JOHNSON COUNTY SOLID WASTE ANALYSIS FINAL REPORT

Prepared for the

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EXECUTIVE SUMMARY

In September 2006, the Johnson County (Kansas) Environmental Department (JCED) retained Engineering Solutions & Design, Inc. (ES&D) to perform a series of waste characterizations – also referred to as waste picks or waste sorts – at three selected sites within the county (Johnson County Landfill, City of Olathe Transfer Station, and APAC-Reno Construction and Demolition Debris Landfill). The waste characterization study process includes field sorting events at three selected sites in Johnson County, Kansas.

Johnson County is located in the northeastern part of Kansas. It is bordered by the Kansas River, Wyandotte County and Leavenworth County to the north, the Kansas-Missouri stateline to the east, Miami County to the south, and Douglas County to the west.

During the week of September 18, 2006, ES&D conducted site visits at the three facilities selected for the waste characterization study. ES&D's project team along with JCED staff met with the landfill or transfer station manager at each facility and explained the waste sort procedure and the waste sort team's needs. Then, the project team toured each facility, reviewed the facility's operating procedures, and discussed the facility's service areas. The project team conducted an inspection at each facility in order to ascertain the best and least intrusive area for the team to conduct the waste sort. Detailed discussions were undertaken between the project team and each facility manager to identify the flow of waste into each site, day-to-day variations in solid waste delivered to each site, and any specific peculiarities in the solid waste delivered to each site.

For this solid waste analysis study a total of two seasonal sorts were conducted at each facility. The first seasonal sort was conducted in October 2006. The second seasonal sort was conducted in late March and April 2007.

APAC-Reno Construction and Demolition Debris Landfill Procedures

The waste sort process at this site involved three steps. The first step was an initial interview of all vehicles that delivered waste to the landfill's working face. This initial interview involved obtaining information on the type of waste and the waste's origin. Once the initial interview was completed, the driver was sent to the working face. At the working face loads were randomly selected for sorting.

Once a sample load was identified, the driver was directed to discharge the load. Because the construction/demolition debris loads are not compacted and the landfill operations staff divides the loads once the delivery vehicle is unloaded, a majority of the waste materials were visible and no further separating action was necessary.

Once the load was discharged, it was visually inspected by walking around the load in a clockwise direction and then once the load had been circumnavigated, the walk around direction was reversed and the load was visually inspected again. Each load was visually inspected, all observed materials were noted, and measurement areas were flagged. Additionally, photographs of each sampled load were taken.

Measurement areas were inspected and the identified material was measured. The results of the measurements were noted. When possible, in addition to measuring identified materials, the entire load was measured to obtain an approximation of the load's volume.

Johnson County Landfill and Olathe Transfer Station Procedures

At each facility the waste sort team was comprised of the project manager, the project coordinator, an individual to collect and record data, and a minimum of four additional individuals to assist in the sorting process. All waste sort team members were outfitted with Tyvek protective suits, Kevlar lined gloves, safety goggles, hard hats, and high-visibility safety vests.

The project manager and project coordinator ensured that the site was secure, identified any changes in the site operation, and communicated with site operations staff. Additionally, these two team members began the set-up process and tested the scales to ensure proper operation and accuracy.

The first step in the sort process was setting up the site. Two tents were configured as work stations with sort tables where portions of the sample were placed for categorizing. Two individuals sorted and categorized waste in each tent. The third tent was configured for material weighing and data gathering. Two scales were utilized for weighing samples and sorted waste. A floor scale (with the capacity to accurately weigh up 300 pounds) was positioned adjacent to the tracking table and a smaller scale (with the capacity to accurately weight up to 50 pounds) was placed on the tracking table.

Once the sort area was setup, the next step was selecting loads for sampling. When a vehicle arrived at the site, a very brief, initial interview was conducted with the driver to determine the load's content and collection location. If this interview revealed the load did not meet the study parameters, the driver was directed to the working face or tipping floor and the load was not sampled. If the load did meet the study parameters, the driver was directed to unload the vehicle in the designated area. After the vehicle was unloaded, the driver was interviewed in more detail. In addition to completing an interview with the vehicle driver, a detailed visual inspection of each selected load was undertaken. This visual inspection entailed observing the load being discharged from the collection vehicle and walking around the entire perimeter of the load once it was discharged (a walk around).

During the unloading and walk around inspections, all anomalies and large seams of a particular waste category were noted. At least three photographs of each load were taken.

The load was randomly selected keeping in mind that a broad spectrum of data was desired. After a load was selected and the portion to be sampled was determined, the physical waste sort began. Waste was gathered from the designated load portion and placed into sampling bins. The sample bins were carried to the sort area and weighed. After the sample bins were weighed, they were taken to one of two sort stations. Each sort station was comprised of two tables with a series of various sized bins. Each bin was labeled with a specific material category. Solid waste was removed from the sample bins and placed on the tables where it was sorted into the waste-material categories by placing the material in the bin that best corresponded to the material. As each bin became full, it was weighed on a digital bench scale and its weight recorded. This process was then repeated for each sample. After the team sorted, categorized, and weighed the designated sample, the waste was discarded. Depending on the facility and site constraints, the waste was discarded onto the tipping floor or the landfill working face.

The data for each sample was recorded on forms prepared for each site. Data for each sample was recorded on separate forms. The sampling program was checked twice daily for consistency and completeness.

APAC-Reno Construction and Demolition Debris Landfill Results

During the two seasonal waste sorts at the APAC-Reno Construction/Demolition Debris Landfill, the project team observed some unique activities that may affect the characteristics of the solid waste collected and disposed at this facility. For example:

1. The loads delivered to the site were relatively clean with little contamination. Sorting this material could be easily accomplished with the proper screening process.

2. A large amount of asphalt shingles are delivered to the site. These could be utilized for on-site roads if ground and run through a magnet to remove roofing nails and other metals.

3. The control of stormwater run-on to the face was very good.

4. The control of unacceptable waste was very good. Two spotters were on site to check loads and if any unacceptable materials were found they were quickly removed.

5. The wet weather conditions during the spring sort impacted the number of loads delivered to the site. A total of 42 vehicles delivered loads to the site during the two-day spring sorting event. In contrast, during the two-day fall sorting event at this site, 166 loads of waste were delivered to the site.

6. Two other issues impacted the number of vehicles delivering waste to this site during the spring sorting event:

    a. The facility's owners implemented a rate increase in January 2007.

    b. A transfer truck's load was rejected approximately two weeks before the spring sorting event was undertaken. No transfer trucks owned by this particular company delivered any waste to this site during the two-day spring sorting event.

7. Yard waste that was delivered to the site arrived in bulk, in plastic bags (non-biodegradable), in biodegradable bags, and loose. The loose yard waste appeared to be thrown into the roll-off containers, rather randomly in most cases, which likely reflects either disposal by others than the intended roll-off users of the roll-off or the roll-off was at a residence where a portion of the work was to remove some of the on-site vegetation.

A survey of all vehicles delivering waste to the working face of this landfill was undertaken as a part of the data gathering activities conducted during the two seasonal waste sorts.

During the fall sort, a total of 166 vehicles were surveyed and 78 of these vehicle loads were sampled. Data from the vehicle survey provided information regarding where the load was collected (both state and county), the number of vehicles delivering waste to the facility from a particular county, and the amount of waste delivered to this facility from a particular county during the fall sorting event.

A total of 99 loads of waste delivered to this facility during the fall and spring sorting events was sampled; 78 of these loads were sampled during the fall sorting event and 21 of the loads were sampled during the spring sorting event.

During the fall sorting event, the top five items sighted in the 78 sampled loads included: (1) scrap lumber; (2) metals; (3) cardboard; (4) wood pallets; and (5) carpet. The top five items sighted in the 21 loads that were sampled at this facility during the spring sort included: (1) scrap lumber; (2) furniture; (3) drywall; (4) cardboard; and (5) yard waste/tree limbs.

From the data collected the majority of waste delivered to the site is from new housing or house remodeling efforts. These loads contain a significant amount of scrap lumber, shingles, drywall, insulation, and metals.

To further determine the impact these top ten materials have on the loads delivered

to the APAC-Reno Construction/Demolition Debris Landfill, 50 of the 99 sampled loads were measured to further define the composition of the loads. Of the 50 loads measured, 20 loads contained at least 53% scrap lumber with 7 of the loads containing more than 75% scrap lumber. Cardboard was found in 10 of these 50 measured loads and the average percentage of cardboard in these loads was 10.

Olathe Transfer Station Results

During the waste sort at the Olathe Transfer Station, the project team observed some unique activities that may affect the characteristics of the solid waste collected and disposed at this facility. For example:

1. The site was well organized and provided a number of services for residential users.

2. The transfer station building was relatively small and this size appears to cause queuing and very tight unloading areas.

3. Food products typically contaminated loads. This contamination was often limited to the bag or container in which the food was disposed.

4. The loads observed appeared to contain mostly bagged waste with limited amounts of loose waste.

5. During the spring sorting event, muddy conditions at the Hamm Waste Services Landfill near Perry, Kansas (the destination of the transfer trucks serving this transfer station) reduced the supply of transfer trailers at the transfer station. This affected the transfer station operation, which in turn resulted in less room for to vehicles unload and reduced the opportunity to capture samples. Consequently, 10 loads were captured for sampling each day during the spring sorting event instead of the 12 sample loads captured each day during the fall sorting event.

During the fall sort, 169 vehicles delivered 602.96 tons of solid waste to the Olathe Transfer Station. The majority of the waste delivered to the Olathe Transfer Station was residential waste (63.63% by weight) and the majority of this residential waste was delivered via Olathe collection vehicles (86.72% by weight). The only mixed waste delivered to this facility was via other professional collection vehicles (non-Olathe owned vehicles) and it comprised a small percentage of the waste stream (3.95% by weight).

The number of private vehicles that delivered waste to this facility (39.07%) and the amount of waste delivered via private vehicles accounted for 10.22% of the waste stream. The number of vehicles that delivered commercial waste comprised 11.57% of the total

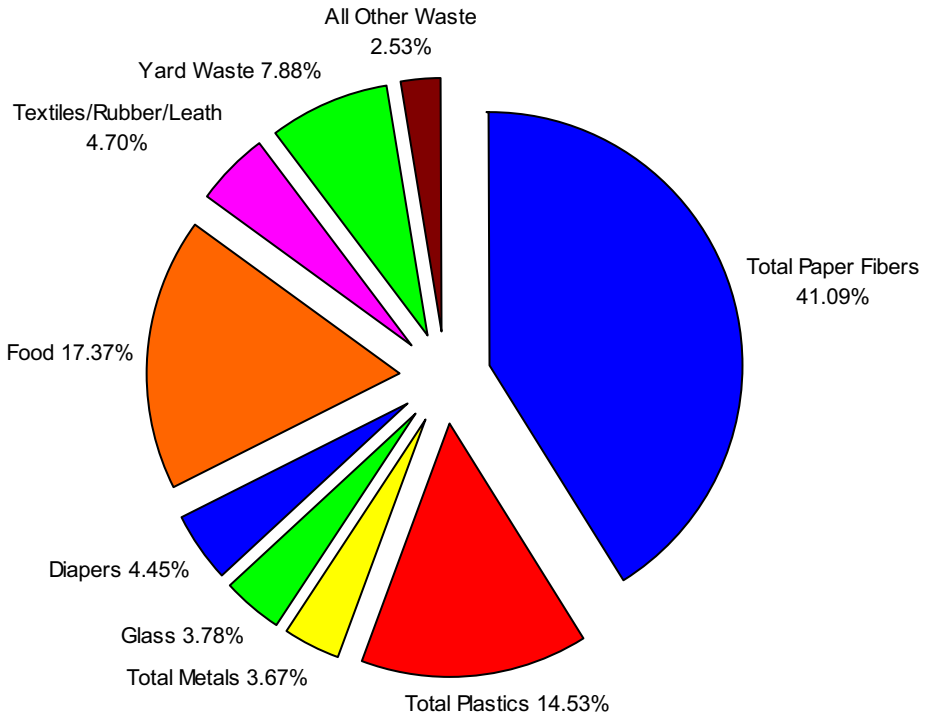
number of vehicles that delivered waste to this facility. Commercial waste accounted for 18.27% of the amount of waste (by weight) delivered to this facility.

A total of 44 loads of solid waste were selected for sampling during the fall and spring sorting events conducted at this facility. Of these 44 sampled loads, 28 were comprised of residential waste (63.3%), 12 were comprised of commercial waste (27.3%), and 4 were comprised of mixed waste (9.1%).

Data from the fall sorting event indicates that the paper fibers component is the largest part of the waste stream at this facility by weight (42.43%). However, the plastics component is the largest part of the waste stream by volume (41.83%), closely followed by the paper fibers component which is 37.28% of the waste stream by volume.

Data from the spring sorting event indicates that the paper fibers component is again the largest part of the waste stream at this facility by weight (39.59%). The plastics component is the largest part of the waste stream by volume (39.41%) and it is again closely followed by the paper fibers component which is 35.71% of the waste stream by volume.

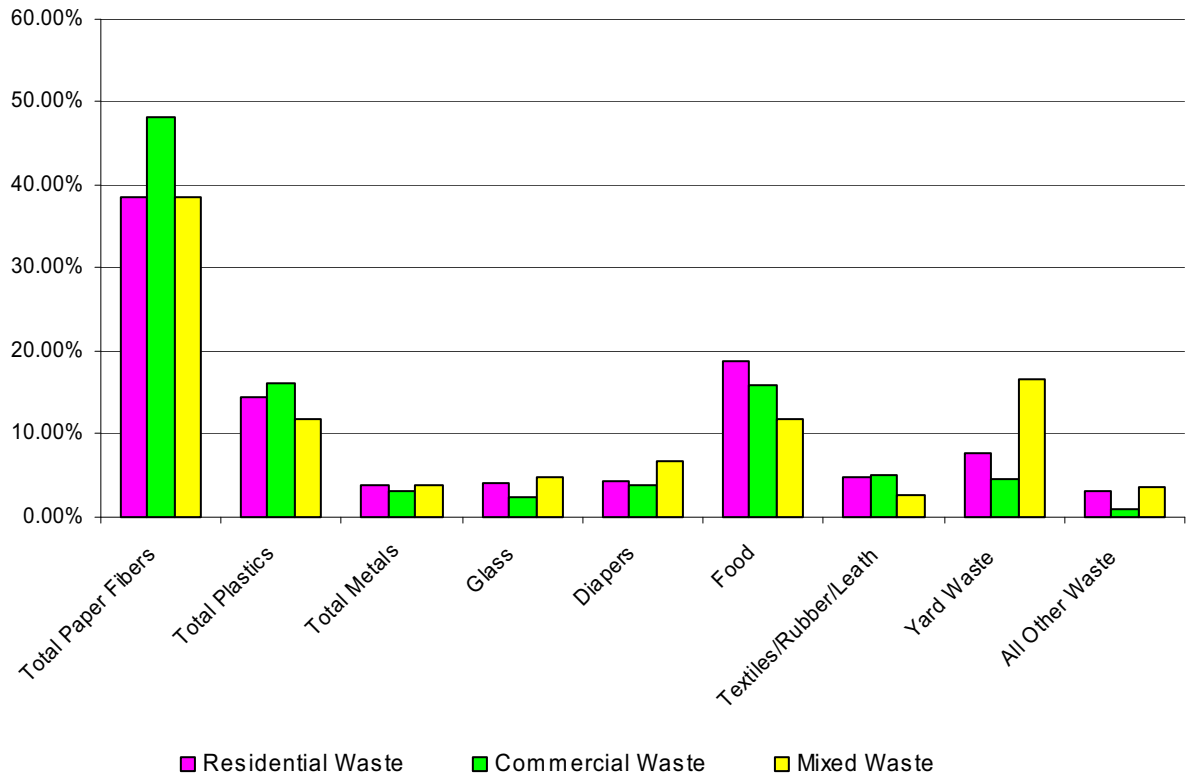
When the data from the fall and spring sorting events is combined, the results are not much different than those for the individual seasonal sorting events. Paper fibers is the largest component of the waste stream by weight (41.09%) and plastics is the largest component of the waste stream by volume (40.69%).



Food is a significant part of the waste stream by weight (17.38% in the fall; 17.36% in the spring; and 17.37% for fall and spring combined). However, food is not a significant part of the waste stream by volume. In the fall, it comprised only 4.73% of the waste stream by volume; in the spring it comprised 4.74% of the waste stream by volume; and for the fall and spring combined it comprised 4.73% of the waste stream by volume.

One other material category merits mention. Yard waste accounted for 6.59% of this waste stream by weight during the fall sorting event and 3.26% of the waste stream by volume. During the spring sorting event, yard waste accounted for 9.31% of the waste stream at this facility by weight and 4.62% of the waste stream by volume.

The residential, commercial, and mixed waste streams at the Olathe Transfer Station were analyzed and compared. The following bar chart presents this comparison.



Johnson County Landfill Results

During the waste sort at the Johnson County Landfill the project team observed some unique activities that may affect the characteristics of the solid waste collected and disposed at this facility. For example:

1. Landfill equipment operators compact the waste quickly to provide areas for the collection vehicles to unload.

2. Most collection vehicles appeared to be rear packers. These trucks tend to have a greater number of seams of loose waste which creates less consolidation of plastics and cardboard.

3. Food products typically contaminated the loads. This contamination was often limited to the bag or container in which the food was disposed.

4. During the fall sorting event, access to roll-off containers was difficult because these trucks were directed to a separate working face. During the spring sorting event, all vehicles were unloading at one working face. Access to the roll-off containers for sampling purposes was much easier.

5. The location of the working face during the spring sort was in an area of the landfill that was quite narrow and this resulted in a tighter working area for the trucks and landfill equipment. Because of the narrower working face, cover material was placed over a portion of the face on Thursday and Friday. This disrupted the flow of collection vehicles and created significant queuing.

6. During both the fall and spring sorting events, project team members observed at least one specific rear packer arriving everyday; its entire load consisted of yard waste disposed in composting bags (see Photo 5.1). When the vehicle driver was interviewed (during the vehicle survey process), he indicated that the waste was collected in Missouri. In addition to this load, yard waste was also found in a number of loads from both Kansas and Missouri. The yard waste was found most frequently in residential loads and it was in plastic bags. Some of the waste was loose; however, this appeared to be in commercial loads that were collected from dumpsters or bins or from residential loads where cans and carts were collected.

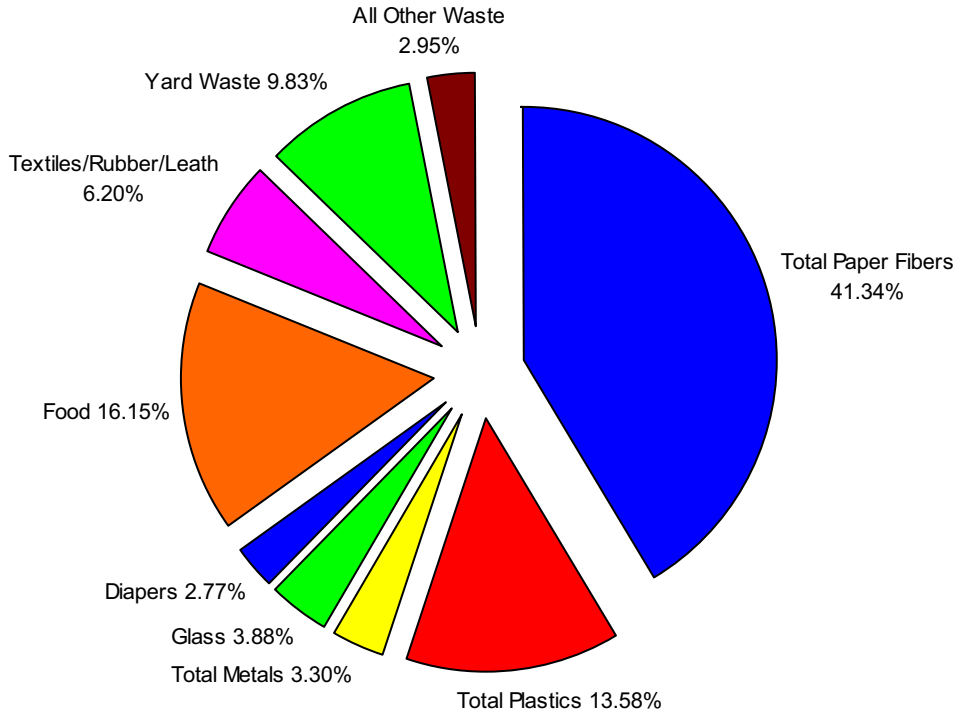
A survey of vehicles delivering waste to the working face of this landfill was undertaken as a part of the data gathering activities conducted during the two seasonal waste sorts. The number of vehicles delivering waste generated in Kansas (60.73%) and the amount of waste generated in Kansas (59.35%) are very comparable. This is also true for the number of vehicles delivering waste generated in Missouri (38.35%) and the amount of waste generated in Missouri (39.72%) as well as the number of vehicles delivering waste generated in both states (0.91%) and the amount of waste generated in both states (0.93%).

A total of 132 loads of solid waste were selected for sampling during the fall and spring sorting events conducted at this facility. Of these 132 sampled loads, 67 were comprised of residential waste (50.8%), 63 were comprised of commercial waste (47.7%), and 2 was comprised of mixed waste (1.5%).

Data from the fall sorting event indicates that the paper fibers component is the largest part of the waste stream at this facility by weight (39.81%). However, the plastics component is the largest part of the waste stream by volume (37.10%), closely followed by the paper fibers component which is 35.77% of the waste stream by volume.

Data from the spring sorting event indicates that the paper fibers component is again the largest part of the waste stream at this facility by weight (42.49%). The plastics component is the largest part of the waste stream by volume (38.83%) and it is again closely followed by the paper fibers component which is 38.28% of the waste stream by volume.

When the data from the fall and spring sorting events is combined, the results are not much different than those for the individual seasonal sorting events. Paper fibers is the largest component of the waste stream by weight (41.34%) and plastics is the largest component of the waste stream by volume (38.08%).



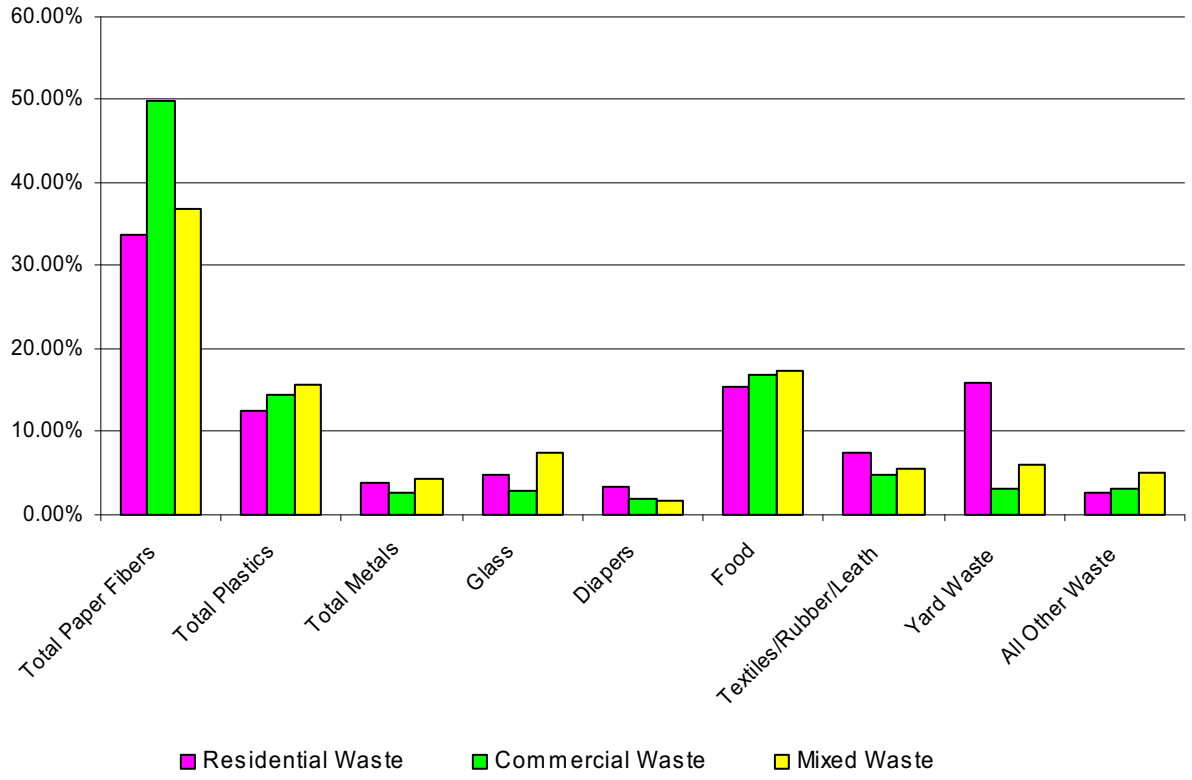
Food is a significant part of the waste stream by weight – 15.21% in the fall; 16.85% in the spring; and 16.15% for the fall and spring combined. However, food is not a significant part of the waste stream by volume. In the fall, it comprised only 4.11% of the waste stream by volume; in the spring it comprised 4.58% of the waste stream by volume; and for fall and spring combined it comprised 4.38% of the waste stream by volume.

During the fall sorting event, yard waste accounted for 10.41% of the waste stream by weight and 5.11% of the waste stream by volume. During the spring sorting event, yard waste accounted for 9.40% of the waste stream by weight and 4.65% of the waste stream by volume.

Two other material categories merit mention. Corrugated paper accounted for 10.21% of this waste stream by weight and 6.62% of this waste stream by volume during the fall sorting event. During the spring sorting event, corrugated paper accounted for 11.93% of the waste stream by weight and 7.79% of the waste stream by volume. Office paper accounted for 5.81% of the waste stream by weight and 6.26% of this waste stream by volume during the fall sorting event. During the spring sorting event, office paper accounted for 7.25% of the waste stream by weight and 7.87% of this waste stream by volume.

During the visual inspection of the sampled loads undertaken at the Johnson County Landfill, a total of 8 different electronic items were identified. Of the electronic items identified, the most frequently sighted items were CPUs, keyboards, monitors, and TVs. A total of 28 different large items were identified during the fall and spring sorting events at the Johnson County Landfill. Of these large items, the three most frequently identified items were lumber, carpet, and wood furniture.

The residential, commercial, and mixed waste streams at the Johnson County Landfill were analyzed and compared. The following bar chart presents this comparison.

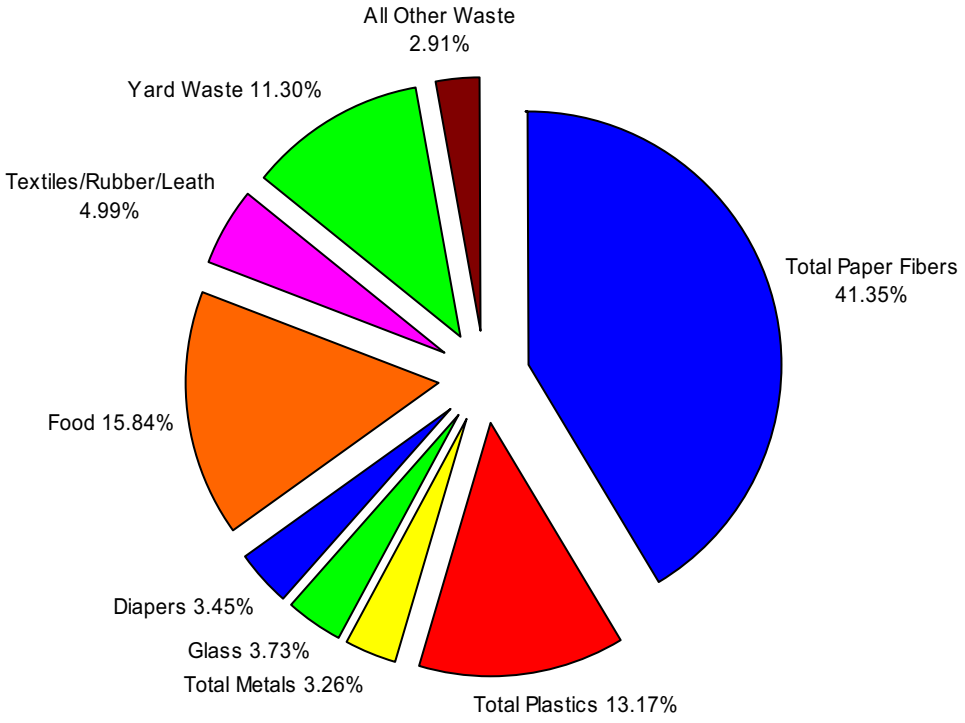


Kansas County Waste Stream

A total of 176 samples were captured at the Olathe Transfer Station and the Johnson County Landfill during the fall and spring (combined) sorting events. Of these 176 samples, 123 samples (69.89%) contained waste generated in Kansas. During the fall sorting event, 59 Kansas samples were captured; during the spring sorting event, 64 Kansas samples were captured. For purposes of this study, the 123 samples that contained waste generated in Kansas will be referred to as the Kansas waste stream.

Data from the fall sorting event indicates that the paper fibers component is the largest part of the Johnson County waste stream by weight (41.37%) and by volume (37.77%). Data from the spring sorting event indicates that the paper fibers component is again the largest part of the Johnson County waste stream by weight (41.34%). However, the plastics component is the largest part of this waste stream by volume (38.11%), closely followed by the paper fibers component which is 37.32% of the waste stream by volume.

When the data from the fall and spring sorting events is combined, the results are not much different than those for the individual seasonal sorting events. Paper fibers is the largest component of this waste stream by weight (41.35%) and paper fibers and plastics are tied as the largest component of this waste stream by volume (37.80% and 37.81%, respectively).



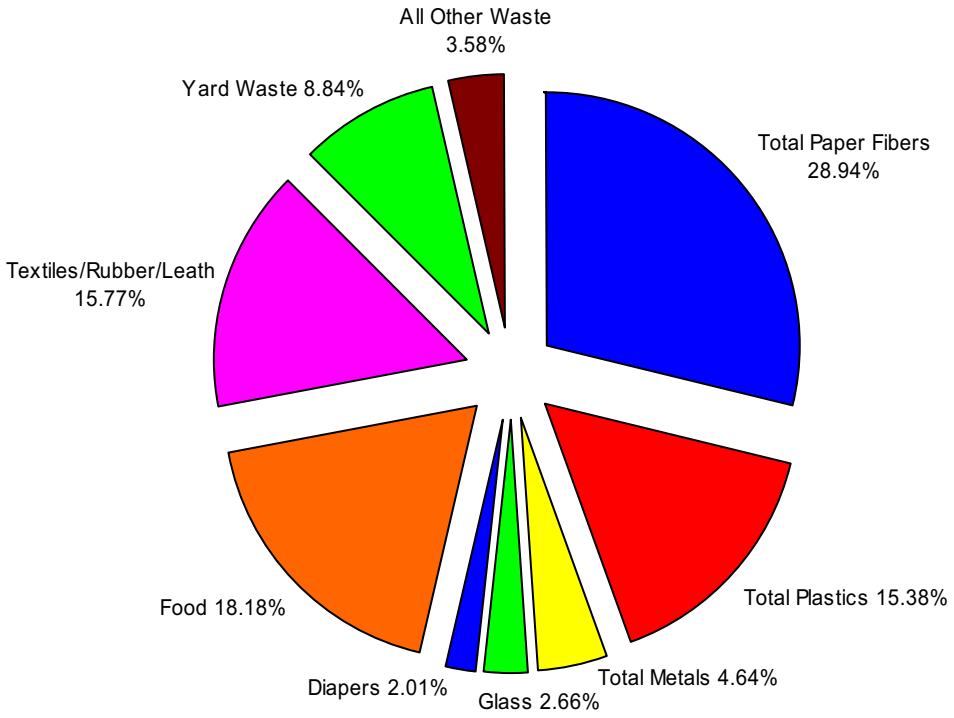
Food is a significant part of the Johnson County waste stream by weight – 14.67% in the fall; 16.69% in the spring; and 15.84% for fall and spring combined. However, food is not a significant part of this waste stream by volume. In the fall, it comprised only 4.10% of the waste stream by volume; in the spring it comprised 4.63% of the waste stream by volume; and for fall and spring combined it comprised 4.41% of the waste stream by volume.

During the fall sorting event, yard waste accounted for 11.69% of the Johnson County waste stream by weight and 5.94% of the waste stream by volume. During the spring sorting event, yard waste accounted for 11.01% of this waste stream by weight and 5.55% of the waste stream by volume.

One other material category merits mention. Corrugated paper accounted for 12.29% of the Johnson County waste stream by weight during the fall sorting event and 8.24% of this waste stream by volume. During the spring sorting event, corrugated paper

accounted for 11.45% of the Johnson County waste stream by weight and 7.61% of the waste stream by volume.

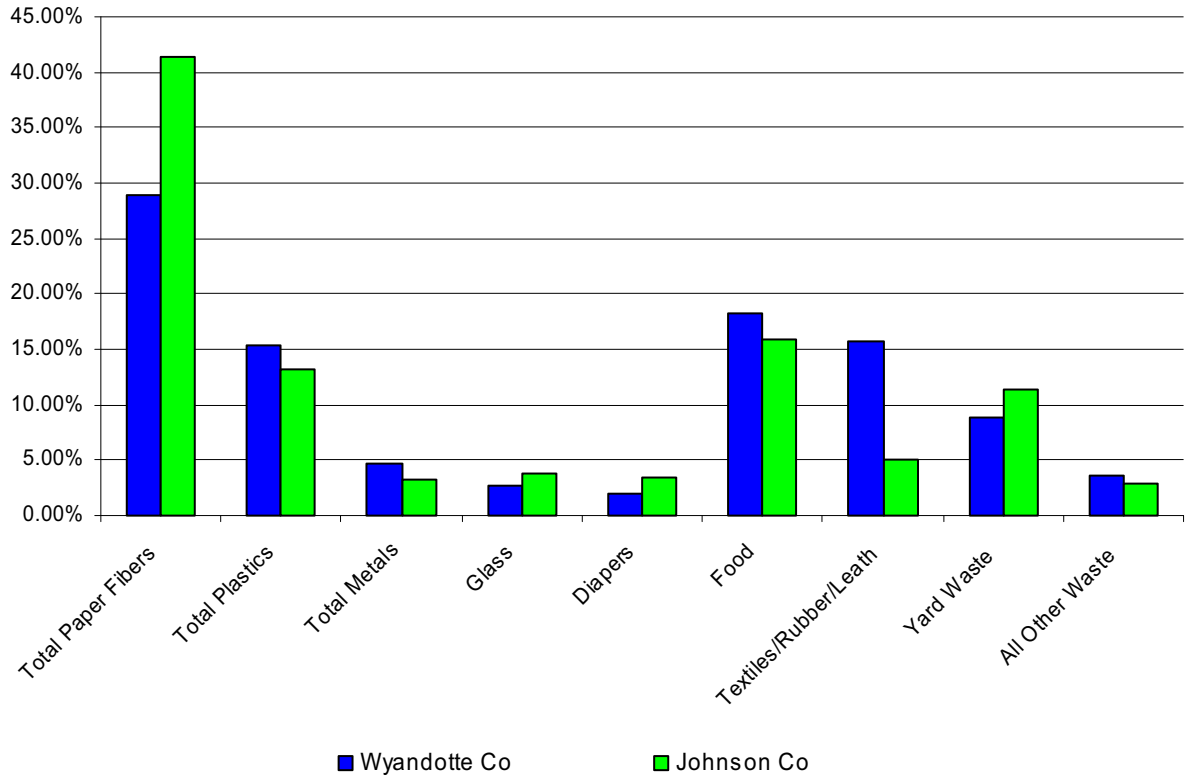
The Wyandotte County data indicate that the paper fibers component comprises the largest part of the waste stream by weight (28.94%). The paper fibers component is followed by food which comprises 18.18% of the waste stream by weight and the textiles/rubber/leather material category which comprises 15.77% of the waste stream by weight.



However, the largest part of the Wyandotte County waste stream by volume is the plastics component at 39.84%. The plastics component is followed by the paper fibers component which accounts for 24.42% of the waste stream by volume and the textiles/rubber/leather material category which comprises 19.71% of the waste stream by volume. The food material category only accounts for 4.62% of the waste stream by volume.

Yard waste does not appear to be a significant part of the Wyandotte County waste stream. It comprises 8.84% of the waste stream by weight and only 4.09% of the waste stream by volume.

The Johnson County waste stream and the Wyandotte County waste stream were analyzed and compared. The following bar chart presents this comparison.



Missouri Waste Stream

A total of 176 samples were captured at the Olathe Transfer Station and the Johnson County Landfill during the fall and spring (combined) sorting events. Of these 176 samples, 53 samples (30.11%) contained waste generated in Missouri. During the fall sorting event, 24 Missouri samples were captured; during the spring sorting event, 29 Missouri samples were captured.

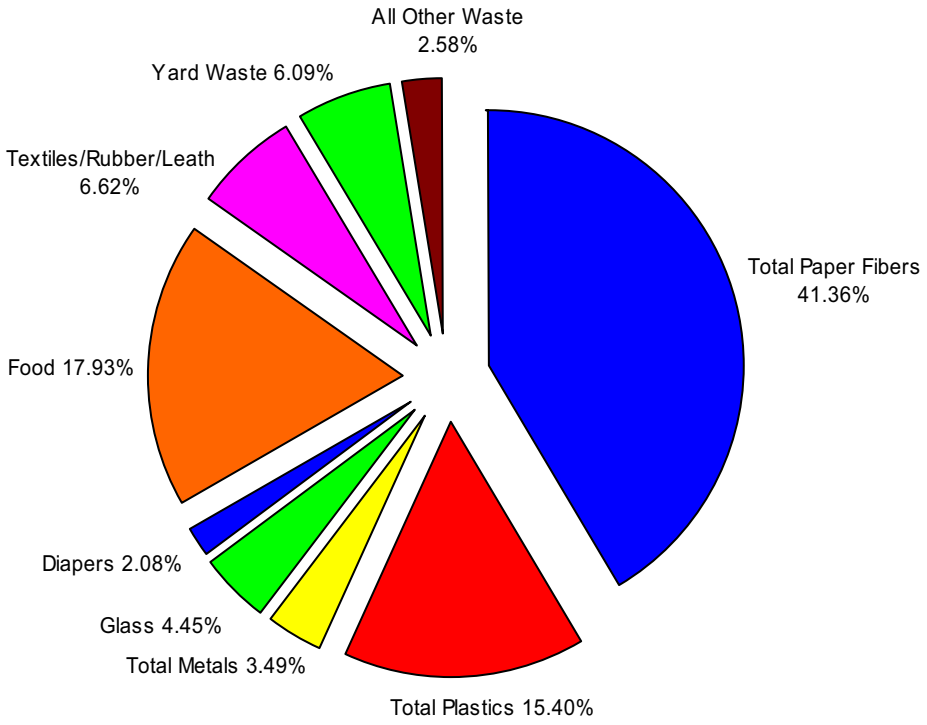
For purposes of this study, the 53 samples that contained waste generated in Missouri will be referred to as the Missouri waste stream. In addition, the Missouri waste stream is further subdivided into four distinct sample groups: (1) the first group encompasses 35 samples that contained waste generated in Jackson County; (2) this group consists of 9 samples that contained waste generated in Clay County; (3) this group consists of 5 samples that contained waste generated in Platte County; and (4) the final group consists of 4 samples of waste generated in Cass County. It is important to note that all of the four groups encompass small sample sets. The information from these sample

sets can be used for comparison purposes; however, it is not a statistically valid representation of the waste stream for any of these four Missouri counties.

Three components (comprised of 12 material categories total) and ten additional material categories comprise the waste stream profile for this study. The three components of the waste stream are paper fibers, plastics, and metals.

The Jackson County data indicate that the paper fibers component comprises the largest part of the waste stream by weight (41.36%). The paper fibers component is followed by food which comprises 17.93% of the waste stream by weight and the plastics component which comprises 15.40% of the waste stream by weight. However, the largest part of the Jackson County waste stream by volume is the plastics component at 41.31%. The plastics component is followed by the paper fibers component which accounts for 35.66% of the waste stream by volume and the textiles/rubber/leather material category which comprises 8.40% of the waste stream by volume. The food material category only accounts for 4.63% of the waste stream by volume.

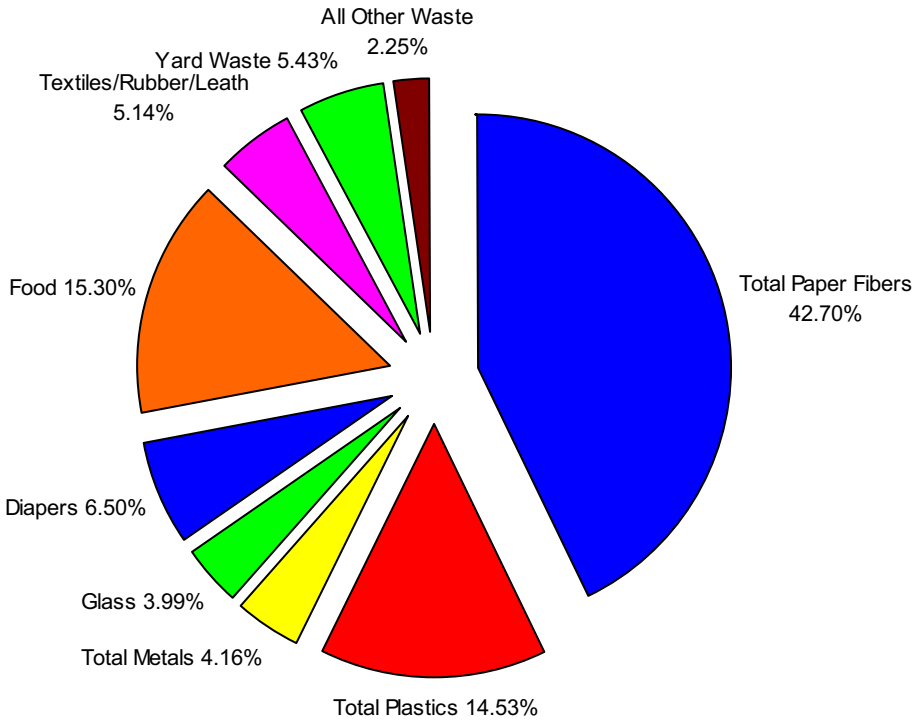
Yard waste does not appear to be a significant part of the Jackson County waste stream. It comprises 6.09% of the waste stream by weight and only 2.86% of the waste stream by volume. Interestingly, the corrugated paper material category accounts for 10.57% of the Jackson County waste stream by weight and 6.55% of the waste stream by volume.



The Clay County data indicate that the paper fibers component comprises the largest part of the waste stream by weight (42.70%). The paper fibers component is followed by food which comprises 15.30% of the waste stream by weight and the plastics component which comprises 14.53% of the waste stream by weight.

However, the largest part of the Clay County waste stream by volume is the plastics component at 40.36%. The plastics component is followed by the paper fibers component which accounts for 36.93% of the waste stream by volume. The food material category only accounts for 4.07% of the waste stream by volume.

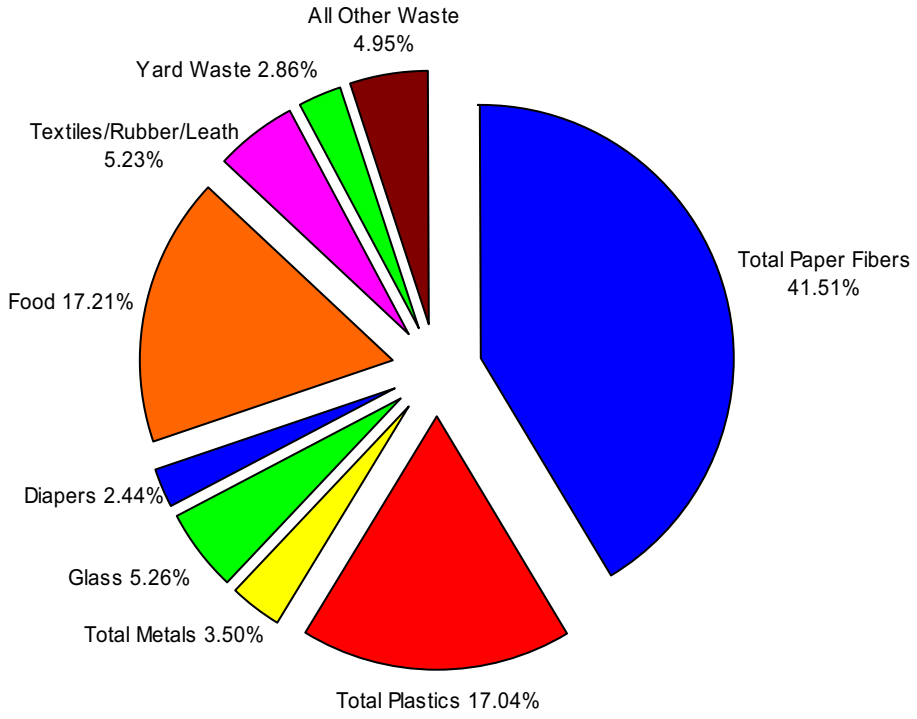
Yard waste does not appear to be a significant part of the Clay County waste stream. It comprises 5.43% of the waste stream by weight and only 2.62% of the waste stream by volume. The other paper material category comprises 13.65% of the waste stream by weight and the corrugated paper material category accounts for 12.61% of the Clay County waste stream by weight. In turn, the film and bags material category accounts for 15.91% of the waste stream by volume and the other paper material category comprises 13.34% of the Clay County waste stream by volume. Corrugated paper accounts for only 8.04% of the Clay County waste stream by volume.



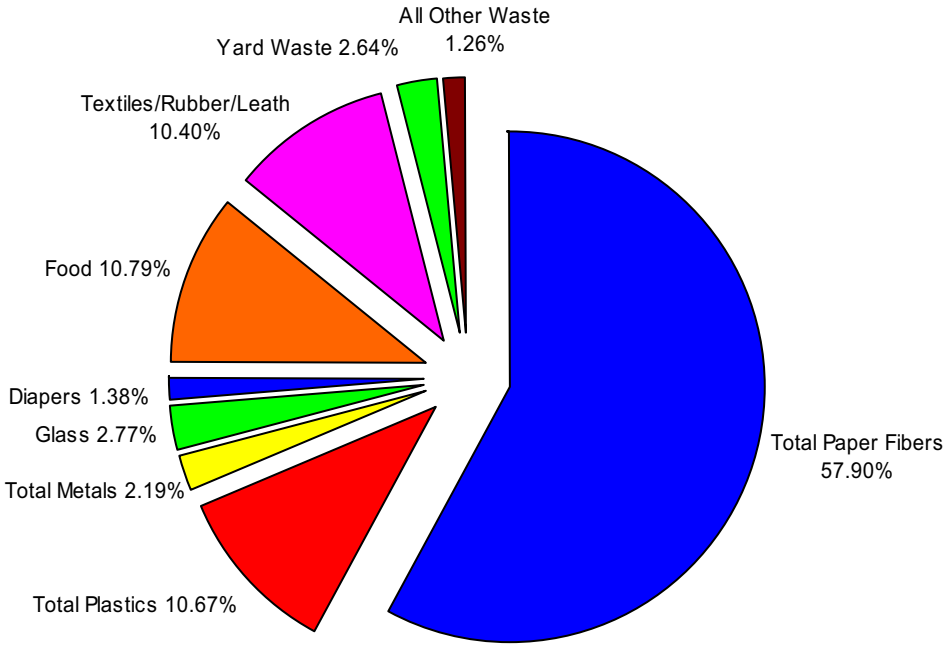
The Platte County data indicate that the paper fibers component comprises the largest part of the waste stream by weight (41.51%). The paper fibers component is followed by food which comprises 17.21% of the waste stream by weight and the plastics component which comprises 17.04% of the waste stream by weight.

However, the largest part of the Platte County waste stream by volume is the plastics component at 44.08%. The plastics component is followed by the paper fibers component which accounts for 36.51% of the waste stream by volume. The food material category accounts for only 4.50% of the waste stream by volume.

Yard waste does not appear to be a significant part of the Platte County waste stream. It comprises 2.86% of the waste stream by weight and only 1.36% of the waste stream by volume. The other paper material category comprises 12.31% of the waste stream by weight. However, by volume, other plastics material category accounts for 19.67% of the waste stream and the other paper material category comprises 11.83% of the Platte County waste stream.



The Cass County data indicate that the paper fibers component comprises the largest part of the waste stream by weight (57.90%). The office paper material category is the largest segment of the paper fibers component. It comprises 42.16% of the weight of the paper fibers component and 24.41% of the weight of the entire Cass County waste stream. Corrugated paper and other paper are also large segments of the paper fibers component. Corrugated paper comprises 24.82% of the weight of the paper fibers component and 14.37% of the weight of the Cass County waste stream. Other paper closely follows corrugated paper accounting for 22.14% of the weight of the paper fibers component and 12.82% of the weight of the Cass County waste stream.



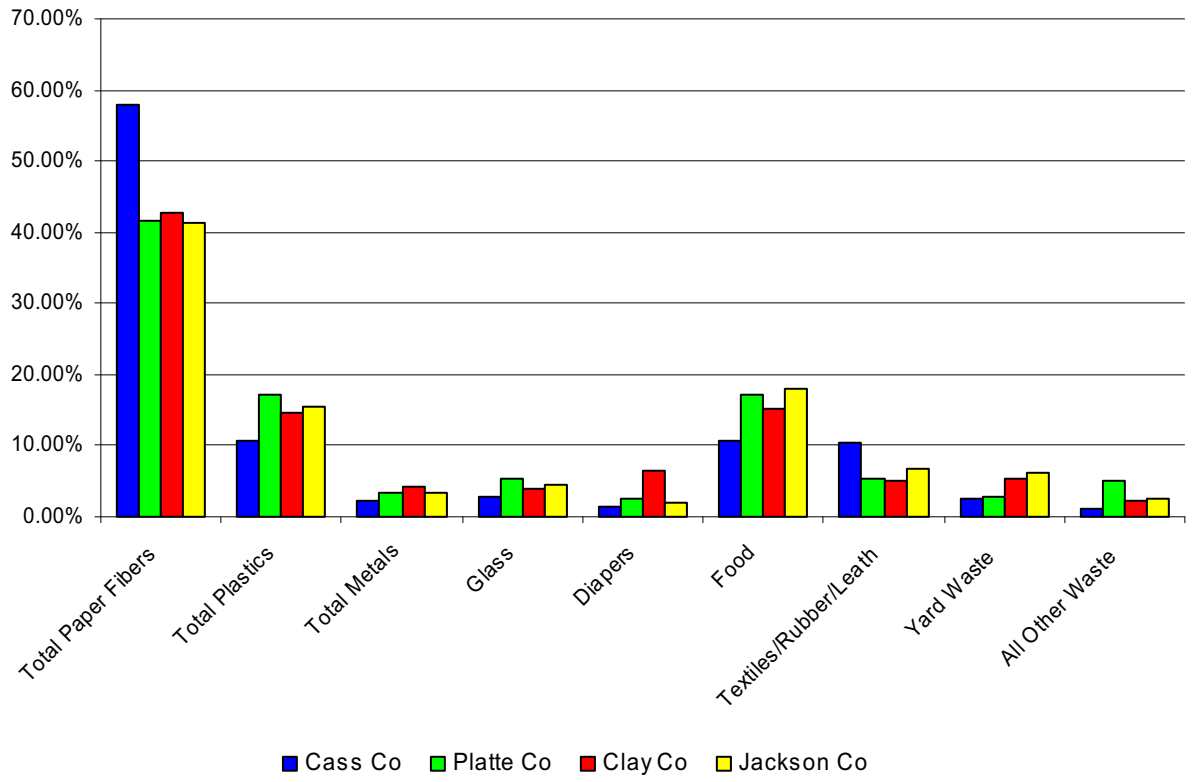
When the material categories that comprise the paper fibers component are excluded, food is the next largest segment of the waste stream; it accounts for only 10.79% of the waste stream by weight. The plastics component and the textiles/rubber/leather material category closely follow food; they account for 10.67% and 10.40% of the weight of the waste stream, respectively.

The largest part of the Cass County waste stream by volume is also the paper fibers component at 50.44%. The plastics component is the next largest part of the Cass County waste stream by volume at 28.38%. Again, the office paper material category is the largest part of the paper fibers component. It comprises 48.66% of the weight of the paper fibers component and 24.54% of the weight of the entire Cass County waste stream. The food

material category accounts for only 2.72% of the waste stream by volume. While, the textiles/rubber/leather material category comprises 12.89% of the waste stream by volume.

Yard waste is not a significant part of the Cass County waste stream as sampled during the fall and spring sorting events. It comprises 2.64% of the waste stream by weight and only 1.21% of the waste stream by volume.

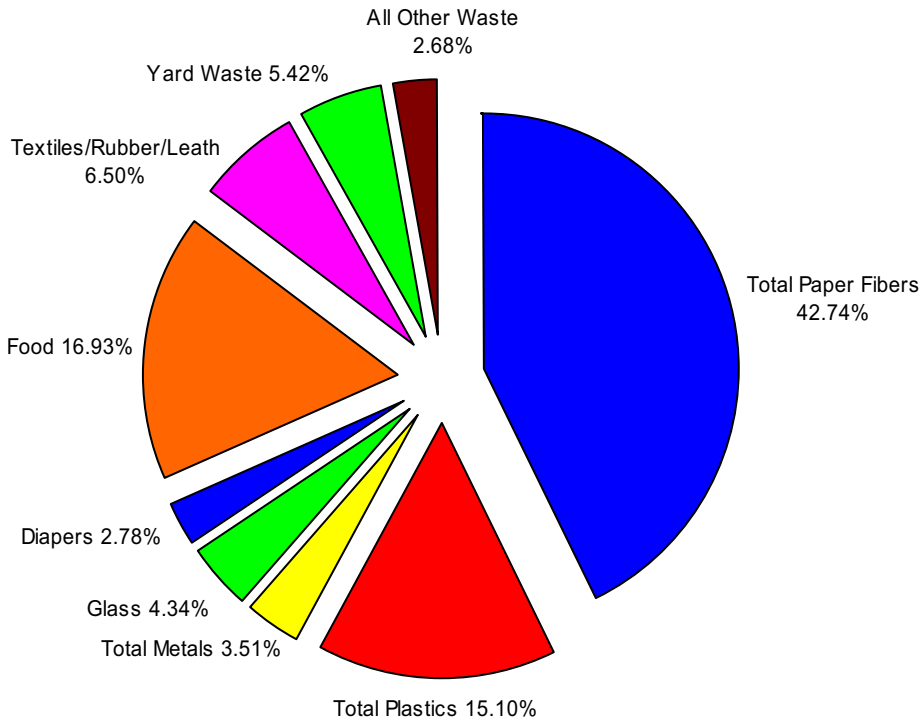
The Jackson County, Clay County, Platte County, and Cass County waste streams were analyzed and compared. The following bar chart presents this comparison.



Three components (comprised of 12 material categories total) and ten additional material categories comprise the waste stream profile for this study. The three components of the Missouri waste stream are paper fibers, plastics, and metals. Together, these three components comprise more than 60% of the Missouri waste stream.

Data from the fall sorting event indicates that the paper fibers component is the largest part of the Missouri waste stream by weight (42.23%). By volume, the plastics component is the largest (40.26%), closely followed by the paper fibers component at 36.26%. Data from the spring sorting event indicates that the paper fibers component is again the largest part of the Missouri waste stream by weight (43.14%). However, the plastics component is the largest part of this waste stream by volume at 40.73%.

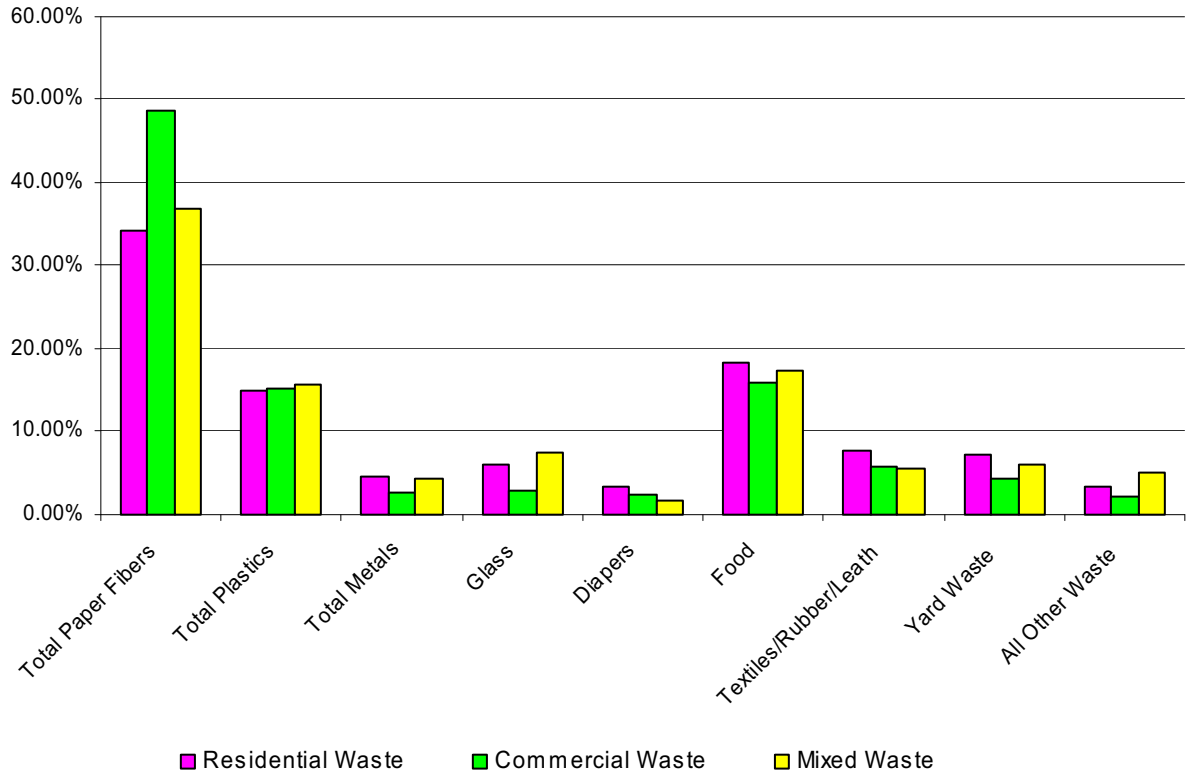
When the data from the fall and spring sorting events is combined, the results are not much different than those for the individual seasonal sorting events. Paper fibers is the largest component of this waste stream by weight (42.74%). The plastics component is the largest part of the Missouri waste stream by volume (40.52%).



Food is a significant part of the Missouri waste stream by weight – 16.14% in the fall; 17.57% in the spring; and 16.93% for fall and spring combined. However, food is not a significant part of this waste stream by volume. In the fall, it comprised only 4.14% of the waste stream by volume; in the spring it comprised 4.60% of the waste stream by volume; and for fall and spring combined it comprised 4.39% of the waste stream by volume.

During the fall sorting event, yard waste accounted for 5.08% of the Missouri waste stream by weight and 2.37% of the waste stream by volume. During the spring sorting event, yard waste accounted for 5.69% of this waste stream by weight and 2.71% of the waste stream by volume.

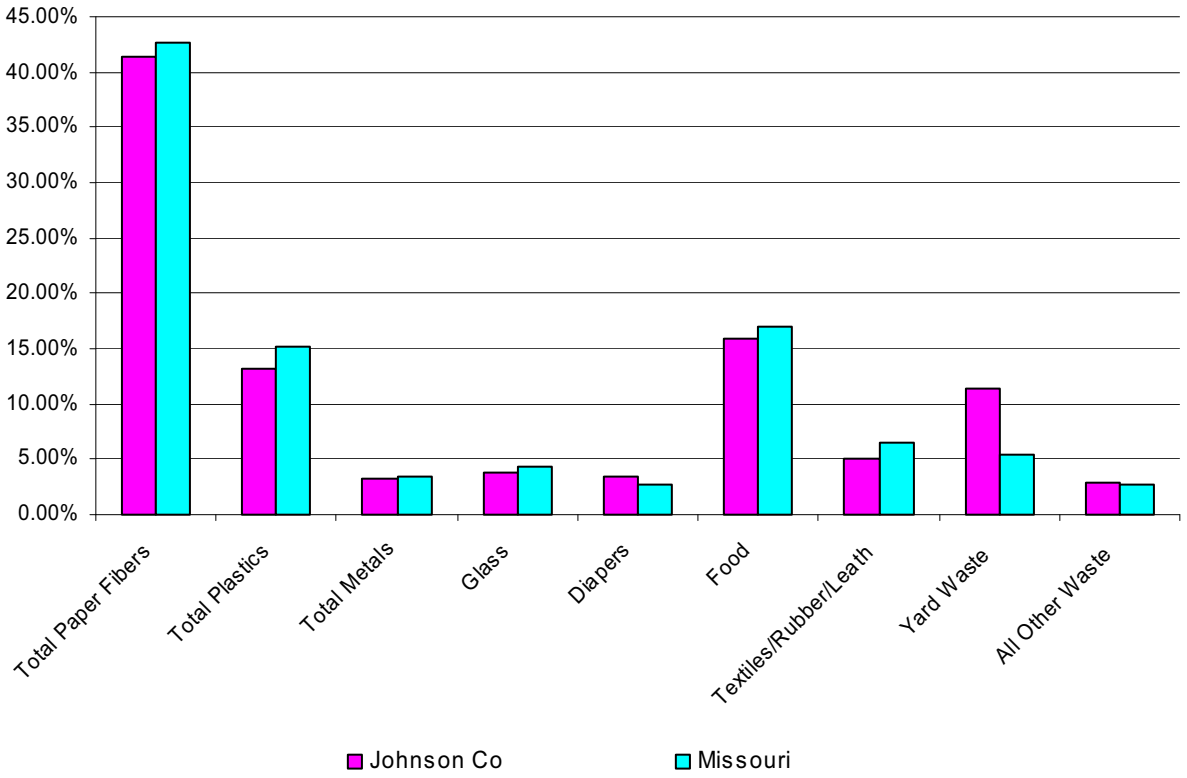
The residential, commercial, and mixed waste streams for waste generated in Missouri were analyzed and compared. The following bar chart presents this comparison.



Kansas-Missouri Waste Stream

A total of 176 samples were captured at the Olathe Transfer Station and the Johnson County Landfill during the fall and spring (combined) sorting events. Of these 176 samples, 115 samples (65.34%) contained waste generated in Johnson County, Kansas. An additional 8 samples (4.55%) contained waste generated in Wyandotte County and Leavenworth County, Kansas. Waste generated in Missouri accounted for 53 (30.11%) of these 176 samples (4 samples from Cass County, 5 samples from Platte County, 9 samples from Clay County, and 35 samples from Jackson County.

The Johnson County waste stream and the Missouri waste stream were analyzed and compared. The following bar chart presents this comparison.

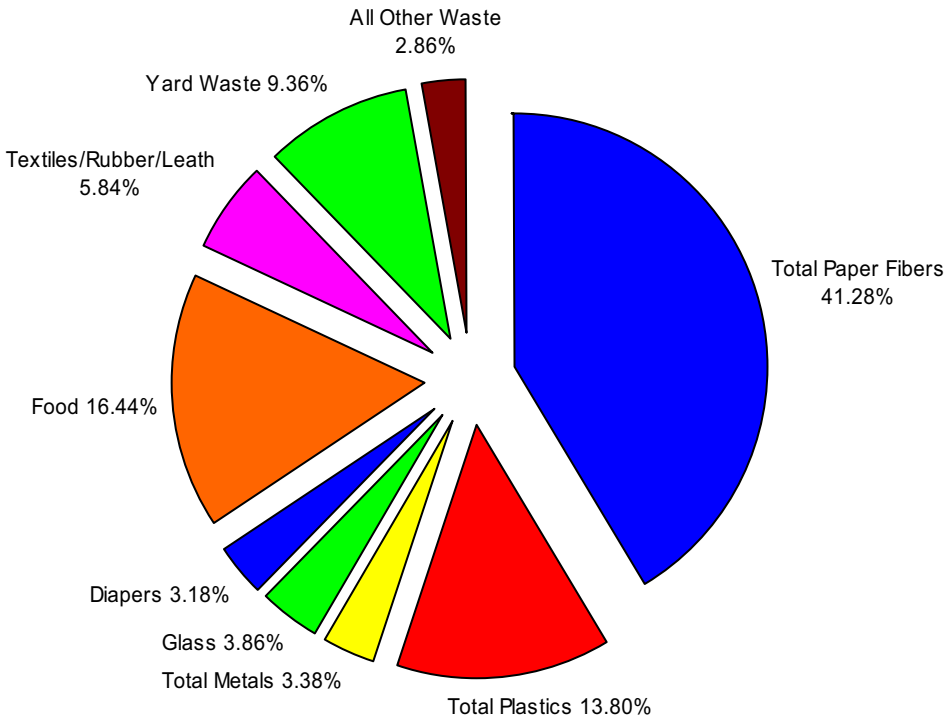


A total of 176 samples were captured at the Olathe Transfer Station and the Johnson County Landfill during the fall and spring (combined) sorting events. Of these 176 samples, 123 samples (69.89%) contained waste generated in Kansas (115 samples from Johnson County and 8 samples from other Kansas counties). Waste generated in Missouri accounted for 53 (30.11%) of these 176 samples. For purposes of this study, all of the captured samples (176) will be referred to as the Kansas-Missouri waste stream.

Three components (comprised of 12 material categories total) and ten additional material categories comprise the waste stream profile for this study. These three components are paper fibers, plastics, and metals. Together, these three components comprise slightly more than 58% of the Kansas-Missouri waste stream.

Data from the fall sorting event indicates that the paper fibers component is the largest part of the Kansas-Missouri waste stream by weight (40.55%). By volume, the plastics component is the largest (38.42%), closely followed by the paper fibers component at 36.19%. Data from the spring sorting event indicates that the paper fibers component is again the largest part of the Kansas-Missouri waste stream by weight (41.89%). However, the plastics component is the largest part of this waste stream by volume at 38.95%.

When the data from the fall and spring sorting events is combined, the results are not much different than those for the individual seasonal sorting events. Paper fibers is the largest component of this waste stream by weight (41.28%). The plastics component is the largest part of the Kansas-Missouri waste stream by volume (38.71%).

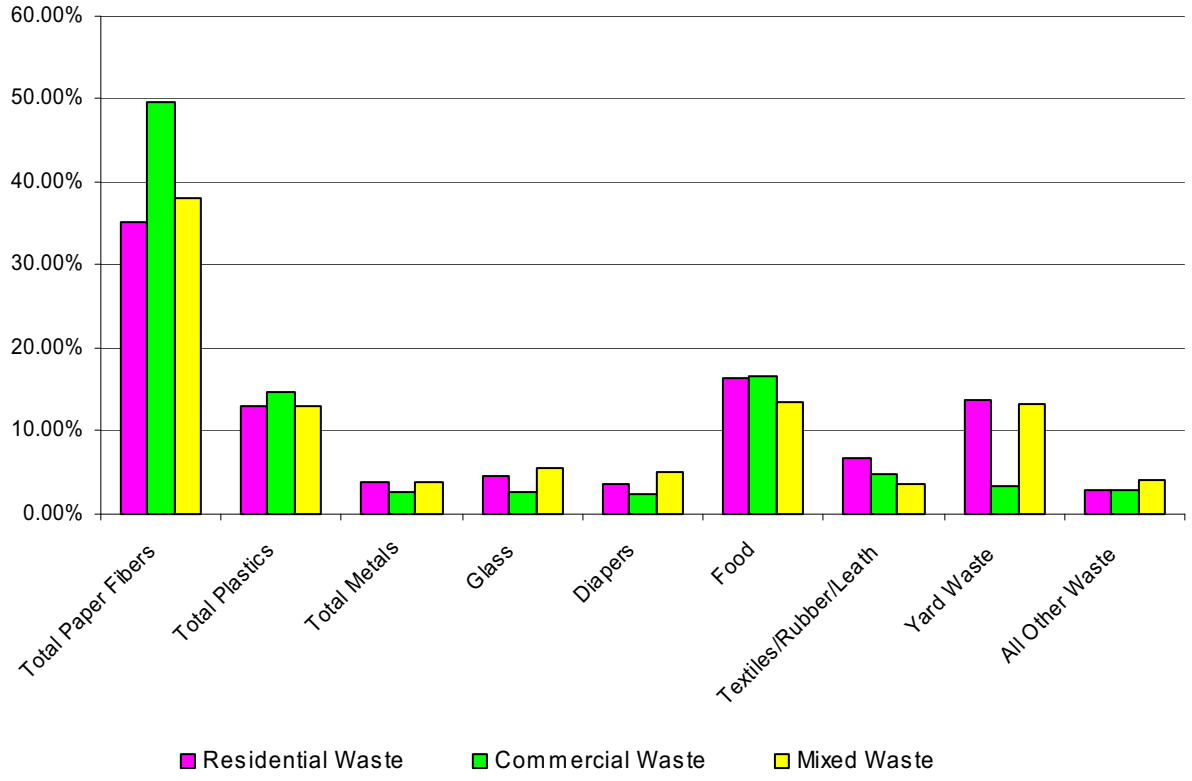


Food is a significant part of the Kansas-Missouri waste stream by weight – 15.82% in the fall; 16.96% in the spring; and 16.44% for fall and spring combined. However, food is not a significant part of this waste stream by volume. In the fall, it comprised only 4.28% of the waste stream by volume; in the spring it comprised 4.62% of the waste stream by volume; and for fall and spring combined it comprised 4.47% of the waste stream by volume.

During the fall sorting event, yard waste accounted for 9.34% of the Kansas-Missouri waste stream by weight and 4.60% of the waste stream by volume. During the spring sorting event, yard waste accounted for 9.38% of this waste stream by weight and 4.64% of the waste stream by volume.

One other material category merits mention. During the fall sorting event, the textiles/rubber/leather material category accounted for 6.57% of the Kansas-Missouri waste stream by weight and 8.74% of this waste stream by volume. The textiles/rubber/leather material category accounted for 5.23% of the Kansas-Missouri waste stream by weight during the spring sorting event and 6.99% of this waste stream by volume.

Residential, commercial, and mixed wastes for the Kansas-Missouri waste stream were analyzed and compared. The following bar chart presents this comparison.



Pure Commercial Loads

A total of 47 pure commercial loads were sampled during the two sampling events at the Johnson County Landfill and the Olathe Transfer Station. A pure commercial load contains only solid waste generated by retail businesses, offices, schools, nursing homes or medical centers, or a combination of these generators. Pure commercial loads were analyzed for the Johnson County waste stream, the Missouri waste stream, and the Kansas-Missouri waste stream.

When assessing the percentages for the combined two-season waste sort for pure commercial loads in the Johnson County waste stream, paper fibers accounted for more than 50% of the weight of this waste stream. More importantly, the amount of corrugated

paper and office paper is significant. Together, these two materials comprised more than 55% of the paper fibers component of this waste stream by weight and almost 30% of the adjusted sorted sample weight of this waste stream. In turn, newspaper and magazines accounted for less than 10% of the paper fibers component of this waste stream by weight and less than 5% of the adjusted sorted sample weight of this waste stream.

Comparing the pure commercial loads sampled to all of the loads sampled during the combined two-season waste sort, the difference in percentages is significant. Paper fibers accounted for 41.87% of all the loads sampled and 51.26% of the pure commercial loads in the Johnson County waste stream. Plastics are slightly higher in Johnson County pure commercial loads as compared to all the loads sampled. When assessing the 7 material categories that are not included in one of the three components, all of the categories – except food – are higher in all of the sampled loads as compared to the Johnson County pure commercial loads. The food material category is 3.57% higher in the Johnson County pure commercial loads as compared to all of the sampled loads.

In considering the paper fibers component separately, there is a significant difference in every material category of this component, except newspaper and magazines, when the Johnson County pure commercial loads are compared to all of the sampled loads. The most significant differences occurred in corrugated paper (the Johnson County pure commercial loads were 9.23% higher), office paper (the Johnson County pure commercial loads were 2.74% higher), and other paper (the Johnson County pure commercial loads were 1.74% higher).

A total of 22 pure commercial loads were sampled from waste collected in Missouri and delivered to the Johnson County Landfill. When assessing the percentages for the combined two-season waste sort for pure commercial loads in the Missouri waste stream, paper fibers accounted for almost 50% of the weight of this waste stream. More importantly, the amount of corrugated paper and office paper is significant. Together, these two materials comprised more than 50% of the paper fibers component of this waste stream by weight and more than 25% of the adjusted sorted sample weight of this waste stream. In turn, newspaper accounted for less than 6% of the paper fibers component of this waste stream by weight and less than 3% of the adjusted sorted sample weight of this waste stream.

Comparing the pure commercial loads sampled to all of the loads sampled during the combined two-season waste sort, the difference in percentages is somewhat significant. Paper fibers accounted for 41.87% of all the loads sampled and 49.39% of the pure commercial loads in the Missouri waste stream. Plastics are also higher in the Missouri pure commercial loads as compared to all the loads sampled. The only other category that is

significantly higher in the Missouri waste stream as compared to all of the sampled loads is food.

In considering the paper fibers component separately, there is a significant difference in the corrugated paper and office paper categories of this component when the Missouri pure commercial loads are compared to all of the sampled loads. Corrugated paper in the Missouri pure commercial loads was 6.02% higher when compared to all of the sampled loads and office paper in Missouri pure commercial loads was 2.94% higher.

Further evaluation of the comparison between the Missouri pure commercial loads and all of the loads indicates that the greatest impact is in the paper component (Missouri pure commercial loads are 7.52% higher), yard waste (Missouri pure commercial loads are 4.52% lower), and the textile category (Missouri pure commercial loads are 1.17% lower). The food and plastics categories present a lesser impact. The Missouri pure commercial loads are 1.50% higher in the food category than all of the sampled loads and the plastics category is 0.88% higher.

A total of 47 pure commercial loads were sampled from waste generated in Kansas and Missouri and delivered to the Johnson County Landfill and Olathe Transfer Station. The pure commercial loads include 24 loads of waste generated in Johnson County, Kansas, 1 load of waste generated in Leavenworth County, Kansas, and 22 loads of waste generated in Missouri.

When assessing the percentages for the combined two-season waste sort for pure commercial loads in the Kansas-Missouri waste stream, paper fibers accounted for 50% of the weight of this waste stream. More importantly, the amount of corrugated paper, office paper, and other paper is significant. Together, these three materials comprised slightly more than 88% of the paper fibers component of this waste stream by weight and more than 40% of the adjusted sorted sample weight of this waste stream.

Comparing the pure commercial loads sampled to all of the loads sampled during the combined two-season waste sort, the difference in percentages is significant. Paper fibers accounted for 41.87% of all the loads sampled and 50.00% of the pure commercial loads in the Kansas-Missouri waste stream. Plastics are slightly higher in the Kansas-Missouri pure commercial loads as compared to all the loads sampled. When assessing the 7 material categories that are not included in one of the three components, all of the categories – except food – are higher in all of the sampled loads as compared to the Kansas-Missouri pure commercial loads. The food material category is 3.23% higher in the Kansas-Missouri pure commercial loads as compared to all of the sampled loads.

In considering the paper fibers component separately, there is a significant difference in every material category of this component, except newspaper and magazines,

when the Kansas-Missouri pure commercial loads are compared to all of the sampled loads. The most significant differences occurred in corrugated paper (the Kansas-Missouri pure commercial loads were 5.89% higher), office paper (the Kansas-Missouri pure commercial loads were 4.24% higher), and other paper (the Kansas-Missouri pure commercial loads were 1.13% higher).

Further evaluation of the comparison between the Kansas-Missouri pure commercial loads and all of the loads indicates that the greatest impact is in the paper component (Kansas-Missouri pure commercial loads are 8.13% higher), food (Kansas-Missouri pure commercial loads are 3.23% higher), yard waste (Kansas-Missouri pure commercial loads are 6.65% lower), and the textile category (Kansas-Missouri pure commercial loads are 1.74% lower). The plastics component presents a lesser impact. The Kansas-Missouri pure commercial loads are 0.83% higher than all of the sampled loads. Although the pure commercial loads accounted for only 47 of the 176 loads sampled, their impact is significant in selected categories.

Based on these results waste reduction efforts in the commercial sector of the waste stream should concentrate on corrugated paper, office paper, and other paper. Corrugated paper is likely generated in all sub-sectors of the commercial waste stream (retail, businesses, schools, etc.). The office paper portion is likely generated by businesses other than retail stores. Utilizing information gathered during interviews with the vehicle drivers for those loads that contained waste generated in schools (19 of the 47 pure commercial loads), it appears that a large percentage of the waste in this sub-sector is office paper and other paper.

Other paper appears to be generated from retail businesses (restaurants, convenience stores, etc.). Another contributor to other paper is nursing homes. As this analysis demonstrates, pure commercial loads in the Kansas-Missouri waste stream have higher paper content, relatively high food content, and a lower yard waste and textiles content.

Another interesting consideration is the difference in pure commercial loads from Missouri when compared to those from Johnson County. The pure commercial loads sampled from Missouri showed an increase in almost all of the paper categories, while the increase in the paper categories for the Johnson County pure commercial loads was more dramatic and occurred in only three paper component material categories (corrugated paper, office paper, and other paper). This may signal a greater waste reduction focus on a few select categories in Johnson County, while in Missouri the waste reduction focus may be broader.

Residential Waste

A total of 95 residential loads were sampled during the two sampling events at the Johnson County Landfill and the Olathe Transfer Station. Of these 95 loads, 71 contained waste generated in Johnson County; 19 contained waste generated in Missouri; the remaining 5 loads contained waste generated in other Kansas counties in the Kansas City metropolitan area. The 95 residential loads were analyzed for the Johnson County waste stream, the Missouri waste stream, and the Kansas-Missouri waste stream.

When assessing the percentages for the combined two-season waste sort for residential loads in the Johnson County waste stream, paper fibers accounted for more than 35% of the weight of this waste stream. More importantly, the amount of other paper is significant (almost 38% of the paper fibers component and more than 13% of the net weight of the adjusted sorted sample). Although not as significant as other paper, the amount of newspaper, magazines, and corrugated paper is a major portion of the waste stream. Together, these three materials comprised slightly more than 50% of the paper fibers component of this waste stream by weight and more than 18% of the adjusted sorted sample weight of this waste stream. In addition to the paper fibers component of this residential waste stream, yard waste and food comprise more than 30% of the net weight of the adjusted sorted sample.

Comparing the Johnson County residential loads to all of the loads sampled during the combined two-season waste sort, the difference in percentages is significant in two material categories – corrugated paper and yard waste. Corrugated paper in the Johnson County residential loads was 4.23% lower as compared to all of the sampled loads. In contrast, yard waste in the Johnson County residential loads was 6.34% higher as compared to all of the sampled loads.

Paper fibers accounted for 41.87% of all the loads sampled and 36.46% of the residential loads in the Johnson County waste stream. Plastics are lower in the Johnson County residential loads as compared to all the loads sampled.

Further evaluation of the comparison between the Johnson County residential loads and all of the loads indicates that the greatest impact of residential loads is in the paper fibers component, the plastics component, and yard waste. Because the residential loads accounted for only 95 of the 176 loads sampled (53.98%), residential waste significantly impacts the other remaining waste stream.

A total of 19 residential loads were sampled from waste collected in Missouri and delivered to the Johnson County Landfill. When assessing the percentages for the combined two-season waste sort for residential loads in the Missouri waste stream, the paper fibers component, plastics component, and food accounted for almost 69% of the weight of this

waste stream. More importantly, the percentage of yard waste in the Missouri residential loads is less than half of the percentage of yard waste in the Johnson County residential loads (7.28% vs. 15.83%).

Comparing the Missouri residential loads to all of the loads sampled during the combined two-season waste sort, the difference in percentages is interesting. Paper fibers accounted for 41.87% of all the loads sampled and 34.92% of the residential loads in the Missouri waste stream. The plastics component, metals component, glass category, food category, and textiles category are also higher in the Missouri residential loads as compared to all the loads sampled.

The difference in percentages is significant in two material categories – corrugated paper and yard waste. Corrugated paper in the Missouri residential loads was 4.53% lower as compared to all of the sampled loads. Yard waste in the Missouri residential loads was 2.22% lower as compared to all of the sampled loads.

Further evaluation of the comparison between the Missouri residential loads and all of the loads indicates that the greatest impact of residential loads is in the paper fibers component, and the glass, yard waste, food, and textile categories. Reduced paper fibers in the residential waste stream is somewhat expected. A reduction in the yard waste category in residential loads in the Missouri waste stream is also somewhat expected given the yard waste ban in Missouri. However, the increase in the glass, food and textile categories is not as easily explained; however, it may be the result of the limited number of samples.

A total of 95 residential loads were sampled from waste generated in Kansas and Missouri and delivered to the Johnson County Landfill and Olathe Transfer Station. The residential loads included 71 loads of waste generated in Johnson County, Kansas; 19 loads contained waste generated in Missouri; the remaining 5 loads contained waste generated in other Kansas counties in the Kansas City metropolitan area.

When assessing the percentages for the combined two-season waste sort for residential loads in the Kansas-Missouri waste stream the paper fibers component and plastics component together with the food and yard waste categories accounted for almost 80% of the weight of this waste stream. More importantly, the amount of other paper, food, and yard waste is significant. Together, these three materials comprised more than 44% of the adjusted sorted sample weight of this waste stream. Comparing the 95 residential loads sampled to all of the loads sampled during the combined two-season waste sort, the difference in percentages is less than 1% in all but three categories – corrugated paper, yard waste, and office paper. Corrugated paper and office paper were both lower in the Kansas-Missouri residential loads (4.39% and 2.45%, respectively). Yard waste in the Kansas-Missouri residential loads was 4.34% higher as compared to all of the sampled

loads. The lower percentage of corrugated paper and office paper in the Kansas-Missouri residential loads explains the 6.25% difference in the paper fibers component of these loads as compared to the paper fibers component for all of the sampled loads. Based on this analysis, it appears that a broad waste reduction effort focused on all material categories would be most effective with an added emphasis on yard waste.

Impact of Collection Vehicle

A comparison of the type of vehicle utilized to collected residential waste that was delivered to the Johnson County Landfill and the Olathe Transfer Station was conducted. Of the 20 waste categories compared, 15 categories indicate less than a 1% difference between the waste collected via side loader and the waste collected via rear packer. Of the remaining 5 categories, 3 of the category percentages – corrugated paper, magazines, and food – were higher in the residential waste collected via side loader. Two of the percentages – the yard waste and textile categories – were higher in the residential waste collected via rear packer. The most significant percentage difference is in the residential yard waste collected via rear packer compared to the residential yard waste collected via side loader. Yard waste was more than 9% lower in the residential waste collected by side loaders than the residential waste collected by rear packers.

Statistical Analysis

This analysis addresses the determination of the 90% confidence level of the data. The analysis focused on three aspects of the database – fall sorting event, spring sorting event, and the fall and spring (combined) sorting events. This analysis also considered each of the sampling sites – the Johnson County Landfill, the City of Olathe Transfer Station, and the landfill and transfer station combined.

The 90% confidence level is first determined graphically for each seasonal sorting event at each facility and the combined site. For ease of analysis within the report, 8 of the 23 waste-material categories were randomly selected for this analysis. These categories are: (1) newspaper; (2) magazines; (3) HDPE #2; (4) tin; (5) glass; (6) food; (7) textiles/rubber/leather; and (8) yard waste. Each of these 8 categories for each of the sorting seasons at the two facilities and the combined sites was graphed. Chart 10.1 through Chart 10.48 present these graphs.

When these 8 waste-material categories were compared for the fall and spring sorting events at the Johnson County Landfill, the following observations were made:

1. The average number of outliers for all 8 categories for the fall sorting event was 3.75. This is 6.4% of the total number of samples sorted during the fall sorting event at the Johnson County Landfill.

2. The average number of outliers for all 8 categories for the spring sorting event was also 3.75. This is 5.1% of the total number of samples sorted during the spring sorting event at this facility.

3. All of the outliers were on the upper portion of the graph.

4. For the fall sort data and the spring sort data, there were slightly more samples below the mean than above the mean. The number of outliers and their proximity to the upper limit of the 90% confidence level directly impacted the number of samples below the mean.

When these 8 waste-material categories were compared for the fall and spring sorting events at the Olathe Transfer Station, the following observations were made:

1. The average number of outliers for all 8 categories for the fall sorting event was 1.5. This is 6.25% of the total number of samples sorted during the fall sorting event at the Olathe Transfer Station.

2. The average number of outliers for all 8 categories for the spring sorting event was also 1.75. This is 8.75% of the total number of samples sorted during the spring sorting event at this facility.

3. All of the outliers were on the upper portion of the graph.

4. For the fall sort data and the spring sort data, there were slightly more samples below the mean than above the mean. The number of outliers and their proximity to the upper limit of the 90% confidence level directly impacted the number of samples below the mean.

When these 8 waste-material categories were compared for the fall and spring sorting events at the Johnson County Landfill and Olathe Transfer Station (combined sites), the following observations were made:

1. The average number of outliers for all 8 categories for the fall sorting event was 5.25. This is 6.3% of the total number of samples sorted during the fall sorting event at both sites.

2. The average number of outliers for all 8 categories for the spring sorting event was also 6. This is 6.45% of the total number of samples sorted during the spring sorting event at both sites.

3. All of the outliers were on the upper portion of the graph.

4. For the fall sort data and the spring sort data, there were slightly more samples below the mean than above the mean. The number of outliers and their proximity to the upper limit of the 90% confidence level directly impacted the number of samples below the mean.

Utilizing the graphs and the analysis, it can be seen that for all of the waste categories analyzed the 90% confidence level is met. This can be seen in the limited number of outliers – less than 10% of all of the samples – the proximity of the samples to the mean, and the relationship between the outliers and the samples below the mean. It is also important to note that for each of the categories the spring sort results are well within 10% of their counterparts from the fall sort results.

Johnson County, Kansas, and Missouri Study Comparisons

A comparison of the results of this study to the statewide composite results from the most recent Kansas and Missouri waste characterization studies was conducted. For this study the data provided is for Johnson County waste stream only. The Kansas data is from the *State of Kansas Waste Characterization Study* (completed by Engineering Solutions & Design, Inc. and funded by the Kansas Department of Health and Environment, 2003). The Missouri data is from the *Missouri Waste Composition Study, Municipal Solid Waste* (completed by the Midwest Assistance Program, Inc. and funded by the Missouri Department of Natural Resources, 1996 and 1997). Based on this comparison the following conclusions were formulated.

1. The Johnson County waste stream has a higher percentage of paper than either the Kansas waste stream or the Missouri waste stream. This is likely because Johnson County is a very urban and it is not as influenced by rural areas. Both the Kansas and Missouri waste streams encompass rural waste.

2. The yard waste category in the Johnson County waste stream Johnson is higher than in the Kansas waste stream. This again reflects the more urban characteristics of Johnson County. It may also reflect the affluence of the county in relationship to the remainder of the state.

3. The textile category for the Kansas waste stream is much higher than either the Johnson County waste stream or the Missouri waste stream. Part of this is likely because of the composition of this category. Another possibility is that the Kansas study may reflect a more transient nature of the population, particularly in the western and rural parts of the state.

4. The food and plastic categories are higher in both the Johnson County waste stream and the Missouri waste stream when compared to the Kansas waste stream. A part of this may be a reflection of the age of the Missouri study. It could also be that both Missouri and Johnson County are much more urbanized, which could be reflected the demographics of both areas.

5. It is important to note that the age of the Kansas and Missouri studies as well as the methodology utilized to conduct both studies explains some of the variances among the studies. For example, although Engineering Solutions & Design, Inc. conducted both the Johnson County study and the Kansas study, the methodology utilized for each study was slightly different. When you combine difference with the age of each study (for example the Missouri study is ten years old), the ability to compare studies with a high degree of confidence is diminished. For this reason, the comparison of these three studies provides some interesting contrasts and commonalities; however, these comparisons must be tempered with a consideration to age and methodology.

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