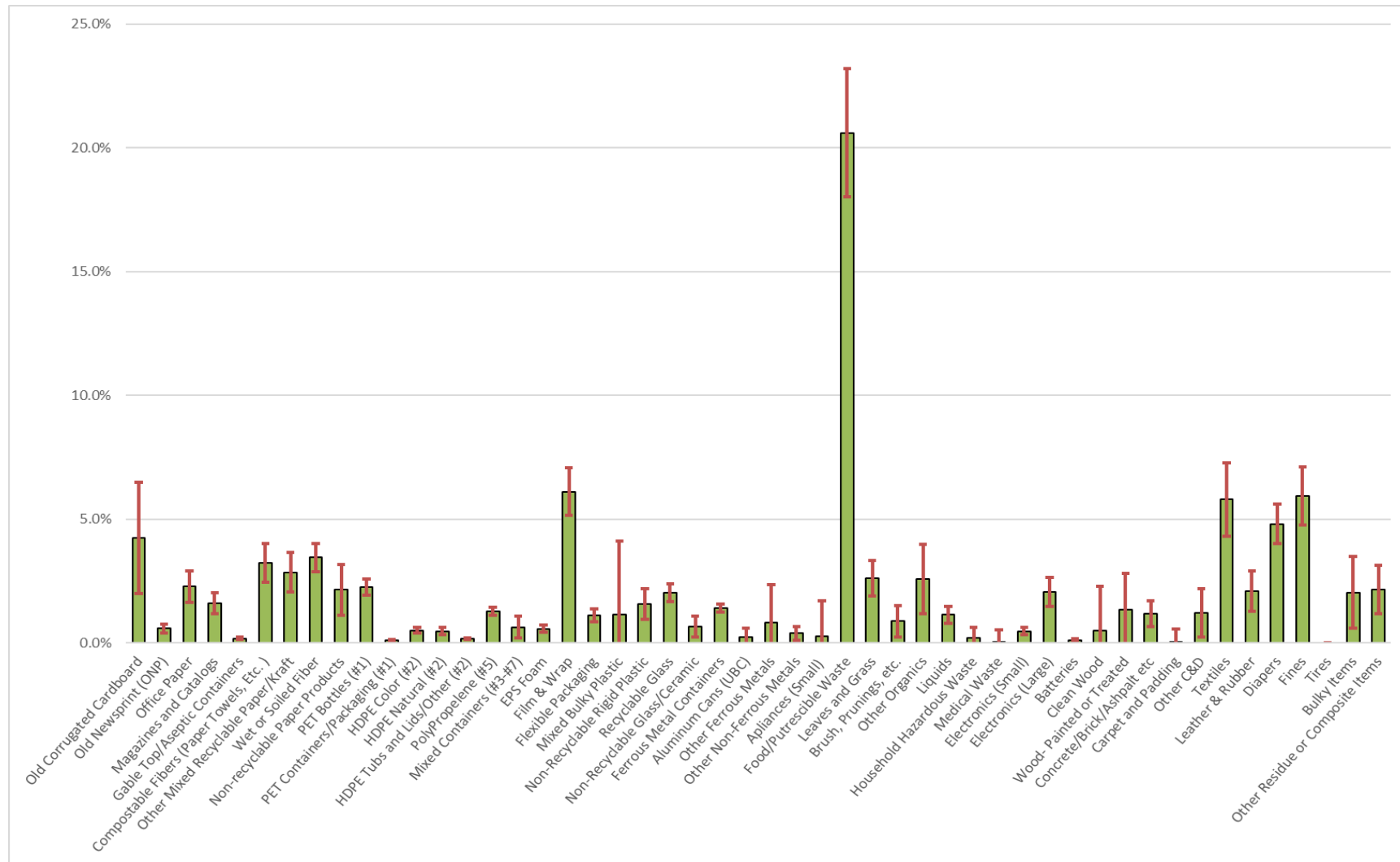


Figure 24 - Commercial Generators (Front-Load and Compactors)

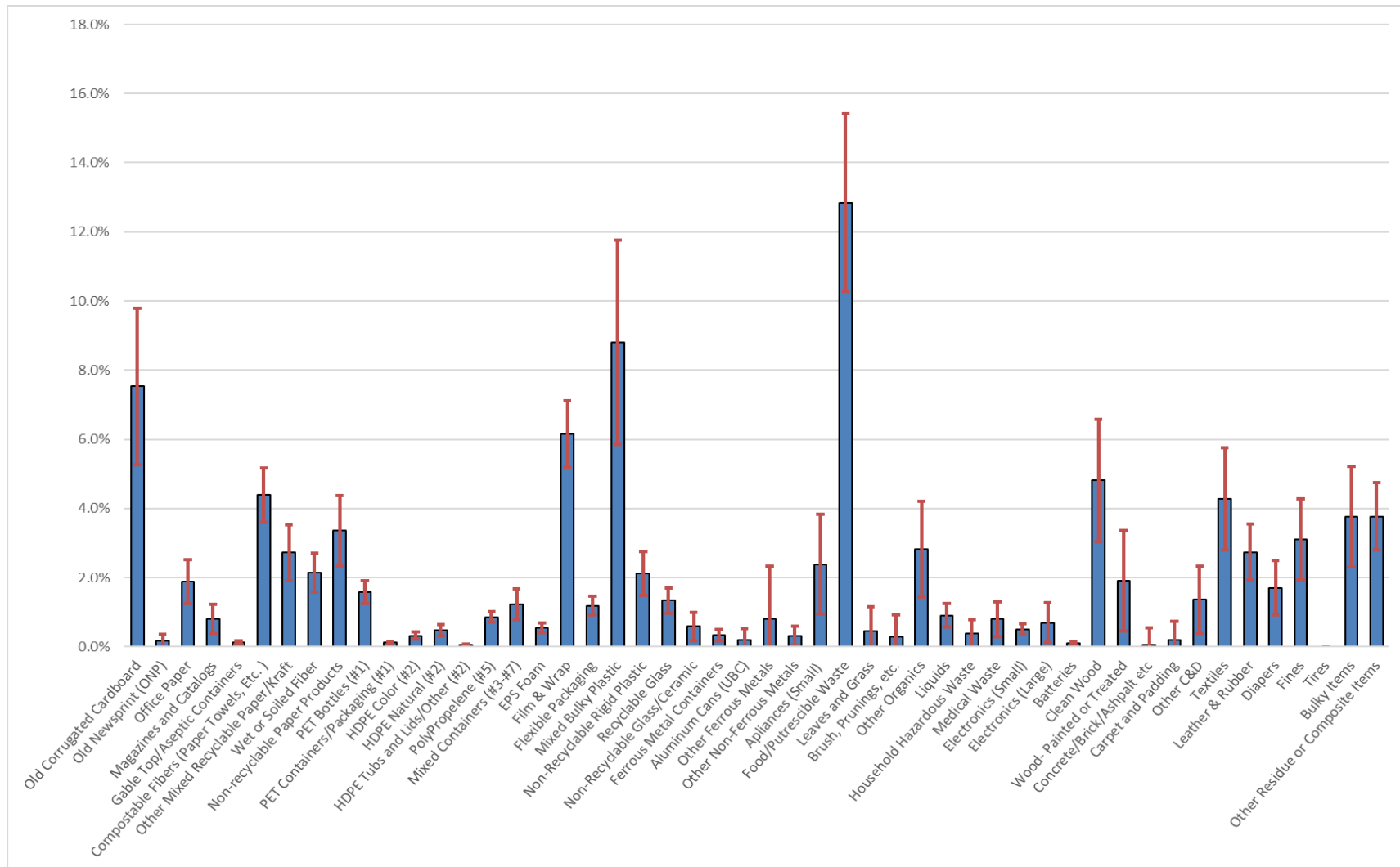
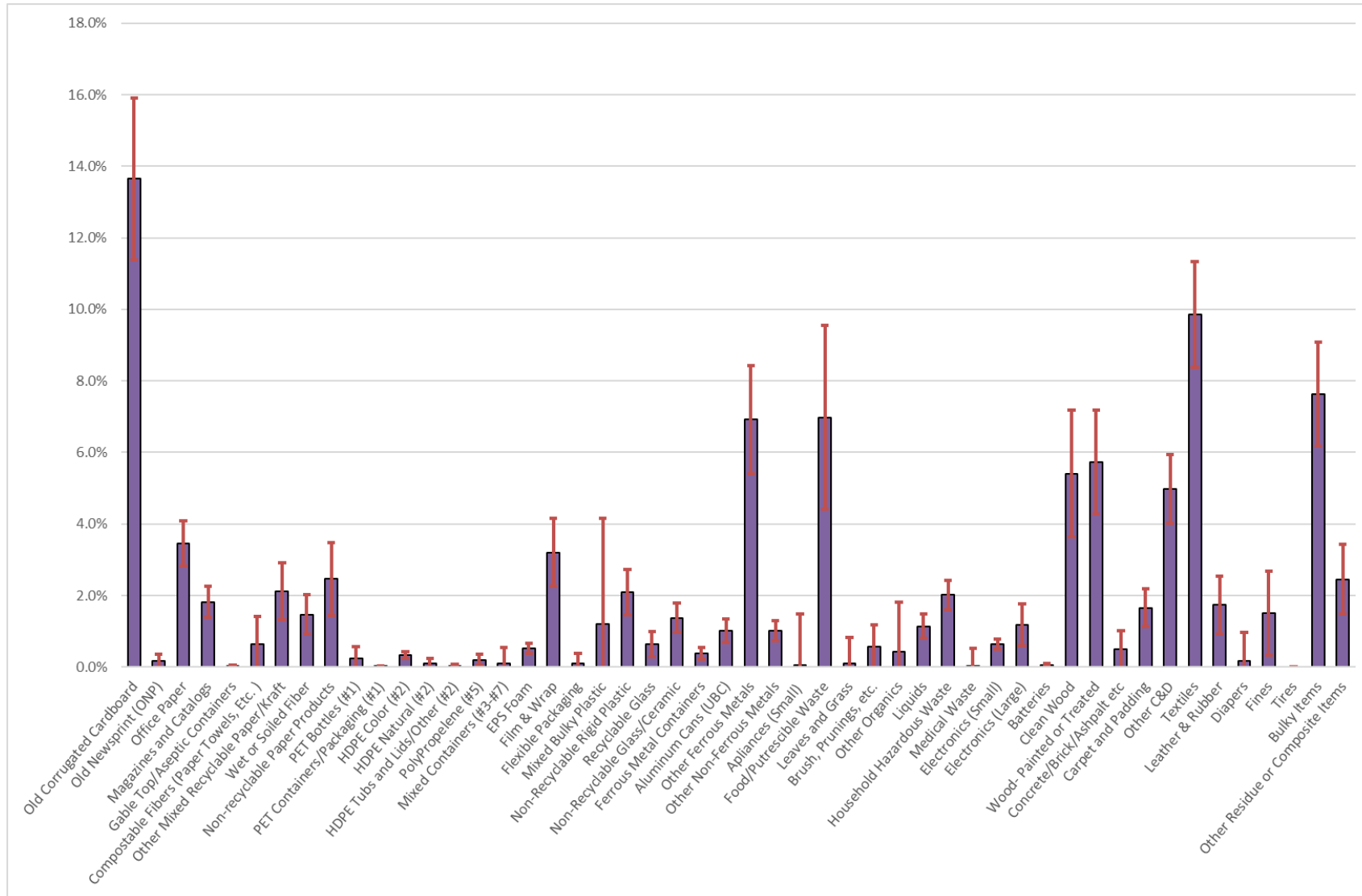


Figure 25 - Other Generators (Roll-offs and Self-Haul)





## 10.5 Comparison to 2017 WTE Waste Sort Study

#	Category	2021 WTE Residential Avg. (%)	2021 Error +/- (90%)	2017 WTE Residential Avg. (%)	2017 Error +/- (90%)	Diff.	2021 WTE Commercial Avg. %	2021 Error +/- (90%)	2017 WTE Commercial Avg. (%)	2017 Error +/- (90%)	Diff.
1	Newsprint	0.1%	0.1%	0.2%	0.1%	-0.1%	0.1%	0.2%	0.2%	0.1%	0.0%
2	High Grade Paper	2.5%	1.9%	1.0%	0.6%	1.6%	1.9%	1.3%	1.4%	0.9%	0.5%
3	Corrugated Cardboard & Kraft	8.4%	4.9%	4.5%	2.7%	3.9%	11.5%	4.9%	9.5%	4.1%	2.0%
4	Other Recyclable paper	1.3%	0.6%	3.1%	1.5%	-1.8%	0.6%	0.4%	2.1%	1.6%	-1.5%
5	Other Non-Recyclable Paper	8.7%	1.8%	11.8%	2.7%	-3.1%	10.5%	3.9%	8.5%	1.8%	1.9%
6	PET (#1)	2.0%	1.0%	1.1%	0.2%	0.9%	1.3%	0.5%	0.7%	0.2%	0.6%
7	HDPE (#2)	0.9%	0.2%	0.5%	0.2%	0.3%	0.5%	0.3%	0.5%	0.2%	0.0%
8	Plastic (#3-#7)	2.7%	0.8%	0.3%	0.1%	2.4%	1.8%	0.7%	0.4%	0.2%	1.4%
9	Plastic Film	7.2%	2.6%	5.7%	1.0%	1.5%	7.2%	2.7%	7.1%	2.1%	0.1%
10	Other Plastics	3.7%	0.9%	7.3%	2.3%	-3.6%	4.8%	3.0%	10.5%	4.4%	-5.6%
11	Food Waste	19.7%	4.5%	15.5%	3.3%	4.2%	9.0%	4.6%	8.2%	3.0%	0.8%
12	Yard Waste	2.6%	1.3%	2.5%	1.3%	0.1%	1.3%	1.5%	0.7%	0.8%	0.5%
13	Wood Waste	2.0%	1.9%	7.0%	7.2%	-4.9%	11.8%	7.1%	7.3%	4.7%	4.5%
14	Other Compostable Organics	7.7%	2.3%	16.8%	3.9%	-9.2%	7.1%	7.1%	12.3%	4.1%	-5.1%
15	Aluminum Cans	0.3%	0.2%	0.1%	0.1%	0.1%	0.3%	0.2%	0.4%	0.2%	-0.1%
16	Other Aluminum	0.0%	0.0%	0.4%	0.2%	-0.4%	0.0%	0.0%	1.1%	1.5%	-1.1%
17	Ferrous Food Cans	1.4%	0.4%	0.6%	0.3%	0.8%	0.4%	0.2%	0.4%	0.2%	0.1%



#	Category	2021 WTE Residential Avg. (%)	2021 Error +/- (90%)	2017 WTE Residential Avg. (%)	2017 Error +/- (90%)	Diff.	2021 WTE Commercial Avg. %	2021 Error +/- (90%)	2017 WTE Commercial Avg. (%)	2017 Error +/- (90%)	Diff.
18	Other Ferrous	0.7%	0.4%	2.2%	1.9%	-1.5%	0.2%	0.1%	1.8%	1.6%	-1.7%
19	Other Non-Ferrous	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.1%
20	Food and Beverage Glass	2.3%	1.1%	1.8%	0.8%	0.5%	0.7%	0.5%	1.1%	0.7%	-0.4%
21	Other Glass	0.6%	0.4%	0.2%	0.1%	0.4%	0.5%	0.5%	0.1%	0.1%	0.4%
22	Small Electric/Electronic Items	1.0%	0.8%	1.1%	0.8%	0.0%	4.9%	7.4%	0.2%	0.3%	4.7%
23	Alkaline Batteries	0.1%	0.2%	0.1%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
24	Other Batteries	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
25	Medical Waste	0.0%	0.0%	0.4%	0.7%	-0.4%	1.6%	2.6%	2.9%	3.3%	-1.4%
26	HHW	0.2%	0.3%	0.3%	0.2%	-0.1%	0.7%	0.5%	0.2%	0.2%	0.5%
27	Textiles	9.4%	2.8%	3.9%	1.6%	5.5%	7.7%	4.3%	3.8%	3.2%	3.9%
28	Special/Problem Waste	2.7%	2.2%	9.5%	6.6%	-6.8%	1.4%	0.8%	12.9%	6.0%	-11.6%
29	Other Inorganics	11.3%	2.2%	2.0%	0.9%	9.3%	12.4%	4.7%	5.7%	3.8%	6.7%



## 10.6 Sizing Data

### Weights without Tare

Sample #	Category	0"-2"	2"-6"	6"-12"	11"-18"	18"+	Truck
1	Old Corrugated Cardboard		1.05	1.85		4.6	S
2	PolyPropelene (#5)	0.05	1.05	1.05			S
3	Mixed Containers (#3-#7)	0.05	0.65	0.85			S
4	PET Bottles (#1)			0.85			F
5	HDPE Bottles		0.65	4.65			F
6	Non-recyclable Paper Products	0.25	2.85	4.85			F
7	PolyPropelene (#5)	0.05	1.65	1.45			F
8	Office Paper	0.05	4.45	7.05			F
9	Textiles	0.05	1.05	0.25	2		F
10	EPS Foam		0.25	1.65			S
11	Non-recyclable Paper Products		0.85	3.45	0.45		B
12	PET Packaging (#1)			1.05	1.85		C
13	PolyPropelene (#5)	0.25	1.85	1.05	0.05		B
14	Other Mixed Recyclable Paper/Kraft		1.65	5.9	3.05		C
15	Office Paper		1.85	1.25	0.25		B
16	Old Corrugated Cardboard			0.25	7.75	4.85	C
17	Other Mixed Recyclable Paper/Kraft		0.85	3.25	2.65		B
18	PolyPropelene (#5)	0.05	2.05	1.65	0.65		
19	Non-recyclable Paper Products	0.05	1.25	3.65			
20	Non-Recyclable Rigid Plastic	0.65	1.85	1.05	1.25		F
21	Old Corrugated Cardboard			0.45	2.25	12.2	S
22	Office Paper	0.25	1.65	6.65			S
23	Other Mixed Recyclable Paper/Kraft		0.45	2.05	5.05		F
24	Office Paper		0.45	4.85			F

### Percentage of Each Sample

Sorted Category	Count	Sample #	0"-2"	2"-6"	6"-12"	11"-18"	18"+	Truck
Old Corrugated Cardboard	3	1	0.0%	14.0%	24.7%	0.0%	61.3%	S
Old Corrugated Cardboard		16	0.0%	0.0%	1.9%	60.3%	37.7%	C
Old Corrugated Cardboard		21	0.0%	0.0%	3.0%	15.1%	81.9%	S
Office Paper	4	8	0.4%	38.5%	61.0%	0.0%	0.0%	F
Office Paper		15	0.0%	55.2%	37.3%	7.5%	0.0%	B
Office Paper		22	2.9%	19.3%	77.8%	0.0%	0.0%	S
Office Paper		24	0.0%	8.5%	91.5%	0.0%	0.0%	F
Other Mixed Recyclable Paper/Kraft	3	14	0.0%	15.6%	55.7%	28.8%	0.0%	C
Other Mixed Recyclable Paper/Kraft		17	0.0%	12.6%	48.1%	39.3%	0.0%	B
Other Mixed Recyclable Paper/Kraft		23	0.0%	6.0%	27.2%	66.9%	0.0%	F
Non-recyclable Paper Products	3	6	3.1%	35.8%	61.0%	0.0%	0.0%	F
Non-recyclable Paper Products		11	0.0%	17.9%	72.6%	9.5%	0.0%	B
Non-recyclable Paper Products		19	1.0%	25.3%	73.7%	0.0%	0.0%	
PET Bottles (#1)	1	4	0.0%	0.0%	100.0%	0.0%	0.0%	F
PET Packaging (#1)	1	12	0.0%	0.0%	36.2%	63.8%	0.0%	C
HDPE Bottles	1	5	0.0%	12.3%	87.7%	0.0%	0.0%	F
PolyPropelene (#5)	4	2	2.3%	48.8%	48.8%	0.0%	0.0%	S
PolyPropelene (#5)		7	1.6%	52.4%	46.0%	0.0%	0.0%	F
PolyPropelene (#5)		13	7.8%	57.8%	32.8%	1.6%	0.0%	B
PolyPropelene (#5)		18	1.1%	46.6%	37.5%	14.8%	0.0%	
Mixed Containers (#3-#7)	1	3	3.2%	41.9%	54.8%	0.0%	0.0%	S
EPS Foam	1	10	0.0%	13.2%	86.8%	0.0%	0.0%	S
Non-Recyclable Rigid Plastic	1	20	13.5%	38.5%	21.9%	26.0%	0.0%	F
Textiles	1	9	1.5%	31.3%	7.5%	59.7%	0.0%	F



## 10.7 Results of November 2021 MRF Sort by RRS

#	Group	Category	Average % - Incoming SS	Error +/- (90%)	Average % - Residue
1	Fiber	OCC	36.7%	7.9%	2.7%
2		News (ONP)	1.6%	0.5%	0.5%
3		Mixed Paper & paper bags	21.3%	3.4%	30.4%
4		Paper FSP cups & clamshells	0.2%	0.1%	0.7%
5		Cartons (Gable & Aseptic)	0.5%	0.1%	0.6%
6		Other Fiber	0.2%	0.3%	2.0%
7	Metals	Deposit Aluminum (UBC)	0.6%	0.3%	1.9%
8		Aluminum Foil & Trays	0.6%	0.4%	2.3%
9		Steel Cans	2.5%	0.5%	0.8%
10		Other Metals	0.3%	0.2%	0.4%
11	Plastics	Deposit PET Bottles (#1)	2.3%	0.6%	0.9%
12		Other PET Bottles (#1)	2.3%	0.5%	4.8%
13		PET Cups and Clamshells (#1)	1.2%	0.2%	1.5%
14		HDPE Bottles (#2)	4.6%	0.7%	3.6%
15		Polypropylene (PP) Tubs Cups & Clamshells (#5)	2.2%	1.2%	11.5%
16		Polystyrene (PS) Cups and Clamshells (#6)	0.4%	0.2%	1.4%
17		Plastics lids and closures	1.1%	1.1%	7.2%
18		Plastic Film	2.8%	1.1%	3.0%
19		Other Plastic	1.4%	0.8%	5.2%
20	Glass	Glass	5.4%	1.4%	1.2%
21	Other	Residue Textiles	0.5%	0.4%	0.2%
22		Residue Organics & Food Waste	0.2%	0.3%	0.9%
23		Residue Fines	5.6%	2.0%	10.2%
24		Residue Bulky Waste	2.8%	1.4%	0.6%
25		Residue Other	2.5%	1.1%	5.3%



## 10.8 Generation Tables for In-County Estimates from County Dataset

Five months of Data was generated from collected data at scalehouse but only Oct-Dec was used to estimated monthly average tonnage:

SKL Kent County MSW						
	SKL Tons	SKL % per year	Residential	Front Load	Compactor	Other
March	4,989	9%	2,217	1,731	758	283
April	4,989	9%	2,217	1,731	758	283
May	4,989	9%	2,217	1,731	758	283
June	4,989	9%	2,217	1,731	758	283
July	4,989	9%	2,217	1,731	758	283
August	4,989	9%	2,217	1,731	758	283
September <sup>1</sup>	4,989	9%	2,217	1,731	758	283
October	6,131	11%	2,602	2,111	922	497
November	4,647	8%	2,189	1,560	685	213
December	4,189	8%	1,862	1,523	667	138
January	2,928	5%	1,406	1,046	290	186
February	2,850	5%	1,313	917	484	137
Total Measured	20,745	20,745	9,370	7,157	3,047	1,171
Average	4,149	check	1,874	1,431	609	234
Average 2021	4,989		2,217	1,731	758	283
<b>Total Est. TPY</b>	<b>55,668</b>		<b>24,891</b>	<b>19,275</b>	<b>8,351</b>	<b>3,151</b>
(1) September data not counted as it was not a full month						
WTE Kent County MSW						
	SKL Tons	SKL % per year	Residential	Front Load	Compactor	Other
March	20,772	9%	8,390	9,292	2,826	264
April	20,772	9%	8,390	9,292	2,826	264
May	20,772	9%	8,390	9,292	2,826	264
June	20,772	9%	8,390	9,292	2,826	264
July	20,772	9%	8,390	9,292	2,826	264
August	20,772	9%	8,390	9,292	2,826	264
September <sup>1</sup>	20,772	9%	8,390	9,292	2,826	264
October	18,617	8%	7,368	8,581	2,428	239
November	22,016	9%	8,905	9,834	3,188	89
December	21,682	9%	8,896	9,462	2,862	463
January	18,036	7%	7,127	8,030	2,766	114
February	17,107	7%	6,487	7,799	2,764	57
Total Measured	97,458	97,458	38,782	43,706	14,008	962
Average	19,492	check	7,756	8,741	2,802	192
Average 2021	20,772		8,390	9,292	2,826	264
<b>Total Est. TPY</b>	<b>242,860</b>		<b>97,508</b>	<b>108,753</b>	<b>33,791</b>	<b>2,808</b>
(1) September data not counted as it was not a full month						
NKTS Kent County MSW						
	SKL Tons	SKL % per year	Residential	Front Load	Compactor	Other
March	4,860	9%	3,467	929	49	415
April	4,860	9%	3,467	929	49	415
May	4,860	9%	3,467	929	49	415
June	4,860	9%	3,467	929	49	415
July	4,860	9%	3,467	929	49	415
August	4,860	9%	3,467	929	49	415
September <sup>1</sup>	4,860	9%	3,467	929	49	415
October	5,007	9%	3,444	1,009	75	480
November	4,843	9%	3,464	958	50	371
December	4,729	8%	3,494	819	24	393
January	4,151	7%	3,032	677	4	438
February	3,688	7%	2,497	711	29	450
Total Measured	22,419	22,419	15,931	4,175	181	2,132
Average	4,484	check	3,186	835	36	426
Average 2021	4,860		3,467	929	49	415
<b>Total Est. TPY</b>	<b>56,437</b>		<b>40,202</b>	<b>10,675</b>	<b>525</b>	<b>5,034</b>
(1) September data not counted as it was not a full month						

## 10.9 Cascadia Group Number Definitions by NAICS Code

Group Number	Included NAICS Codes	Industry
<b>1</b>		<b>Arts, Entertainment, &amp; Recreation</b>
	711	Performing Arts & Spectator Sports
	712	Museums, Historical Sites & Similar
	713	Gambling, Recreation, Amusement
<b>2</b>		<b>Durable Wholesale &amp; Trucking</b>
	423	Durable Goods Wholesalers
	484	Truck Transportation
	491	Postal Service
	492	Couriers & Messengers
	493	Warehousing & Storage
<b>3</b>		<b>Education</b>
	611	Educational Services
<b>4</b>		<b>Hotels &amp; Lodging</b>
	721	Accommodation
<b>5</b>		<b>Manufacturing - Electronic Equipment</b>
	334	Computer & Electronic Products
	335	Electrical Equipment & Appliances
<b>6</b>		<b>Manufacturing - Food &amp; Nondurable Wholesale</b>
	311	Food Manufacturing
	312	Beverage & Tobacco Products
	424	Nondurable Goods Wholesalers
<b>7</b>		<b>Manufacturing - All Other</b>
	313	Textile Mills
	314	Textile Product Mills
	315	Apparel Manufacturing
	316	Leather & Allied Products
	321	Wood Products
	322	Paper Products
	323	Printing & Related Support Activities
	324	Petroleum & Coal Products
	325	Chemical Products
	326	Plastics & Rubber Products
	327	Nonmetallic Mineral Products
	331	Primary Metal Manufacturing
	332	Fabricated Metal Products
	333	Machinery
	336	Transportation Equipment
	337	Furniture & Related Products
	339	Miscellaneous Manufacturing
	511	Publishing Industries, except Internet
<b>8</b>		<b>Medical &amp; Health</b>
	621	Ambulatory Health Care Services
	622	Hospitals
	623	Nursing & Residential Care Facilities
<b>9</b>		<b>Public Administration</b>
	92X	Public Administration
<b>10</b>		<b>Restaurants</b>
	722	Food Services & Drinking Places
<b>11</b>		<b>Retail Trade - Food &amp; Beverage Stores</b>
	445	Food & Beverage Stores

Group Number	Included NAICS Codes	Industry
<b>12</b>		<b>Retail Trade - All Other</b>
	441	Motor Vehicle & Parts Dealers
	442	Furniture & Home Furnishings
	443	Electronics & Appliance Stores
	446	Health & Personal Care Stores
	447	Gasoline Stations
	448	Clothing & Clothing Accessories
	451	Sporting Goods, Hobby, Books, Music
	452	General Merchandise Stores
	453	Miscellaneous Store Retailers
	454	Nonstore Retailers
<b>13</b>		<b>Services - Management, Administrative, Support, &amp; Social</b>
	425	Electronic Markets, Agents, Brokers
	551	Management of Companies & Enterprises
	561	Administrative & Support Services
	624	Social Assistance
	813	Religious, Civic, Professional & Similar
<b>14</b>		<b>Services - Professional, Technical, &amp; Financial</b>
	515	Broadcasting, except Internet
	517	Telecommunications
	518	Data Processing, Hosting & Related
	519	Other Information Services
	521	Monetary Authorities - Central Bank
	522	Credit Intermediation & Related
	523	Financial Investment & Related
	524	Insurance Carriers & Related Activity
	525	Funds, Trusts, Other Financial Vehicles
	531	Real Estate
	532	Rental & Leasing Services
	533	Lessors of Nonfinancial Intangible Assets
	541	Professional & Technical Services
<b>15</b>		<b>Services - Repair &amp; Personal</b>
	811	Repair & Maintenance
	812	Personal & Laundry Services
<b>16</b>		<b>Not Elsewhere Classified</b>
	111	Crop Production
	112	Animal Production
	113	Forestry & Logging
	114	Fishing, Hunting & Trapping
	115	Agriculture & Forestry Support Activities
	211	Oil & Gas Extraction
	212	Mining, except Oil & Gas
	213	Support Activities for Mining
	22X	Utilities
	444	Building Materials & Garden Supplies
	481	Air Transportation
	482	Rail Transportation
	483	Water Transportation
	485	Transit & Ground Passenger Transport
	486	Pipeline Transportation
	487	Scenic & Sightseeing Transportation
	488	Support Activities for Transportation
	512	Motion Picture & Sound Recording
	562	Waste Management & Remediation Services



## 10.10 2021 County Tonnage Data

Used to calculate the tons sent from NKTS to Central Landfill (Highlighted)

TONNAGE BY SITE and MATERIAL TYPE																
Year 2021																
	SKL				WTE	NK	MRF		MONTHLY	NKT	NKT	WTE to		MRF	MRF	MRF
	General	SKL	SKL		Reject	to SKL	to SKL		TOTAL	to Pierson	Tons	Ottawa County	WTE	to WTE	to OCF	Inbound
2021	Refuse	Charities	Sludge	Total	& Transfer	Transfer	Transfer	Ash	(SKL)		Received	Farms	Refuse	Transfer	Transfer	Tonnage
January	12,820.41	0.00	1,653.84	14,474.25	5,476.56	0.00	37.86	3,256.60	23,245.27	7,041.64	7,041.64		19,424.56	586.83		3,170.45
February	12,251.43	0.00	1,390.82	13,642.25	2,772.95	0.00	0.00	3,748.44	20,163.64	6,076.72	6,076.72		18,268.46	431.97		2,547.35
March	18,339.60	0.00	1,759.98	20,099.58	6,080.19	0.00	0.00	3,568.11	29,747.88	9,456.89	9,456.89		22,383.98	466.06		3,122.29
April	18,042.70	0.00	2,114.42	20,157.12	7,380.26	0.00	0.00	3,359.74	30,897.12	11,501.33	11,501.33		21,714.25	440.49		2,898.46
May	18,646.54	0.00	1,604.66	20,251.20	4,642.74	29.73	49.18	4,192.57	29,165.42	11,022.81	11,052.54		20,846.92	476.75		2,729.44
June	20,559.41	0.00	1,905.82	22,465.23	6,656.45	0.00	39.77	4,110.38	33,271.83	12,198.58	12,198.58		24,857.66	612.46		3,048.76
July	19,649.30	0.00	2,016.65	21,665.95	6,767.06	9.60	50.25	4,018.05	32,510.91	11,609.32	11,618.92		23,899.64	758.87		2,750.27
August	19,670.59	0.00	1,772.78	21,443.37	7,075.86	0.00	70.53	3,695.44	32,285.20	10,687.80	10,687.80		23,412.62	405.80		2,641.34
September	20,127.39	0.00	1,997.56	22,124.95	7,120.47	0.00	51.13	2,701.96	31,998.51	10,722.45	10,722.45	1,105.81	22,402.79	382.44		2,681.45
October	20,332.23	0.00	2,295.65	22,627.88	7,991.78	0.00	50.93	2,647.75	33,318.34	11,362.76	11,362.76	1,621.59	19,410.28	338.14	42.56	2,568.74
November	17,998.98	0.00	1,584.11	19,583.09	6,192.29	24.35	89.88	3,778.09	29,667.70	10,714.92	10,739.27	1,103.27	22,848.15	416.89	0.00	2,691.72
December	16,883.28	0.00	2,306.50	19,189.78	6,211.48	0.00	75.61	3,811.83	29,288.70	9,199.85	9,199.85	255.70	22,481.72	358.62		3,000.16
2021 Total	215,321.86	0.00	22,402.79	237,724.65	74,368.09	63.68	515.14	42,888.96	355,560.52	121,595.07	121,658.75	4,086.37	261,951.03	5,675.32	42.56	33,850.43
Gen Refuse								YTD TOTAL	355,560.52							
2021 Budget	230,000	-	13,000		85,000		2,000	42,500			100,000		270,000			30,000
2020 Tonnage	196,871	-	12,426		65,726			42,225			115,565		256,512			28,336



## 10.11 Category Generation Estimate by Generator Type

Number	Type	Category	Average %: Residential	in-county Res. TPY	Average %: Commercial	in-county Comm. TPY	out-of- county Comm. TPY	Average %: Other	in-county Other TPY	Total Generation TPY
1		Old Corrugated Cardboard	4.2%	6,902	7.5%	13,655	8,355	13.6%	1,500	30,412
2		Old Newsprint (ONP)	0.6%	953	0.2%	323	198	0.2%	20	1,493
3		Office Paper	2.3%	3,701	1.9%	3,429	2,098	3.5%	380	9,609
4		Magazines and Catalogs	1.6%	2,606	0.8%	1,463	895	1.8%	200	5,164
5	Fiber	Gable Top/Aseptic Containers	0.2%	291	0.1%	231	141	0.0%	1	664
6		Compostable Fibers (Paper Towels, Etc.)	3.2%	5,246	4.4%	7,964	4,873	0.6%	69	18,151
7		Other Mixed Recyclable Paper/Kraft	2.9%	4,640	2.7%	4,930	3,016	2.1%	233	12,818
8		Wet or Soiled Fiber	3.4%	5,597	2.1%	3,895	2,383	1.5%	161	12,037
9		Non-recyclable Paper Products	2.1%	3,485	3.4%	6,087	3,725	2.5%	270	13,567
10		PET Bottles (#1)	2.3%	3,682	1.6%	2,875	1,759	0.2%	27	8,343
11		PET Containers/Packaging (#1)	0.1%	164	0.1%	230	140	0.0%	1	535
12		HDPE Color (#2)	0.5%	822	0.3%	575	352	0.3%	36	1,785
13		HDPE Natural (#2)	0.5%	771	0.5%	866	530	0.1%	10	2,177
14		HDPE Tubs and Lids/Other (#2)	0.2%	267	0.0%	77	47	0.0%	4	395
15	Plastic	PolyPropylene (#5)	1.3%	2,083	0.9%	1,550	948	0.2%	22	4,604
16		Mixed Containers (#3-#7)	0.6%	1,035	1.2%	2,240	1,370	0.1%	10	4,655
17		EPS Foam	0.6%	924	0.5%	992	607	0.5%	57	2,578
18		Film & Wrap	6.1%	9,929	6.2%	11,156	6,826	3.2%	352	28,263
19		Flexible Packaging	1.1%	1,819	1.2%	2,157	1,320	0.1%	12	5,308
20		Mixed Bulky Plastic	1.1%	1,846	8.8%	15,951	9,760	1.2%	132	27,690
21		Non-Recyclable Rigid Plastic	1.6%	2,546	2.1%	3,848	2,354	2.1%	229	8,976
22	Glass	Recyclable Glass	2.0%	3,291	1.3%	2,420	1,481	0.6%	69	7,262
23		Non-Recyclable Glass/Ceramic	0.7%	1,070	0.6%	1,073	656	1.4%	151	2,950
24		Ferrous Metal Containers	1.4%	2,292	0.3%	618	378	0.4%	42	3,331
25		Aluminum Cans (UBC)	0.2%	395	0.2%	352	215	1.0%	112	1,075
26	Metals	Other Ferrous Metals	0.8%	1,345	0.8%	1,480	906	6.9%	761	4,491
27		Other Non-Ferrous Metals	0.4%	630	0.3%	562	344	1.0%	111	1,648
28		Appliances (Small)	0.3%	433	2.4%	4,319	2,643	0.0%	5	7,399
29	Organics	Food/Putrescible Waste	20.6%	33,511	12.8%	23,303	14,258	7.0%	768	71,841
30		Leaves and Grass	2.6%	4,230	0.4%	801	490	0.1%	11	5,533
31		Brush, Prunings, etc.	0.9%	1,410	0.3%	533	326	0.6%	62	2,332
32		Other Organics	2.6%	4,198	2.8%	5,128	3,138	0.4%	47	12,511
33		Liquids	1.1%	1,834	0.9%	1,638	1,002	1.1%	126	4,600
34	HHW	Household Hazardous Waste	0.2%	337	0.4%	701	429	2.0%	221	1,687
35		Medical Waste	0.0%	26	0.8%	1,440	881	0.0%	1	2,348
36	Electronics	Electronics (Small)	0.5%	770	0.5%	918	562	0.6%	70	2,320
37		Electronics (Large)	2.1%	3,351	0.7%	1,266	774	1.2%	129	5,520
38		Batteries	0.1%	169	0.1%	169	103	0.1%	6	446
39	C&D	Clean Wood	0.5%	812	4.8%	8,719	5,335	5.4%	595	15,461
40		Wood- Painted or Treated	1.3%	2,189	1.9%	3,470	2,123	5.7%	629	8,411
41		Concrete/Brick/Ashpalt etc	1.2%	1,916	0.0%	84	51	0.5%	54	2,106
42		Carpet and Padding	0.0%	40	0.2%	365	223	1.7%	182	810
43		Other C&D	1.2%	1,966	1.4%	2,459	1,505	5.0%	548	6,478
44	Textiles	Textiles	5.8%	9,416	4.3%	7,748	4,741	9.9%	1,084	22,989
45		Leather & Rubber	2.1%	3,371	2.7%	4,963	3,037	1.7%	190	11,562
46		Diapers	4.8%	7,814	1.7%	3,097	1,895	0.2%	18	12,823
47	Other	Fines	5.9%	9,669	3.1%	5,624	3,441	1.5%	166	18,900
48		Tires	0	0	0	0	0	0.0%	0	0
49		Bulky Items	2.0%	3,304	3.8%	6,803	4,163	7.6%	839	15,109
50		Other Residue or Composite Items	2.2%	3,501	3.8%	6,825	4,176	2.5%	270	14,773
									<b>Total</b>	<b>465,940</b>



10.12

Raw MCW Study Data with Tares Removed

Cumulative Sample Number	Truck Type	Old Corrugated Cardboard	Old Newsprint (ONP)	Office Paper	Magazines and Catalogs	Gable Top/Aseptic Containers	Compostable Fibers (Paper Towels, Etc.)	Other Mixed Recyclable Paper/Kraft	Wet or Soiled Fiber	Non-recyclable Paper Products	PET Bottles (#1)	PET Containers/Packaging (#1)	HDPE Color (#2)	HDPE Natural (#2)	HDPE Tubs and Lids/Other (#2)	Polypropylene (#5)	Mixed Containers (#3-#7)	EPS Foam	Film & Wrap	Flexible Packaging	Mixed Bulky Plastic	Non-Recyclable Rigid Plastic	Recyclable Glass	Non-Recyclable Glass/Ceramic	Ferrous Metal Containers	Aluminum Cans (UBC)	Other Ferrous Metals	Other Non-Ferrous Metals	Appliances (Small)	Food/Putrescible Waste	Leaves and Grass	Brush, Pruning, etc.	Other Organics	Liquids	Household Hazardous Waste	Medical Waste	Electronics (Small)	Electronics (Large)	Batteries	Clean Wood	Wood- Painted or Treated	Concrete/Brick/Asphalt etc.	Carpet and Padding	Other C&D	Textiles	Leather & Rubber	Diapers	Fines	Tires	Bulky Items	Other Residue or Composite Items	Sample Total	
1	B	8.7	0.5	2.7	4.1	0.0	18.7	6.5	15.1	11.1	8.5	0.3	2.5	0.5	0.0	7.1	0.0	2.5	22.3	3.7	3.5	4.1	7.2	0.8	6.0	3.5	4.0	0.6	0.0	46.5	1.1	0.0	14.4	0.0	0.0	0.0	0.0	2.0	0.0	0.2	0.2	0.0	0.0	0.0	18.1	46.5	0.3	41.4	36.1	0.0	4.4	6.5	361.0
2	C	0.7	0.0	0.0	0.0	0.0	13.9	1.7	1.5	6.9	2.3	0.3	0.1	0.1	0.0	0.1	0.0	0.1	5.9	0.5	17.2	3.5	0.0	0.0	0.0	0.3	0.4	0.2	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.1	1.5	0.0	4.3	0.0	20.8	0.0	109.7			
3	B	2.5	0.0	0.0	0.0	0.1	0.0	0.9	21.3	2.7	2.7	0.0	0.9	0.7	0.3	0.9	0.0	1.5	21.7	2.1	3.5	0.9	4.2	0.0	0.8	0.3	0.0	0.2	0.0	77.5	0.0	7.5	0.0	2.4	0.0	0.0	0.0	0.0	0.0	0.0	10.0	26.0	0.0	0.0	0.0	26.9	19.9	22.0	24.7	0.0	7.0	2.7	293.8
4	C	12.5	0.0	0.0	0.0	0.0	3.4	0.0	4.7	5.9	1.5	0.0	0.0	0.0	0.0	1.3	3.3	2.7	2.6	1.5	0.0	1.3	0.0	1.8	0.2	0.1	0.0	0.0	0.0	0.0	1.5	0.0	0.0	95.0	0.0	0.0	0.0	0.2	0.0	0.0	1.0	0.0	0.0	0.0	4.7	0.0	1.5	0.0	3.5	0.0	0.0	56.1	205.7
5	C	13.2	0.0	0.9	0.0	0.3	0.0	1.1	0.0	53.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	43.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	0.0	0.0	9.6	0.0	52.6	0.0	0.0	0.0	0.0	24.8	205.9		
6	F	19.9	0.0	0.0	0.3	0.5	1.1	2.3	11.1	0.0	7.5	0.3	0.5	0.5	0.1	2.3	0.7	1.9	12.9	0.0	5.7	4.3	1.5	7.8	2.0	1.3	0.4	0.0	0.0	63.1	0.0	0.0	3.2	3.6	1.8	0.0	2.8	0.0	0.0	5.6	0.0	2.6	0.0	0.0	23.3	0.5	52.6	8.1	0.0	25.5	4.3	280.8	
7	F	11.1	0.0	5.5	1.3	0.5	4.4	4.9	11.5	2.9	3.9	0.3	0.1	1.5	0.5	2.7	0.0	1.5	17.5	4.3	0.0	0.3	6.8	5.4	1.1	3.4	0.0	0.0	0.0	35.1	0.0	12.3	5.4	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	80.0	0.0	0.0	8.9	6.3	0.7	1.6	26.9	0.0	3.9	14.3	286.9
8	S	4.9	0.9	5.3	1.5	0.0	4.3	18.5	14.3	1.5	3.9	0.3	0.0	0.7	0.7	5.9	3.9	1.1	24.5	3.7	0.0	5.5	3.5	0.5	4.7	0.1	0.0	0.0	0.0	48.1	15.7	0.3	10.8	0.0	0.0	0.0	3.4	0.0	0.0	0.8	1.0	0.0	0.0	0.0	23.9	1.5	25.6	32.9	0.0	1.1	5.1	279.1	
9	S	7.3	0.0	29.7	6.9	0.3	1.8	1.5	12.7	2.7	2.5	0.0	1.3	1.1	0.0	1.1	0.9	1.1	6.9	0.9	0.5	5.9	0.8	0.0	2.7	0.0	1.3	0.2	0.0	15.3	6.3	0.0	5.0	1.8	0.0	0.0	2.4	27.0	1.6	0.0	2.6	0.4	0.0	0.0	28.3	19.9	3.2	21.3	0.0	0.0	15.5	239.6	
10	S	37.0	0.0	1.5	0.0	0.3	3.8	8.5	7.1	2.1	9.5	0.1	1.7	0.9	0.0	2.1	4.5	0.9	6.7	1.1	3.5	0.7	8.8	3.0	2.3	0.5	2.2	0.2	0.0	11.9	0.0	0.0	0.0	1.6	0.0	0.0	0.4	0.0	1.0	0.2	0.0	0.0	0.0	0.0	5.7	0.0	0.2	5.9	0.0	0.0	1.1	136.1	
11	C	53.5	0.0	0.3	0.0	0.0	8.9	2.1	2.5	0.7	0.3	0.0	0.5	0.0	0.3	0.1	3.7	0.0	18.1	0.7	0.0	5.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	94.4	0.0	0.0	0.0	0.0	8.1	0.0	2.5	0.0	0.0	0.7	203.1		
12	S	17.3	0.0	4.1	1.1	0.1	2.9	12.7	6.3	3.7	4.5	0.0	0.7	0.7	0.5	2.5	3.5	2.5	8.6	2.1	4.1	6.5	7.6	1.0	4.5	0.3	6.0	0.2	0.0	36.9	16.0	0.0	6.5	4.2	0.0	0.0	0.2	0.0	0.0	1.2	3.0	0.0	0.0	0.0	14.1	0.7	7.0	22.5	0.0	0.0	19.9	235.0	
13	S	1.5	0.3	2.5	4.1	0.1	11.1	8.5	0.0	8.9	2.3	0.1	0.3	1.9	0.7	2.5	1.7	0.7	70.8	2.9	2.7	7.5	0.6	2.0	2.5	0.5	1.2	0.4	0.0	63.9	0.0	2.3	13.2	1.6	6.0	0.0	7.0	28.2	0.0	0.0	7.4	0.0	0.0	1.9	28.7	4.9	11.2	17.7	0.0	4.7	5.5	341.1	
14	F	7.9	0.7	4.9	2.7	0.1	21.5	2.5	2.9	10.5	2.1	0.1	0.9	0.5	0.0	1.1	0.1	0.3	19.2	0.3	3.7	1.5	0.4	0.0	0.7	0.3	0.0	0.0	0.0	20.7	18.7	0.0	0.0	0.0	2.4	33.4	0.0	0.0	0.4	19.8	0.0	0.0	0.0	0.0	1.9	1.8	0.0	3.1	0.0	0.0	6.5	192.3	
15	C	3.7	0.0	1.9	0.0	0.0	0.3	38.7	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	3.0	12.4	10.1	0.0	0.0	0.0	0.0	0.0	0.6	0.0	79.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.4	0.0	0.0	0.0	0.9	0.1	0.0	0.0	0.0	0.0	0.0	0.0	159.8		
16	B	9.7	0.7	3.1	1.3	0.5	7.5	7.5	0.0	2.1	2.7	0.5	0.3	0.9	0.1	1.5	0.3	0.5	13.9	1.5	9.5	3.5	8.4	0.8	5.9	0.3	0.2	1.2	0.0	41.5	7.7	1.1	0.8	1.6	0.0	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.5	3.6	16.2	9.1	0.0	13.0	3.1	186.8	
17	F	26.3	0.0	12.3	1.3	0.9	7.5	1.7	4.9	7.9	4.7	0.5	0.9	0.9	0.3	2.1	9.3	1.5	22.3	1.9	5.2	4.7	3.8	0.0	3.8	0.3	2.0	0.2	0.0	16.9	0.0	0.0	0.0	0.0	6.0	0.0	0.9	3.2	0.0	8.9	0.0	0.0	0.0	0.0	50.7	1.5	6.8	29.1	0.0	4.5	1.1	255.5	
18	F	71.5	0.0	25.3	7.1	1.1	8.5	6.3	4.1	8.5	4.3	0.3	0.3	0.7	0.0	3.3	1.5	3.1	12.9	2.1	0.0	1.9	4.0	0.4	3.1	1.1	0.0	1.4	0.0	41.9	0.0	0.0	0.0	9.2	0.0	0.0	3.2	0.0	0.2	6.2	0.0	0.0	0.0	0.0	3.3	0.9	2.6	6.3	0.0	55.8	1.7	303.0	
19	S	2.3	0.0	3.3	3.9	2.7	5.9	2.3	10.9	13.1	1.5	0.3	0.1	0.7	0.7	3.7	2.5	2.1	11.9	4.1	0.9	1.9	0.6	0.0	1.9	1.1	1.2	0.4	0.0	60.5	0.0	0.1	5.0	0.2	0.0	0.0	0.4	3.5	0.0	1.2	1.0	0.0	0.0	0.0	8.3	3.5	12.4	17.1	0.0	0.5	0.9	193.2	
20	F	4.7	3.3	4.3	1.5	0.3	10.1	2.5	24.5	5.7	6.1	0.5	1.5	3.9	0.9	4.9	0.3	1.5	20.7	3.5	1.5	2.3	6.6	0.8	1.5	1.1	0.6	1.8	0.0	76.1	0.0	0.0	10.2	2.8	9.6	0.0	3.4	8.8	0.2	32.2	34.6	0.0	0.0	0.0	14.9	0.3	11.2	4.3	0.0	0.0	3.7	328.0	
21	S	5.3	0.9	6.5	3.5	0.0	10.1	6.9	6.5	5.1	3.5	0.7	0.3	0.5	1.5	4.1	0.0	1.1	8.1	2.3	0.3	1.1	7.0	3.8	2.3	0.5	0.0	1.0	7.5	60.1	0.0	5.9	8.0	1.0	0.0	1.8	0.0	0.0	1.6	0.0	0.0	0.0	2.9	6.5	3.4	8.5	0.0	0.0	1.5	190.3			
22	S	3.5	2.7	4.3	3.3	0.5	15.9	5.7	7.1	8.9	7.1	0.1	2.1	1.9	0.3	5.1	1.5	2.9	13.3	6.7	8.5	4.7	2.6	3.2	3.9	0.7	2.6	0.2	0.0	97.3	0.0	6.5	13.4	5.6	0.0	0.0	1.4	0.0	0.4	0.4	0.5	6.0	0.0	0.3	19.5	1.3	12.4	12.9	0.0	0.0	1.5	297.4	
23	B	16.9	0.9	5.5	7.5	0.9	16.1	8.5	0.5	5.3	16.3	0.3	3.3	3.9	0.3	3.7	0.9	1.5	8.3	4.7	1.3	6.5	6.4	2.0	5.7	0.5	4.2	3.2	0.0	69.1	1.9	0.0	7.8	0.0	1.8	0.6	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.7	9.1	1.5	13.4	6.9	0.0	3.5	5.9	256.7	
24	C	6.1	0.7	13.3	9.3	0.7	11.7	10.7	3.1	8.1	4.7	1.7	1.1	1.3	0.0	4.9	2.5	1.5	10.3	3.7	4.7	3.3	10.2	2.6	2.5	0.5	2.2	1.4	3.6	49.1	0.1	0.0	8.2	2.4	0.0	0.0	4.4	1.6	0.4	1.1	0.0	0.2	0.0	0.7	4.9	0.7	4.0	10.1	0.0	9.2	4.5	226.6	
25	H	3.5	0.5	6.9	0.0	0.1	0.3	1.7	0.0	0.5	0.3	0.0	0.3	0.0	0.0	0.0	0.0	0.7	0.7	0.0	0.0	0.7	1.4	0.0	2.3	0.0	0.6	0.0	0.0	4.7	0.0	0.0	2.1	0.0	6.8	0.0	0.8	0.0	0.0	0.8	0.2	0.0	0.0	0.0	27.3	0.9	0.0	0.0	20.5	1.8	85.7		
26	H	5.3	2.9	23.5	16.9	0.0	2.1	0.7	25.1	1.9	0.5	0.1	0.0	0.5	0.0	0.1	0.0	0.5	1.5	1.1	0.7	2.7	1.0	2.0	1.9	0.1	0.6	0.0	0.0	1.9	2.7	7.3	0.6	1.0	0.6	0.0	0.4	0.0	0.0	0.0	0.0	25.0	1.8	18.4	6.7	3.1	0.0	0.0	1.7	0.0	36.1	0.0	197.8
27	H	4.3	0.0	0.5	0.3	0.0	0.7	0.0	0.0	0.1	0.0	0.0	0.3	0.0	0.0	0.1	0.0	0.3	3.3	0.1	0.0	4.4	0.0	0.0	0.0	0.0	40.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0	0.0	0.6	0.0	0.0	1.8	0.2	0.0	0.0	0.3	0.9	0.0	0.0	15.7	0.0	82.1	
28	H	3.3	0.0	4.3	22.3	0.0	0.																																														





Cumulative Sample Number	Truck Type	Paper Products										Plastics										Metals										Organics										Hazardous Waste										Construction & Other										Sample Total
		Old Corrugated Cardboard	Old Newsprint (ONP)	Office Paper	Magazines and Catalogs	Gable Top/Aseptic Containers	Compostable Fibers (Paper Towels, Etc.)	Other Mixed Recyclable Paper/Kraft	Wet or Soiled Fiber	Non-recyclable Paper Products	PET Bottles (#1)	PET Containers/Packaging (#1)	HDPE Color (#2)	HDPE Natural (#2)	HDPE Tubs and Lids/Other (#2)	Polypropylene (#5)	Mixed Containers (#3-#7)	EPS Foam	Film & Wrap	Flexible Packaging	Mixed Bulky Plastic	Non-Recyclable Rigid Plastic	Recyclable Glass	Non-Recyclable Glass/Ceramic	Ferrous Metal Containers	Aluminum Cans (UBC)	Other Ferrous Metals	Other Non-Ferrous Metals	Appliances (Small)	Food/Putrescible Waste	Leaves and Grass	Brush, Pruning, etc.	Other Organics	Liquids	Household Hazardous Waste	Medical Waste	Electronics (Small)	Electronics (Large)	Batteries	Clean Wood	Wood- Painted or Treated	Concrete/Brick/Asphalt etc.	Carpet and Padding	Other C&D	Textiles	Leather & Rubber	Diapers	Fines	Tires	Bulky Items	Other Residue or Composite Items											
38	S	16.3	0.1	0.7	0.0	0.3	4.7	13.7	6.9	9.9	4.9	0.3	2.5	0.5	0.1	1.7	1.1	0.7	12.4	6.5	1.1	3.1	5.4	1.0	1.5	0.7	0.0	3.0	0.0	48.3	0.0	0.0	29.4	2.2	0.0	0.0	1.2	0.0	0.0	0.0	0.0	0.0	2.5	8.1	1.1	16.6	5.1	0.0	0.0	11.7	224.1											
39	F	12.5	0.0	3.9	3.1	0.3	8.3	13.5	1.9	4.3	4.7	0.7	2.7	0.9	0.1	3.1	1.5	1.7	14.1	2.7	0.3	2.7	4.0	1.0	0.9	0.1	5.6	4.2	1.6	25.7	0.0	3.5	0.4	1.8	2.6	0.2	0.6	10.8	0.4	7.4	5.0	0.0	0.0	16.3	9.3	5.3	1.0	6.5	0.0	3.3	5.3	204.4										
40	F	16.5	1.7	4.3	0.0	0.3	9.5	2.7	5.7	4.3	5.9	0.1	0.7	0.5	0.0	0.3	2.7	0.9	5.5	2.1	4.7	0.5	0.8	1.2	1.1	0.3	0.3	0.3	0.0	21.9	0.0	0.0	0.4	8.6	0.0	0.0	0.4	0.0	1.8	2.6	0.2	0.0	0.0	0.5	11.1	1.9	4.0	9.7	0.0	3.9	3.7	142.3										
41	C	7.5	0.0	0.1	0.0	0.0	23.5	0.5	2.1	0.0	6.3	0.0	0.0	5.7	0.0	1.5	16.5	0.0	9.9	2.7	9.3	1.8	0.0	0.0	0.0	0.0	5.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.7	111.1													
42	S	16.9	2.1	9.1	7.3	0.7	11.7	7.5	12.5	6.3	4.7	0.7	3.5	1.7	0.5	6.5	2.1	1.5	2.5	10.7	0.7	3.7	2.8	0.0	3.7	0.0	1.1	0.6	0.0	43.5	0.0	62.4	2.4	0.0	0.4	0.0	0.8	0.0	0.0	1.8	7.0	0.0	24.2	0.0	9.9	4.5	1.0	13.1	0.0	9.5	5.3	305.6										
43	S	3.3	0.9	4.5	8.1	1.1	17.3	11.5	21.1	4.7	6.1	0.5	2.5	2.1	0.1	1.7	2.3	1.9	16.1	5.1	4.9	4.7	3.0	0.6	5.5	0.9	2.8	3.8	0.0	61.1	0.0	0.7	33.4	2.4	9.2	4.2	3.4	0.0	0.4	0.0	0.0	0.0	0.0	0.0	18.3	1.3	10.8	16.0	0.0	22.6	8.5	328.0										
44	F	7.1	0.0	4.7	4.1	0.3	4.5	0.0	8.3	11.1	1.1	1.1	0.5	0.9	0.0	1.3	0.3	0.1	17.5	2.9	0.0	1.5	0.0	1.2	0.3	0.3	0.2	1.2	0.0	95.1	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	3.3	5.5	3.6	5.6	0.0	20.0	5.5	208.9										
45	S	9.5	1.1	3.9	5.5	0.7	6.3	6.3	1.5	5.5	2.5	0.5	0.9	0.5	0.0	1.7	0.9	0.7	6.3	4.1	0.0	1.9	1.2	4.0	0.5	0.1	3.0	0.4	0.0	57.5	0.0	1.9	7.0	1.0	0.2	0.0	0.0	8.0	0.0	0.0	0.0	34.2	0.0	0.0	1.5	6.9	3.9	3.4	107.9	0.0	0.0	4.1	305.7									
46	F	10.7	0.9	7.5	0.3	0.5	5.1	5.1	3.3	7.3	4.9	0.3	2.3	0.0	0.0	3.7	0.5	3.5	12.3	2.7	0.5	1.3	10.4	0.0	0.3	0.7	2.2	0.8	0.0	41.9	0.0	0.0	1.0	5.8	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	4.9	5.7	1.4	5.4	7.3	0.0	0.0	1.7	166.0											
47	F	22.1	0.0	2.3	1.3	0.0	13.3	8.1	2.9	1.9	3.1	0.1	0.9	0.9	0.0	2.7	0.3	0.5	8.1	1.9	0.0	13.8	5.4	0.4	0.3	0.1	0.7	0.2	0.0	37.9	0.0	0.0	6.2	2.4	0.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	4.9	5.9	1.8	1.9	0.0	26.0	0.0	179.8											
48	S	31.6	0.7	1.1	2.5	0.3	8.5	0.0	1.7	4.5	4.7	0.1	1.9	1.5	0.5	2.5	0.3	0.7	7.1	3.7	0.3	3.1	0.0	1.8	1.9	0.1	3.6	0.4	0.0	47.9	0.0	0.9	3.4	5.8	0.0	0.8	1.0	0.0	0.2	1.2	0.6	0.0	0.0	0.5	6.3	0.9	14.6	17.7	0.0	17.1	5.1	207.8										
49	C	12.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.0	0.0	2.1	3.0	0.0	163.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.7	0.0	0.0	0.0	0.0	0.0	0.0	187.5											
50	C	22.1	0.3	0.7	0.7	0.0	4.3	0.3	0.0	0.7	0.7	0.0	0.1	0.1	0.1	0.1	0.1	0.0	8.5	1.4	146.1	49.3	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.5	16.1	0.0	0.3	0.0	0.0	0.0	1.3	259.7												
51	R	36.5	0.0	1.9	0.7	0.1	3.5	3.1	0.0	30.5	0.5	0.0	1.1	0.9	0.0	0.3	0.0	0.0	0.6	0.1	2.9	0.3	1.2	0.0	0.0	0.1	0.0	0.0	0.0	1.1	0.0	0.0	1.4	1.4	0.0	0.0	0.2	7.0	0.0	4.8	0.0	0.0	0.0	0.0	18.3	1.7	0.2	0.0	0.0	0.0	0.7	120.2										
52	R	9.9	0.9	12.1	19.1	0.0	2.1	6.9	0.0	4.1	0.7	0.1	0.5	0.3	0.9	2.1	0.1	0.9	1.5	0.9	4.3	1.5	1.6	3.2	0.3	0.1	3.5	0.2	0.0	57.9	0.0	0.0	3.0	3.6	0.0	0.0	2.6	0.0	0.6	3.2	0.0	0.0	0.0	59.2	10.3	0.0	2.3	0.0	0.0	12.5	231.7											
53	R	20.6	0.0	0.0	0.0	0.0	1.3	1.5	0.0	1.1	1.9	0.0	0.5	0.3	0.0	0.7	0.5	0.7	40.6	0.9	0.0	0.0	0.0	0.0	1.3	0.1	6.3	21.3	0.0	36.3	0.0	0.0	0.0	0.0	4.2	0.0	0.0	0.0	0.0	63.4	0.0	0.0	24.4	4.9	0.3	4.4	0.0	0.0	0.0	0.0	2.5	239.1										
54	R	31.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.7	0.0	3.3	0.0	1.8	0.0	0.0	0.1	0.7	0.0	0.0	0.0	0.0	0.0	1.6	0.0	0.0	0.0	0.0	0.0	43.2	0.0	7.6	0.0	22.8	0.5	1.1	0.0	1.7	0.0	0.0	0.3	126.4											
55	R	22.4	0.0	0.1	0.0	0.0	1.1	0.5	0.0	0.3	0.5	0.0	0.0	0.0	0.0	0.3	0.1	13.2	11.9	0.1	0.0	0.0	0.0	0.0	0.0	0.3	36.9	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	75.1	91.8	0.0	0.0	25.6	0.7	0.1	0.0	0.3	0.0	34.2	0.0	315.2													
56	R	98.7	0.0	10.9	0.0	0.0	0.3	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.5	0.1	0.0	0.0	1.5	0.0	0.0	0.0	0.1	18.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	6.8	0.3	1.7	0.0	14.2	0.0	0.0	0.9	155.1												
57	R	24.3	0.0	0.5	0.0	0.0	0.7	0.9	15.1	0.3	0.1	0.0	0.0	0.0	0.0	0.5	0.3	0.5	4.1	0.0	13.1	0.0	0.0	0.0	0.0	0.0	35.4	0.3	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	13.4	0.0	4.6	0.0	1.0	3.4	23.0	0.0	34.9	57.7	0.9	0.9	0.0	14.1	0.0	0.0	0.7	250.8								



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