

SOLID WASTE STREAM STUDY FOR BROKEN BOW, NEBRASKA



Prepared for

WasteCap Nebraska
610 J Street, Suite 300
Lincoln, Nebraska 68508

Prepared by

Engineering Solutions & Design, Inc.
9393 W. 110th Street, Suite 500
Overland Park, Kansas 66210
(800) 298-1851



January 9, 2015

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1	STUDY PURPOSE AND DEFINITIONS.	1-1
1.2	PARTICIPATING FACILITIES	1-5
1.3	PRE-SORT SITE ASSESSMENTS.	1-7

2.0 METHODOLOGY

2.1	LOAD SELECTION PROCESS	2-2
2.2	SELECTING THE SAMPLE.	2-5
2.3	SORTING AND CATEGORIZATION PROCESS	2-5
2.4	WEIGT DETERMINATION.	2-10
2.5	DATA RECORDING AND QUALITY CONTROL	2-10

3.0 DATA RESULTS AND ANALYSIS

3.1	WORK PLAN	3-1
3.2	FIELD SORTING EVENT AND CONDITIONS	3-2
3.3	DATA RESULTS	3-3
3.4	DATA ANALYSIS.	3-8
3.4.1	Waste Characterization	3-8
3.4.2	Recycling Potential	3-8
3.4.3	Commercial Waste Characteristics	3-10
3.4.4	Visual Inspection Analysis.	3-10

4.0 WASTE REDUCTION POTENTIAL

4.1	OBSERVATIONS.	4-1
4.2	CONCLUSIONS	4-3

1.0 INTRODUCTION

Engineering Solutions & Design, Inc. (ES&D) was contracted by WasteCap Nebraska to perform a limited waste characterization study to provide waste stream information for five selected communities in Nebraska. One-day field sampling events were conducted at the solid waste facilities where each of the five selected community's waste was delivered for disposal.

1.1 STUDY PURPOSE AND DEFINITIONS

The main objective of this study was to identify the waste stream characteristics of the five selected Nebraska communities. These five communities are involved in zero waste efforts and this study is designed to provide a basic understanding of the composition of the waste in each community. This information can then be utilized to identify opportunities for reducing and eventually eliminating waste in these communities.

In order to better understand the purpose of this project, it is important to define waste characterization, also known as a waste sort or waste pick. In general, a waste characterization project encompasses sorting a portion of the solid waste stream. For this project, the waste sort encompassed sorting through a portion of the one-day solid waste stream at five predetermined selected facilities. Solid waste that was sorted during these one-day field sorting events was generated from a variety of users and included residential, commercial, or mixed waste.

Throughout this report a variety of terms specific to the waste characterization process are used. Definitions for some of these terms are listed in Table 1.1. For purposes of this study, waste generated at apartment complexes was considered either residential or commercial waste depending upon how it was collected and delivered to the solid waste facility. Apartment waste placed in dumpsters and collected together with waste from commercial generators such as restaurants, offices, retail stores, etc. was considered a part of the commercial waste stream. Conversely, apartment waste that was placed in cans, bags and/or totes and collected along with waste collected from single family dwellings was considered a part of the residential waste stream.

**TABLE 1.1
DEFINITIONS**

<i>Term</i>	<i>Definition</i>
Field Sorting Event	Activities undertaken at a participating solid waste facility that encompassed all functions necessary to gather data to accurately determine the characteristics of the waste stream (also see Waste Pick or Waste Sort).
Waste Pick or Waste Sort	The sorting of a sample of waste to determine its characteristics. This effort can be used to define the characteristics of the entire waste stream or to identify specific items in the waste stream.
Load	The contents of a solid waste collection vehicle.
Sample	The portion of the load selected for sorting. The optimum sample size varies from 200 to 300 pounds.
Waste-Material Category	A defined single category for a portion of the waste stream or a group of related waste-material components. For example, paper fibers, food waste, yard waste, and diapers are waste-material categories; and the paper fibers category comprised of the cardboard, office paper, newsprint, magazines, paperboard, and mixed paper waste-material components.
Waste-Material Component	A defined portion of the waste stream that combines with other related components to form a category. For example, cardboard, PET #1, clear glass containers, and aluminum containers are all waste-material components.
Visual Inspection	An inspection conducted by walking around the load once it is removed from the collection vehicle. This inspection is utilized to identify large items in a load as well as to ascertain a broad concept of the characteristics of the load.
Residential Waste	Waste generated by households at either single family residences or apartment residences.
Commercial Waste	Waste collected from restaurants, grocery stores, dry goods stores, apartment buildings, small businesses, office buildings, schools, medical centers, and/or similar facilities.
Mixed Waste	A combination of commercial and residential waste.

**TABLE 1.1
DEFINITIONS (continued)**

<i>Term</i>	<i>Definition</i>
Curbside or Street Collection	The process of placing bags, cans, carts and/or toters filled with solid waste at the curbside or edge of street for collection.
Front Loader	A solid waste collection vehicle that collects waste utilizing two forks to lift various size containers or dumpsters. Solid waste is loaded into the top of the truck and compacted within the box. This type of truck is typically utilized for the collection of solid waste generated by commercial users.
Rear Packer	A solid waste collection vehicle that collects waste by placing it in an opening at the rear of the truck. The waste can be placed manually or via automated means. The solid waste is mechanically pushed into the box of the truck and compacted. This type of truck is typically utilized to collect solid waste generated by residential users.
Side Loader	A solid waste collection vehicle that collects waste by placing it in an opening at the side of the truck. The waste can be placed manually or via automated means. The solid waste is mechanically pushed into the box of the truck and compacted. This type of truck is typically utilized to collect solid waste generated by residential users.
Roll-Off	A solid waste collection vehicle that collects waste deposited in a large metal container (dumpster) from one location, such as a construction site, large store, shopping mall, or industrial site. This vehicle then delivers the waste to a disposal facility, where the container is rolled off and unloaded. The empty container is then returned to the waste generator.
Bags	Non-rigid plastic containers that are filled with solid waste and placed at the curb or in alleys for collection. The opening of the container is usually secured by a metal or plastic tie.
Cans	Rigid metal or plastic containers that are filled with solid waste and placed at the curb or in alleys for collection. The opening in these containers is typically secured with a lid.

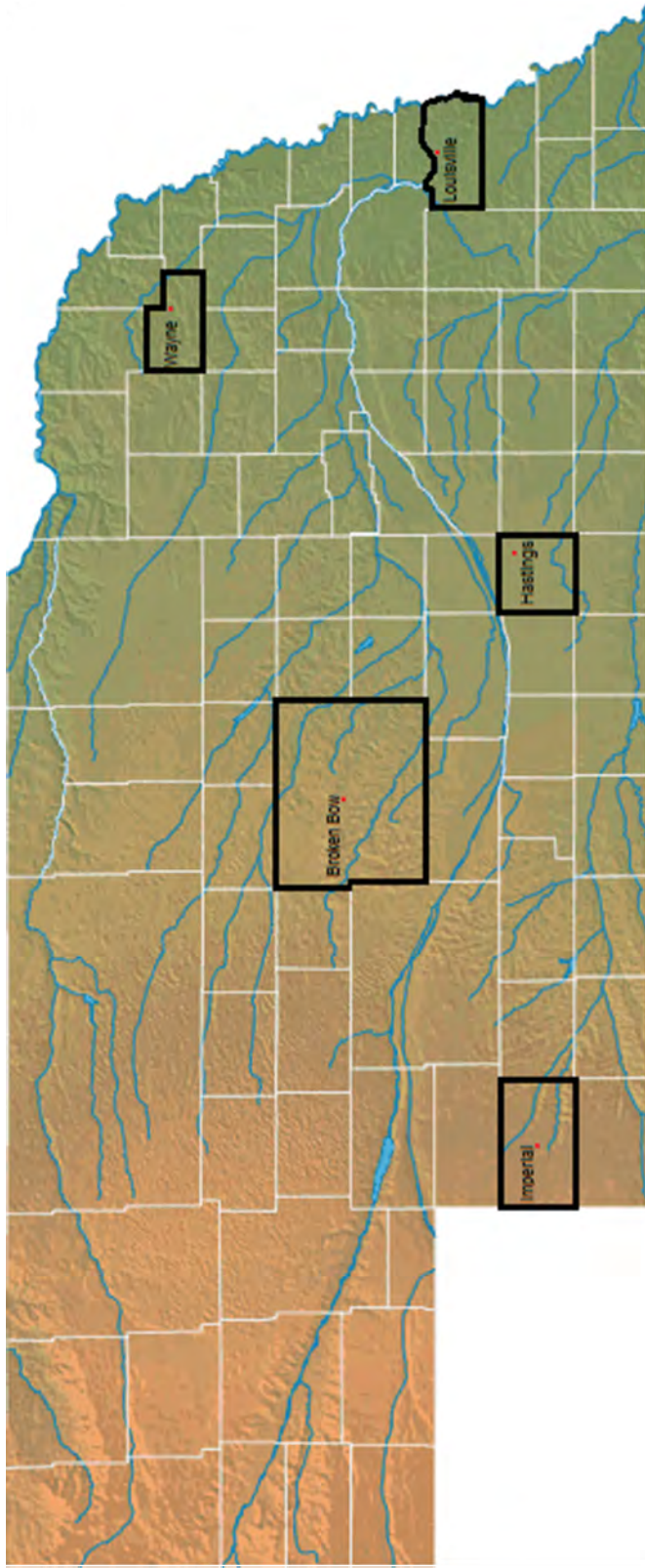
TABLE 1.1
DEFINITIONS (continued)

<i>Term</i>	<i>Definition</i>
Carts or Toters	Rigid plastic containers that are filled with solid waste and placed at the curb or in alleys for collection. These containers have wheels and are designed to be utilized by collection vehicles that have automated mechanisms for lifting the container and unloading it into the collection vehicle. The opening in these containers is typically at the top and secured with a lid that is attached to the container.
Dumpsters	Rigid metal or plastic containers that are filled with solid waste. These containers are typically rectangular in shape and are typically utilized to service large commercial waste generators. These containers are collected by front loading vehicles that utilize forks to lift the dumpster onto the top of the truck where the container is tipped and the contents unloaded in the vehicle. The opening in these containers is typically at the top or side and is secured with a lid that is attached to the container.

1.2 PARTICIPATING FACILITIES

One-day field sorting events (waste sorts) were undertaken at facilities where each selected community's solid waste was delivered for disposal. The five selected Nebraska communities included Imperial, Wayne, Louisville, Hastings, and Broken Bow (see Map 1.1) and are briefly delineated below.

1. All of the residential and commercial waste collected in Imperial is delivered to the South West Nebraska Transfer Station on Tuesdays and Thursdays. The transfer station is owned and operated by the South West Nebraska Solid Waste Agency and is located south and slightly west of the city. Imperial is the county seat of Chase County and is located in the southwest corner of Nebraska.
2. Wayne's residential and commercial solid waste is collected by a private hauling company on Wednesdays and delivered to the City of Wayne Solid Waste Transfer Station. This facility is privately owned and operated. It is located near the eastern boundary of the city. Wayne serves as the county seat for Wayne County, which is in the northeast portion of Nebraska.
3. Louisville is located in Cass County, just south of the Cass County-Sarpy County line. Louisville's residential waste is collected by a private hauling company on Thursdays and delivered to the Sarpy County Landfill. Commercial waste generated in Louisville is collected throughout the week by a variety of private haulers along with waste from other communities and delivered to the Sarpy County Landfill. The landfill is publicly owned and privately operated. It is located near Springfield, Nebraska, which is south and slightly west of the Omaha Metropolitan Area.
4. All of Hastings' residential and commercial waste is collected by private haulers and delivered to the City of Hastings Landfill. Waste from Hastings is delivered to the landfill every weekday. The landfill is publicly owned and operated. It is located in Adams County in the southwestern quadrant of the city. Hastings is the county seat for Adams County.
5. Broken Bow's residential and commercial solid waste is collected by a private hauling company and delivered to the Custer Transfer Station, which is located in the western portion of the city. The transfer station is privately owned and operated. The majority of Broken Bow's waste is collected and delivered to this facility on Mondays and Wednesdays. Broken Bow is in Custer County, which is located in the approximate center of the state, and serves as the county seat.



MAP 1.1
LOCATION OF FIVE SELECTED COMMUNITIES

1.3 PRE-SORT SITE ASSESSMENTS

During the week of August 19, 2014, ES&D visited each community and facility selected for participation in this study. ES&D's project team met with the landfill or transfer station manager at each facility and explained the field activity procedures and the team's needs. Then, the project team toured the facility, reviewed the facility's operation procedures, and discussed the facility's service areas. During the facility tour, the project team ascertained the best and least intrusive area for the team to conduct its field sorting activities. 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.

At the conclusion of these site visits, ES&D established a schedule for the field activities and determined the sorting area needs and configuration at each facility. Keeping in mind that only waste from each of the selected communities would be sampled, the schedule for field sorting events was established and is presented in Table 1.2.

**TABLE 1.2
SCHEDULE OF FIELD SORTING EVENTS**

Community	Facility	Day and Date of Scheduled Field Sorting Event
Imperial	South West Nebraska Transfer Station	Tuesday, September 30, 2014
Wayne	City of Wayne Solid Waste Transfer Station	Wednesday, October 1, 2014
Louisville	Sarpy County Landfill	Thursday, October 2, 2014
Hastings	City of Hastings Solid Waste Landfill	Friday, October 3, 2014
Broken Bow	Custer Transfer Station	Monday, October 6, 2014

2.0 METHODOLOGY

During field sorting events at each participating facility, the work day varied in length and was dependent upon the facility's operating hours and the anticipated number of loads from the selected community. Set-up time consumed approximately one-half hour as did breakdown time at the end of each day.

At each facility the waste sort team size varied based on the size of the facility and the anticipated number of samples. The sort team was typically comprised of the project manager, an individual to collect and record data (data analyst), and one or two additional individuals to assist in the sorting process. All field sorting team members were outfitted with Tyvek protective suits, Kevlar lined gloves, safety goggles, hard hats, and high-visibility safety vests.

The first step in the sort process is setting up the site. At the City of Hastings Landfill, the sort area was located as close to the working face as possible, but in a location that did not adversely impact the operation of the facility. The sorting area was set up within 100 feet of the edge of the working face in order to reduce the distance team members needed to traverse when carrying samples to the sort area.

A two-tent complex comprised the sort area. One of the tents was configured as a work station with sort tables where portions of the sample were placed for categorizing. Two or three material sorters sorted and categorized waste in this tent. The second tent was configured with tables, scales, and supplies for material weighing and data gathering. Two scales were utilized for weighing captured samples and sorted waste. A floor scale (with the capacity to accurately weigh up to 220.0 pounds) was positioned adjacent to the tracking table and a smaller scale (with the capacity to accurately weight up to 100.00 pounds) was placed on the tracking table. This configuration allowed for an ease of use and reduced the need for excessive bending and lifting.





An identical configuration was used at the transfer station facilities where field sorting events were undertaken for this project. However, instead of erecting a tent complex, the stations and tables were set up inside the building. At all of these facilities, the sort area was located in a segregated portion of the building so the sort team's interference with the facility's operation was minimized.

At the end of each day, the sort area was dismantled. All equipment was placed in the proper carrying cases and loaded into the team's vehicles. All setup and breakdown procedures were reviewed with, and approved by, the facility operators to reduce misunderstandings and allow for adjustments as necessary.

2.1 LOAD SELECTION PROCESS

When a vehicle arrived at the site with waste from the selected community, an initial interview was conducted with the driver to re-confirm the load content and collection location. Upon confirmation that the load contained waste from the selected community, the driver was directed to unload the vehicle at a segregated location near the landfill's working face or adjacent to the sorting area in the transfer station.

Vehicles were unloaded in thirds. This was accomplished by unloading the first third of the load and then moving the vehicle forward approximately 10 feet. The next third was then unloaded and the vehicle moved again. The final third of the load was then unloaded. Depending on how tightly the waste was compacted within the vehicle, the load flowered which allowed for an easier selection of the sort sample.

After the vehicle was unloaded, the driver was interviewed in more detail. A standard interview form was utilized for consistency. Some of the information gathered during this interview included: (1) vehicle owner; (2) type of collection vehicle; (3) type of waste – residential, commercial, or mixed; (3) county of origin and specific service area, if available; (4) net weight of load, if available; and (5) any driver observations or noted anomalies within the load.

In addition to completing an interview with the vehicle driver, a detailed visual inspection of each selected load was undertaken. An example of the interview and visual inspection form utilized throughout this study is presented in Table 2.1. The 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). The walk around was first conducted in a clockwise direction. Once the entire perimeter was traversed, a second walk around was conducted in a counter-clockwise direction. This method allowed for a complete observation of the load while also taking into account variations in lighting, the likely skewed position of the load, and viewing the load from a variety of angles.



During the unloading and walk around inspections, all anomalies and large seams of a particular waste category were noted. Photographs of each load were taken to note the overall characteristics of the load along with a photograph of the delivering vehicle. All large or bulky items were noted, and where possible, the predominant materials of the load were determined.

**TABLE 2.1
EXAMPLE INTERVIEW AND VISUAL INSPECTION FORM**

CONTROL #		SAMPLE BIN NUMBERS	
FACILITY		DATE	
TRUCK OWNER		TRUCK #	
TIME IN		NET WGT	
TYPE OF TRUCK	<input type="checkbox"/> REAR <input type="checkbox"/> FRONT <input type="checkbox"/> SIDE <input type="checkbox"/> ROLL-OFF		
SERVICE AREA	County: _____ Community: _____		
TYPE OF WASTE	<input type="checkbox"/> RES <input type="checkbox"/> COM <input type="checkbox"/> MIX		
DRIVER OBSERVATIONS	<input type="checkbox"/> Single Family <input type="checkbox"/> Apartments <input type="checkbox"/> Retail <input type="checkbox"/> Offices <input type="checkbox"/> Restaurants <input type="checkbox"/> Nur Home <input type="checkbox"/> Hospital <input type="checkbox"/> Dr Offices <input type="checkbox"/> Schools		
CPUs		Televisions	Sofas
Keyboards		VCR or DVD	Stuffed Chairs
Monitors		Tires	Mattresses
Printers		Wood Pallets	Fluorescent Bulb
Stereos		Small Apps	Oil Filters
Speakers		Large Apps	Dead Animals
Lumber <input type="checkbox"/> Plumbing Fix <input type="checkbox"/> Elec Wire/Cable <input type="checkbox"/> Insulation <input type="checkbox"/> Siding <input type="checkbox"/> Shingles <input type="checkbox"/> PVC Pipe <input type="checkbox"/> Plastic Strap <input type="checkbox"/> Carpet <input type="checkbox"/> Metal <input type="checkbox"/> Doors <input type="checkbox"/> Windows <input type="checkbox"/> Drywall <input type="checkbox"/> Linoleum <input type="checkbox"/> Styrofoam <input type="checkbox"/> Plastic Bins <input type="checkbox"/> Patio Furn <input type="checkbox"/> Wood Furn <input type="checkbox"/> Metal Furn <input type="checkbox"/> Office Furn <input type="checkbox"/> Yard Equip <input type="checkbox"/> Garden Hose <input type="checkbox"/> Bicycles <input type="checkbox"/> Car Seats <input type="checkbox"/> Strollers <input type="checkbox"/> Plastic Toys <input type="checkbox"/> Stuffed Toys <input type="checkbox"/> Books <input type="checkbox"/> Car Parts - Body <input type="checkbox"/> Car Parts - Engine <input type="checkbox"/> Limbs & Brush <input type="checkbox"/> Yard Waste <input type="checkbox"/>			

2.2 SELECTING THE SAMPLE

After the selected load was discharged from the collection vehicle and the detailed visual inspection was completed, a decision was made to determine what portion of the load was to be sampled. The portion to be sampled was randomly selected keeping in mind that a broad spectrum of data was desired. Using information and observations garnered from the visual inspection, locations within the load were selected and the sample materials were collected from these locations. The goal was to gather a sample weighing between 200 and 300 pounds. It was important to maintain a consistent sample size in order to ensure accuracy, allow for continuity between sort locations, and allow for ease in controlling the sort activities. This results in greater confidence in the data.



2.3 SORTING AND CATEGORIZATION PROCESS

After a load was discharged from the delivering vehicle and the portion to be sampled was determined, the physical waste sort could commence. Waste was gathered from the designated load portion and placed into sampling bins. The sample bins were then carried to the sort area, weighed and then taken to the sort station. The sort station was comprised of two tables with a series of various sized bins. Each bin was labeled with a specific material category or component. Solid waste was removed from the sample bins and placed on the tables where it was sorted into the different waste-material categories/components 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. Table 2.2 presents an example of the form used to record the waste-material category weights for each sample. Table 2.3 provides brief definitions of each of the waste-material categories and components used throughout this study.

After the team sorted, categorized and weighed the designated sample materials, the waste was discarded. Depending on the facility and site constraints, the waste was discarded onto the tipping floor at transfer stations, into the bucket of a front-end loader, or onto a portion of the working face at the participating landfill.

**TABLE 2.2
EXAMPLE DATA RECORDING SHEET**

CONTROL NUMBER			SAMPLE BIN NO.			
FACILITY			DAY/DATE			
SAMPLE BIN WGT			SAMPLE BIN WGT			
SAMPLE BIN WGT			SAMPLE BIN WGT			
SAMPLE BIN WGT			SAMPLE BIN WGT			
GROSS SAMPLE WEIGHT			NET SAMPLE WEIGHT			
MATERIAL CATEGORY	WEIGHT	WEIGHT	WEIGHT	WEIGHT	WEIGHT	WEIGHT
Cardboard						
Office Paper						
Newsprint						
Magazines						
Paperboard/Liner Board						
Mixed Paper						
PET#1						
HDPE #2						
Other Numbered Containers						
Plastic Film/Wrap/Bags						
Other Plastics						
Glass Containers						
Other Glass						

**TABLE 2.2
EXAMPLE DATA RECORDING SHEET (continued)**

MATERIAL CATEGORY	WEIGHT	WEIGHT	WEIGHT	WEIGHT	WEIGHT	WEIGHT
Aluminum Cans						
Tin Cans						
Other Aluminum						
Other Tin						
Food Waste						
Diapers						
Textiles/Rubber/Leather						
Yard Waste						
Non-Distinct						
Household Hazardous						
Electronic Waste						
Empty Aerosol Cans						
Mixed Metals						
Dry-Cell Batteries						
Misc. C/D Waste						
Wood						
Oil Filters						

**TABLE 2.3
WASTE-MATERIAL CATEGORY DEFINITIONS**

PAPER FIBERS CATEGORY	
Cardboard	Cartons and boxes made of corrugated paper
Office Paper	High-grade paper, printing and writing papers including ground-wood and thermo-chemical pulps
Newsprint	Printed ground-wood newsprint and other minimally bleached ground wood
Magazines	Glossy papers and inserts including catalogs, magazines, and mailings
Paperboard/Liner Board	Heavyweight liner board, cereal boxes, and forms
Mixed Paper	Paper not included above or that is not easily recycled including carbon paper, tissues, napkins, paper towels, foil-lined paper, and waxed-coated papers (i.e. milk and juice cartons)
PLASTICS CATEGORY	
PET #1	Soft drink, water or mouthwash bottles and similar containers with PET or #1 inscribed on the container
HDPE #2	Milk, water or juice bottles and similar containers with HDPE or #2 inscribed on the container
Other Numbered Containers	Clear food packaging, wire and cable insulation, squeezable bottles, ketchup bottles, yogurt containers, margarine tubs, compact disc jackets, egg cartons, meat trays, and similar materials with #3, #4, #5, #6 or #7 inscribed on the container
Plastic Film/Wrap/Bags	Plastic bags and film including dry cleaning bags, bread bags, retail bags, trash bags, plastic wrap, and bubble wrap
Other Plastics	All other plastics including compact discs, hard plastic toys and similar materials that do not have a number inscribed on them
GLASS CATEGORY	
Glass Containers	Clear and colored glass bottles and jars
Other Glass	Window glass, mirrors, light bulbs, ceramics

**TABLE 2.3
WASTE-MATERIAL CATEGORY DEFINITIONS (continued)**

METALS CATEGORY	
Aluminum Cans	Beverage cans made of non-ferrous metal
Tin Cans	Empty ferrous metal containers including tin cans, steel cans and metal containers to which a magnet adheres
Other Aluminum	Ferrous metal pieces that are not containers and to which a magnet adheres
Other Tin	Non-ferrous metals that are not containers including cookware, take-out containers, and metals to which a magnet does not adhere
OTHER WASTE CATEGORIES	
Food	Vegetative matter and animal byproducts
Diapers	Plastic disposable diapers
Textiles/Rubber/Leather	Clothing, shoes, cushions, curtains, rubber mats, rugs, and similar products
Yard Waste	Leaves, grass clippings, garden waste, and brush
Non-Distinct Waste	Miscellaneous materials, kitty litter, wax, soap, etc. and those items made of mixed materials including the following categories.
Household Hazardous	Paints, pesticides, cleaners, solvents, antifreeze, etc. and containers with any unused portion of these products
Electronic Waste	Computer parts and peripherals, small appliances, cameras, cellular phones and other wireless devices, televisions, audio and stereo equipment, videocassette recorders and digital video disc players, video cameras, telephones, fax machines, copy machines, video game consoles, and similar products
Empty Aerosol Cans	Pressurized containers that dispense a substance as an aerosol
Mixed Metals	Items that contain both ferrous and non-ferrous materials
Dry-Cell Batteries	Cell phone batteries and other alkaline and non-alkaline batteries
Misc. C/D Waste	Pieces of asphalt shingles, drywall, plumbing fixtures, HVAC and similar pieces of materials used in construction
Wood	Dimension lumber used in construction and plywood pieces
Oil Filters	Filters that treat oil in automobiles, trucks, and other machinery

2.4 WEIGHT DETERMINATION

To facilitate weighing each sampling bin, a portable electronic scale (Ohaus ES Bench Scale, Model #ES100L) was utilized. The scale's weighing capacity is accurate to 0.1 pound up to a capacity of 220.0 pounds. At the sorting stations, as each categorized bin became full it was carried to a separate scale and weighed. This scale's (Champ SQ with an Ohaus Model CD-11 indicator) weighing capacity is 100.00 pounds and is accurate to 0.01 pounds. The gross weight of the bin and waste was recorded and the bin was transported to a separate area and emptied. For some categories, each bin was filled and weighed several times. For other categories, each bin was either fully- or partially-filled and weighed at the end of the categorization process for that specific sample. When the categorization process for each selected sample was complete, the gross weight (bin + waste), bin weight, and net weight (gross weight - bin weight) for each waste-material category or component was totaled.

2.5 DATA RECORDING AND QUALITY CONTROL

The data for each sample was recorded on forms prepared specifically for this project (see Table 2.1 and Table 2.2). The data forms were prepared so that the data could be easily entered into a computer data base. Data for each sample was recorded on separate forms. Each sample was assigned a unique control number. Each sample's control number was recorded on all forms and data related to that specific sample. This numbering system ensured that data from one sample was not contaminated with information from another sample.

All sort procedures were monitored regularly by the project manager throughout each field sorting day. Each sort result was reviewed for anomalies and no sample was discarded until the data was initially reviewed.

3.0 DATA RESULTS AND ANALYSIS

Broken Bow's residential and commercial solid waste is collected by a private hauling company and delivered to the Custer Transfer Station, which is located in the western portion of the city. The transfer station is privately owned and operated. The majority of Broken Bow's waste is collected and delivered to this facility on Mondays and Wednesdays. Broken Bow is in Custer County, which is located in the approximate center of the state, and serves as the county seat.

According to 2010 U.S. Census Bureau data, the population of Broken Bow was 3,559 and its land area encompassed 1.9 square miles. In addition, Custer County's population was 10,939 in 2010 and it occupied a land area of 2,576 square miles.

3.1 WORK PLAN

During the pre-sort site visit to Broken Bow and the transfer station that accepts its waste, ES&D's project team met with the facility's manager and explained the field activity procedures and the team's needs. Then, the project team toured the facility, reviewed the facility's operation procedures, and discussed the facility's service areas. During the facility tour, the project team ascertained the best and least intrusive area for the team to conduct its field sorting activities. Additionally, through discussions with the facility's operations staff and the private hauling company that collects and delivers Broken Bow's waste to this facility, the project team ascertained when solid waste from Broken Bow was delivered to the facility, day-to-day variations in the solid waste delivered to the site, and any specific peculiarities in the solid waste delivered to the site.

At the conclusion of this site visit, ES&D decided that Monday would be the best day to undertake the one-day field sorting event at this facility. It was further determined that two, and sometimes three, loads of waste from the community are delivered to this site on Mondays. Additionally, the private hauling company agreed to pick up waste from the schools in Broken Bow during the morning of the one-day sorting event instead of the previous Saturday. This arrangement would provide a more comprehensive cross section of the community's waste to be delivered to the facility for sampling and sorting.

After discussing the sort team's needs, it was decided that the sorting area would be set up inside the transfer station building, west of the tipping floor and loading bay. The hauling company would employ its normal operation and deposit its load onto the tipping floor. Once the samples were captured and all pertinent information obtained, operators could employ their normal procedures and place the remainder of the waste into the transfer trailer.

3.2 FIELD SORTING EVENT AND CONDITIONS

Field activities to sort Broken Bow's waste were undertaken on Monday, October 6, 2014. The set up and organization of waste characterization equipment was conducted inside the transfer station. The sort area configuration encompassed two stations with one used for sorting waste and one for weighing and recording weights.

Two loads of mixed waste from the community of Broken Bow were delivered to the transfer station by S & L Sanitation Service on Monday, October 6, 2014. Once the waste was unloaded onto the tipping floor, the driver interviewed, the visual inspection conducted, and the sample captured, the remainder of the waste was pushed into a subterranean transfer trailer with a front-end loader and the area was swept.

The captured samples were taken to the sort area where they were sorted, categorized, and weighed following the methodology outlined in Section 2.0 of this report. After the materials from a sample were sorted, categorized, and weighed, they were discarded onto the tipping floor and the facility's operators pushed them into the transfer trailer to be transported to a facility for final disposal.

While the sort was conducted, eight trucks arrived to unload various types of trash including construction debris and road crew trash. In addition, this transfer station offers recycling and numerous citizens dropped off recyclable materials.



3.3 DATA RESULTS

Detailed data for the two samples was compiled throughout the one-day field sorting event undertaken at this facility. For example, the weights of the materials found in each sample were recorded, items sighted during the visual inspection were quantified and noted, and sample specifics like the type of waste, county of origin, etc. were also noted. Data sheets for each of the samples captured for Broken Bow are presented in Table 3.1 and Table 3.2. Each sample's weight data along with each sample's specifics were then compiled into a summary table, which is presented in Table 3.3 and Chart 3.1.

**TABLE 3.1
WEIGHT DATA FOR BROKEN BOW SAMPLE 1**

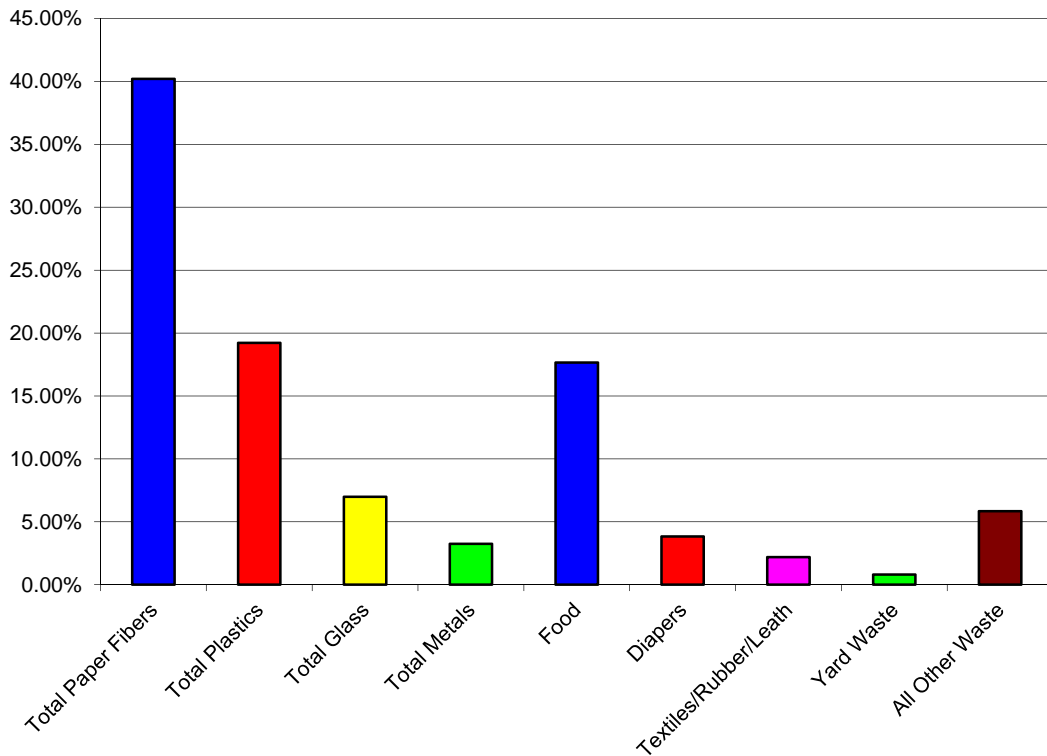
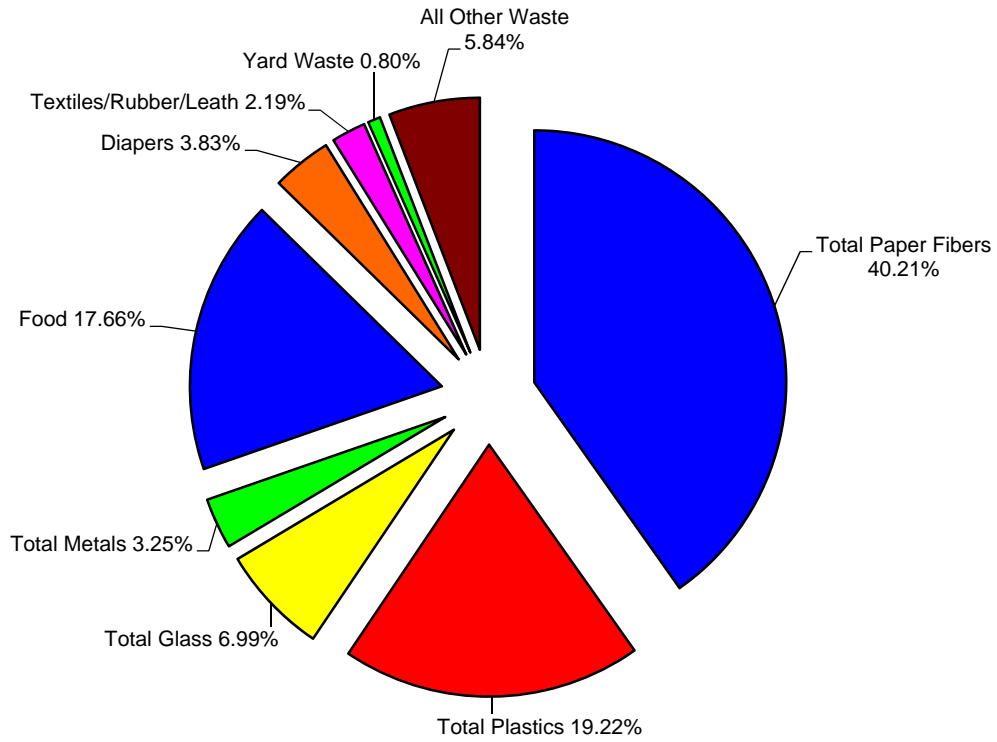
DAY AND DATE	Monday, October 6, 2014		
ORIGIN OF WASTE - COMMUNITY	Broken Bow		
TYPE OF WASTE	Mixed	Single Family Homes, Restaurants, Nursing Homes, Hospitals, Doctors' Offices, Schools	
NET WEIGHT AND TYPE OF TRUCK	6.37 tons	Rear Packer	
Material Category	Net Weight (pounds)	% of Material Category	% of Sorted Sample
Cardboard	35.95	33.74%	15.05%
Office Paper	7.10	6.66%	2.97%
Newsprint	8.75	8.21%	3.66%
Magazines	3.80	3.57%	1.59%
Paperboard/Liner Board	11.50	10.79%	4.82%
Mixed Paper	39.45	37.02%	16.52%
TOTAL PAPER FIBERS	106.55		44.62%
PET #1	4.90	9.62%	2.05%
HDPE #2	1.45	2.85%	0.61%
Other Numbered Containers	3.85	7.56%	1.61%
Plastic Film/Wrap/Bags	19.10	37.49%	8.00%
Other Plastics	21.65	42.49%	9.07%
TOTAL PLASTICS	50.95		21.34%
Glass Containers	8.55	99.42%	3.58%
Other Glass	0.05	0.58%	0.02%
TOTAL GLASS	8.60		3.60%
Aluminum Cans	2.05	33.88%	0.86%
Tin Cans	3.15	52.07%	1.32%
Other Aluminum	0.70	11.57%	0.29%
Other Tin	0.15	2.48%	0.06%
TOTAL METALS	6.05		2.53%
Food	43.40		18.17%
Diapers	5.70		2.39%
Textiles/Rubber/Leather	3.95		1.65%
Yard Waste	0.05		0.02%
Non-Distinct Waste	11.35		4.75%
Wood and Misc. C/D	2.20		0.92%
TOTAL WEIGHT OF SORTED SAMPLE*	238.80		100.00%
<i>* Medical Waste found in this load totaled approximately 10.30 pounds. This weight is NOT included in the Total Weight for this sample.</i>			

**TABLE 3.2
WEIGHT DATA FOR BROKEN BOW SAMPLE 2**

DAY AND DATE	Monday, October 6, 2014		
ORIGIN OF WASTE - COMMUNITY	Broken Bow		
TYPE OF WASTE	Mixed	Single Family Homes, Apartments, Retail, Offices, Restaurants, Doctors' Offices	
NET WEIGHT AND TYPE OF TRUCK	5.77 tons	Rear Packer	
Material Category	Net Weight (pounds)	% of Material Category	% of Sorted Sample
Cardboard	25.25	26.92%	9.73%
Office Paper	2.50	2.67%	0.96%
Newsprint	9.00	9.59%	3.47%
Magazines	11.65	12.42%	4.49%
Paperboard/Liner Board	17.65	18.82%	6.80%
Mixed Paper	27.75	29.58%	10.70%
TOTAL PAPER FIBERS	93.80		36.16%
PET #1	19.50	43.53%	7.52%
HDPE #2	4.95	11.05%	1.91%
Other Numbered Containers	1.10	2.46%	0.42%
Plastic Film/Wrap/Bags	6.40	14.29%	2.47%
Other Plastics	12.85	28.68%	4.95%
TOTAL PLASTICS	44.80		17.27%
Glass Containers	26.20	100.00%	10.10%
Other Glass	0.00	0.00%	0.00%
TOTAL GLASS	26.20		10.10%
Aluminum Cans	4.05	39.90%	1.56%
Tin Cans	4.25	41.87%	1.64%
Other Aluminum	0.60	5.91%	0.23%
Other Tin	1.25	12.32%	0.48%
TOTAL METALS	10.15		3.91%
Food	44.60		17.19%
Diapers	13.40		5.17%
Textiles/Rubber/Leather	6.95		2.68%
Yard Waste	3.95		1.52%
Non-Distinct Waste	13.70		5.28%
Wood and Misc. C/D	1.85		0.71%
TOTAL WEIGHT OF SORTED SAMPLE	259.40		100.00%

**TABLE 3.3
WEIGHT DATA SUMMARY FOR BROKEN BOW**

DAY AND DATE	Monday, October 6, 2014		
ORIGIN OF WASTE - COMMUNITY	Broken Bow		
TYPE OF WASTE	Mixed		
NET WEIGHT OF LOADS SAMPLED	12.14 tons		
Material Category	Net Weight (pounds)	% of Material Category	% of Sorted Sample
Cardboard	61.20	30.55%	12.28%
Office Paper	9.60	4.79%	1.93%
Newsprint	17.75	8.86%	3.56%
Magazines	15.45	7.71%	3.10%
Paperboard/Liner Board	29.15	14.55%	5.85%
Mixed Paper	67.20	33.54%	13.49%
TOTAL PAPER FIBERS	200.35		40.21%
PET #1	24.40	25.48%	4.90%
HDPE #2	6.40	6.68%	1.28%
Other Numbered Containers	4.95	5.17%	0.99%
Plastic Film/Wrap/Bags	25.50	26.63%	5.12%
Other Plastics	34.50	36.03%	6.92%
TOTAL PLASTICS	95.75		19.22%
Glass Containers	34.75	99.86%	6.98%
Other Glass	0.05	0.14%	0.01%
TOTAL GLASS	34.80		6.99%
Aluminum Cans	6.10	37.65%	1.22%
Tin Cans	7.40	45.68%	1.49%
Other Aluminum	1.30	8.02%	0.26%
Other Tin	1.40	8.64%	0.28%
TOTAL METALS	16.20		3.25%
Food	88.00		17.66%
Diapers	19.10		3.83%
Textiles/Rubber/Leather	10.90		2.19%
Yard Waste	4.00		0.80%
Non-Distinct Waste	25.05		5.03%
Wood and Misc. C/D	4.05		0.81%
TOTAL WEIGHT OF SORTED SAMPLES	498.20		100.00%



**CHART 3.1
DISTRIBUTION OF THE SUMMARY
WEIGHT DATA FOR BROKEN BOW**

3.4 DATA ANALYSIS

Utilizing the data presented in the previous section, the one-day field sorting event results were analyzed. This analysis focused on the percentage of each material category and its percentage of the total sample. The analysis also evaluated the nine categories that comprise the waste stream (paper fibers, plastics, glass, metals, food, diapers, textiles\rubber\leather, yard waste, and non-distinct). These categories provide a distinct separation of materials within the sample and allow for ease in identifying those portions of the sample with potential for recovery and reuse.

3.4.1 Waste Characterization

Two loads of mixed municipal solid waste (residential and commercial) generated in the community of Broken Bow were sampled for this project. The samples were then sorted into categories and components to determine the waste's characteristics.

The largest category found in the two loads of mixed waste generated in Broken Bow was paper fibers which accounted for 40.21% of the total sample. The largest component of this category was mixed paper, which comprised 13.49% of the sample. The smallest category in this sample was metals, which comprised only 3.25% of the total sample.

The paper fibers, plastics, glass, and metals categories combined comprised 69.67% of the total sample. Of the remaining nine categories, the largest category was food which accounted for 17.66% of the total sample.

3.4.2 Recycling Potential

Approximately 90% of the sample captured and sorted during the one-day field sorting event undertaken for this community is potentially recoverable and/or recyclable. Almost 45% of these materials are paper fibers and over 21% of these materials are plastics.

In an effort to further identify the recycling and/or recoverable potential of materials found in the waste stream, materials were classified as high, medium, or low signifying their potential for recycling or recovery. The potential for recycling or recovery of any material found in the solid waste stream depends on the: (1) demand for the material; (2) value of the material; (3) location of processing facilities; and (4) reuse potential of the material.

For certain materials, cardboard for example, the demand and the value of the material is high and this often outweighs the cost to transport the material to a processing facility. This results in cardboard having a high potential.

In turn, the Number 5 through 7 plastics do not have a high value, but do have a good demand level. The cost to transport the material is less than cardboard because these plastics are lighter weight and more of the material can be transported in one load. This results in the Number 5 through 7 plastics having a medium potential.

Glass has a low demand and value and there are very limited processing facilities for these materials. Further the raw material utilized in the production of glass is plentiful and inexpensive and the reuse of glass on a large scale is limited given its fragile nature. This results in glass having a low potential.

In general, and for purposes of this study, the following materials have been classified as having a high recycling or recovery potential:

- cardboard
- office paper
- paperboard/liner board
- PET #1
- HDPE #2
- aluminum cans
- food
- yard waste
- textiles/rubber/leather

Those materials that have been classified as having a medium recycling or recovery potential include:

- newsprint
- magazines
- mixed paper
- other numbered containers
- film/wrap/bags
- tin cans
- other aluminum
- other tin

Finally, those materials that have been classified as having a low recycling or recovery potential include:

- other plastics
- glass

When the materials found in the sample captured and sorted during the one-day field sorting event undertaken for Broken Bow are segregated using the classifications as explained above, more than 48% of the recyclables and recoverables are considered as having a high potential; more than 28% of the recyclables and the recoverables are considered as having a medium potential; and 14% of the recyclables and recoverables are considered as having a low potential.

3.4.3 Commercial Waste Characteristics

Two loads of waste generated in Broken Bow and sampled for this project contained both commercial and residential waste. The commercial accounts that were collected in this load included retail stores, restaurants, doctors' offices, offices, hospitals, schools, and nursing homes.

The impact of the commercial accounts collected and sampled in this load can be seen in the quantity of food, mixed paper, and film and bags. The sizeable amount of food can likely be attributed to the collection of waste from retail stores (which includes grocery stores) and restaurants. The mixed paper category is impacted by retail stores, restaurants, and nursing homes because of the amount of paper towels and food containers generated and disposed by these establishments. In addition, waste collected from restaurants, retail stores, and nursing homes impact the quantity of film and bags found in a load. The type of film that is typically discarded is shrink wrap and the number of bags that are discarded increases given the number of times waste canisters are emptied during the day.

3.4.4 Visual Inspection Analysis

A visual inspection was undertaken for each load sampled for this project. The items noted during the visual inspection included electronic items, items that were of significant interest, and items that were too bulky and/or heavy to be included in a 200 to 300 pound sample. The sampled loads of residential and commercial waste from Broken Bow contained a number of large items including lumber, siding, plastic bins, automobile engine parts, wood furniture, patio furniture, and PVC pipe.

4.0 WASTE REDUCTION POTENTIAL

The following section provides observations made during the field sorting event conducted at the Custer Transfer Station and throughout the development of this report. In addition, we utilized the results of the analyses presented previously in this report to develop a set of conclusions. Both the observations and conclusions consider the concept of waste reduction and the ultimate goal of zero waste.

4.1 OBSERVATIONS

A number of observations were made during the field sorting event for Broken Bow. These observations are provided in no particular order and should be considered as observations made at the time or during the report preparation.

1. The two solid waste loads for Broken Bow sorted at the Custer Transfer Station contained a number of materials that can be recycled. These items include: cardboard, paperboard, newsprint, office paper, mixed paper, HDPE #2 containers, PET #1 containers, aluminum cans, tin cans, and other numbered plastic containers.
2. The transfer station where field sorting events were conducted was well organized and maintained. A recycling facility adjoins the transfer station and recycling drop off is provided.
3. While at the transfer station, it was noted that loads of waste delivered to the facility by private citizens and private businesses contained shingles, wood, furniture, and paper.
4. While conducting the visual inspection, building materials, furniture (office, home, and patio), car parts, packing material, and toys were noted.
5. The collection vehicles that were selected for sorting were rear packers.
6. Adult diapers were found more frequently than baby diapers.
7. Food comprised 17.6% of the waste stream.

8. Plastics comprised 19% of the waste stream. Other plastics comprised a predominant part of the plastics waste stream, followed by film and bags and PET #1.
9. The amount of glass and metals in the waste stream was relatively small. Glass was approximately 7% of the waste stream and metals comprised a little over 3% of the waste stream.
10. The amount of yard waste in the sampled loads was relatively small. This is likely due to the time of year when the sort occurred along with the state's yard waste ban.
11. The amount of textiles/rubber/leather was 2.19% of the waste stream. This category varies significantly and is dependent upon the time of the month and time of year. More textiles/rubber/leather are found in loads at the end and beginning of each month, when most rental leases expire. Additionally, more of these materials are found in the early fall and late spring, which corresponds to the start and end of the school year.
12. Non-distinct waste comprised over 5% of the waste stream. The non-distinct waste included batteries, wood, and electronic waste as well as drywall.

4.2 CONCLUSIONS

The conclusions provided in this section are based on the observations presented previously as well as our experience with previously conducted waste characterization studies.

1. Based on this limited study, it appears the Broken Bow waste stream can be reduced. The percentage of potential reduction varies from 48% to 90%, depending upon the materials that are targeted for recycling or recovery.
2. The more recyclables that can be captured, based on total numbers, the greater the potential for a recycling program's success.
3. Continual public education and training should be instituted in order to increase the amount of recycling and waste reduction that occurs, with an emphasis on capturing recyclables at the point of generation.
4. A system of collecting the recyclables and recoverables at the community level as well as at the regional and state level should be established. As the public is better motivated and trained to recycle, a well-functioning system must be in place to respond to the increased amount of recyclables.
5. Financial support of the recycling efforts from local, regional, and state agencies as well as the private sector should continue. This support should address education and infrastructure needs, with the goal of the recycling system reaching self-sustainability.

