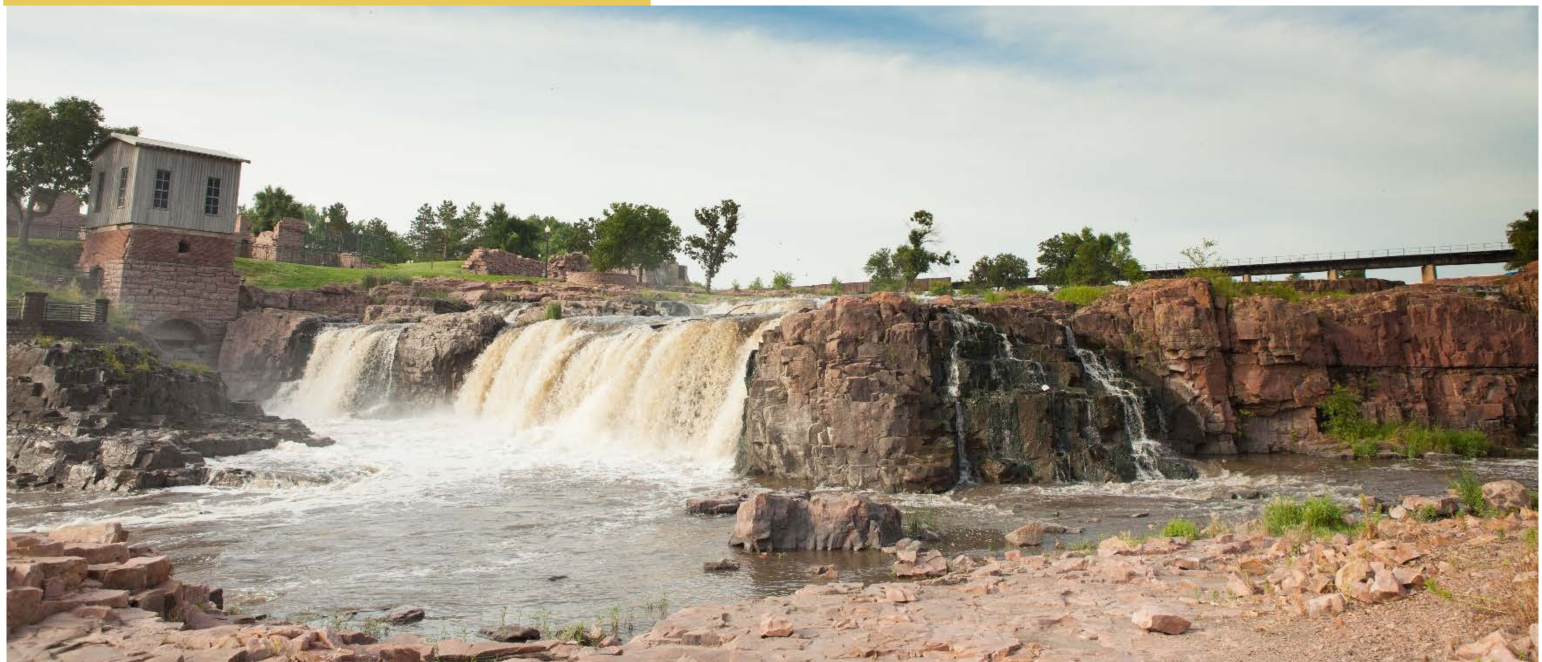
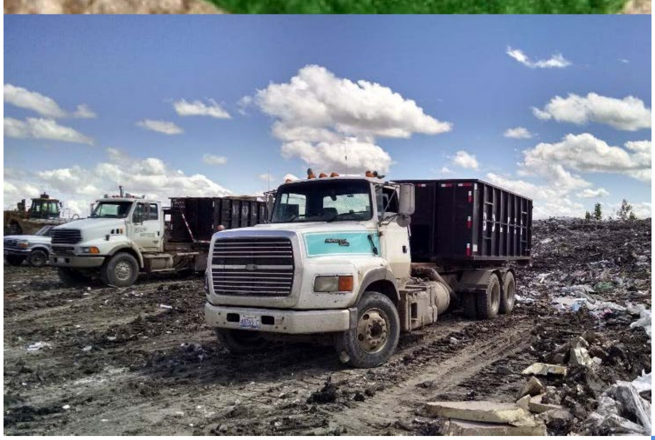
City of Sioux Falls
SOUTH DAKOTA



City of Sioux Falls Solid Waste Management Master Plan



November 2017

Updated December 2019

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Acronyms and Abbreviations

AD	Anaerobic Digestion
BHWMP	Business Hazardous Waste Management Program
BTU	British Thermal Unit
C&D	Construction and Demolition Debris
CAA	Clean Air Act
CESQG	Conditionally Exempt Small Quantity Generator
CFR	Code of Federal Regulations
CNG	Compressed Natural Gas
DENR	Department of Environment and Natural Resources
EISA	Energy Interdependence and Security Act
EPA	U.S. Environmental Protection Agency
EPAct	Energy Policy Act
GCCS	Gas Collection and Control System
HHW	Household Hazardous Waste
ICI	Industrial/Commercial/Institutional
LNG	Liquefied Natural Gas
LFG	Landfill Gas
LFGTE	Landfill Gas-to-Energy
MRF	Material Recovery Facility
MSA	Metropolitan Statistical Area
MSW	Municipal Solid Waste
NHSM	Non-Hazardous Secondary Materials
NMOC	Non-Methane Organic Compound
PAYT	Pay As You Throw
RDF	Refuse-Derived Fuel
RECs	Renewable Energy Credits
RFS	Renewable Fuel Standard
RFS2	Renewable Fuel Standard, expanded program
RIN	Renewable Identification Number
RNG	Renewable Natural Gas
scfm	Standard Cubic Feet Per Minute
SEAM	Secure Enterprise Asset Management
SOP	Standard Operating Procedures
SRF	Solid Refuse Fuel
SWMMP	Solid Waste Management Master Plan
WWTP	Wastewater Treatment Plant

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1 Planning Purpose and Process

1.1 Planning Purpose

In 2016, the City of Sioux Falls (City) began the development of a 30-year Solid Waste Management Master Plan (SWMMP) that would serve as a guide for future policies, programs, and infrastructure investments in the City's integrated solid waste management system. Some of the key drivers in initiating the long-range master planning effort included:

- **Establishing a Roadmap for the Next 30 Years** – The future of solid waste management in the City encompasses a wide variety of operations including collection, processing, conversion, and disposal of materials generated by the residential and commercial sectors in a five-county area, including the counties of Lake, Lincoln, McCook, Minnehaha, and Turner (Service Area). The SWMMP sought to develop a thoughtful and comprehensive roadmap for managing those materials and operations over the next 30 years.
- **Build Upon the City's Sustainability Master Plan** – The Sustainability Master Plan was presented at a public open house in June of 2012. Elements of the Sustainability Master Plan touch on solid waste management issues, and the sustainability goals and initiatives for the City were reviewed and considered as the SWMMP planning process unfolded. The relevance of the Sustainability Master Plan to the solid waste management system included elements for waste minimization, energy conversation and renewable energy, transportation, and community vitality.
- **Evaluate Existing System and Improvements to Enhance It** – While the City already enjoys an efficient and environmentally aware solid waste management system, it is recognized that there may be room for improvement on current operations as well as new opportunities to consider for the next 30 years.

Long-range planning is essential to achieving a cost-effective and environmentally sound integrated solid waste management system. To this end, the planning process facilitated a cooperative effort between various City departments and divisions, and provides a framework for budget preparation and infrastructure planning by anticipating future needs. Direction for both short-term and long-term management of the solid waste system is established by the SWMMP. It documents the existing conditions of the City's integrated system, identifies opportunities to address system needs and goals, and makes recommendations for future policies, programs, and infrastructure to accomplish those goals. The SWMMP is intended to be a "living document." It will need to be revisited by City staff on a regular basis to evaluate progress, reassess initiatives and implementation plans, and potentially make updates to the SWMMP considering future conditions.

1.2 Planning Process

The scope of the planning process effort included four main phases of work. The first phase focused on researching the current condition of the City's solid waste management system to provide a basic understanding the current system, and begin to identify needs and opportunities, guiding the remaining efforts. The second phase sought to further identify potential strategies to improve and enhance the current system. The third phase included prioritizing the potential strategies, and the final phase included drafting the SWMMP document.

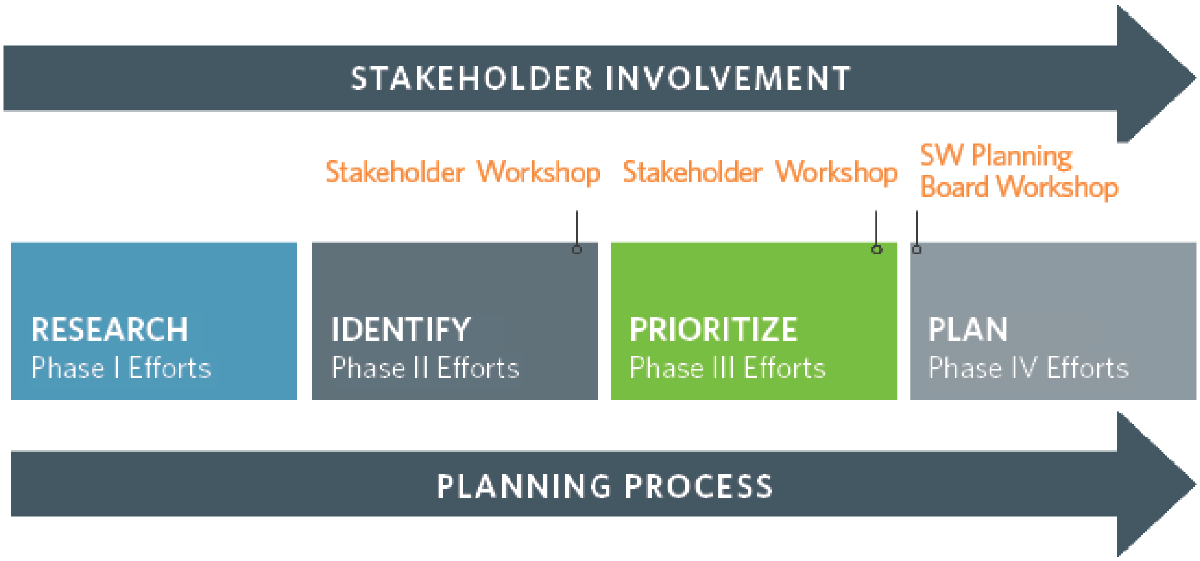

Table 1-1 outlines the specific main tasks, and provides a reference for quickly identifying the location of specific topics in the SWMMP.

Table 1-1. Solid Waste Management Master Plan Tasks

Task No.	Task Name	Task Results Reference (Chapter and/or Appendix)
1	Waste Characterization	Chapter 2; Appendix A
2	Waste Collection Alternatives	Chapters 2 and 4; Appendix B
3	C&D MRF and Integrated Facility Options	Chapter 5; Appendix C
4	Key Landfill Operational Issues	Chapters 2 and 5; Appendix D
5	Waste Generation and Disposal Projections	Chapter 2; Appendix E
6	Pending Legislative and Regulatory Framework	Chapter 8
7	Public Education Program	Chapters 2 and 3; Appendix F
8	Emerging Technologies	Chapters 5; Appendix G
9	Household Hazardous Waste and Problem Materials Management	Chapters 2 and 5; Appendix H
10	Identify Innovative Green Projects	Chapters 3 and 5; Appendix I
11	Transfer Station	Chapter 4; Appendix J

Table 1-1. Solid Waste Management Master Plan Tasks

Task No.	Task Name	Task Results Reference (Chapter and/or Appendix)
12	Long-term Landfill Gas Options	Chapters 2 and 6; Appendix K
13	Stakeholder Input Process	Chapter 1; Appendix L
14	Monitoring the Master Plan	Chapter 7
15	Prepare Solid Waste Management Master Plan	NA

1.3 Goals of the SWMMP

The City's goals for the solid waste system were also used to guide the planning process, and include the following:

- Protect the public and environment
- Develop and maintain an integrated, sustainable solid waste management system
- Continue to increase recycling and reuse opportunities
- Streamline collection practices
- Maintain the cleanliness of the region
- Facilitate public input on the system

The solid waste system provides opportunity to promote green initiatives which can build local markets, create green jobs, and reduce waste in the Service Area. Ultimately, the SWMMP seeks to optimize the solid waste system and enhance the sustainability, cost effectiveness, preservation of landfill airspace, and longevity of the system.

1.4 Stakeholder Input Process

The stakeholder input process included multiple workshops and hauler interviews. For the stakeholder workshops, City staff invited members of the community to participate in the process. In November of 2016, the first series of stakeholder workshops were held, including one workshop in the early afternoon for commercial sector representatives and one workshop in the early evening for residential representatives. The workshops included a presentation and group discussions, covering a variety of topics related to the solid waste system. The participants were presented with an overview of the planning project, the goals for the SWMMP, an overview of the current system, and some initial ideas for enhancing the current system. Participants asked questions and provided input on the potential strategies that were being considered, and offered up their own ideas for enhancing the system.

To obtain feedback from haulers, phone interviews were conducted. At the time of this writing, the City has twenty-five licensed haulers offering services as follows: twenty-one collecting residential and commercial garbage, recyclables, construction and demolition debris (C&D), and yard waste; three that only haul C&D; and one that primarily hauls C&D along with some commercial garbage. Each of the twenty-five licensed haulers were contacted, and fourteen haulers participated in the survey. The survey asked for input regarding current and potential collection practices, their opinion of the need for a transfer station, and their opinion on landfill operations.

For the second round of stakeholder workshops, it was decided that the residential and commercial groups could be combined into one, and the second workshop was held in February 2017. Additional research, including results from the hauler interviews, were presented to the participants, and participants again provided their feedback. Participants were asked to “vote” on priorities for the City to keep in mind while deciding on strategies to include in the SWMMP. Each participant was provided with three sticker dots, and were presented with four priorities. Each participant could allocate the three dot votes in any manner they preferred (e.g., all three dots for one item, two dots for one item and one for another item, or one dot for each of three items). As shown in Figure 1-1, the results of the dot voting showed that convenience and environmental stewardship were equally valued (six dots each), while cost received five dot votes, and aesthetics received only one dot vote.

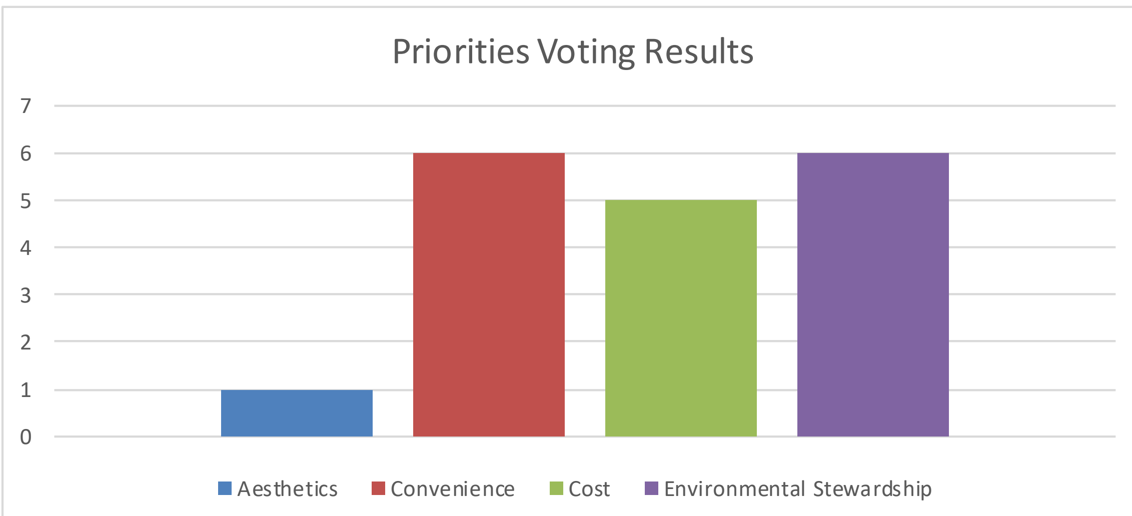

Figure 1-1: Priorities Voting Results

In April 2017, the Solid Waste Planning Board was invited to a workshop to review the results of the planning process to date, and to provide their feedback. The following day, a similar workshop was provided to City staff from a variety of departments.

Each of the workshop presentations and meeting notes, as well as the hauler interview results are provided in Appendix L (Stakeholder Outreach Materials).

1.5 2019 Plan Update Process

In August 2019, the City of Sioux Falls retained HDR, Inc. to prepare and update the SWMMP to include population projections, tonnage projections, recycling, and waste generation rates. In addition, each Chapter of the SWMMP was given a comprehensive review with updates provided to Implementation Strategies as appropriate. Revisions to Appendices A-L were not undertaken as part of the 2019 update process.

1.6 Acknowledgements

The City of Sioux Falls and the entire Project Team would like to thank the citizens that participated in our stakeholder workshops, the haulers that participated in our hauler interview process, and the Solid Waste Planning Board, for volunteering their time and attention, and providing their feedback.

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2 System Overview

Establishing a baseline understanding of the 2016 solid waste management system, with updates in 2019, assists in identifying factors that could influence the City's population and waste generation trends as well as policies, programs and infrastructure going forward. This information was used to develop waste generation projections for the 30-year planning period. The waste projections were then used to evaluate potential capacity needs and timing at existing and potential new facilities over the planning period. Efforts associated with the overview also included review of contracts, operating reports, ordinances, other relevant municipal data, and other materials relevant to understanding current and future needs and challenges within the City's solid waste management system. In addition, members of the HDR team conducted site visits and reviews of the Sioux Falls Regional Sanitary Landfill (Landfill), the Household Hazardous Waste Facility (HHW Facility), and the Educational Facility. The information obtained from those site visits and reviews was used in the development of the current system overview and assisted with the preliminary needs assessment.

The 2016 system overview includes a summary of policies, programs and infrastructure for the full loop of the City's solid waste management system (i.e., generation/public outreach, collection, transfer, processing, disposal and conversion). The City's service area includes the five-county area consisting of: Lake, Lincoln, McCook, Minnehaha, and Turner counties. Materials managed by the City's system are depicted in Figure 2-1, and generally include garbage, C&D, yard waste, recyclables, and Household Hazardous Waste (HHW).

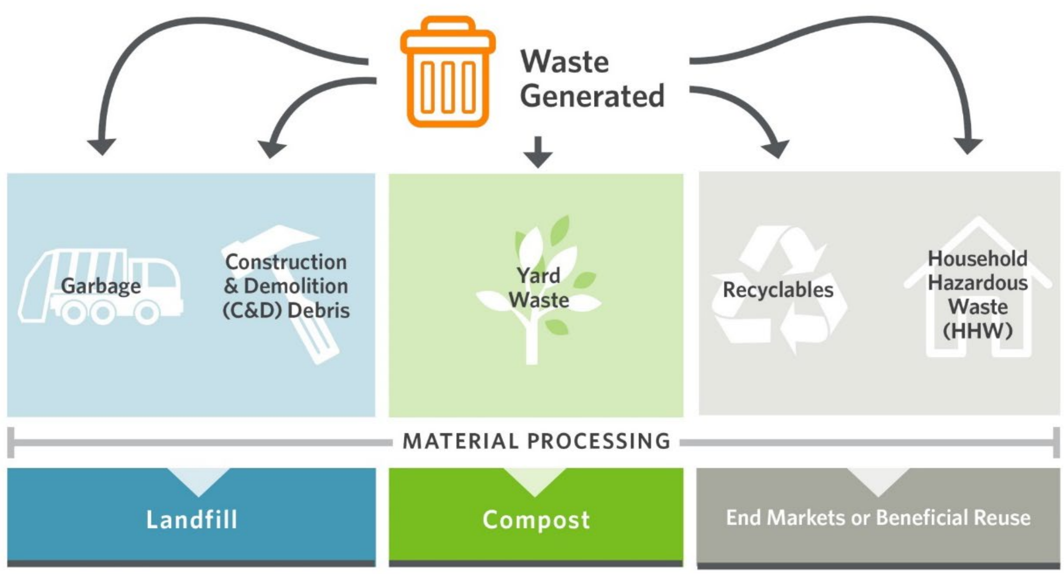


Figure 2-1: 2016 System Overview

The following sections provide a brief overview of the solid waste management system.

2.1 Historical and Projected Population

To plan for the City's future in solid waste management, it is important to develop an understanding of the anticipated population changes in the Service Area over the 30-year planning horizon. Historical population trends and future population projections were researched and analyzed for the planning process. Population projections were also used for waste projections.

For Sioux Falls Metropolitan Statistical Area (MSA), which includes the counties of Minnehaha, Lincoln, Turner, and McCook, Census Data was used for historical population data. Shape Sioux Falls population data obtained from the City Planning Department was used for the Sioux Falls MSA for projection years. For Lake County, Census Data was used for historical populations, and South Dakota State University data was used for its growth rates, which were applied to Census Data for projection years. Table 2-1 shows the 2015 and 2018 populations for the entire Service Area as well as county by county.

Table 2-1: Service Area Population (2018)

Jurisdiction	2015 Population	2018 Population
Minnehaha	185,179	192,876
Lincoln	53,000	58,807
Turner/McCook	15,050	13,970
Lake	12,622	13,057
Total Service Area	265,851	279,969

Figure 2-2 shows the Service Area historical and projected population through the planning horizon. As shown, by 2050, population in the Service Area is projected to nearly double, to 580,089.

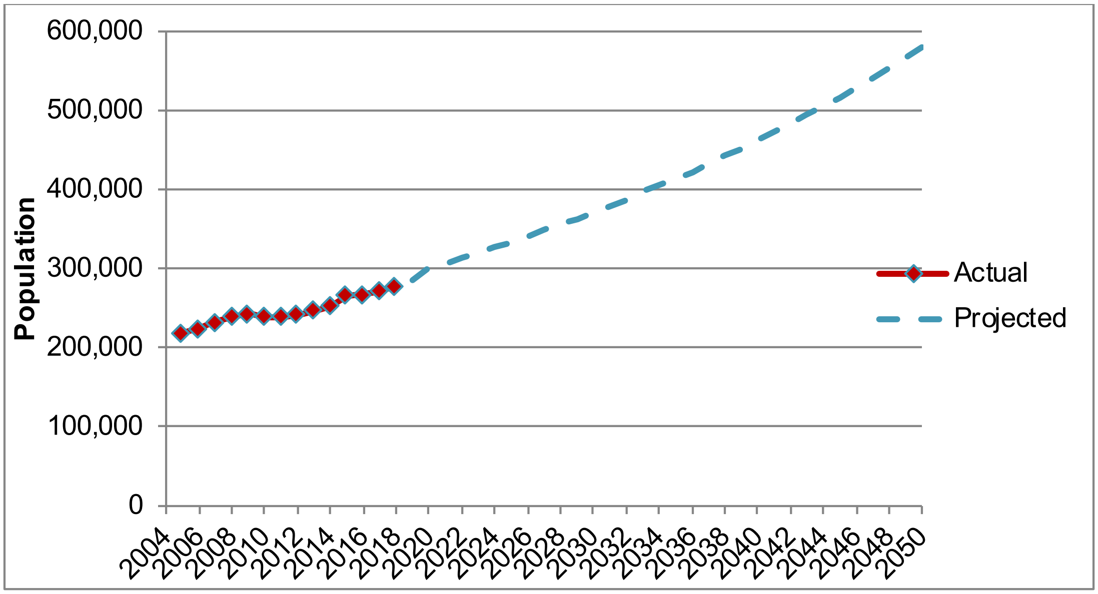


Figure 2-2: Service Area Historical and Projected Population

2.2 Waste Characterization

One of the first tasks undertaken in the planning process was to perform a waste characterization study of the municipal solid waste (MSW) stream received at the Landfill. The study also included visual characterization of a limited number of C&D debris loads received at the landfill during the waste characterization study period. The primary objective of the waste characterization study was to provide the City with accurate, annualized composition data for the MSW delivered to the Landfill.

To achieve the objectives described above, the following tasks were undertaken as part of the waste characterization study methodology:

1. Identified the "universe" of waste included in the study;
2. Determined material categories and definitions;
3. Completed pre-sort site visit and assessment;
4. Developed detailed sampling and sorting plan;
5. Conducted sampling and sorting event;
6. Compiled, reviewed, and analyzed collected data;
7. Completed statistical modeling; and
8. Developed a waste characterization for the Landfill.

The primary task of conducting the sampling and sorting event at the landfill was completed from May 9 through May 14, 2016.

A total of 50 samples representing nearly 13,000 pounds of MSW were sorted for the study. In addition, 10 C&D debris visual assessments were conducted, representing more than 12 tons of C&D waste. The MSW was physically sorted into 49 material categories (see Appendix A for the full report as well as categories and detailed definitions). The weights of the various materials in each sample were compiled by generator type (i.e., residential, industrial/commercial/institutional (ICI), and mixed load). The results were then aggregated to arrive at the overall MSW characterization for the Landfill.

2.2.1 MSW Composition

Table 2-2 presents the overall MSW composition results in a tabular format along with the standard deviation and confidence intervals for each material category. The confidence intervals indicate that, with a 90% level of confidence, the actual arithmetic mean (the arithmetic mean obtained if an infinite number samples were sorted) is within the upper and lower limits shown. This provides an understanding of how much variation occurred in the quantity of each material type found in the samples sorted.

Table 2-2: 2016 Landfill Municipal Solid Waste Composition (% by weight)

Material Group	Material	Mean	Standard Deviation	Confidence Interval	
				Lower Bound	Upper Bound
Paper	Newsprint	0.5%	0.8%	0.3%	0.7%
Paper	Magazines	1.1%	1.7%	0.7%	1.5%
Paper	High Grade Office Paper	1.1%	2.0%	0.7%	1.6%
Paper	OCC and Kraft Bags	6.6%	8.9%	4.5%	8.8%
Paper	Mixed Recyclable Paper	4.8%	4.6%	3.7%	5.9%
Paper	Non-Recyclable Paper	2.8%	3.6%	2.0%	3.7%
Paper	Compostable Paper	7.7%	4.5%	6.6%	8.7%
Total Paper		**24.7%**	**26.1%**	**18.5%**	**30.9%**
Plastics	#1 PET Containers	2.4%	2.1%	1.9%	2.8%
Plastics	#2 HDPE Containers	0.7%	0.9%	0.5%	0.9%
Plastics	Other Plastic Containers	1.8%	1.7%	1.4%	2.2%
Plastics	Other Plastic Products	3.8%	3.9%	2.9%	4.8%
Plastics	Film/Wrap/Bags	7.3%	4.6%	6.2%	8.4%
Total Plastics		**16.0%**	**13.1%**	**12.9%**	**19.1%**
Metals	Aluminum Beverage Containers	0.9%	0.7%	0.7%	1.0%
Metals	Ferrous Containers	0.8%	1.0%	0.6%	1.0%
Metals	Other Ferrous Metals	0.9%	1.6%	0.5%	1.2%
Metals	Other Non-Ferrous Metals	0.2%	0.3%	0.2%	0.3%
Total Metals		**2.8%**	**3.6%**	**1.9%**	**3.6%**

Table 2-2: 2016 Landfill Municipal Solid Waste Composition (% by weight)

Material Group	Material	Mean	Standard Deviation	Confidence Interval	
				Lower Bound	Upper Bound
Glass	Clear Glass	0.8%	1.2%	0.5%	1.1%
Glass	Green Glass	0.2%	0.6%	0.0%	0.3%
Glass	Blue Glass	0.0%	0.2%	0.0%	0.1%
Glass	Brown Glass	0.3%	0.9%	0.1%	0.5%
Glass	Other Mixed Cullet	0.2%	0.9%	0.0%	0.4%
Total Glass		**1.6%**	**3.8%**	**0.7%**	**2.5%**
Yard Waste	Grass and Leaves	3.4%	7.3%	1.7%	5.2%
Yard Waste	Brush and Trees	0.5%	1.1%	0.2%	0.8%
Total Yard Waste		**3.9%**	**8.5%**	**1.9%**	**5.9%**
Food Waste	Food Waste	7.6%	8.1%	5.7%	9.5%
Total Food Waste		**7.6%**	**8.1%**	**5.7%**	**9.5%**
Wood	Non-Treated Wood	3.8%	12.7%	0.8%	6.8%
Wood	Treated Wood	1.1%	2.7%	0.4%	1.7%
Total Wood		**4.9%**	**15.4%**	**1.3%**	**8.5%**
Construction & Demolition Debris	C&D Debris	3.3%	6.5%	1.7%	4.8%
Total Construction & Demolition Debris		**3.3%**	**6.5%**	**1.7%**	**4.8%**
Durables	Electrical and Household Appliances	2.0%	4.0%	1.0%	2.9%
Durables	Central Processing Units/Peripherals	0.0%	0.2%	0.0%	0.1%
Durables	Computer Monitors/TVs	0.1%	1.2%	0.0%	0.4%
Durables	Cell Phones and Chargers	0.0%	0.0%	0.0%	0.0%
Durables	Other Durables	0.4%	2.6%	0.0%	1.0%
Total Durables		**2.6%**	**8.0%**	**1.0%**	**4.5%**
Textiles and Leathers	Textiles and Leathers	5.1%	6.0%	3.6%	6.5%
Total Textiles and Leathers		**5.1%**	**6.0%**	**3.6%**	**6.5%**
Diapers	Diapers	2.7%	3.9%	1.8%	3.7%
Total Diapers		**2.7%**	**3.9%**	**1.8%**	**3.7%**
Rubber	Rubber	1.8%	2.6%	1.1%	2.4%
Total Rubber		**1.8%**	**2.6%**	**1.1%**	**2.4%**

Table 2-2: 2016 Landfill Municipal Solid Waste Composition (% by weight)

Material Group	Material	Mean	Standard Deviation	Confidence Interval	
				Lower Bound	Upper Bound
HHW	Automotive Products	0.5%	1.8%	0.1%	1.0%
HHW	Paints and Solvents	1.1%	3.0%	0.4%	1.8%
HHW	Pesticides, Herbicides, Fungicides	0.0%	0.1%	0.0%	0.1%
HHW	Household Cleaners	0.0%	0.1%	0.0%	0.1%
HHW	Lead Acid Batteries	0.0%	0.0%	0.0%	0.0%
HHW	Other Batteries	0.0%	0.1%	0.0%	0.1%
HHW	Mercury Containing Products	0.0%	0.0%	0.0%	0.0%
HHW	Other HHW	0.2%	0.3%	0.1%	0.2%
Total Household Hazardous Waste		**2.0%**	**5.4%**	**0.7%**	**3.3%**
Tires	Tires	0.2%	1.1%	0.0%	0.5%
Total Tires		**0.2%**	**1.1%**	**0.0%**	**0.5%**
Sharps	Sharps	0.1%	0.4%	0.0%	0.2%
Total Sharps		**0.1%**	**0.4%**	**0.0%**	**0.2%**
Other Organic	Other Organic	6.6%	11.3%	3.9%	9.3%
Total Other Organic		**6.6%**	**11.3%**	**3.9%**	**9.3%**
Other Inorganic	Other Inorganic	1.6%	3.9%	0.7%	2.6%
Total Other Inorganic		**1.6%**	**3.9%**	**0.7%**	**2.6%**
Fines/Super Mix	Fines/Super Mix	11.8%	7.0%	10.1%	13.4%
Total Fines/Super Mix		**11.8%**	**7.0%**	**10.1%**	**13.4%**
Other Materials	Other	1.0%	5.4%	0.0%	2.2%
Total Other Materials		**1.0%**	**5.4%**	**0.0%**	**2.2%**
GRAND TOTAL		**100.0%**			

Figure 2-3 depicts the 2016 annualized MSW composition results for the Landfill.

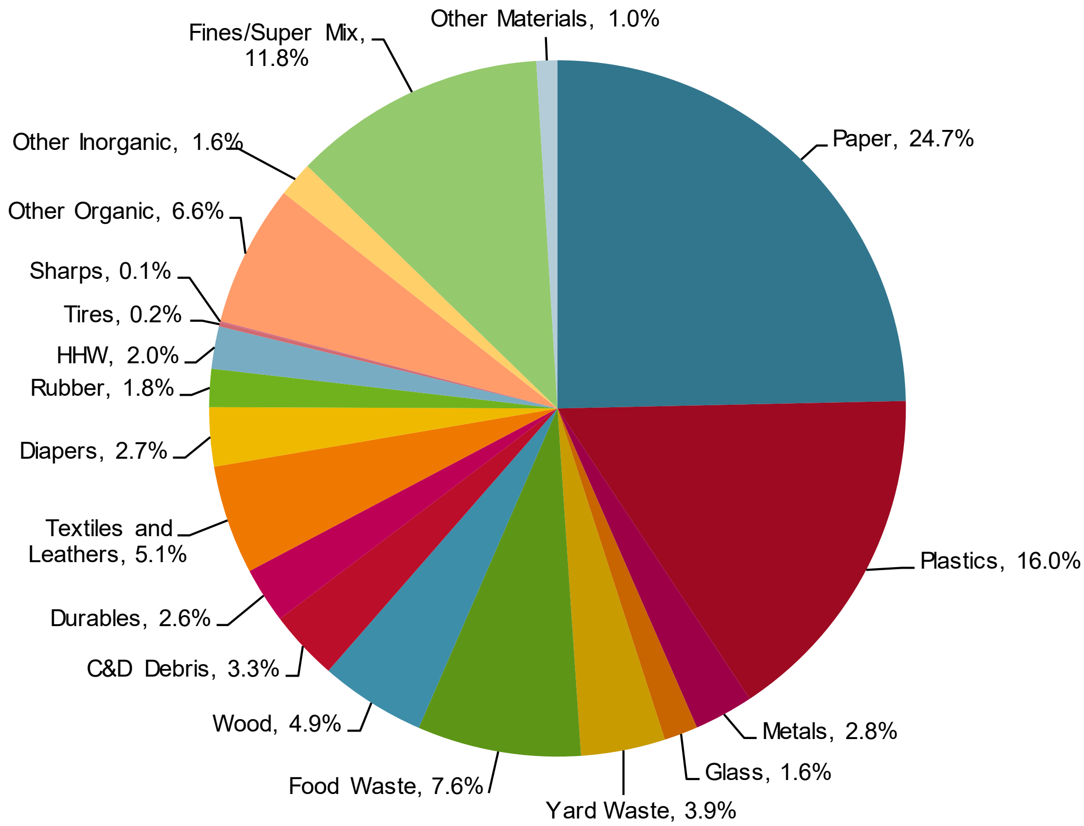


Figure 2-3: 2016 Landfill Municipal Solid Waste Composition (% by weight)

2.2.2 Solid Waste Composition

The following results present the overall solid waste composition of all materials landfilled at the Landfill on an annual basis. These results include not only MSW sampled, but also materials such as dedicated C&D debris loads and special wastes (e.g., source separated yard waste and wood waste, contaminated soil, appliances, scrap metal, electronics, recyclables, dead animals, and other materials requiring special handling) which were not included in the sampling related to the waste characterization study. To develop these annualized solid waste composition results, the HDR Team obtained tonnage information for all material streams accepted at the Landfill during calendar year 2015. The MSW characterization results were multiplied by the total tons of MSW received at the Landfill in 2015 and then weighted based on the overall solid waste tons received at the landfill during 2015, to arrive at the mean percentage and annual tons by material type. C&D and special waste categories were added to the material group list and their percentage of the overall solid waste stream received at the Landfill were calculated based on the 2015 tonnage data.

Table 2-3 presents the 2015 landfill's overall solid waste characterization.

Table 2-3: 2015 Landfill Overall Solid Waste Composition (% by weight)

Material Group	Material	Mean	Tons (2015)
Paper	Newsprint	0.30%	785
Paper	Magazines	0.69%	1,812
Paper	High Grade Office Paper	0.69%	1,821
Paper	OCC and Kraft Bags	4.05%	10,714
Paper	Mixed Recyclable Paper	2.91%	7,695
Paper	Non-Recyclable Paper	1.72%	4,555
Paper	Compostable Paper	4.67%	12,348
Total Paper		**15.03%**	**39,728**
Plastics	#1 PET Containers	1.43%	3,792
Plastics	#2 HDPE Containers	0.45%	1,180
Plastics	Other Plastic Containers	1.07%	2,836
Plastics	Other Plastic Products	2.35%	6,200
Plastics	Film/Wrap/Bags	4.47%	11,826
Total Plastics		**9.77%**	**25,834**
Metals	Aluminum Beverage Containers	0.52%	1,386
Metals	Ferrous Containers	0.48%	1,277
Metals	Other Ferrous Metals	0.52%	1,374
Metals	Other Non-Ferrous Metals	0.15%	397
Total Metals		**1.68%**	**4,434**
Glass	Clear Glass	0.50%	1,311
Glass	Green Glass	0.11%	286
Glass	Blue Glass	0.02%	62
Glass	Brown Glass	0.19%	501
Glass	Other Mixed Cullet	0.14%	365
Total Glass		**0.96%**	**2,525**
Yard Waste	Grass and Leaves	2.09%	5,528
Yard Waste	Brush and Trees	0.29%	773
Total Yard Waste		**2.38%**	**6,301**
Food Waste	Food Waste	4.63%	12,237
Total Food Waste		**4.63%**	**12,237**
Wood	Non-Treated Wood	2.34%	6,181
Wood	Treated Wood	0.65%	1,718
Total Wood		**2.99%**	**7,899**
Durables	Electrical and Household Appliances	1.21%	3,210
Durables	Central Processing Units/Peripherals	0.02%	59
Durables	Computer Monitors/TVs	0.08%	219

Table 2-3: 2015 Landfill Overall Solid Waste Composition (% by weight)

Material Group	Material	Mean	Tons (2015)
Durables	Cell Phones and Chargers	0.00%	13
Durables	Other Durables	0.26%	677
Total Durables		**1.58%**	**4,177**
Textiles and Leathers	Textiles and Leathers	3.08%	8,143
Total Textiles and Leathers		**3.08%**	**8,143**
Diapers	Diapers	1.67%	4,415
Total Diapers		**1.67%**	**4,415**
Rubber	Rubber	1.08%	2,843
Total Rubber		**1.08%**	**2,843**
HHW	Automotive Products	0.33%	884
HHW	Paints and Solvents	0.69%	1,836
HHW	Pesticides, Herbicides, Fungicides	0.02%	62
HHW	Household Cleaners	0.02%	63
HHW	Lead Acid Batteries	0.00%	0
HHW	Other Batteries	0.02%	49
HHW	Mercury Containing Products	0.00%	4
HHW	Other HHW	0.10%	274
Total Household Hazardous Waste		**1.20%**	**3,171**
Tires	Tires	0.11%	303
Total Tires		**0.11%**	**303**
Sharps	Sharps	0.04%	101
Total Sharps		**0.04%**	**101**
Other Organic	Other Organic	4.01%	10,594
Total Other Organic		**4.01%**	**10,594**
Other Inorganic	Other Inorganic	1.00%	2,638
Total Other Inorganic		**1.00%**	**2,638**
Fines/Super Mix	Fines/Super Mix	7.17%	18,962
Total Fines/Super Mix		**7.17%**	**18,962**
Other Materials	Other	0.59%	1,569
Total Other Materials		**0.59%**	**1,569**
C&D Waste		34.72%	91,796
Total C&D Waste		**34.72%**	**91,796**
Special Waste [1]		6.32%	16,696
Total Special Waste [1]		**6.32%**	**16,696**
GRAND TOTAL		**100.00%**	**264,369**

[1] "Special Waste" includes source separated yard waste, wood waste, tires, contaminated soil, appliances, scrap metal, electronics, recyclables, and dead animals.

Figure 2-4 depicts the 2015 annualized overall solid waste composition results for the Landfill.

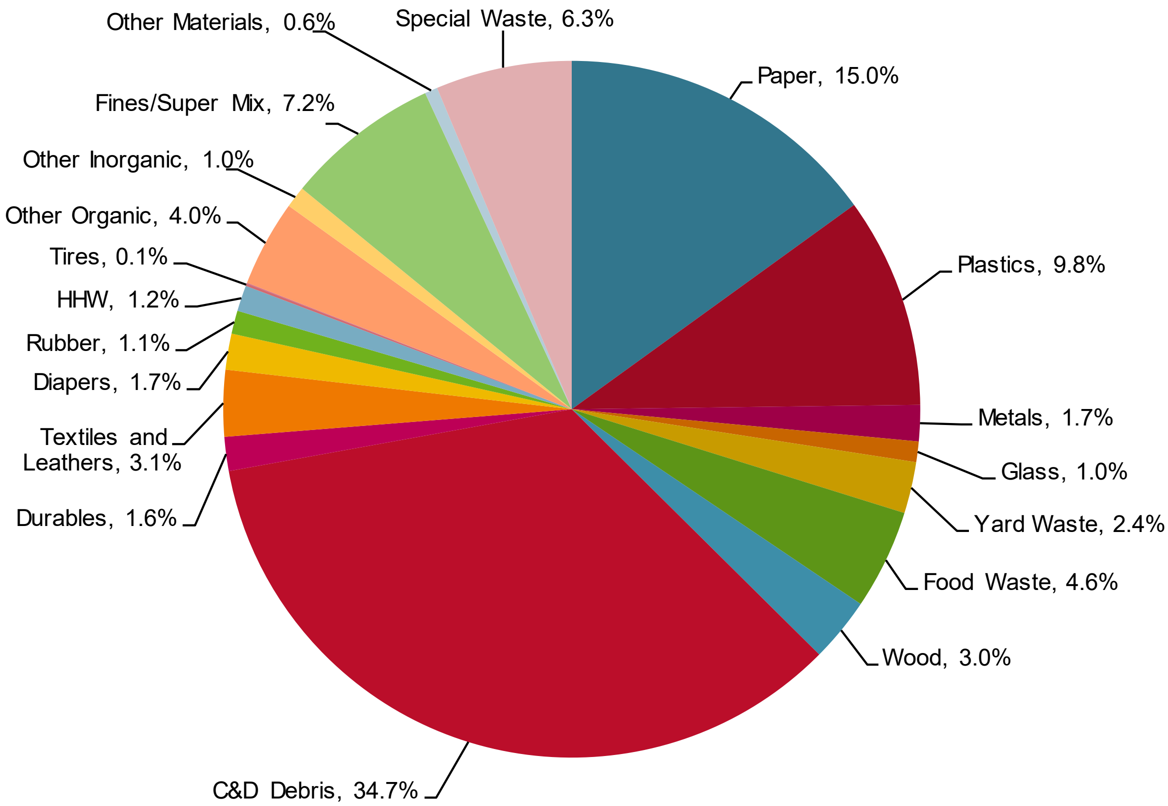


Figure 2-4: 2015 Landfill Overall Solid Waste Composition (% by weight)

Additional detail regarding every aspect of the waste characterization study, including methodology, data collection, analysis, and results can be found in Appendix A.

2.3 Waste Generation Projections

2.3.1 Per Capita Generation Rates

The per capita generation rates were developed by averaging the annual per capita generation rate, using historical tonnage data for each material type tracked at the Landfill and historical population for each year. The average generation rates are based on 5 years of data (2013 to 2018). A 10-year average was also calculated, though it was determined that the 5-year average would be more accurate for projection purposes since the single stream recycling program took effect in 2012. Complete projection data tables are provided in Appendix E. As shown in Table 2-4, the total per capita generation rate is 1.113 tons per year.

Table 2-4: Per Capita Generation Rates

	Tons per Year (Avg. 2010-2015)	Tons per Year (Avg. 2013-2018)	Tons per Year (2018)
MSW*	0.678	0.651	0.639
Yard Waste	0.033	0.034	0.026
C&D	0.315	0.314	0.309
Wood Waste	0.026	0.024	0.004
Mattresses	0.001	0.023	0.042
Asbestos	0.001	0	0.001
Contaminated Soil	0.039	0.053	0.067
Tires	0.002	0.002	0.002
Bio Solids	0	0.064	0.064
Total	**1.095**	**1.113**	**1.155**

2.3.2 Waste Generation Projections Through 2050

By applying the per capita generation rate to the population projections described in Section 2.1, the total projected waste generation was calculated. As shown in Figure 2-5, by 2050 (end of planning period) the total tons projected reaches approximately 677,000 tons. In 2018, 321,781 total tons came into the Landfill. A spike in tons of materials received at the Landfill occurred in 2013, which was attributable to excess bio solids coming from the City's water reclamation division.) The projected total tonnage coming into the Landfill is expected to increase by 78 percent through the planning period.

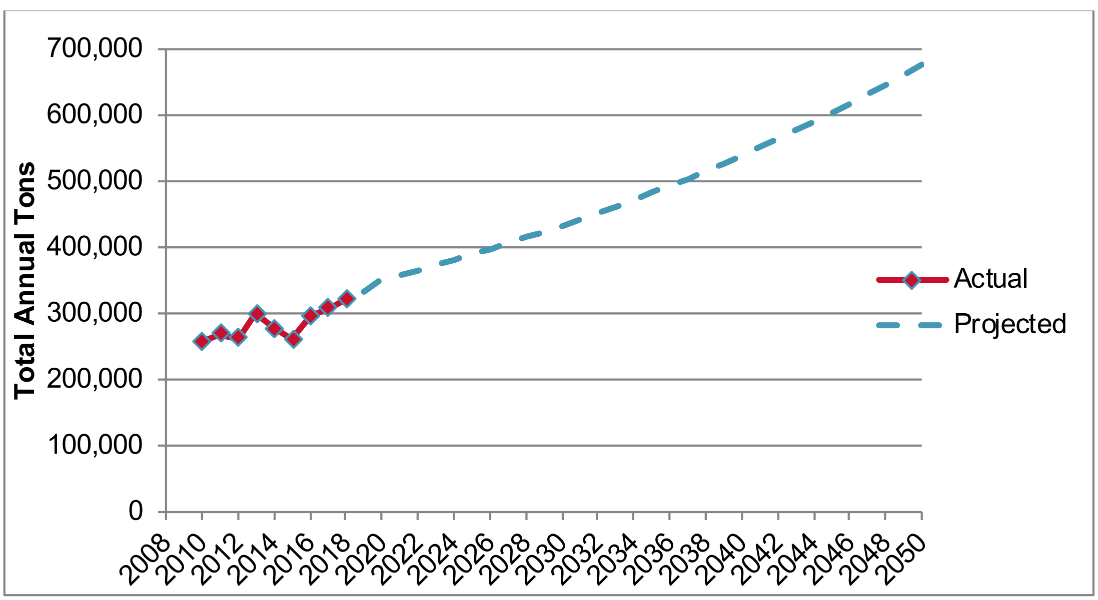


Figure 2-5: Waste Generation Projections

2.3.3 Projected Waste Generation by Material Type

By applying the results of the waste characterization study to the waste generation projections, the projected waste generation by material type was calculated. Table 2-5 and Figure 2-6 detail the waste projections by material type through 2050.

Table 2-5: Waste Projections by Material Type

		Projected Tons							
	Waste Fractions	2015	2020	2025	2030	2035	2040	2045	2050
Total Paper	15.03%	37,219	45,368	50,440	56,097	62,492	69,772	78,076	87,568
Total Plastics	9.77%	24,203	29,502	32,799	36,478	40,637	45,370	50,770	56,943
Total Food Waste	4.63%	11,465	13,975	15,537	17,279	19,249	21,492	24,050	26,974
Total Other Organic	4.01%	9,925	12,098	13,451	14,959	16,665	18,606	20,821	23,352
Total Fines/ Super Mix	7.17%	17,765	21,654	24,075	26,775	29,827	33,302	37,266	41,796
Total C&D Waste	34.72%	85,999	104,827	116,546	129,617	144,393	161,214	180,402	202,334
Total Special Waste	6.32%	15,641	19,066	21,197	23,574	26,262	29,321	32,811	36,800
Other Waste*	18.35%	45,456	55,408	61,602	68,511	76,321	85,212	95,354	106,947

* Note: Other Waste includes remaining waste fractions that are less than 4% of total waste individually.

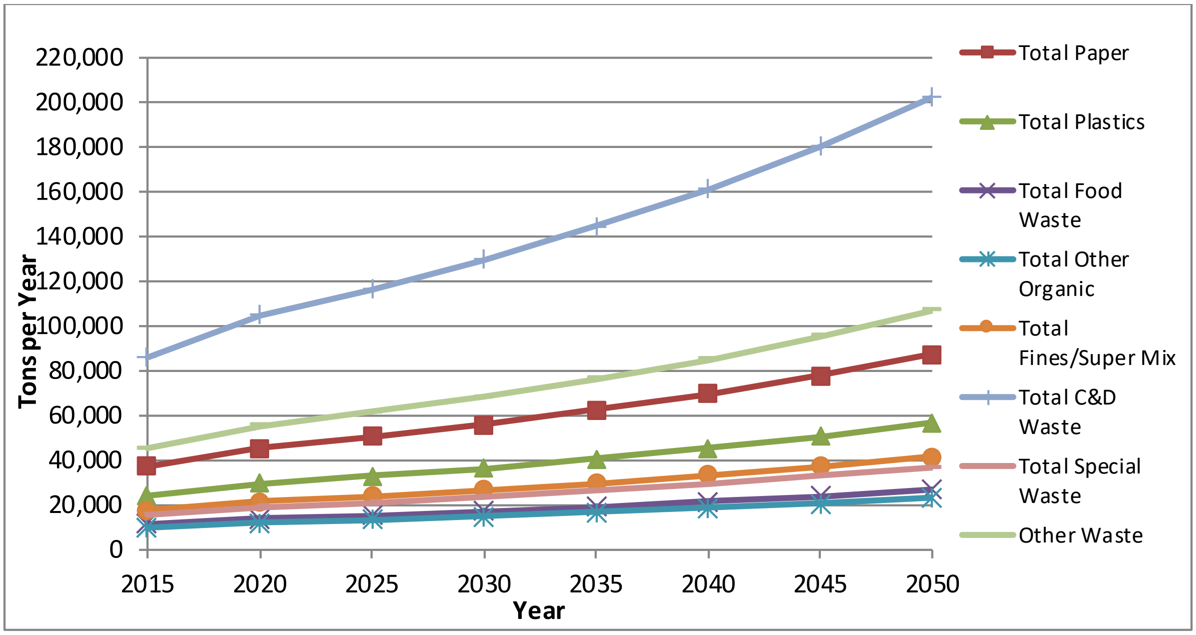


Figure 2-6: Waste Projections by Material Type

2.4 Public Outreach Overview

The City has an established recycling program, known as The Leading Green initiative, operated by the City's Sustainability Program. The Leading Green initiative is a guiding program that creates a more sustainable community by promoting and assisting with the implementation of measurable solutions to environmental, social and economic concerns. The City has mandated recycling for all residents and businesses. The City ordinance bans certain materials from being disposed as waste in the Landfill, and items such as plastics, metal containers, paper and cardboard are accepted in the recycling program. Twenty-one licensed haulers provided services to residential customers throughout the Service Area in 2015 which is three more than those licensed in 2019. The City requires haulers to lessen the burden on the Landfill by working towards meeting an annual recycling goal.

The education and outreach activities of the recycling program are led by the City Public Works Department. Since the 2012 mandatory shift in the program to single-stream recycling, a relatively new education campaign focuses on how to properly recycle materials in the new system. The City has committed to improving community health and safety by providing programs, education and leadership on how to reduce waste in the community. The public education program is a coordinated effort between the City, haulers, and the community.

2.4.1 Solid Waste Planning Board

The City has a planning board for its solid waste and recycling program. The members of the board are selected by the mayor and are tasked with improving recycling and solid waste issues in Sioux Falls. The board meets quarterly and the public is welcome to attend the meetings. Membership is comprised of city employees, representatives from the hauling industry, representative from the South Dakota Multi-Housing Association, the business community, citizens of Sioux Falls, and representatives of each of the five counties in the Service Area. Specifically, two members must be City employees: the Landfill Manager, and the Environmental Manager; two members must be representatives of the garbage hauling/recycling industry; one member must be a representative of the South Dakota Multi-Housing Association; one member must be a representative of the business community who generates solid waste within the five county region served by the Landfill and who has no financial interest in the garbage/recycling industry; one member must be from the Minnehaha County Planning Office; three members must be citizens of the City of Sioux Falls who have no financial interest in the garbage/recycling industry. In addition, one member must be selected by each of the governing bodies of Lake County, Lincoln County, McCook County, and Turner County.

2.4.2 Education Programming

The City has developed a classroom education program and recycling education kits that meet state core curriculum standards. The curriculum is developed to target students in three grade ranges; K-2nd, 3rd-5th, and 6th-8th grade. Schools are encouraged to reserve a kit for use in their own classrooms. The City offers Landfill tours for residents or groups interested in learning more about the program. They also have dedicated space for public meetings and resources for solid waste management education. The City hosts several events throughout the year dedicated to recycling and solid waste management.

One such event held annually is called Magic of Recycling. The event occurs in elementary schools and teaches children about the importance of recycling through an interactive magic show. The program covers how to properly recycle, reduce and reuse, and introduces students to the Landfill and the importance of reducing the amount of waste brought to the Landfill.

Annual recycling events such as Christmas tree, leaf, and pumpkin collection for composting boost participation in waste diversion and continued interest in the promotion of a more sustainable community. There are year-round drop-off opportunities at the Landfill for recyclable or reusable items such as white goods, yard waste, wood pallets, lawn mowers, scrap metal, and tires. The City also promotes and accepts year-round household hazardous waste and electronics from residents at their HHW Facility. The HHW Facility works to identify HHW items that have been collected and determines if they can be redistributed in the reuse room.

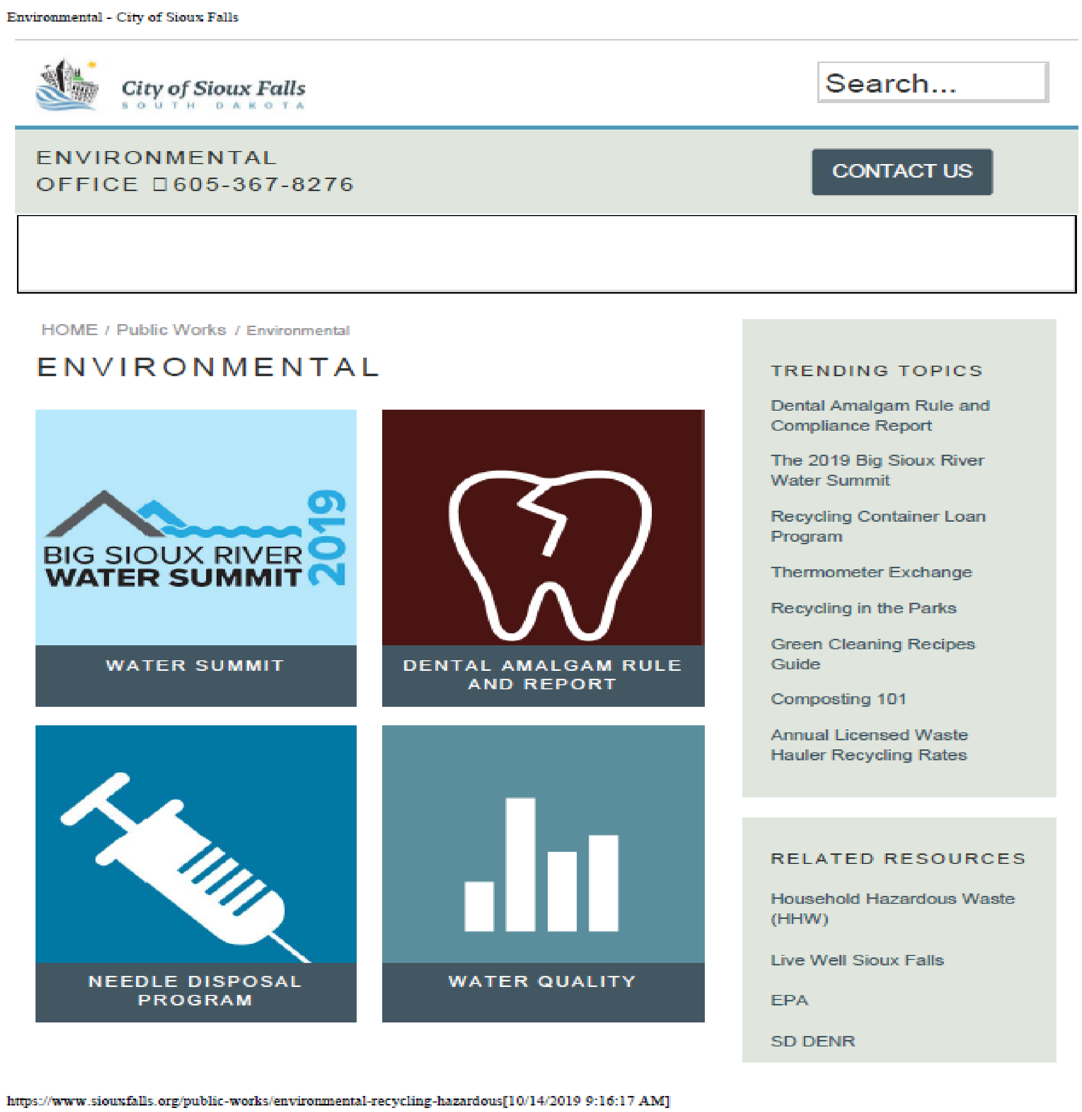
2.4.3 Branding

The City has a developed brand identity for its recycling program. The Leading Green brand is used with some consistency across all media platforms and outreach/education materials.

2.4.4 Website

The City hosts resources on the environmental page of the City's website, as shown in part in Image 2-1. The site offers links to program details, recycling guides, downloadable education materials, news releases, and videos. The Landfill website also contains important information related to waste and recycling, which is a separate site although there is a link on the environmental page to the landfill page. While the site is sufficient in providing access to information, it is not intuitively accessible.

Image 2-1: Sioux Falls Environmental Website



2.4.5 Social Media

The City has an active presence on both Facebook and Twitter. Various departments in the City have their own social media pages and often will *tag team* social media efforts on departmentally related events or notices. The City's Public Works Sustainability

Program, Leading Green, uses these platforms to post topics such as water quality, water flow, the city landfill, lawn watering and upcoming events. The Leading Green program also posts about the Parks and Recreation, Public Works and Mayor's departments. Leading Green's social media posts include photos, videos and infographics highlighting upcoming events and education tools for visitors. The Leading Green Facebook page hosts public service announcement videos. Two particular videos have higher viewership - a new pet waste station with over 8,000 views, and an earth day public service announcement with over 1,500 views. The newest video, added in 2019, No Bags in the Bin has over 2,100 views. Social media is used often for program alerts, updates, and event notifications, as shown in the example in Image 2-2.

Image 2-2: Social Media – Sioux Falls Leading Green

2.4.6 Video Outreach

The City has a YouTube channel with playlists dedicated to different City offices. There are educational videos about the Landfill and where trash goes. With more than 1.4 million views, the YouTube channel had 868 subscribers and almost 40 playlists in 2016. In 2019, the YouTube channel has 2,480 subscribers and over 300 playlists. There are playlists for Sioux Falls Park, Recreation, and Environmental. The Environmental playlist is where Leading Green videos are located. There are videos with press conferences/interviews and some educational videos. The press conference/interview videos are longer in length with the educational videos around 30 seconds long. The nine videos on this playlist are on average seven minutes long. Video promotions are used often for the recycling program.

2.4.7 Other Tools

The City publishes recycling fliers to all Sioux Falls households twice per year to remind residents of what can and cannot be recycled. The City provides other promotional items such as stickers and green cleaning recipe books to help create more awareness and encourage residents to create less waste by reusing bottles and make their own green cleaning products, rather than purchasing new. Waste haulers were provided with stickers indicating proper materials that can be collected in single stream recycling.

These stickers are intended to be placed on the recycling containers. The City provides the haulers with the educational materials, providing a standardized approach and messaging.

2.4.8 Public Outreach Successes

The City's strengths and successes exist in the relationship building with local haulers and the support and encouragement by the Mayor's office. The City enjoys strong relationships with the private haulers throughout the community. They work well with the City staff, who are viewed as a resource, rather than a policing agent. The haulers involvement in the Planning Board provides them a seat at the table and encourages open dialogue about the goals and implementation of the program.

The City sets recycling goals each year. In 2014, Sioux Falls had a record-setting year and surpassed their desired goal for the year. Enforcement of requirements helps to meet this goal. Individual haulers are required to meet at least 80%of the City's recycling goal or fines will be imposed. Haulers who exceed the goal can qualify for incentives provided by the City. Again in 2018, Sioux Falls had a record setting year with a recycling goal set at 18.2 percent and an actual recycling rate at 23.4 percent which surpassed the goal. In 2019, Sioux Falls has set a recycling goal of 23.4 percent.

2.4.9 Public Outreach Challenges

The material recycling facilities that process the City's recyclables face a challenge with contamination. Since transitioning to single-stream, contamination has remained a concern. The City has worked to combat the issue with education and outreach regarding contamination. The City attempts to explain of how waste is properly sorted on the back end through earned media opportunities, social media, and public service announcements.

2.5 Collection and Transfer

The City's current collection system is commonly referred to as an "open" or "subscription" based collection service. Chapter 110 (Licensing) of the City's code of ordinances covers the licensing requirements and fees for haulers in the City. Licenses are issued by the Public Works Department. In 2016, twenty-one (21) haulers were licensed to collect MSW and recyclables in the City. As of September 2019, the number of licensed haulers has dropped to eighteen (18).

While the City has an open/subscription system in place, the City's ordinances provide some control over collection services generally, as well as specific requirements designed to increase recycling. Section 57.033 of Chapter 57 requires that all waste generated in the City be disposed at the City's landfill (Landfill). Certain materials, including certain recyclables and yard waste, are banned from disposal in the Landfill.

2.5.1 Garbage (MSW)

Residents and businesses in the City are required to subscribe for once per week garbage collection service, per Chapter 57 (Garbage and Recycling) of the City's code of ordinance. Residents may also self-haul their waste (and recyclables) directly to the

Landfill and/or to a recycling facility. Licensed haulers are required to establish a pay as you throw (PAYT) rate system to enhance recycling. Residential curbside garbage rates charged by licensed haulers currently range from $15 to $35 per household month.

2.5.2 Recycling

The City requires haulers to offer recycling collection services, and residents are required to recycle. Licensed haulers are required to annually achieve a standard of 80% of the City's recycling goal and file required reports, per Section 57.081 of Chapter 57. Residential curbside recycling rates are included in the garbage rates.

2.5.3 Yard Waste

Chapter 57 of the City's code of ordinances requires that yard waste must be collected a minimum of once per week, seasonally. Residential curbside yard waste rates charged by licensed haulers currently ranged from $13 to $18 (seasonal) per household per month in 2016.

2.5.4 Household Hazardous Waste

The City owns a HHW Facility and is currently operated under contract by Veolia ES Technical Services. The HHW Facility is open to the public Tuesday through Friday 8:00 a.m. to 5:00 p.m. and Saturday 8:00 a.m. to 12:00 noon. The facility accepts HHW materials free of charge from individual residents of Lake, Lincoln, McCook, Minnehaha and Turner counties (the Service Area), with identification. HHWs are products that contain ingredients that are toxic, flammable, reactive or corrosive. If disposed improperly, these products can be harmful to humans, wildlife and the environment. Proper disposal prevents HHW from entering the environment; damaging soil, groundwater and streams; or causing harm to people and animals. For acceptance at the HHW Facility materials must be in containers of 5 gallons or less. Larger containers/quantities may be accepted by calling ahead. In 2009, the City added an electronic recycling program to provide daily collection of electronics including televisions, computers, video players, gaming devices, handheld electronics, printers, stereo systems and other electronic devices. The HHW Facility does not currently accept waste from businesses, farms, nonprofit organizations, churches, schools or government entities. Residents from the Service Area drive under the awning of the HHW Facility and the staff unload the materials. Items accepted at the HHW Facility include:

- Automotive Chemicals
- Lawn Care Chemicals
- Household Chemicals
- Home Improvement Chemicals
- Electronics
- Microwaves

The facility also includes a HHW Reuse Room, pictured in Image 2-3, for items still in good, reusable condition. These items are placed in the Reuse Room for redistribution to the public. One must be a resident of the Service Area to take items, and there is a limit of 3 items per week per resident.

Image 2-3: Reuse Room

2.5.5 Construction and Demolition Debris

C&D haulers did not have to hold a City-issued license until January 2017. A City-issued license is now required for haulers to collect C&D, per Chapter 57, Section 57.065 (License Required), of the City's code of ordinances.

2.6 Processing and Disposal

The Sioux Falls Regional Sanitary Landfill (Landfill) is the largest permitted landfill in the State of South Dakota and is located on 709 acres approximately five (5) miles west of Sioux Falls at the intersection of 41st St. and 464th Ave. Approximately 260,000 people across the Service Area contributed to the disposal of approximately 160,000 tons of MSW and 87,000 tons of C&D waste in 2015. In 2018, approximately 280,000 people contributed to the disposal of approximately 178,000 tons of MSW and 86,000 tons of C&D waste. The City operates the Landfill for simultaneous disposal of MSW and C&D as two separate waste streams in two discrete landfills. Other waste management services, programs, and facilities at the Landfill include a scale house, a maintenance shop and offices, a public drop-off area, an appliance recycling building, wood waste recycling, a compost pad, a landfill gas blower and flare system, and a gas conditioning building.

The public drop-off area is located near the scale house and includes the collection of MSW and recyclables such as white goods (stoves, refrigerators, microwaves, freezers, dishwashers, washers and dryers, hot water heaters, water softeners, etc.), yard waste, wood pallets, lawn mowers, scrap metal, tires, and non-artificial Christmas trees. Eight roll-off bins are available in the public drop-off area with the capability to receive waste from vehicle sizes ranging from compact cars to pickup trucks with trailers; however, some public customers choose to unload the waste at the active face of the MSW landfill and/or C&D landfill.

Yard waste is composted on a portion of the property north of the closed landfill and east of the public drop-off area. Finished compost is available to residents for free at the Landfill. There is also a wood recycling area south and adjacent to the compost pad area.

Landfill gas from the closed MSW landfill and portions of the active MSW landfill is collected through a series of vertical and horizontal wells and processed at the gas conditioning building before being directed to the POET ethanol plant in Chancellor.

2.7 Material Markets

In general, #1 PET and #2 HDPE plastics, and metals are processed domestically in the North-Central United States, while mixed plastics are either processed domestically or sent to overseas markets. Markets for recyclable materials are currently weak to non-existent due to reduced demand from foreign purchasers such as China.

In July 2017, China's government announced that it would ban 24 recyclables, including "unsorted mixed paper" and "mixed plastics," starting in 2018. This ban originates from China's "National Sword" campaign to crackdown on smuggling and contaminated scrap imports.

China applied a strict new contamination standard for other recyclables. Starting in March 2018, all scrap materials imported into China may not exceed 0.5 percent contamination. This restriction risks excluding virtually all domestic recyclables from sale in China.

With a few exceptions, China has frozen the approval of all scrap paper import permits. As a result, most scrap paper import companies cannot import any scrap paper into China, causing a total suspension of all imports since Sept. 2017. This has created market uncertainty, even for materials not covered by the restrictions.

In 2018, China's government implemented new restrictions on what recyclables may be imported into their country, impacting South Dakota's recycling programs. China no longer allows the importation of low-grade plastics and unsorted paper. The regulations aim to increase the quality of the recyclables entering China by requiring a low amount of contamination in recyclables it imports.

The import ban is creating a disruption in South Dakota and throughout the nation. Material recovery facilities, which receive mixed recyclables and sort them for resale to commodities brokers, have been drastically slowing down their processing of recyclable materials in an attempt to reduce contamination. This slowdown has reduced the amount of material that can be processed. In the short term, some materials may not be able to be processed and recyclable materials may need to be disposed of in a solid waste handling facility.

An important factor for marketing of recyclable materials collected in Sioux Falls is the cost of transporting them to processing facilities and end-markets, some of which are outside of South Dakota. The low market value of many recyclable materials limits the number of materials that can be cost-effectively moved to markets and may limit accepted materials. Some local recycling facilities, such as Millennium Recycling and Advanced Recycling, have stopped accepting plastic bags and glass in the single stream due to China's restrictions.

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3 Waste Generation / Public Outreach

The purpose of this Chapter 3 is to provide a summary of key findings and recommendations related to reducing waste generation by focusing on public outreach initiatives, as well as initiatives for specific material types. When and where consumers generate waste is the first point where City outreach initiatives have the potential to minimize waste generation and maximize waste diversion.

3.1 Recycling Education Program

As described in Chapter 2, the City has an established recycling program, known as The Leading Green initiative, operated by the City's Sustainability Program. The Leading Green initiative is a guiding program that creates a more sustainable community by promoting and assisting with the implementation of measurable solutions to environmental, social and economic concerns.

3.1.1 Summary of Key Findings

As part of the 2016 planning efforts for the SWMMP, a benchmarking of similar communities was conducted to compare tactics and tools used for public outreach. The communities benchmarked included Sioux City, IA; Saint Paul, MN; Fargo, ND; and Lincoln, NE. The matrix in Table 3-1 illustrates the benchmark comparison of tools and tactics each city employs in their current communication practices for education and outreach. It should be noted that several cities indicated recent changes in the recycling program and future changes will likely be made to the approach for education and outreach.

Table 3-1: Communication Tactic Matrix

Communication Tactic	Sioux Falls, SD	Sioux City, IA	Saint Paul, MN	Fargo, ND	Lincoln, NE
Dedicated Recycling Webpage	x	x		x	x
Public Works/Environmental Webpage or Other	x		x		
Dedicated Social Media	x	x			x
City Social Media			x	x	x
Paid Advertising	x		x	x	x
Public Service Announcements	x		x		x
Meetings	x	x			x
Primary Education Curriculum	x			x	x
Video	x			x	
Recycling Guide	x	x	x	x	x
Stickers	x				
Television/Radio	x				
Tours/Classes	x	x		x	x
Special Events	x	x	x	x	x
Direct Mailings	x		x	x	x
Infographics			x		
Advisory Board	x	x			
Survey			x	x	
Branding				x	
Earned Media	x	x	x	x	x
Pop-up/Mobile Events			x		

Each city included in this analysis acknowledged the need for a dedicated recycling program and the importance of using outreach and educational materials to better prepare residents for use. More detailed information on the benchmark communities is available in Appendix F.

3.1.2 Recommendations

The immediate question – what is the overall vision and scope of the recycling education program? The analysis investigated this question on a subjective basis. Criteria used to assess the current recycling education program are malleable and often largely dependent on organizational structure and personnel. Context and need for an effort will broadly determine what approaches would serve well.

The following recommendations were based on the findings of the benchmark analysis, discussions with City staff, as well as feedback from stakeholders that participated in the SWMMP workshops.

- **Adopt core values for recycling education:** Identify and adopt core values for the Sioux Falls recycling education program. These values should be a result of community based conversation and engagement that allows varying stakeholders and users the opportunity to contribute and weigh-in on what is important to them. The Solid Waste Planning Board could champion this initiative.

- **Develop and maintain a consistent brand identity**: Understanding the power of branding is essential to managing how the recycling education program is perceived by the public. It is the sum of experiences, impressions, and knowledge a person has about the program. Development of a brand identity would serve well to communicate the recycling program's vision. Using consistent brand and program voice across all communications will help to ensure the public is accurately informed. The City's solid waste management staff should work with the City to identify a clear vision and mission for the brand. Brand development should involve an assessment of the strengths and challenges and identification of mission, vision and tone (personality) of the brand. Good design and brand will help audiences identify and relate while inspiring action. Brand identity should be more than a logo and color scheme, rather is should be about vision and personality.
- **Diversify information delivery**: In a drive for more sustainable practices, reliance on traditional tools (e.g., direct mailings, flyers, and paper-based educational materials) potentially sends the wrong message. In a digital world, communities are more reliant on mobile devices for alerts, notifications, and engagement opportunities that are accommodating to a flexible schedule. Hosting pop-up events in spaces where the community is naturally converging provides access to information in a convenient way. However, traditional tools should not be abandoned altogether, as some members of the community may not frequent social media. A balance of old and new forms of information delivery should be maintained.
- **Ensure frequent engagement**: Developing a consistent relationship with haulers and residents is key to behavioral change. When there is a relational investment, people are more likely to have ongoing follow-through. Coupled with a prominent brand identity, programming and education efforts will be easily recognizable. This identification breeds loyalty and an affinity for the desired behavior. The City should continue its current efforts and look for ways to enhance the relationships with haulers and residents.
- **Develop dedicated tools**: A branded, dedicated recycling program website will offer a central clearing house for all tools and resources of the program. City policy should be further evaluated to determine if a dedicated website is possible.
- **Improve access and ease-of-use**: The website offers a variety of resources however; organization and accessibility could be strengthened. Minimizing the number of "clicks" a user must go through to access their desired resource allows for a more gratifying user experience.
- **Develop visual communications**: Visual communications are becoming the most commonly used method of education with the public. Humans are visual in nature and are more likely to relate and remember information when presented in visual mediums. Continued use of videos and graphical materials is encouraged. Tools should use consistent and targeted messaging to allow the visual story to emerge. Videos should be developed with a more succinct message and should be delivered shorter in length. Typical Public Service Announcements should run no longer than 45 seconds. Videos used on social media should be 15 to 30 seconds long.

Commercial and radio spots need to have simplified messages that target one primary educational goal.

- **Take advantage of earned media/social media (vs. paid media)**: Earned media, or the opportunities for media coverage that is not paid for, is often the result of providing easy access to messaging, the story, and the hook to media outlets. This allows the City to help control the message, while gaining the media attention. This is a cost-effective way to communicate about your program.

  Additionally, social media is a common mechanism for news and information gathering. Communities turn more often to what is being communicated on social media than to traditional news coverage. Considerable costs can be saved by developing a social media framework for communication and creating targeted messaging and visuals to generate online interest. Actively engaging followers on social media help to confirm accessibility and demonstrates commitment on the part of the City to the program. Keep posts timely, relevant, and interesting.

  Use social media as a platform for education and dissemination of ideas and knowledge. Social media sites have a way to reach a more diverse group of users and provide a mechanism for simple and succinct messaging.

3.2 Recycling Enhancements

3.2.1 Summary of Key Findings

Based on the Waste Characterization study, traditional recyclables represent nearly 13% of materials currently landfilled (8.6% recyclable paper, nearly 2% #1 and #2 plastics, 1% metal containers, nearly 1% glass) of municipal solid waste. As a means of increasing recycling participation and community involvement, residential recycling could be enhanced through an established program. Programs such as Recyclebank, a private company, encourages participation in curbside recycling programs by offering discounts and rewards based on collected volume. Programs like these could encourage a greater capture rate of materials currently included in curbside recycling services. However, one of the licensed haulers in the City currently provides a curbside recycling incentive program, and the feedback received through stakeholder workshops revealed that incentive programs do not seem to entice more recycling. Instead, it was discussed to look for ways to enhance commercial recycling. Potentially, a program could be developed to help enhance commercial recycling. A commercial recycling incentive program would likely need to include waste audits for individual businesses to identify specific materials that could be targeted for recycling. Demonstrating a potential cost savings through lower waste collection and disposal costs by recycling more materials could be used to provide economic incentive for businesses. Because the nature of businesses varies widely, as does the waste generated by those businesses, the audit approach would allow specific, targeted recycling assistance that makes the most sense for the respective business. (E.g., an office building would generate more office paper materials that could be recycled; a retail store likely generates more cardboard than office paper; a restaurant generates more food scraps and bottles.) Commercial recycling incentive programs tend to be more successful when a technical assistance approach, such as waste audits and education on recycling programs that make the most sense for specific businesses, is taken. Some communities begin with a technical assistance and education program before mandating recycling.

3.2.2 Recommendations

With the current open collection system including 18 different haulers, administering an incentive program through the collection process would be challenging, although incentive program administrators such as Recyclebank could work with residents, businesses and individual haulers. As a starting point for incentivizing recycling, the City could:

Develop and Maintain Guidelines for Recycling and Diversion: Through the current City Ordinance, the City, local businesses and the haulers could work cooperatively to develop guidelines for recycling and diversion requirements by business types.

Conduct Business Site Visits: The City could also consider visiting with businesses to determine opportunities for recycling and provide recycling educational materials as part of the voluntary site visits.

3.3 Food Waste Rescue

3.3.1 Summary of Key Findings

As described in more detail in Appendix I (Innovative Green Projects), food waste rescue, by collaborating with local stakeholders, is a means to prevent food waste at the source. Food waste has earned a place in the current spotlight, at a critical intersection of economic, social, and environmental concerns. The City can play an important role in influencing policies and community programs to rescue food before it enters the municipal waste stream. The City's support of such an initiative would be akin to utilities investing in demand-side management programs: The easiest waste to manage is what is never generated at all. This project would start with the support of food donation programs and proceed with the formation of a Food Rescue Committee to assist in evaluation of specific food rescue approaches.

3.3.2 Recommendations

Create a Food Rescue Committee to further evaluate food waste rescue opportunities: To further evaluate food rescue programs, the City should form a committee of stakeholders to further evaluate the potential for food rescue opportunities. The food rescue committee should endeavor to understand the full lifecycle impacts, taking into consideration the benefits of preventing these materials from being disposed in the Landfill, the cost and feasibility of setting up and/or promoting the food rescue programs, impacts on composting operations, impacts on any potential landfill gas to energy projects, and the additional fuel and energy use required for collection and distribution of the food rescued, and processing of food waste.

Support Food Donation Programs – The City and the Support the Feeding South Dakota Food bank operations could work cooperatively to encourage food donations from individuals and businesses as a starting point to divert food waste from landfilling.

3.4 Alternatives for Diverting Difficult to Recycle Items

3.4.1 Summary of Key Findings

DOW Energy Bag Program: Based on the Waste Characterization study, plastic film/wrap/bags represent approximately 5.3%of residential municipal solid waste. This program would target the recovery of energy from the hard to recycle plastics. The program is currently being piloted in Citrus Heights, California. The program is designed to fill the gap between traditional curbside recycling and composting programs, capturing often non-recycled plastics (such as chip bags, candy bar wraps, film plastic, Styrofoam, and drink pouches). Instead of putting these items in a landfill, consumers in these select markets can collect these plastics into the Hefty Energy Bags, which local haulers collect from regular recycling bins and carts. The Energy Bags are sorted at the local recycling facilities, and directed to regional waste-to-energy facilities.

No new equipment or systems are likely to be required on the part of the City; however, the current curbside recycling processors may need an area to store the collected plastics until there is an adequate quantity to ship. The processor would also need additional manpower to recover the bags from the waste stream. The nearest waste-to-energy plants are in Minnesota, and an agreement would be needed. Programs would need to be developed and promoted properly to manage costs, and the likeliness of implementing such a program may depend on the success of the programs currently being pilot tested in other communities.

Other Programs: As described on their website (www.terracycle.com), *"TerraCycle is Eliminating the Idea of Waste® by recycling the "non-recyclable." Whether it's coffee capsules from your home, pens from a school, or plastic gloves from a manufacturing facility, TerraCycle can collect and recycle almost any form of waste."* TerraCycle partners with collectors and major generators to divert items that are considered difficult to recycle from landfills and incinerators, currently in 20 different countries.

3.4.2 Recommendations

For these types of alternatives for diversion, the potential landfill diversion is likely to be low and acceptance would need to be studied. It may be advisable to wait on implementation until information can be obtained from the pilot cities and other examples to see what lessons have been learned, which can be observed by the Recycling Advisors described in Section 3.2.2.

Monitor DOW Energy Bag Program: The City should continue to monitor the success of the pilot studies and availability of the program, as the feasibility is not yet known.

Monitor and Research Other Programs: The City should continue to research and monitor the success of other programs, such as TerraCycle programs, for new opportunities to divert items that are difficult to recycle.

Identify Third-Party Partners to Recycle Additional Materials at the Landfill: The City should continue to identify and monitor the success of recycling programs that have the potential to divert any recycled additional materials at the Landfill.

3.5 Increase Waste Diversion

3.5.1 Summary of Key Findings

Legislation relating to taxing or banning plastic bags is commonly enacted at the State level, although the District of Columbia has enacted D.C. specific legislation. Some examples include:

- The State of California, in August of 2014, became the first state to enact legislation imposing a statewide ban on single-use plastic bags at large retail stores. There is also a 10¢ minimum charge for recycled paper bags, reusable plastic bags, and compostable bags.
- The State of Delaware, in 2009, enacted legislation that encourages the use of reusable bags by consumers and retailers, and requires a store to establish an at-store recycling program that provides an opportunity for a customer to return clean plastic bags.
- Washington, DC, in 2009, enacted legislation that protects its aquatic and environmental assets, to ban the use of disposable non-recyclable plastic carryout bags, to establish a fee on all other disposable carryout bags provided by grocery stores, drug stores, liquor stores, restaurants, and food vendors, to give the Mayor the authority to implement rules and procedures to collect the fee, and to establish a non-lapsing recurring Anacostia River Cleanup and Protection Fund.

Legislation or regulation of Styrofoam, which is DOW Chemical's brand name for polystyrene, is commonly enacted at the local government level.

- Starting July 1, 2015, New York City began its ban on single-use EPS products including cups, bowls, plates, takeout containers and trays and packing peanuts, which are not allowed to be possessed, sold, or offered in New York City. Companies have six months to comply or face a fine. Some legal actions are on-going regarding the ban, which may be overturned.
- Other communities that have banned the use of polystyrene foam food containers include:
  - Albany County, NY
  - Portland, OR
  - San Francisco, CA
  - Seattle, WA
  - Amherst, MA

3.5.2 Recommendations

Implementation of a ban or a tax would take some investigation to determine the feasibility prior to implementing the program. The potential landfill diversion is likely to be low, and acceptance would need to be studied.

- **Support a state ban or tax on plastic bags**: A bag ban or tax would best be left to the state to implement, and is not recommended at the City level. The City could monitor progress at the state level, and offer support as appropriate.
- **Promote Consumer Use of Re-usable Items -** Reducing consumer use of common single-use items, for example, promotion of re-usable shopping bags and produce bags could be implemented by the City as a potential landfill diversion strategy.

4 Collection and Transfer

The purpose of this Chapter 4 is to provide a summary of key findings and recommendations related to collection and transfer activities in the City.

4.1 Collection

4.1.1 Summary of Key Findings

As part of the 2016 planning effort, a benchmark of waste collection practices was conducted to give the City an understanding of collection programs in similar communities in the region. City staff provided input on which cities in the region would be included in the benchmark effort. Communities that the City commonly uses for comparison purposes in other circumstances were originally selected for benchmarking, including: Cedar Rapids, IA; Fargo, ND; Lincoln, NE; Rapid City, SD; Rochester/Olmstead County, MN; and Sioux City, IA. After the initial information was gathered for these communities, it was noted that each community either had an open system or a municipal system; therefore, it was determined that additional communities should be added to the comparison exercise to provide insight into a franchise/contract collection approach. (Saint Paul, MN, and West Des Moines, IA, were subsequently added to efforts.) Contracted collection took effect in St. Paul, MN in late 2018 through Ordinance adoption. On August 22, 2019, the Minnesota Supreme Court ordered the City to place the Ordinance that created rules for garbage collection on the ballot for city-wide vote. The vote on the Ordinance took place on November 5, 2019 and voters overwhelmingly voted to keep the City's current organized, contracted garbage collection system. Table 4-1 provides general demographic information and the basic approach for providing collection services for each of the eight benchmark communities, as well as Sioux Falls with an update to Saint Paul, MN in 2019 based on contracted collection implementation. More details on the collection system evaluation as well as the full benchmark matrix is included in Appendix B.

Table 4-1: Benchmark Communities General Information

Community	Population (Census 2015)	Households (Census 2010 – 2014)	Collection Approach / Service Provider
Sioux Falls, SD	171,544	64,197	Open/Subscription
Cedar Rapids, IA	130,405	53,125	Municipal
Fargo, ND	118,523	48,958	Municipal
Lincoln, NE	277,348	106,512	Open/Subscription
Rapid City, SD	73,569	28,244	Municipal
Rochester/Olmstead County, MN	111,402/ 149,000	43,651	Open/Subscription
Saint Paul, MN	300,851	112,407	Franchise/Contract
Sioux City, IA	82,517	31,419	Municipal
West Des Moines, IA	64,113	25,261	Franchise/Contract

Based on these benchmark communities, it appears that organized collection is more prevalent in Iowa than the other states represented in the benchmark communities. Some of the communities with municipal collection reported that the implementation of organized collection was driven by State law and that organized collection has been in place for a very long time.

Sioux Falls is one of the largest of these cities in terms of population and number of households to have an open/subscription system, except for Lincoln, NE.

Table 4-2 summarizes some comparisons of the benchmark communities with open/subscription collection service for residential customers. Each of the communities has some form of licensing procedure, though the jurisdiction that resides over the licensing varies (city, county, state). Only one of the communities, Rochester/Olmstead County, limits the number of haulers that can be licensed to collect. When considering the ratio of haulers to households, the community that limits the number of haulers has the second highest number of households per hauler.

Table 4-2: 2016 Open System Comparisons

	Sioux Falls, SD	Lincoln, NE	Rochester/Olmstead County, MN
Licensing procedure	Yes, City	Yes, State	Yes, County
Limit # of haulers	No	No	Yes
# of current haulers	21	44	8
Ratio (# of households / # of haulers)	3,057	2,421	5,456

Figure 4-1 compares the number of households per hauler for each of the communities benchmarked. As shown, haulers in communities with organized collection provide service to a much higher number of households than the haulers in communities with open collection systems.

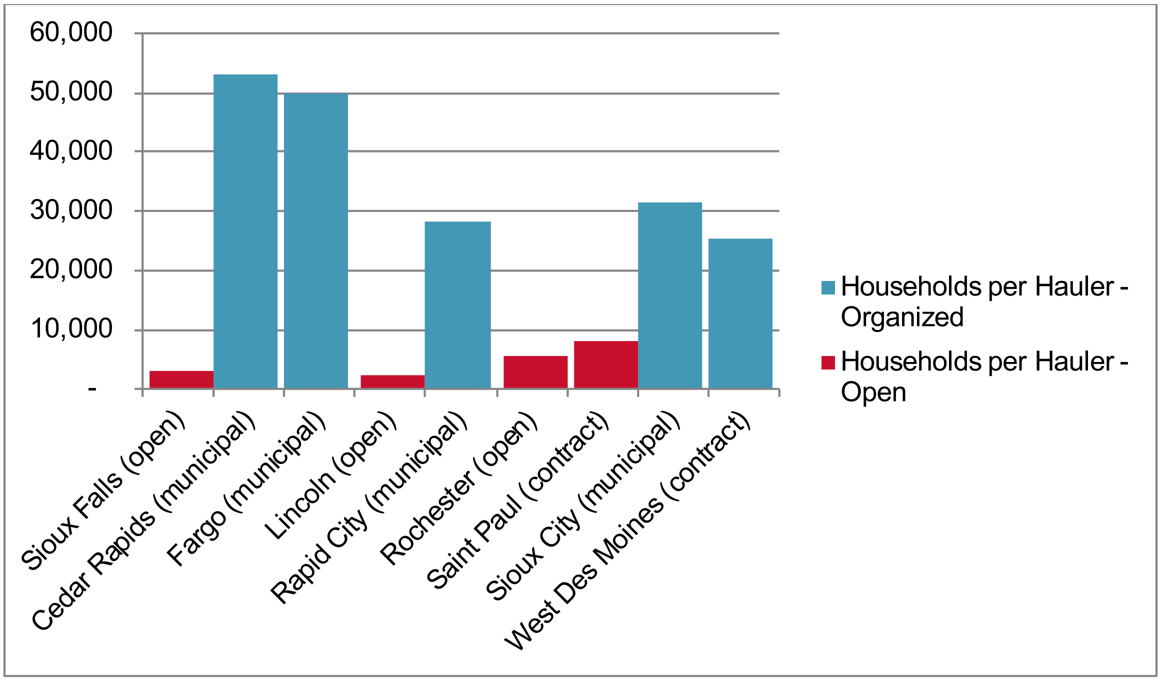

Figure 4-1: Households per Hauler Comparisons

Table 4-3 summarizes curbside collection rate information obtained from each of the benchmark communities, expressed in dollars per household per month. The primary level and style of garbage collection for each community is once per week and most commonly uses automated carts. For communities with open/subscription collection, either ranges of rates or an average of rates have been provided, as available. Bulk waste collection rates are not included in the table, as it is most common for bulk waste to be at an additional fee on an on-call basis, if the service is offered.

When comparing rates, it is important to remember that there are a variety of factors that can impact cost and rates. However, comparing collection rates can provide some insight. As shown in Table 4-3 and Figure 4-2, the communities with organized collection have lower rates than the open/subscription system rate ranges.

Table 4-3: Curbside Collection Service Rate Comparisons

Community	Provider [1]	Garbage Rate [2]	Recycling Rate [2]	Yard Waste Rate [2]	Total [2]
Sioux Falls, SD	O	Range: $15 to $35	Included with Garbage	Range: $13 to $18 (seasonal)	Range: $28 to $53
Cedar Rapids, IA	M	$16.02 35-Gal Cart; $1.50 for Additional Stickers	$4.30	Included with garbage	$20.32
Fargo, ND	M	42-gal $6 64-gal $9 96-gal $14	No additional charge (optional)	Not included	$6 to $14
Lincoln, NE	O	$20 avg.	$10 avg.	Included with garbage	$30

Table 4-3: Curbside Collection Service Rate Comparisons

Community	Provider [1]	Garbage Rate [2]	Recycling Rate [2]	Yard Waste Rate [2]	Total [2]
Rapid City, SD	M	35-gal $14.99/month 64-gal $16.83/month 96-gal $18.68/month	Included with garbage	Included with garbage	$14.99 to $18.68
Rochester/Olmstead County, MN	O	$30 avg.	Included with garbage	Not included	$30
Saint Paul, MN (Updated in 2019)	O	35 gallons: $60.83/quarter (every other week collection); 35 gallons: $70.34/quarter; 64 gallons: $96.08/quarter 96 gallons: $102.44/quarter	$4.85	Not included $120/year or $3/bag	$20.27 to $34.14
Sioux City, IA	M	$16.30 + $1 per extra bag	Included with garbage	Not included	$16.30
West Des Moines, IA	C	$7.96 48 gal. $8.66 96 gal.	$2.59	PAYT – stickers and bags	$10.55 to $11.25

Note: [1] M = municipal; O = Open/subscription; and C = contract/franchise. [2] Rates expressed in dollars per household per month.

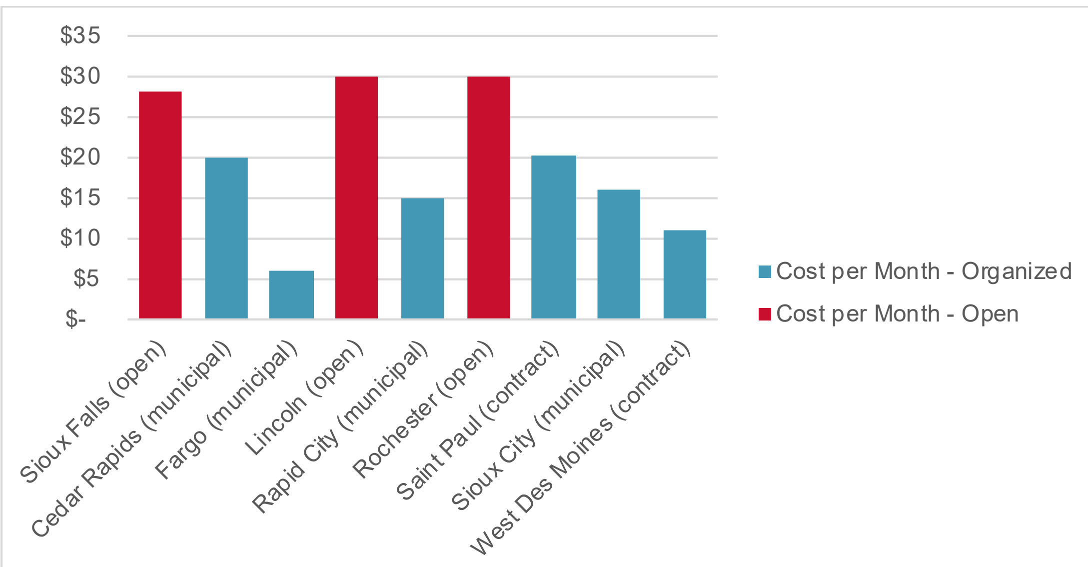

Figure 4-2: Curbside Collection Rate Comparisons

Although Sioux Falls has some haulers offering rates as low as $15 per household per month for garbage collection, the garbage and recycling rates can be as high as $35 per household per month. Among the other communities with open/subscription systems, the lowest rate for garbage collection is in Lincoln at $20 with another $10 for recycling collection; the highest rate is in Rochester at $30 per household per month for garbage, but recycling is included. Conversely, communities with organized collection, have garbage and recycling collection rates ranging from as low as $6 (Fargo), and as high as $34.14 (St. Paul) per household per month. Among these benchmark communities, organized collection systems are at least $10 less expensive than open/subscription systems per month.

The following main conclusions can be drawn from the collection system evaluation and benchmark efforts.

- In 2016, the City had 21 different haulers providing residential collection services, which equates to 3,057 households per hauler. Organized collection typically results in higher economies of scale, and a much higher number of households served per hauler. In 2019, the number of different haulers has reduced to 18.
- Organized collection advantages outnumber disadvantages; however, organizing collection may displace some haulers and limits the residents' choice in service provider.
    - Main Advantages:
        - Provides the City with the most control over collection services
        - Less large vehicle traffic on streets (increased public safety, fewer emissions, less wear and tear on roads)
        - Economies of scale with one service provider could mean more efficient and therefore less expensive collection costs
        - Improved aesthetics with specified collection days, eliminating the potential of garbage containers sitting out every day of the week
    - Main Disadvantages
        - Customers do not get a choice in service provider
        - Implementation could displace some haulers
- Open/subscription service allows residents to choose their hauler and would not displace haulers.
    - Main Advantages
        - Customer choice in service providers
        - Multiple haulers, including local/independent haulers, can provide service
    - Main Disadvantages
        - City has little control over collection services
        - Multiple large vehicles traveling on the same streets (increased risk to public safety, more emissions, more wear and tear on roads)
        - Less economies of scale with multiple service providers could mean less efficient and therefore more expensive collection costs
- If the City implemented organized collection (municipal or franchise/contract), revisions to the City Code of Ordinances, Chapters 57 and 110, would need to be drafted and adopted to reflect the changes.
- Based on an initial review, it does not appear State rules or regulations would prohibit or limit the City's ability to organize collections.

As part of outreach efforts in 2016, hauler interviews were conducted, which covered a variety of topics. One topic discussed with haulers included obtaining their suggestions on curbside collection efficiency and convenience improvement. The following are key responses from the fourteen haulers that participated in the survey effort.

- Each of the respondents that collect from dumpsters expressed some concern over illegal dumping. Feedback included the following: the City needs to address illegal dumping in dumpsters; it is a huge problem in commercial dumpsters; need enforcement with a community awareness advertising campaign.
- A few of the respondents suggested that the City should move away from walk up service, and allow cans to be on the curb. Related feedback included: this change would allow haulers to upgrade to automated collection vehicles; there is a high rate of injuries to hauler employees under the current system, liability for accessing private property is an issue and inefficiency in providing the service under the current system drives up the rates to customers.
- A few of the respondents suggested that allowing earlier routes would help hauling time and efficiency, and allow truck traffic to be off the City streets when traffic, citizens and children are there.
- One respondent suggested that the City could require that all residents and commercial businesses have both trash and recycling collection. Traditionally, there has been a significant decrease in illegal dumping, particularly on the commercial side, when this type of service is required by the local government.
- Each of the haulers interviewed expressed a need for the City to listen to the suggestions from the licensed haulers. It was indicated that the last time haulers were surveyed by the City, the feedback was ignored.
- One hauler expressed concern that there are currently haulers that have no identification on their trucks and are operating trucks without safety equipment. It was suggested that the City should require a Department of Transportation level inspection on haul trucks with enforcement for a hauler to maintain a City license.
- One hauler suggested that solid waste is a health and human services issue, and should be recognized and enforced as such.

Respondents were also asked, if the City decided to organize collection, potentially with a franchise system, what would be suggested to include in the process. There was consensus among the respondents that they were opposed to the idea of franchising. The following are some of the responses:

- All the respondents indicated that the City should not limit free enterprise. It was stated that the current system gives the City residents the ability to select their own haulers based on their needs.
- A few respondents pointed out that a franchise system would eliminate the small haulers, as they could not compete with the large companies.
- One respondent suggested that the City should leave the system competitive but limit the number of licenses issued, possibly on a per-capita basis; adding that all current haulers could be grandfathered in with the ability to sell licenses.
- All the respondents indicated that the current haulers should be protected because they have a lot of money invested.

- One respondent suggested that the City should stop additional license issuance, and allow haulers to sell their licenses or establish a bid process for sale of licenses.
- One respondent suggested that the City needs to proceed with caution on franchising, adding that the last time this issue was brought up there was a firestorm of public outcry.

4.1.2 Recommendations

Given the size of the City and its anticipated continued growth, it is recommended that the City further explore the possibility of organizing collection services over time. Steps that are recommended for the City in 2019 include the following:

- **Initiate community outreach**: Using the efforts of the City of Saint Paul as an example (see Appendix B for more details), community outreach should be initiated to determine the opinions of the residents. Political will is necessary to undertake such a change, and determining the preference for organized collection among residents should be a priority.
- **Expand benchmarking and rate comparisons**: While this planning effort conducted a high-level evaluation of collection service rates in the different communities included in the benchmark efforts, the City should conduct a more thorough review and evaluation of current collection rates paid by residents in the City, as well as additional comparisons to other jurisdictions with municipal and franchised/contracted collection service to better anticipate the likely impact on rates in an organized collection system.
- **Work cooperatively with the haulers to review the licensing system**: The City of the haulers could undertake a cooperative effort to review the current hauler licensing system while considering grandfathering of current haulers and limiting future city hauler licenses issue.

4.2 Transfer Station

4.2.1 Summary of Key Findings

The planning effort included analyzing the waste stream data to determine the material fractions that could be received at a potential transfer station, the sizing and orientation of the facility to safely and efficiently process the material, and the development of an opinion of probable construction cost. All this information was utilized as inputs to develop a financial pro forma to determine the estimated annualized and per-ton operations and maintenance costs for the potential transfer station facility.

Using 20-year waste projections, the facility sizing calculations were prepared for the peak daily tonnage of MSW, C&D and yard waste quantities, and storage of that quantity of material on the tipping floor. In addition, the sizing was confirmed respective of the maximum hourly and daily number of vehicles anticipated based on historical vehicle counts at the Landfill, to ensure there would be enough unloading bays provided within the overall building envelope. An opinion of probable construction cost was prepared by itemizing and estimating the major facility elements related to the construction of the overall transfer station facility. Recent bid tabulation information from similar projects and pricing guides were utilized for estimation of the material and labor costing. Details related to the sizing, orientation, probable construction cost, and a financial pro forma are included in Appendix J.

As part of hauler interviews, respondents were asked if they felt that a transfer station located somewhere in the City would be helpful to collection services. Four (4) respondents felt that a transfer station might be helpful while nine (9) felt a transfer station would not help their operations. The majority felt that a transfer station would cause significant rate increases to the citizens due to additional handling and transport of waste, would put additional heavy truck traffic on City streets, and would not be a significant benefit due to the current proximity of the landfill to haul routes.

Municipalities and private solid waste management companies that do not “control” the collection of the waste streams tend to have a difficult time justifying the additional operational and capital costs of a transfer station, since the cost is basically a “pass-through” or added cost to the customers. Further, with the relatively short distance to the Landfill (current final disposal location) from collection points in the current system, the efficiencies that could potentially be gained may be minimal. However, if the final disposal location was a further distance from collection points throughout the City, the desire for a transfer station could increase.

4.2.2 Recommendations

Evaluate the need for a transfer station based on population growth, tonnage and the collection system: Given the current Landfill life estimated through 2075, it does not appear to be in the City’s best interest to move forward with siting a transfer station in the City during the 30-year planning horizon of the SWMMP. Should future changes to the waste management system and/or waste market result in the desire/need to proceed with siting a transfer station, it is recommended that the City utilize the operating cost information provided herein to evaluate the impact to the overall waste management system operating budget, as one of the many factors to consider before making a final decision on whether to build a transfer station. The need for a transfer station in the future should be based on population growth, tonnages and potential collection system impacts.

5 Processing and Disposal Facilities

5.1 Sioux Falls Regional Sanitary Landfill

As previously described, the City operates the Landfill for simultaneous disposal of MSW (or Garbage) and C&D as two separate waste streams in two discrete landfills. Other waste management services, programs, and facilities at the Landfill include a scale house, a maintenance shop and offices, a public drop-off area, an appliance recycling building, wood waste recycling, a compost pad, a landfill gas blower and flare system, and a gas conditioning building.

Tonnage accepted at the Landfill is a main aspect of operations. As shown in Figure 5-1, historic trends show a generally flat rate of growth for the average daily inbound tonnage of all waste streams accepted at the Landfill from 2013 to 2016. Seasonal peaks observed in the C&D waste stream during the second quarter of each year exhibit a steady decline, in part due to diversion efforts. Daily MSW tonnage has held approximately constant over the sample period (2013 through 2016) at 600 tons per day, with the observed annual fluctuations in MSW and yard waste streams peaking in the third and early fourth quarters each year, which are expected occurrences consistent with industry norms. Yard waste has remained consistent except for a spike in 2013 due to a large ice storm. More details related to landfill operations can be found in Appendix D.

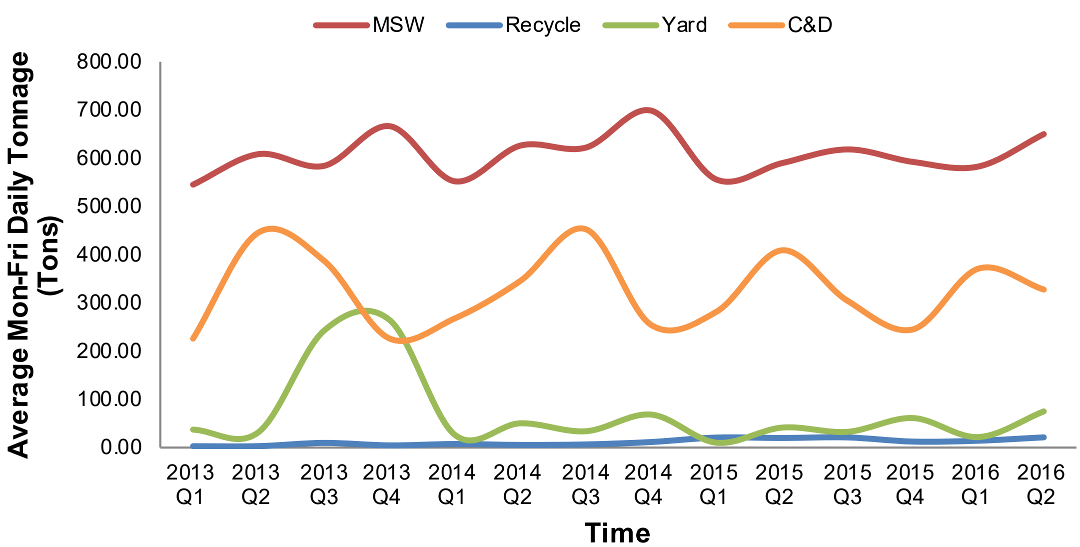

Figure 5-1: Landfill Historic Average Daily Inbound Tonnage (2013-2016)

5.1.1 Public Drop-Off Area

The public drop-off area at the Landfill consists of eight roll-off bins and recyclable unloading areas, which are located immediately east of the scales and scale house.

These bins are intended to be utilized by small vehicle users to keep this predominantly residential traffic separate from commercial vehicles and off the working faces at the landfills. However, some residential customers prefer to unload their waste at the working faces of the landfills.

Summary of Key Findings

Quite often, the residential customers that use the public drop-off area tend to not follow directions on which bins to unload their waste and recyclables while the City attempts to segregate certain waste or recyclables. The lack of conformance to directions by the residential customers results in commingled waste bins, increased operational challenges and frustration for Landfill employees. Saturdays are the most difficult days for City staff to control the residential customers in this area, and queuing of vehicles is difficult. In support of this, additional staff is assigned to the public drop-off area during the summer months. Although it is typical industry-wide to see significantly higher residential (i.e., small vehicle) customers on Saturdays, the number of public drop-off area users consistently experienced at the Landfill is considerably above average when compared to similarly sized Midwestern municipalities.

Recommendations

Improve drop-off area functionality: To improve the drop-off area functionality, service provided to the City's customers, and operational burden on Landfill staff, revisions to the existing process should be considered.

In order to limit capital costs associated with expanding the existing "Z" wall where customers place waste in roll-off bins, other portions of the large public drop-off area should be reconfigured to encourage slow but steady traffic progression and to accommodate peak traffic flow periods occurring on Saturdays during fall cleanups. This can be accomplished by leaving the area in the center of the drop-off area open for traffic with bright clearly distinguishable traffic paint and signage directing customers where to go based on materials to be dropped off. Additionally, creating large concrete bunkers for customers to place separated materials streams with rear access for emptying would get customers in and out faster by maintaining consistent customer disposal access and minimizing cross-contamination.

5.1.2 Landfill Operations

Currently, the Landfill includes two separate landfills, a MSW landfill and a C&D landfill. Each landfill shares the same primary access road from the scale house to the active faces, with the entrance to the MSW landfill further north of the entrance to the C&D landfill.

Summary of Key Findings

Active Face Operations and Fill Sequence

Both landfills' working faces were within close proximity of the shared access road during site observations. With both working faces so close to the access road, there was very limited queuing space resulting in a backup of vehicles waiting on the access road for both landfills.

At the time of the onsite visit the available spatial requirements of the MSW landfill active face were limited and were mainly consumed by the compactor and the dozer, resulting in only three to four tipping slots for haul trucks and extremely tight conditions for landfill personnel to operate around customers.

Like the working face of the MSW landfill, the working face of the C&D landfill was close to the shared access road, but likely due to filling sequence. A single operator alternates between the compactor and dozer for the C&D working face. Customers unload the waste in an area below the equipment. Often, residential customers take an extra amount of time to unload their vehicles, resulting in a backup of vehicles and causing safety concerns. Considering the lesser tonnage received at the C&D landfill, the single operator and shared scraper are adequately meeting existing operational needs.

Vehicle Trafficking and Support Facilities

Approximately 400 vehicles utilize the main access road between the scale house and the landfill access roads on a daily basis. It is a heavily traveled road with minimal shoulders and inadequate space for roll-off truck bin turning and untarping. This is the same access road the City uses to haul daily and intermediate cover material from the current soil borrow area north of the MSW landfill to the two active landfill cells. On wet weather days, the shared access road accumulates a significant amount of mud and debris. The distance from the active landfills to the outbound scale is a benefit and aids in removing soil and debris, but the collected materials continues to be deposited on the outbound road north of the outbound scale.

Leachate Management

Ponding of leachate is occurring adjacent to the northern boundary of the waste slope but within the containment area. It is possible that the excessive precipitation in the weeks prior to the site visit contributed to the accumulation of leachate as well as how the waste terminates prior to reaching the north containment berm.

The quantity of leachate requiring management outside the landfill in the leachate management system is also a challenge for Landfill staff. Multiple rainfall events have impacted the capacities of the leachate lagoons that require staff time to both utilize recirculation lines and utilize the Neptune evaporator. Simultaneously, tanker trucks haul leachate to the local publicly owned wastewater treatment plant (WWTP). The City is handling and disposing of leachate utilizing methods that are effective and efficient, but is having a significant challenge keeping up with the quantities of leachate being generated.

Recommendations

- **Design Evaluations and Enhancements:** Design enhancement considerations that may be enhanced in the future that would provide benefits to landfill operations by increasing efficiencies and decreasing maintenance include, but are not limited to, the following items:

  - Increase in leachate sump capacity. Based on the cell areas and drainage patterns of the future designed sumps, the dimensions of the sumps in the permit drawings appear undersized. Inadequate sump capacity can result in frequent on-off times for a pump which is an inefficient means of transferring large volumes of liquid and tends to burn out pumps.
  - Leachate collection trench columns should be exposed to be in intimate contact with the waste. Biological clogging of sand drainage layers and geotextiles can occur in base liner systems. Having larger aggregate in a leachate collection trench can offset the biological clogging and provide both better drainage and a contingency in case leachate piping collapse or buckle.
  - Intermediate containment berms can be better utilized to stabilize and provide a ballast point for waste slopes. Additionally, a smaller intermediate containment berm can be installed with the base liner system for the waste slope to begin while allowing future tie-in on the other side of the berm. The tie-in point can be prepared with a rain flap to prevent storm water intrusion into the leachate collection system during construction.
  - Geogrid in the side slope liner system on 3H:1V slopes may be excessive. Without reviewing the stability calculations for the designed side slope, it is difficult to determine whether or not geogrid is necessary. However, a 3H:1V side slope is not overly difficult to place drainage sand, and it is rare for a geogrid to be utilized on base liner slopes more gradual than 2H:1V.
  - The use of riprap to line diversion berms on side slopes and letdowns in the final cover system could become difficult to maintain. There are other materials available to armor the erosive areas that provide better efficiencies for maintenance.
  - The general fill portion (36 inches) of the final cover system may be reduced, which would reduce construction costs and provide additional waste capacity over the entire landfill footprint.
- **Immediate Steps for Safety, Environmental Compliance, and to Set Stage for Future:** As a priority set of actions to undertake, the following list is recommended based on opportunities to quickly and cost-effectively improve onsite safety (both for Landfill operators and customers), environmental compliance and resource management, and to prepare the active landfill areas for future recommended actions related to operational fill sequence and daily cell filling strategies.
  - Improve surface of existing customer access road leading to lower elevations of landfill to create a long-term all-weather road.
  - Move all dry weather fill operations to the northwest corner of the cell to bring the area at a lower waste elevation (with only the fluff lift currently in place) up to the plateau elevation of surrounding waste.
  - Begin use of the existing west access road leading to the soil borrow area as the exclusive route for soil hauling equipment.
  - Using the recommended soil haul road, place soil cover over exposed or flagging trash.

- After completing fill placement as described in Item 2, transition to the area north of the existing customer haul road at the toe of the west slope of the existing active face.
- To preserve in-place soil cover and reduce the quantity of storm water entering the cell as leachate, install a soil diversion berm on the existing south sideslope and seed the existing south and north sideslopes.
- Develop Operations Plans to Increase Landfill Efficiency: After implementing the above priority actions, the Landfill will be ready to shift gears towards developing a clear, intentional, and fact-based daily and intermediate-term cell filling operation.
- Implement an Operational Fill Plan: An Operational Fill Plan for both the MSW and C&D landfills could increase efficiencies and help minimize operational challenges. Operational fill plans provide details on where to fill, time it takes to fill an area, identifies wet weather areas, how to control storm water, and minimizes construction of all-weather access roads.
- An alternative to adjusting the sequence of the fill operation to allow adequate space for slow unloading of C&D material at the landfill by residential customers, simply direct all residential customers to the public drop-off area and direct commercial C&D haulers to the MSW landfill on Saturdays.
- Implement a Soil Borrow Area Development Plan: Like the Operational Fill Plan concept, a Soil Borrow Area Development Plan is recommended to assist with controlling soil usage and management of resources.
- Implement Pancake Fill Method: To reduce soil usage, improve waste densities, increase efficiencies of the site equipment, and effectively reduce leachate generation, it is recommended to adjust the placement of waste at the working face to a pancake fill method.
- Implement Design Enhancements for Cost Savings & Operational Efficiencies: As identified during onsite observations, leachate disposal and handling methods are stressing operations through the use of a multitude of options (recirculation, evaporation, hauling to WWTP, and storage). Due to the stress on staff availability and the cost of hauling over time, it is recommended to install a direct discharge from the leachate ponds via a pipeline into the City's sanitary sewer collection system.
- Prior to the next cell construction, the potential design modifications recommended should be reviewed and refined to identify cost savings.
- The existing compost area adequately serves the current needs of the City’s yard waste stream. However, as the yard waste stream increases, the existing compost area will require expansion or a change in operation to expedite the composting process such as forced aeration. Monitor the direction of other processes such as anaerobic digestion prior to expanding or adjusting operations.

5.1.3 Recycling

Summary of Key Findings

Traditional Recyclables

Licensed haulers are required to offer recycling collection services, and residents and businesses are required to recycle. The licensed haulers deliver recyclables collected directly to private recycling facilities, not owned or operated by the City. Through the City's education and outreach efforts, the City works to help reduce contamination in the recyclables, but the City has no other direct responsibilities in the processing of traditional recyclables.

The recycling facilities must obtain a recyclable collectors' license from the City and only licensed waste haulers can collect required recyclables, according to Section 57.080 in the City's Code of Ordinances. There are currently two recycling facilities licensed to accept traditional recyclables. (The City has licensed a few other facilities that only accept and recycle certain items like antifreeze and oil.) The Landfill staff can choose which facility to take the single stream items and cardboard brought to the Landfill, based on fees. For City buildings, the City bids out its trash and recycling collection services on a multi-year agreement, and delivery of recyclables to a recycling facility is part of that agreement.

White Goods

Citizens in the Service Area may drop off white goods at the Landfill's public drop-off area. If the white goods contain Freon, it is removed at the landfill. All white goods free of Freon, are sold to a scrap metal contractor (currently $96/ton).

Mattresses

The collection of mattresses is one of several recycling services the City provides its customers. Mattresses are collected at the Landfill and hauled to an end user at a cost of $9 per mattress charged to customers.

Recommendations

Traditional Recyclables

Continue to educate citizens: The City should continue to work to educate citizens about proper recycling procedures to reduce contamination.

White Goods

Continue the White Goods program: It is a very common practice in the solid waste industry for facilities to collect white goods, remove the Freon, and sell the materials to a scrap metal contractor. As such, the City is operating an efficient and effective white goods collection program and should continue with the program in existence.

5.1.4 Yard Waste/Organics

Yard waste is required to be collected once per week, seasonally, and is delivered to the Landfill. However, yard waste, along with certain other recyclables, are banned from disposal in the Landfill. The City currently composts yard waste on a portion of the Landfill property. Finished compost is available to residents for free at the Landfill. There is also a wood pallet recycling area south and adjacent to the compost pad area at the Landfill. The City is not currently recycling or processing other types of organics.

Summary of Key Findings

Anaerobic Digestion

As described in more detail in Appendix I (Innovative Green Projects), Anaerobic Digestion may be possible to develop an innovative green project where food waste and certain other organic materials may be processed in conjunction with ongoing operations at either the WWTP or the Landfill (Anaerobic Digestion [AD]) technology and process is described in more detail in Appendix G). This may be implemented in several ways and be taken to varying levels of biogas processing. Based on the Waste Characterization study conducted in June 2016, food waste and other organic materials represent approximately 5.6 and 11.6%of ICI municipal solid waste, respectively. Some of these source separated materials may be possible to concentrate by targeting specific regional food processing facilities, dairy operations, restaurants and cafeterias, and possibly food retailers.

AD processing of food waste and concentrated organics is successfully operating in several projects in the US and around the world, and has been in place for several years. Key to any project is the independent capture of the feedstock food waste and organics. This may require the establishment of specialized collection routes designed to capture the target materials. About 150–200 cubic meters of raw gas (low quality) can be produced per ton of food waste, although the production for this system would need to be further evaluated. Odor is always a concern for food and organic AD operations, and careful consideration of these needs and issues would be required. The AD may be completed at the WWTP or the Landfill, the potential differences in approach at either site are described in more detail in Appendix I (Innovative Green Projects).

Industrial Waste Composting

As described in more detail in Appendix I (Innovative Green Projects), industrial waste composting could be pursued, and based upon the Waste Characterization study results, there could be the potential to increase diversion. To accomplish this objective, specific materials and sources such as food processing by-products, food waste, publicly owned treatment works wastes, and other organic materials generated by regional food processing facilities, dairy operations and possibly food retailers would be targeted for special handling. Composting operations may be expanded to address more than yard waste, diverting additional materials from disposal in the Landfill. No unique equipment not already used by the City would be required to complete industrial composting, although as the project grows, additional equipment may be needed. Operational adjustments to capture these industrial compostable materials would increase the composting operation activity at the Landfill. This may require some changes to the composting operation, limit uses for certain products, and increase operating and capital costs for the Public Works Department, and may require review and modification to the permits for the Landfill composting operations.

Zoo Waste (Manure) Composting

Zoo waste (manure) composting, could be implemented as a means of increasing landfill diversion. A project such as that successfully implemented and maintained at the Oregon Zoo since 1988 could be developed. “Zoo Doo” is produced from herbivore manure and bedding at an on-site aerated static pile and used throughout the facility as plant bedding and mulch. The product is also made available to the public for free.

Organic waste from the Great Plains Zoo is estimated at approximately 700 tons per year.

Recommendations

Continue yard waste and wood recycling programs: The City should continue its yard waste composting and wood pallet recycling activities at the Landfill, unless or until a more beneficial approach to organics processing that can include yard waste and/or wood pallets is implemented.

Industrial Waste Composting

Further evaluate industrial waste composting: The City should first identify potential users and initiate discussions to determine interest. If interest is identified, the City should consider an analytical study to understand the full lifecycle impacts, taking into consideration the benefits of preventing these materials from being disposed of in the Landfill, impacts on any potential landfill gas energy projects, changes required to composting operations and the additional fuel and energy use required for collection and processing of industrial organic waste. Consideration of potential odor and vermin issues would need to be addressed for some of the materials targeted.

Zoo Waste

Coordinate with the Great Plains Zoo to evaluate Zoo Waste composting: The City should coordinate with the Zoo, and consider a study to understand the full lifecycle impacts, taking into consideration the benefits of preventing these materials from being disposed in the Landfill, the cost and feasibility of setting up operations at the Zoo or changes required to Landfill composting operations, impacts on any potential landfill gas energy projects, and the additional fuel and energy use required for collection and processing of the Zoo Doo.

5.1.5 Construction and Demolition Debris

Much of the operational findings and recommendations relating to the C&D Landfill are included in Sections 5.1.3 – Landfill Operations. This section describes aspects of C&D not covered in 5.1.3. Also, note that Appendix C includes a high-level review of the Feasibility Study for the Construction and Demolition Material Recovery Facility prepared by R.W. Beck in September 2011. A Construction and Demolition Material Recovery Facility (C&D MRF) may be in conflict with potential other opportunities the City may entertain with the current waste stream currently. At the time of this writing, it does not appear the existing Feasibility Study includes a comprehensive cost analysis consistent with current practices, waste stream, and desires of the City. More specific items that require updating or further review are described in Appendix C.

Summary of Key Findings

Because of the heavy weight typically associated with C&D materials, it can offer considerable weight for recycling and diversion, which can increase weight-based recycling rates. As such, C&D was considered as part of a broader effort to identify innovative green projects the City could consider implementing.

C&D Material Rescue and Reuse

As described in more detail in Appendix I (Innovative Green Projects), a C&D Material Rescue and Reuse program can be promoted by collaborating with local stakeholders to prevent C&D material that can be reclaimed and repurposed from being sent to the Landfill. This effort could potentially collaborate with Habitat for Humanity to expand capacity and improve effectiveness of building material and home goods recovery. The effort could convene stakeholders to understand current barriers, opportunities, and challenges of salvaging reusable building materials. An incentive to recycle C&D material, or alternatively a mandate that requires a certain percentage of material be recycled could also be established. The Landfill could further C&D sorting operations to reuse or recycle certain C&D materials with viable uses or markets, after it is delivered to the Landfill.

Carpet

Carpet is currently accepted at the Landfill in both the municipal solid waste portion of the Landfill and the C&D portion of the Landfill for the current waste disposal fee. Per the Waste Characterization Study conducted in June of 2016, an estimated 253.5 pounds of the waste stream consisted of carpet going into the C&D portion of the Landfill. However, it should be noted that the limited number of samples (10) conducted during the Waste Characterization Study is insufficient to provide enough data to develop statistically significant composition estimates for the C&D material stream. When the number of samples is limited, it is possible (even with random selection of loads to be observed), to obtain results that are skewed and not reflective of the overall composition of the C&D waste stream as a whole.

The U.S. is currently seeing growth in the carpet recycling industry, as national negotiations are beginning to stimulate more business interest in processing and end-market demand. Existing end-markets for carpet derived materials include carpet fiber, auto parts, and wood-plastic composites. The Carpet America Recovery Act website provides information on the current state of the carpet recycling industry in the U.S. In South Dakota, there are currently few opportunities for recycling of carpet, none of which appear to be within a reasonable proximity to the City.

Recommendations

C&D Material Rescue and Reuse

Conduct a C&D material rescue test pilot: Establish a test pilot program to evaluate the potential of C&D Material Rescue and Reuse program. The test pilot program would allow the City to identify how much and what types of materials can be recovered. Furthermore, the City should consider an analytical study to understand the full lifecycle impacts, taking into consideration the costs and benefits of preventing these materials from being disposed in the Landfill, the cost and feasibility of setting up and promoting/enforcing the C&D material rescue programs, and, if any, the additional fuel and energy use required for collection and processing of the C&D material, as well as energy savings from using recycled materials. Convening stakeholders, perhaps including local builders' associations and companies as well as demolition companies should also be considered to gain a better understanding of challenges and opportunities in the marketplace.

Carpet Recommendations

- Continue the current practice of disposing of carpet waste in the Landfill, until viable recycling opportunities can be identified and implemented.
- In cooperation with the State of South Dakota Department of Environment and Natural Resources, review the potential of grant funding a pilot project to recycle carpet waste.
- Open discussion with the South Dakota Department of Environment and Natural Resources staff on a collaborative strategy to convene a coalition of stakeholders to review regional carpet recycling infrastructure and end-markets for carpet waste.

5.2 Household Hazardous Waste Facility

The HHW Facility is currently operated under contract by Veolia ES Technical Services (Veolia or Contractor). The City operates a Reuse Room, adjacent to the HHW Facility, at the City of Sioux Falls Environmental Center, that redistributes household and automotive chemicals in good, usable condition back to the public. Residents of the Service Area may pick up three items per week for free. More details regarding the HHW Facility are included in Appendix H.

5.2.1 Summary of Key Findings

Household Hazardous Waste

As part of the Veolia contract requirements, Veolia provided a Facility Operating Plan, and is required to maintain a Standard Operations Procedures manual for accepting, unloading, segregating, packaging, labeling, storing, preparing for shipment, and transportation of HHW for final disposal.

Operationally, as customers enter the HHW Facility, they are greeted by contractor staff who operates a handheld scanner provided by the City to record facility visits. Contractor staff record customer name, address and product accepted into the scanner which is then downloaded to the City Information Technology Department. City staff noted that the scanner malfunctions on occasion and experiences operational discrepancies. In 2015, approximately 10% of the customer visits were blank in the system. Table 5-1 depicts adjusted customer visits to the HHW Facility.

Table 5-1: HHW Facility Customers

Year	Customers Recorded	Scanner Discrepancies	Adjusted Customer Count	Average Daily Customers
2018	26,244	N/A	26,244	101
2017	29,891	N/A	29,891	115
2016	27,964	N/A	27,964	108
2015	28,212	(2,630)	25,582	98
2014	27,054	(2,516)	24,538	94

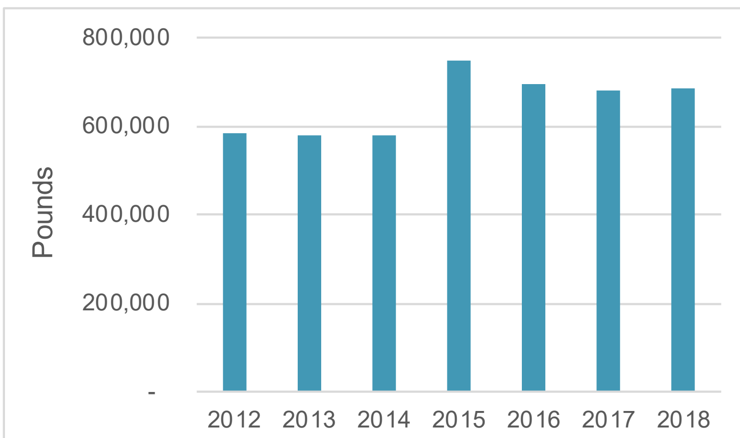

Figure 5-2: Total HHW Accepted at Facility

The HHW Facility experienced an increase in pounds of HHW materials accepted from 2014 to 2015, as exhibited in Figure 5-2. This increase was attributable to an increase in latex paint and oil based paint product acceptance at the HHW Facility which has since leveled out. The Re-use Room was relocated from the HHW Facility to the Environmental Center Building. The contractor redistributes reusable products that are dropped off at the HHW Facility to the Reuse Room. Although the staff cannot guarantee the quality of the products, each item is inspected before it is made available to the public. In 2014, there were 4,875 reported Re-use Room customers and in 2015, 6,529 customers. The City is staffing the Re-Use Room with volunteers, on occasion, although the contract with Veolia requires the Contractor to operate the program. There is currently limited oversight for this program.

HHW is manifested and shipped from the HHW Facility by Veolia staff. In 2015, latex paint and oil based paint accounted for 83% of the waste stream shipped to a Veolia facility. These waste streams are not currently volume reduced and are shipped in the paint containers that customers bring in.

Table 5-2 provides an overview of HHW pounds shipped 2014 to 2018 as well as payments to the Contractor for facility operations, supplies and recycling and/or disposal.

Table 5-2: HHW Shipped for Recycling/Disposal (in pounds)

Year	Pounds Shipped	Paid to Contractor
2018	524,620	$505,713.98
2017	504,960	$526,026.54
2016	465.380	$519.029.70
2015	461,474	$443,658.55
2014	343,571	$390,721.05

Electronics

In May 2004, the City passed Ordinance No. 38-04 amending City Ordinance Chapter 18, which banned a specific list of electronic waste from the Landfill in order to extend the life of the Landfill, avoid the negative impacts of electronic waste, and put a stronger emphasis on recycling. The City of Sioux Falls currently accepts regional household electronic waste at its HHW Facility.

Electronics are collected at the HHW Facility and stored in trailers owned by Secure Enterprise Asset Management ("SEAM," formerly known as Bargain Bytes). When sufficient quantity is collected, SEAM transfers the trailer to their facility where the electronics are recycled and/or repurposed. Table 5-3 provides an overview of electronics collected and shipped 2014 to 2018 including expenses for payments to SEAM for recycling and/or repurposing the materials. The cost for accepting electronics through the HHW Facility is included in the operating costs for the facility and is not directly allocable to the electronics program.

Table 5-3: Electronics Collected (in pounds)

Year	Pounds Collected	Paid to SEAM
2018	1,175,972	$206,259.16
2017	1,361,655	$262,318.41
2016	1,544,648	$96,627.31
2015	1,486,649	$101,867.16
2014	1,482,830	$91,929.55

HHW Facility staff segregate working electronics, test them, and hold a drawing for customers to receive the product, free of charge, monthly. In 2014, 1,767 pounds and in 2015, 2,239 pounds of electronics were given away through this electronics program. To implement this program, the HHW Facility layout was reconfigured and the Re-Use room was moved to the City of Sioux Falls Environmental Center. Approximately 15–20% of the HHW Facility is currently utilized for testing of electronics, contractor office space and break room. These giveaways were rarely conducted in 2016 and 2017.

Conditionally Exempt Small Quantity Generator (CESQG) Waste

The City, in coordination with Veolia, has developed a Business Hazardous Waste Management Program (BHWMP). This program is designed to give area businesses and institutional facilities an economical option to dispose of small quantities of hazardous wastes while diverting these waste streams from the Landfill and sanitary sewer. Certain eligibility requirements must be met to participate in the program.

There are currently 90+ CESQG's registered with the City through return of the CESQG Verification Form for this program. In 2015, 15 CESQG's participated in the program at a cost to the City of $5,460.00. No records of waste shipped are currently available.

Tires

Tires are currently accepted at the Landfill for a fee. There is currently no limit to the number of tires customers can bring to the Landfill, but they may only bring a limited quantity of tires on rims. The scale-house attendant at the Landfill determines either the number of tires per load for the per-tire fee charged, or weighs the load and assesses the per ton fee.

In 2016, the South Dakota Department of Environment and Natural Resources (DENR) obtained a grant authorizing it to issue sub grants for eligible projects for the collection and disposal of waste tires. The City used the sub grant for waste tire collection and disposal, which offset $100,000 in costs. The Landfill began accepting tires, in part to avoid standing water and eliminate breeding areas for mosquitoes. The City committed to match 20% of the grant. However, grant funding officially expired on July 31, 2017.

The City currently contracts with Liberty Tire Recycling for disposal and recycling of waste tires for a fee of $153.50 per ton. Tires are collected on an asphalt pad at the Landfill. When sufficient quantity is collected, Liberty Tire loads the tires into trailers and transfers them to their facility where they are reused for energy. In addition, the Landfill is authorized, under their operating permit, to chip tires and reuse as an alternate daily cover. The chipped tires are then mixed 4:1 with soil and reused as landfill daily cover. It is the Landfill's goal to reuse 20% of the tires collected in this method. The City has also used tire chips as aggregate in leachate recirculation. Table 5-4 provides an overview of tires collected 2014 through 2018 including expenses for operating the tire program.

Table 5-4: Tires Collected (in tons)

Year	Tons Collected	Paid to Liberty Tire
2018	540.25	$96,949.01
2017	580.01	$90,509.69
2016	1,021.24	$147,730.50
2015	368.23	$49,120.17
2014	525.28	$64,832.17

Appliances

Appliances, also known as "white goods," including stoves, refrigerators, freezers, dishwashers, washers, dryers, air conditioners and hot water heaters, are currently accepted at the Landfill as part of the flat fee charged per vehicle ($9 for cars; $18 for pick-up trucks). Refrigerators, freezers and air conditioning units contain refrigerants, commonly known as Freon, that deplete the ozone layer. Since 1992, Federal Law prohibits the release of Freon into the atmosphere and requires that Freon be removed from appliances before they are disposed.

Appliances are collected at the Landfill and landfill personnel recover (remove) the Freon. The scrap metal from these appliances and other white goods is then recycled through a contract with TJN Enterprises. Appliances are stockpiled on an asphalt pad and TJN Enterprises mobilizes to the Landfill every three to four weeks to bale and ship the metal for recycling.

The TJN pays the City for scrap metal material at the Landfill based on the American Metals Market using a formula outlined in their current contract.

Table 5-5 provides appliance tonnage baled and recycled for 2014 through 2018:

Table 5-5: Metals Recycled (in tons)

Year	Tons Recycled
2018	978.68
2017	1,210.42
2016	1,314.05
2015	835.24
2014	823.81

5.2.2 Recommendations

- **Household Hazardous Waste recommendations include:**
  - Update the Operations Plan specifically for the City of Sioux Falls HHW Facility. This Operations Plan should be specific to the current facility operations and should incorporate the goals and outcomes for landfill diversion and recycling.
  - Develop and Implement Standard Operating Procedures for each waste stream entering the HHW Facility, the waste handling processes and procedures, re-use program and equipment operational processes and procedures.
  - Implement a volume reduction program for latex paints, oil base paints and aerosols with the purchase, installation and operation of a latex can crusher, oil base paint can crusher and aerosol can crusher for bulking these waste streams.
  - Research the feasibility of implementing a volume reduction program for small propane cylinders with the purchase and operations of a Red Dragon Propane flare system.
  - Evaluate the purchase and installation of a computer tracking system for the HHW Facility with the ability to track customers (scanning capabilities), waste

streams and quantities. The Landfill is currently operating the Paradigm software system at the scale-house to record customer scale crossings and calculate fees. This same software system, which has scanner capabilities, could be modified for use at the HHW Facility to assist in eliminating discrepancies, and to access fees for CESQG waste if the City decides to accept CESQG hazardous waste at the HHW Facility.

  - Consider expanding the existing HHW Facility to accommodate more waste types, conditionally exempt small quantity generator waste and extended hours of operation as increases in waste volumes warrant.

- **Electronics recommendations include:**
  - Continue the current program of diverting electronics from disposal in the Landfill through the HHW Facility.
  - Continue contracting for electronics recycling with an outside vendor.
  - Discontinue the current practice of the HHW Facility contractor staff segregating electronics, testing for operability and redistributing to customers, as the current electronics recycling contractor repurposes and sells usable electronics. In addition, discontinue this program could save space in the facility as well as avoid third party liability.
  - Review the current contract for electronics recycling for potential cost savings or revenue generation to the City in the future.
- **Tire recommendations include:**
  - Continue the current program of diverting tires from disposal in the Landfill.
  - Continue contracting for tire recycling/re-use with an outside vendor.
  - Work with the State of South Dakota Department of Environment and Natural Resources for future grant funding of tire diversion and recycling.
  - Continue the current permitted use of chipping tires for use as an alternate daily cover.
  - Review the tire tipping fee in comparison to tire recycling costs on a yearly basis and modify the tire tipping fee as necessary to cover costs.
- **Appliance recommendations include:**
  - Continue the current program of diverting appliances from disposal in the Landfill.
  - Continue contracting for appliance recycling with an outside vendor.
  - Continue the current practice of Landfill staff removing Freon from appliances prior to recycling.
  - Consider requiring that doors be removed from refrigerators and freezers prior to entering the Landfill, as a safety precaution.

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6 Conversion

6.1 Landfill Gas to Energy

Landfill gas (LFG) from the closed MSW landfill and portions of the active MSW landfill is collected through a series of vertical and horizontal wells and processed at the gas conditioning building before being directed to the POET ethanol plant in Chancellor. The facility also houses a backup flare. The LFG collection system for the Closed MSW Landfill consists of an approximately 88-acre footprint. Within the Active MSW Landfill (Cells 1 and 2) the gas collection area consists of an approximately 19-acre footprint. Cell 3 in the Active MSW Landfill consists of an approximately 15-acre footprint. This 15-acre area is currently in the process of installing the landfill gas header piping and trenches for collection of landfill gas.

The contract between the City and POET has been renewed with an expiration date in 2029.

Landfill Gas-to-Energy (LFGTE) projects are based on the anaerobic decay of solid waste that naturally occurs in landfills, which generates LFG at various rates based on particular site variables. To appropriately design beneficial end uses for the LFG, engineering estimates must be developed regarding the future generation of LFG at a particular site, or from a particular waste mass – known as LFG generation modeling. The U.S. Environmental Protection Agency (EPA) LandGEM model is one tool that is used for LFG generation modeling. This program allows for input of waste receipt tonnages, methane content of LFG, two kinetic variables, and the NMOC content of the LFG. These variables can be based on Clean Air Act (CAA) requirements, EPA's Inventory default values, and/or site-specific data. Typically, CAA values are used to determine a facility's compliance with regulatory requirements, and inventory or site-specific values are used for emission calculations for collection and beneficial use.

6.1.1 Landfill Gas Generation and Collection Estimates

The LFG generation curve (past, present and future) is provided as Figure 6-1. This curve is based on the "Revised Waste Projection – LFG Model Update_Update_110818.xls" summary model results provided by the City. The "captured/available LFG is estimated by the City based on a variable collection efficiency (CE) assumed to be estimated by continual expansion of the gas collection and control system (GCCS) as necessary.

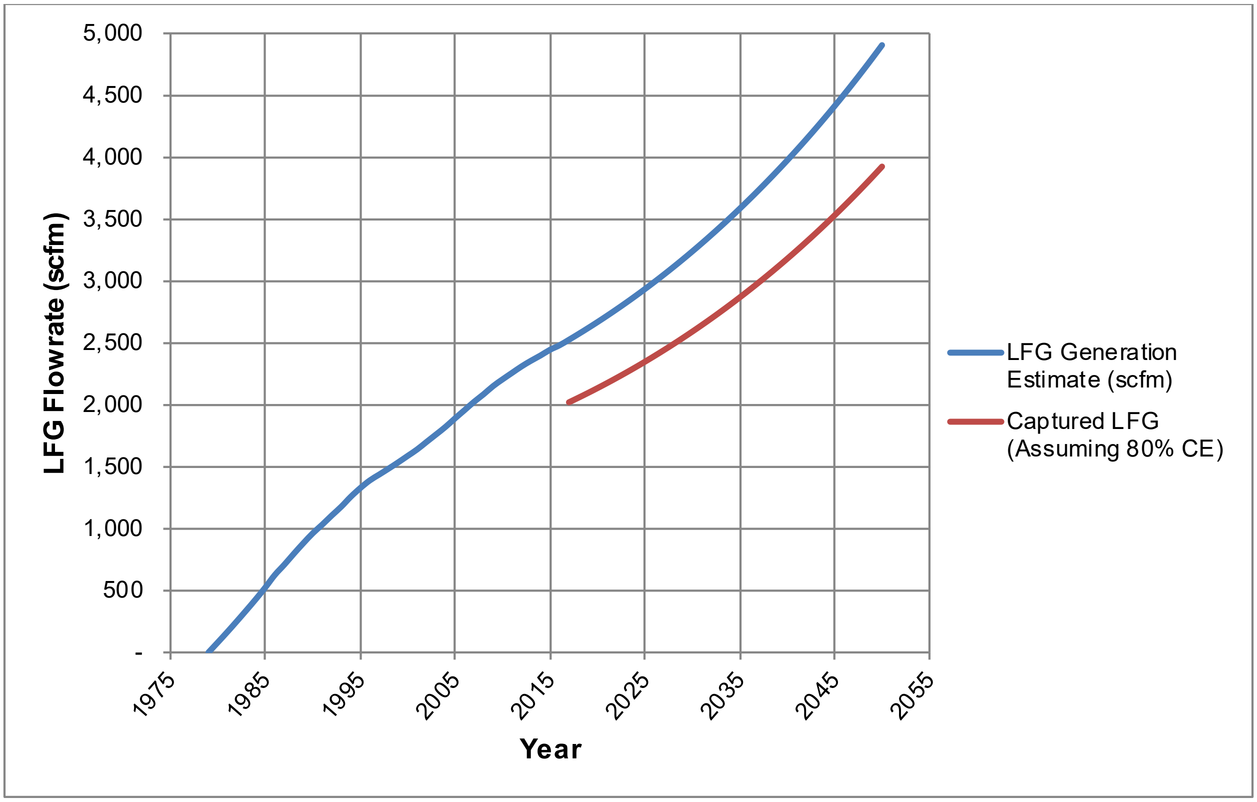

Figure 6-1: LFG Generation and LFG Available for Alternative Use

As shown in Figure 6-1, the "LFG Available for Alternative Use" (i.e., the total collected LFG) is approximately 1,470 standard cubic feet per minute (scfm) average flow rate in 2019. The City-provided model provides estimate values through 2031. These values assume continued expansion of the GCCS to achieve collection efficiency between 78%-85%. It is also important to note that the "LFG Available for Alternative Use" does NOT subtract any LFG currently (or future) contracted for delivery to POET. This obligation could serve to decrease the available LFG until this contractual obligation expires in 2019 (or a future year, depending upon current negotiations). Of note is that all (over 95%) of the LFG flow rate collected at the Landfill has been sold to POET in recent years.

It is important to realize that most of the LFG generation in a waste mass takes place in waste that is approximately 5 years of age and older (depending upon site conditions). This is the time it takes for a unit of waste to become completely anaerobic and start to contribute meaningfully to the LFG generation at a site. Therefore, new diversion efforts or addition of specific waste streams have relatively little effect in the shorter term, but effect changes in the long term, on LFG generation.

6.1.2 Summary of Key Findings

Based on the City-provided LFG modeling results (and the POET contractual obligation caveat), the LFG available for alternative use is approximately 1,470 scfm LFG in 2019, with fluctuating values through 2031 as shown in Figure 6-1. Based on this available LFG, the following provides an overview of alternative uses for the collected LFG. This overview of LFGTE technologies can assist the City in understanding alternative or supplemental options (depending upon contractual obligations to POET).

Medium-British Thermal Unit (BTU) Gas

This option is familiar to the City and involves direct thermal utilization of the LFG as a medium-Btu fuel by piping the LFG to a nearby thermal energy-user (to offset natural gas or other fossil fuel usage). The City currently conditions LFG in an on-site building and then directs the LFG to the POET ethanol plant. As the infrastructure is already in place for this particular medium-BTU option, there are a few options to boost revenues: (a) re-evaluate existing contracts with POET (as currently planned by the City); and (b) explore the possibility of identifying another end user for which the existing piping infrastructure could be utilized (in whole or in part).

Electricity Generation

Producing electricity from LFG is the most common LFGTE application in the U.S., accounting for about three-fourths of all U.S. LFGTE projects. Electricity can be produced by using LFG as a fuel source in an internal combustion engine, a gas turbine, or microturbines. Irrespective of the technology employed to convert LFG fuel to electricity, the electricity can be sold to utility companies both locally and to non-local companies by means of “wheeling” power over the shared grid. The following is a listing of applicable details that should be considered when analyzing potential sales of electricity:

- Commonly, electric utility companies will pay based on contractual agreement with the electricity seller. The payment is generally quantified in terms of “avoided cost” – cost of electricity that the utility would have to produce. These avoided costs tend to fluctuate and can vary significantly based on various factors, such as plant capacity, on-site loads, or excess generation, and type of energy source the utility uses for electricity production.
- Interconnection with the local utility company (or other purchasing entity) is required for all electrical generation projects. These costs are generally based on the scale of the project and arrangements with the electricity purchasing entity. These interconnection costs may vary significantly based on arrangements with the purchasing entity.
- Renewable Energy Credits (RECs) and other similar state-specific incentive programs are additional sources of potential revenue from sales of electricity generated by LFG. Given the current administrative environment and generally low value of RECs, it is currently recommended to carefully consider counting on future revenue from REC’s in exploring the financial viability of LFGTE projects.

Specific to the landfill, the “LFG available for alternative use” could support two primary electricity generation technologies: Engine generators and turbines, for which more details are included in Appendix K.

High-BTU Gas

LFG can also be processed to the equivalent of pipeline-quality high-Btu gas (renewable natural gas, or RNG), compressed natural gas (CNG), or LNG. Pipeline-quality gas can be injected into a nearby natural gas pipeline and the energy and/or environmental attributes sold to the local utility or other buyer(s) at other locations. If the energy is sold to the utility and the environmental attributes are retained, these can be sold once the equivalent RNG is converted into CNG or LNG. CNG and/or LNG can be used on-site to fuel vehicles at the landfill, fuel refuse-hauling trucks, and possibly supply the general commercial market, or delivered to a remote location by displacement on the natural gas pipeline system. The following are the typical processes that are commercially employed in the United States: Water Scrubbing; Amine Scrubbing; Molecular Sieve; and Membrane Separation. In general, these high-Btu processes can result in product gas with an equivalent heating value to natural gas. This RNG product gas is commonly utilized (sold) by either direct injection into a nearby natural gas pipeline, or further processing (compression) to produce alternative transportation fuels such as CNG.

Similar to electricity generation, there are incentive programs for the use of RNG as a transportation fuel. The EPA has developed the Renewable Fuel Standard (RFS) program, which was created by the Energy Policy Act (EPAct) of 2005. The original program was referred to as RFS1. It was expanded to RFS2 under the Energy Independence and Security Act (EISA) of 2007. The purpose of the RFS2 program is to displace fossil fuel used as vehicle fuel for transportation with fuel derived from renewable resources. Although natural gas prices are generally down and electricity prices are not escalating, the RFS2 program can be a means by which High-BTU projects can realize revenue (while the market prices hold).

Given the current political environment, the future of the RFS2 program is uncertain – and therefore difficult to build economic pro-forma around. From a risk analysis standpoint, it is currently assumed that the program can last for the next few years at its current rates. This is a small window to develop projects that will inherently require years to recover capital investment and come to a “breakeven” point.

6.1.3 Recommendations

- **Recreate the LFG generation and collection models, as necessary**: Although the Landfill has potential new avenues of waste diversion in the future; i.e., Materials Recovery Facility, Solid Refuse Fuel, and/or EPA 2030 Food Waste Goal; these are generally difficult to quantify individually. As these potential new facilities come on-line or these new community practices are implemented, it would be most appropriate for the City to re-create the LFG generation and collection calibration procedure to holistically adjust the models in the future. Changes in the waste stream take approximately 5 years to affect noticeable changes in LFG generation/collection.
- **Conduct a more detailed financial evaluation for LFGTE to determine best option:** The following LFGTE options are available to the City for the expected LFG flow rates as presented. These options would require a more detailed financial evaluation and current market analysis to fully determine the net present value of each option and determine true financial feasibility:

- **Medium-BTU Gas Option**: As the City is already aware of this option and have the existing infrastructure and relationship in place, this option may be more suitable for the City, as it maintains status-quo.
- **Electricity Generation**: Engines generators would be appropriate as either a supplemental project, or as a stand-alone project (in lieu of selling LFG to POET). This technology can be planned to modularly match the available LFG curve into the future.
- **High-BTU Gas**: If the City currently operates or plans to purchase CNG vehicles or retrofit an existing fleet, CNG might be a viable technology – although the amount of available fuel a project like this would generate would require a very large fleet of vehicles retrofitted for CNG use. Otherwise, high-BTU pipeline injection could provide a project with more operational flexibility to the City, and the ability to apply for and trade Renewable Identification Numbers (RINs) in the RFS2 program (assuming the continuation of the program and an advantageous market).

Each of the above options are technically feasible, and might be economically feasible under an array of different ownership options (i.e., City investment and operation versus City contracts with a Developer for investment and operation). To further investigate the technical and financial feasibility of these technologies (specific to the landfill and the current status of the energy, REC and RIN markets), it is recommended that the City conduct a complete financial feasibility study comparing these viable options.

6.2 Solid Refuse Fuel

A unique and new opportunity for Sioux Falls may be the development of a Solid Refuse Fuel (SRF) Production process, where waste materials are transformed into a fuel product that is considered a non-hazardous secondary material for a facility that uses industrial boilers as a substitute for coal, oil, wood or biomass fuels used at the facility. While there are no nearby Thermal Technology (Municipal Waste Combustor) facilities (regulated under Section 129 of the CAA) that might be interested in purchasing the fuel product for their facility, there may be Industrial Boilers that could use the fuel as a substitute for coal, oil, wood or biomass fuels used at the facility. These facilities are regulated under the CAA Section 112 and would most likely want to remain with that designation.

6.2.1 Summary of Key Findings

Under the recently developed rules in Section 241 of the CAA, the EPA is encouraging the development of Non-Hazardous Secondary Materials (NHSM) that can be used as a fuel substitute for traditional fuels. Under the NHSM provisions and certain management practices, certain materials usually considered to be wastes can be used as a traditional fuel substitute without causing the boiler to be subject to the provisions of Section 129 of the CAA and the unit would remain regulated under Section 112. This provision is often used for materials such as pulp and paper wastes at a paper mill, or even for combustion of certain other materials such as tires or railroad ties. To distinguish this process from refuse-derived fuel (RDF) production, this plan uses the term solid recovered fuel (SRF) for the fuel produced that achieves the requirements of Section 241.3 of the CAA.

Section 241.3 has several provisions that must be demonstrated. First, the process must be more than just shredding. The rule will likely require removal of fines, glass, metal and other inert materials, as well as certain other undesirable components of the waste stream such as moisture and chlorine. These provisions will demonstrate a "legitimacy criteria" demonstrating that a viable SRF is produced and used and it no longer is a waste. The SRF must be managed as a valuable commodity. This can often be demonstrated through the existence of contract agreements for sale and use of the SRF. The SRF must have meaningful heating value and be used as a fuel to recover energy (or as a process input). Lastly the SRF must be comparable to the traditional fuel in regard to the contaminant levels contained in the fuel.

When applied to mixed municipal waste, the requirements require more processing than is typically used for a standard RDF production plant at a Municipal Waste Combustion facility. The SRF fuel produced must be more consistent and more closely resemble the traditional fuel(s) that are displaced. SRF properties must be comparable or better than the traditional fuel(s) that are to be replaced. For example, pelletizing or forming the SRF into briquettes may be required.

Other requirements may include provisions such as:

- Consistently maintain a heating value greater than 5,000 Btu/lb
- SRF moisture content must be less than 15%
- SRF ash content must be less than 15%
- SRF chlorine content must be less than 0.3%
- Sulfur to chlorine ratio must be less than 1:1

The processing system to generate the SRF must be capable of achieving these requirements consistently, demonstrated by daily composite sampling. Of the typical requirements, generally one of the most difficult to achieve is low chlorine content. This requirement may require the use of optical sorters or other screening measures to remove PVC plastics and other chlorine containing materials. Metals and inert fines such as glass and grit will need to be removed to reduce the ash content. Removal of some items such as fine organics will help reduce the moisture content and may also reduce the chlorine content of the SRF. Incorporation of the equipment necessary to make the SRF properties comparable or better than the traditional fuel displaced increases the complexity of the processing system. This process coupled with a long-term agreement with a local Industrial Boiler facility may offer the greatest potential for waste diversion for Sioux Falls.

6.2.2 Recommendations

Continue the SRF dialogue with POET: The landfill gas that is piped to POET is utilized as fuel for their industrial boilers. POET has made inquiries to the City in the past in search of additional alternative fuels to further support their operations. Wood wastes and corn stalks are some of the alternative fuels POET uses in addition to the landfill gas. POET has shown interest in utilizing an SRF to further enhance their sustainability practices as long as the fuel can efficiently operate within their system. As such, the City is in discussions with POET regarding the possibility of converting the City's waste stream into an SRF material for use in POET's boilers. It is recommended that the City continue to have dialogue with POET and further evaluate the feasibility of processing the waste stream to create SRF.

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7 Implementation and Monitoring Plan

This Chapter describes each of the recommended strategies and presents them with estimated implementation activities over the planning period, by category. Each strategy is categorized into one of four groups (Waste Generation/Public Outreach, Collection and Transfer, Processing and Disposal, and Conversion) based on which category the specific strategy is expected to have the greatest impact on the City's integrated waste management system.

Chapter 3: Waste Generation/Public Outreach

Chapter 3 discusses existing programs and provides recommendations for two related topics: waste generation and public outreach. The following recommendations are proposed:

Recycling Education Program

- Adopt core values for recycling education and outreach.
- Develop and maintain a consistent brand identity for outreach materials.
- Develop visual communications across different types of outreach.
- Diversify information delivery of outreach materials.
- Ensure frequent engagement.
- Develop dedicated tools for outreach, including a dedicated website.
- Improve access and ease-of-use of website information.
- Take advantage of earned media/social media.

Recycling Enhancements

- Develop and Maintain Guidelines for Recycling and Diversion for Businesses.
- Conduct Business Site Visits to Determine Opportunities for Recycling and Provide Educational Materials.

Food Waste Rescue

- Form a Food Rescue Committee with regular meetings to evaluate the feasibility of specific food rescue approaches to implement as feasible.
- Support Food Donation Programs.

Difficult to Recycle Items

- Monitor DOW Energy Bag Program.
- Monitor and Research Other Programs that Target Difficult to Recycle Materials.
- Identify Third-Party Partners to Recycle Additional Materials at the Landfill.

Increase Waste Diversion

- Support a State Ban or Tax on Plastic Bags.

- Reduce consumer use of common single-use items through promotion of re-usable shopping bags and produce bags as an example.

Some of these recommendations have no direct costs, but could lead to additional costs through new programs that may be needed in the future.

Chapter 4: Collection and Transfer

Chapter 4 discusses existing municipal solid waste collection services in Sioux Falls and benchmarks waste collection practices in similar communities. Chapter 4 concludes with the following recommendations:

- Initiate community outreach to obtain feedback regarding current collection system and potential next steps.
- Expand benchmarking and rate comparison.
- Work cooperatively with the haulers to review the licensing system.
- Evaluate the need for a transfer station based on population growth, tonnage and the collection system.

These recommendations have no direct costs but will require staff time for monitoring activities and meeting facilitation.

Chapter 5: Processing and Disposal Facilities

Chapter 5 discusses the City of Sioux Falls Regional Landfill and other waste management services and programs and facilities. The Chapter concludes with the following recommendations:

Landfill Operations

- Improve public drop-off area functionality.
- Design enhancements
- Immediate operational and safety steps

Recycling

- Continue to education the citizens.
- Continue the white good program.

Yard Waste/Organics

- Continue yard waste and wood recycling programs.
- Coordinate with the Great Plains Zoo to discuss diversion of zoo waste.
- Research industrial waste composting.

Construction and Demolition Debris

- Coordinate with Habitat for Humanity.
- Coordinate with State of South Dakota Department of Environment and Natural Resources for programs related to recycling of carpet waste.
- Pilot study for additional C&D recovery.

- Promote the proper reuse, recycling and disposal of C&D debris.

Hazardous Waste Facility

- Update the HHW facility operations plan.
- Develop and implement standard operating procedures.
- Evaluate the purchase and installation of a computer tracking system.
- Purchase and install can crushers.
- Purchase and operate a Red Dragon propane flare system.
- Evaluate the need for expansion or additional drop-off sites.
- Continue the current programs for diversion of tires, household hazardous waste, appliances and electronics from the landfill.
- Consider expanding the existing HHW Facility to accommodate more waste types, conditionally exempt small quantity generator waste and extended hours of operation as increases in waste volumes warrant.

These recommendations require staff time, and have potential impacts to revenues and fees due to additional volumes of materials accepted and recycled/disposed.

Chapter 6: Conversion

Chapter 6 discusses landfill gas collected from the closed MSW landfill and portions of the active landfill areas and alternative uses for the landfill gas and the possibility of implementing a solid refuse fuel project. The following recommendations are made for landfill gas conversion and solid refuse fuel:

- Recreate the LFG generation and collection models, as necessary.
- Conduct a more detailed financial evaluation for LFGTE to determine best option.
- Continue the solid refuse fuel dialogue with POET.

These recommendations require staff time and potentially outside consultant experience to comply with LFG testing, recordkeeping and reporting requirements.

Table 7-1 provides the 2019 Solid Waste Management Master Plan Implementation Schedule for a five year planning period.

Table 7-1: City of Sioux Falls Solid Waste Management Master Plan Implementation Schedule

Recommendations	2020	2021	2022	2023	2024
Waste Generation / Public Outreach					
Recycling Education Program					
Adopt core values for recycling education and outreach	Ongoing				
Develop and maintain a consistent brand identity for outreach materials	Ongoing				

Table 7-1: City of Sioux Falls Solid Waste Management Master Plan Implementation Schedule

Recommendations	2020	2021	2022	2023	2024
Develop visual communications across different types of outreach	Ongoing				
Diversify information delivery of outreach materials	Ongoing				
Ensure frequent engagement	Ongoing				
Develop dedicated tools for outreach, including dedicated website, if possible	Ongoing				
Improve access and ease-of-use of website information	Ongoing				
Take advantage of earned media/social media	Ongoing				
Recycling Enhancements					
Develop and maintain guidelines for recycling and diversion requirements, by business type through City Ordinance	Ongoing				
Visit with businesses to determine opportunities for recycling and provide recycling educational materials	Ongoing				
Food Waste Rescue					
Form a Food Rescue Committee with regular meetings to evaluate the feasibility of specific food rescue approaches to implement as feasible	X	X	X	X	X
Support the Feeding South Dakota Food Bank operations for food donations	X	X	X	X	X
Difficult to Recycle Items					
Identify programs targeting difficult to recycle items	Ongoing				
Monitor success of the programs identified	Ongoing				
Identify third-party partners to recycle additional materials at a landfill	Ongoing				
Implement recycling and diversion programs at the Landfill with third-party partners as appropriate	Ongoing				
Increase Waste Diversion					
Support a State ban or tax on plastic bags	X	X	X	X	X
Reduce consumer use of common single-use items, for example, promote re-usable shopping bags and produce bags.	X	X	-	-	-
Collection and Transfer					
Collection and Transfer					
Evaluate the need for a transfer station based on population growth, tonnages and the collection system	-	-	-	-	X
Initiate community outreach to obtain feedback regarding current collection systems and potential next steps	X	X	-	-	-
Expand benchmarking and rate comparison	X	-	-	-	-
Work cooperatively with the haulers to review the current hauler licensing system while considering grandfathering of current haulers and limiting future city hauler licenses issued.	X	X	X	-	-

Table 7-1: City of Sioux Falls Solid Waste Management Master Plan Implementation Schedule

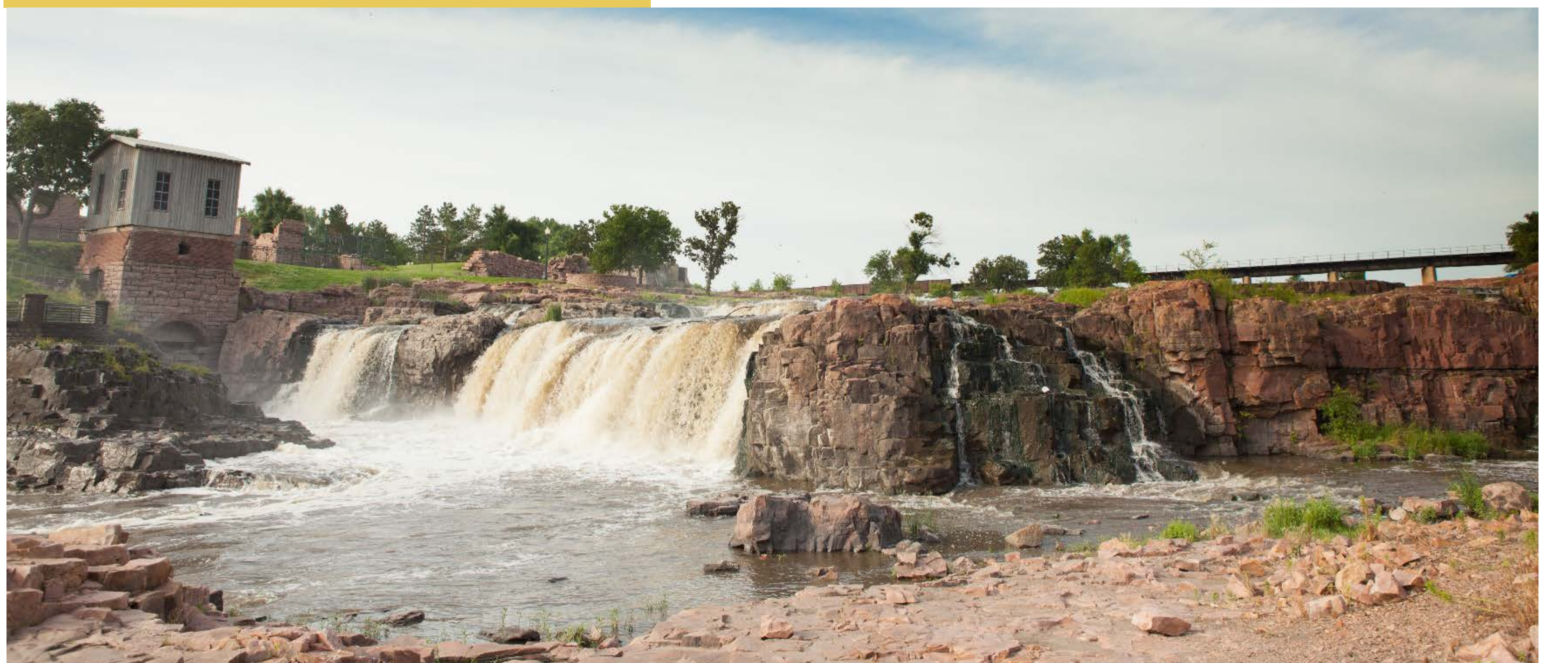
Recommendations	2020	2021	2022	2023	2024
Processing and Disposal Facilities					
Landfill Operations					
Improve Public Drop-Off Area Functionality	X	-	-	-	-
Design Enhancements					
Review recommended design enhancements to determine which should be implemented	X	-	-	-	-
Develop the necessary permit modifications	-	X	-	-	-
Immediate Operational and Safety Steps					
Develop an Operational Fill Plan	X	-	-	-	-
Develop a Soil Borrow Plan	X	-	-	-	-
Leachate Forcemain Development	-	X	-	-	-
Evaluate public drop-off area conceptual plans, budgeting, and schedule	-	-	X	X	-
Recycling					
Continue to educate citizens	Ongoing				
Continue the white goods program	Ongoing				
Yard Waste/Organics					
Continue yard waste and wood recycling programs	Ongoing				
Coordinate with the Great Plains Zoo to discuss diversion and recycling options for zoo waste and implement programs as recommended.	X	X	-	-	-
Research industrial waste composting	Ongoing				
Construction and Demolition Debris					
Coordinate with Habitat for Humanity	Ongoing				
Coordinate with State of South Dakota Department of Environment and Natural Resources for programs related to recycling of carpet waste	Ongoing				
Pilot Study for additional C&D recovery	-	-	-	X	-
Promote the proper reuse, recycling and disposal of C&D Debris	Ongoing				
Hazardous Waste Facility					
Update the Operations Plan	Ongoing				
Develop and Implement Standard Operating Procedures	Ongoing				
Evaluate the purchase and installation of a computer tracking system	X	-	-	-	-
Evaluate the purchase and installation of can crushers	X	-	-	-	-
Evaluate the purchase and operation of a Red Dragon Propane flare system	-	X	-	-	-
Evaluate the need for expansion or additional drop-off sites	-	-	X	-	-

Table 7-1: City of Sioux Falls Solid Waste Management Master Plan Implementation Schedule

Recommendations	2020	2021	2022	2023	2024
Continue the current programs for diversion of tires, household hazardous waste, appliances and electronics from the landfill			Ongoing		
Consider expanding the existing HHW Facility to accommodate more waste types, conditionally exempt small quantity generator waste and extended hours of operation as increases in waste volumes warrant			Ongoing		
Conversion					
Landfill Gas to Energy					
Update LFG Generation and Collection Estimates	X	X	X	X	X
New Source Performance Standards/Emission Guidelines Tier 2 Testing for NMOC Emission Rate	-	-	X	-	-
Detailed Landfill Gas to Energy Feasibility Study Update	-	-	-	X	-
Increased GCCS operational and recordkeeping requirement	-	-	-	X	-
GCCS Monitoring, Recordkeeping and Reporting			Ongoing		
LFGTE Monitoring, Recordkeeping and Reporting			Ongoing		
Solid Refuse Fuel					
Continue the solid refuse fuel dialogue with Poet			Ongoing		

Note: X indicates Implementation Year for recommendations.

City of Sioux Falls
SOUTH DAKOTA



City of Sioux Falls Solid Waste Management Master Plan

APPENDICES

HDR

November 2017

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City of Sioux Falls
SOUTH DAKOTA

City of Sioux Falls
Solid Waste Management
Master Plan

Appendix A: Task 1 –
Waste Characterization Study

HDR

May 2016

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City of Sioux Falls, South Dakota

Waste Characterization Study

May, 2016

HDR

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ES Executive Summary

The City of Sioux Falls, SD (City) recently retained HDR Engineering, Inc. (HDR) to assist the City in developing a long range Solid Waste Management Master Plan. The first task in the scope of work for the Solid Waste Management Master Plan was to perform a waste characterization study of the municipal solid waste (MSW) stream received at the Sioux Falls Regional Sanitary Landfill (SFRSL) located at 26750 464th Avenue in Hartford, SD. The SFRSL is operated and managed by the City of Sioux Falls Public Works Landfill Division. The study also included visual characterization of a limited number of construction and demolition (C&D) debris loads received at the landfill during the study period.

The primary objective of the waste characterization study was to provide the City with accurate, annualized composition data for the MSW delivered to the SFRSL.

The results of the characterization study will allow the City to:

- Identify the types and quantities of potentially recyclable and compostable materials in the disposed waste stream;
- Gather data on the region's solid waste stream that can be used to help evaluate and potentially improve existing and future solid waste programs; and
- Compare 2006 waste characterization results to the 2016 study results in order to identify changes in the composition of disposed waste over the last 10 years.

To achieve the objectives described above, the following tasks were undertaken as part of the study methodology:

1. Identified the "universe" of waste included in the study;
2. Determined material categories and definitions;
3. Completed pre-sort site visit and assessment;
4. Developed detailed sampling and sorting plan;
5. Conducted sampling and sorting event;
6. Compiled, reviewed, and analyzed collected data;
7. Completed statistical modeling; and
8. Developed a waste characterization for the SFRSL.

The primary task of conducting the sampling and sorting event at the landfill was completed from May 9 through May 14, 2016.

A total of 50 samples representing nearly 13,000 pounds of MSW were sorted for the study. In addition, 10 C&D debris visual assessments were conducted, representing more than 12 tons of C&D waste. The MSW was physically sorted into 49 material categories (see Appendix A for categories and detailed definitions). The weights of the various materials in each sample were compiled by generator type (i.e. residential, industrial/commercial/institutional (ICI), and mixed load). The results were then aggregated to arrive at the overall MSW characterization for the SFRSL.

MSW Composition

Table ES-1 presents the overall MSW composition results in a tabular format along with the standard deviation and confidence intervals for each material category. The confidence intervals indicate that, with a 90 percent level of confidence, the actual arithmetic mean (the arithmetic mean obtained if an infinite number samples were sorted) is within the upper and lower limits shown. This provides an understanding of how much variation occurred in the quantity of each material type found in the samples sorted.

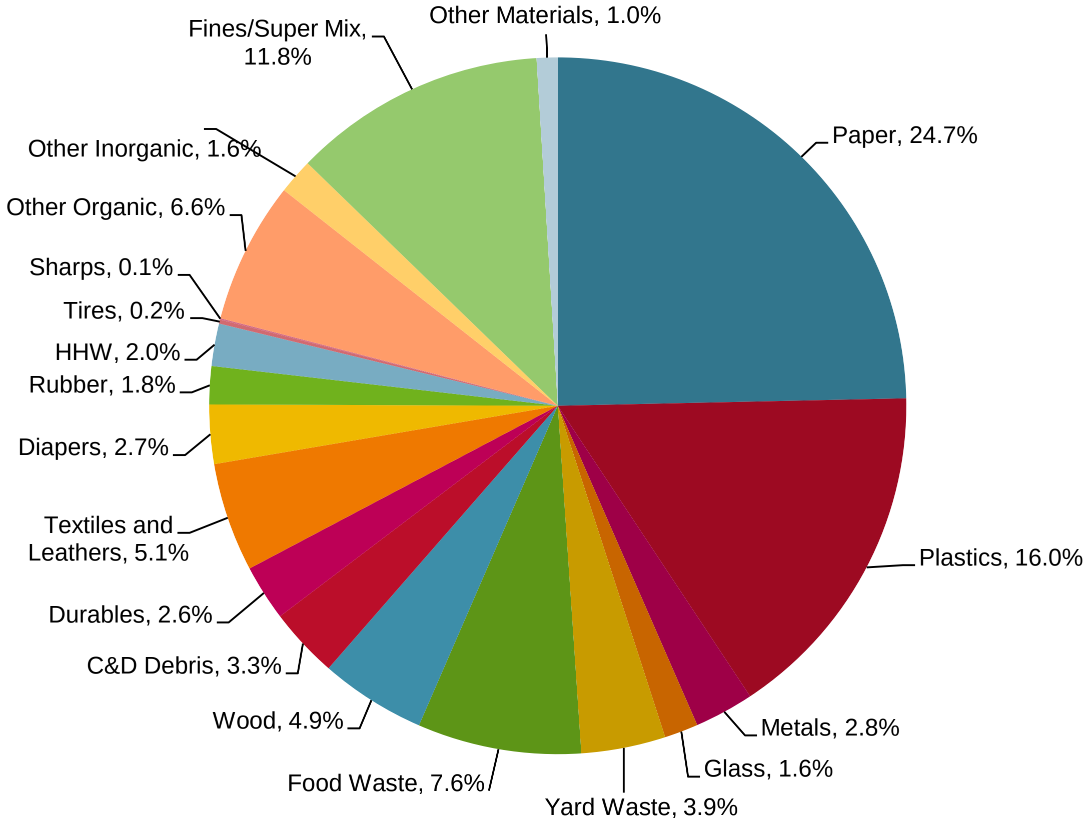
Table ES-0.1 Sioux Falls Regional Sanitary Landfill, Municipal Solid Waste Composition (% by weight)

				Confidence Interval	
Material Group	**Material**	**Mean**	**Standard Deviation**	**Lower Bound**	**Upper Bound**
Paper	Newsprint	0.5%	0.8%	0.3%	0.7%
Paper	Magazines	1.1%	1.7%	0.7%	1.5%
Paper	High Grade Office Paper	1.1%	2.0%	0.7%	1.6%
Paper	OCC and Kraft Bags	6.6%	8.9%	4.5%	8.8%
Paper	Mixed Recyclable Paper	4.8%	4.6%	3.7%	5.9%
Paper	Non-Recyclable Paper	2.8%	3.6%	2.0%	3.7%
Paper	Compostable Paper	7.7%	4.5%	6.6%	8.7%
Total Paper		**24.7%**	**26.1%**	**18.5%**	**30.9%**
Plastics	#1 PET Containers	2.4%	2.1%	1.9%	2.8%
Plastics	#2 HDPE Containers	0.7%	0.9%	0.5%	0.9%
Plastics	Other Plastic Containers	1.8%	1.7%	1.4%	2.2%
Plastics	Other Plastic Products	3.8%	3.9%	2.9%	4.8%
Plastics	Film/Wrap/Bags	7.3%	4.6%	6.2%	8.4%
Total Plastics		**16.0%**	**13.1%**	**12.9%**	**19.1%**
Metals	Aluminum Beverage Containers	0.9%	0.7%	0.7%	1.0%
Metals	Ferrous Containers	0.8%	1.0%	0.6%	1.0%
Metals	Other Ferrous Metals	0.9%	1.6%	0.5%	1.2%
Metals	Other Non-Ferrous Metals	0.2%	0.3%	0.2%	0.3%
Total Metals		**2.8%**	**3.6%**	**1.9%**	**3.6%**
Glass	Clear Glass	0.8%	1.2%	0.5%	1.1%
Glass	Green Glass	0.2%	0.6%	0.0%	0.3%
Glass	Blue Glass	0.0%	0.2%	0.0%	0.1%
Glass	Brown Glass	0.3%	0.9%	0.1%	0.5%
Glass	Other Mixed Cullet	0.2%	0.9%	0.0%	0.4%
Total Glass		**1.6%**	**3.8%**	**0.7%**	**2.5%**
Yard Waste	Grass and Leaves	3.4%	7.3%	1.7%	5.2%
Yard Waste	Brush and Trees	0.5%	1.1%	0.2%	0.8%
Total Yard Waste		**3.9%**	**8.5%**	**1.9%**	**5.9%**
Food Waste	Food Waste	7.6%	8.1%	5.7%	9.5%
Total Food Waste		**7.6%**	**8.1%**	**5.7%**	**9.5%**
Wood	Non-Treated Wood	3.8%	12.7%	0.8%	6.8%
Wood	Treated Wood	1.1%	2.7%	0.4%	1.7%
Total Wood		**4.9%**	**15.4%**	**1.3%**	**8.5%**

Construction & Demolition Debris	C&D Debris	3.3%	6.5%	1.7%	4.8%
Total Construction & Demolition Debris		**3.3%**	**6.5%**	**1.7%**	**4.8%**
Durables	Electrical and Household Appliances	2.0%	4.0%	1.0%	2.9%
Durables	Central Processing Units/Peripherals	0.0%	0.2%	0.0%	0.1%
Durables	Computer Monitors/TVs	0.1%	1.2%	0.0%	0.4%
Durables	Cell Phones and Chargers	0.0%	0.0%	0.0%	0.0%
Durables	Other Durables	0.4%	2.6%	0.0%	1.0%
Total Durables		**2.6%**	**8.0%**	**1.0%**	**4.5%**
Textiles and Leathers	Textiles and Leathers	5.1%	6.0%	3.6%	6.5%
Total Textiles and Leathers		**5.1%**	**6.0%**	**3.6%**	**6.5%**
Diapers	Diapers	2.7%	3.9%	1.8%	3.7%
Total Diapers		**2.7%**	**3.9%**	**1.8%**	**3.7%**
Rubber	Rubber	1.8%	2.6%	1.1%	2.4%
Total Rubber		**1.8%**	**2.6%**	**1.1%**	**2.4%**
HHW	Automotive Products	0.5%	1.8%	0.1%	1.0%
HHW	Paints and Solvents	1.1%	3.0%	0.4%	1.8%
HHW	Pesticides, Herbicides, Fungicides	0.0%	0.1%	0.0%	0.1%
HHW	Household Cleaners	0.0%	0.1%	0.0%	0.1%
HHW	Lead Acid Batteries	0.0%	0.0%	0.0%	0.0%
HHW	Other Batteries	0.0%	0.1%	0.0%	0.1%
HHW	Mercury Containing Products	0.0%	0.0%	0.0%	0.0%
HHW	Other HHW	0.2%	0.3%	0.1%	0.2%
Total Household Hazardous Waste		**2.0%**	**5.4%**	**0.7%**	**3.3%**
Tires	Tires	0.2%	1.1%	0.0%	0.5%
Total Tires		**0.2%**	**1.1%**	**0.0%**	**0.5%**
Sharps	Sharps	0.1%	0.4%	0.0%	0.2%
Total Sharps		**0.1%**	**0.4%**	**0.0%**	**0.2%**
Other Organic	Other Organic	6.6%	11.3%	3.9%	9.3%
Total Other Organic		**6.6%**	**11.3%**	**3.9%**	**9.3%**
Other Inorganic	Other Inorganic	1.6%	3.9%	0.7%	2.6%
Total Other Inorganic		**1.6%**	**3.9%**	**0.7%**	**2.6%**
Fines/Super Mix	Fines/Super Mix	11.8%	7.0%	10.1%	13.4%
Total Fines/Super Mix		**11.8%**	**7.0%**	**10.1%**	**13.4%**
Other Materials	Other	1.0%	5.4%	0.0%	2.2%
Total Other Materials		**1.0%**	**5.4%**	**0.0%**	**2.2%**
GRAND TOTAL		**100.0%**			

Figure ES-1 depicts the annualized MSW composition results for the SFRSL.

Figure ES-0.1 Sioux Falls Regional Sanitary Landfill, Municipal Solid Waste Composition (% by weight)



Solid Waste Composition

The following results present the overall solid waste composition of all materials landfilled at the SFRSL on an annual basis. These results include not only MSW, but also materials such as dedicated C&D debris loads and special wastes (e.g. source separated yard waste and wood waste, contaminated soil, appliances, scrap metal, electronics, recyclables, dead animals, and other materials requiring special handling) which were not included in the sampling related to this study. To develop these annualized solid waste composition results, the HDR Project Team obtained tonnage information for all material streams accepted at the SFRSL during calendar year 2015. The MSW characterization results were multiplied by the total tons of MSW received at the SFRSL in 2015 and then weighted based on the overall solid waste tons received at the landfill during 2015, in order to arrive at the mean percentage and annual tons by material type. C&D and special waste categories were added to the material group list and their percentage of the overall solid waste stream received at the SFRSL were calculated based on the 2015 tonnage data.

Table ES-2 presents the landfill's overall solid waste characterization.

Table ES-0.2 Sioux Falls Regional Sanitary Landfill, Overall Solid Waste Composition (% by weight)

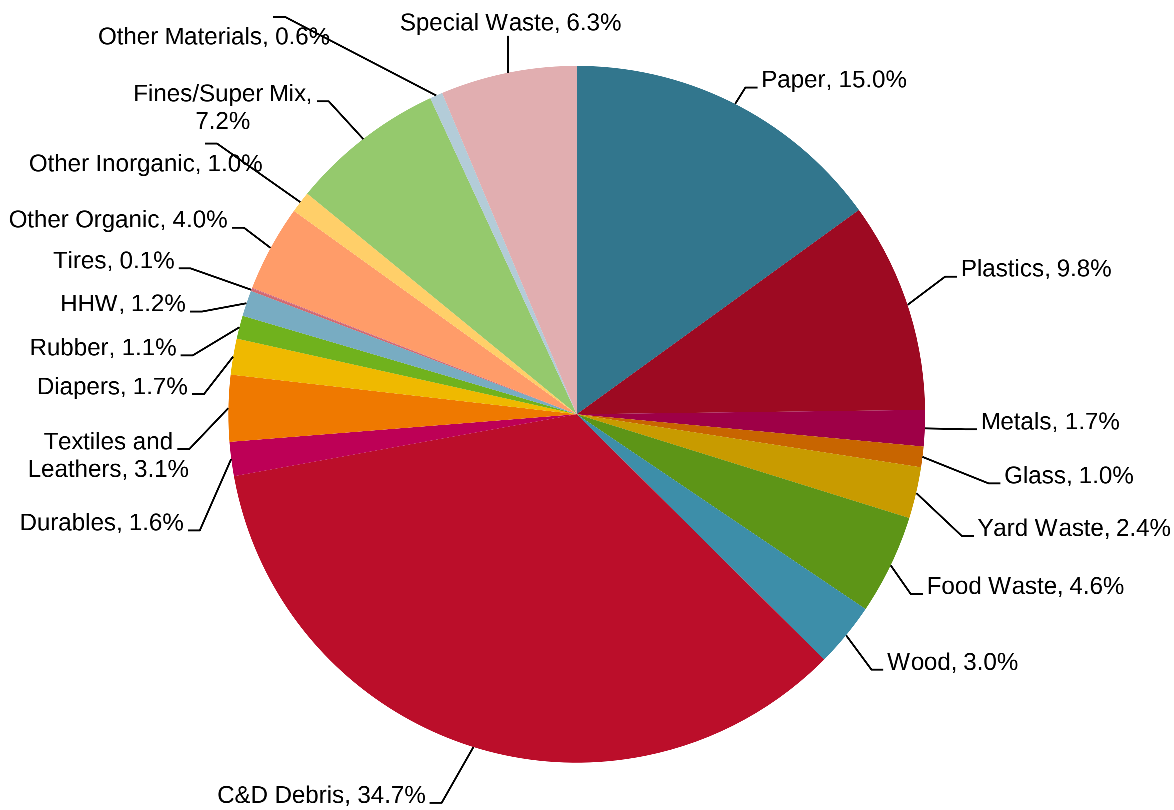
Material Group	Material	Mean	Tons (2015)
Paper	Newsprint	0.30%	785
Paper	Magazines	0.69%	1,812
Paper	High Grade Office Paper	0.69%	1,821
Paper	OCC and Kraft Bags	4.05%	10,714
Paper	Mixed Recyclable Paper	2.91%	7,695
Paper	Non-Recyclable Paper	1.72%	4,555
Paper	Compostable Paper	4.67%	12,348
Total Paper		**15.03%**	**39,728**
Plastics	#1 PET Containers	1.43%	3,792
Plastics	#2 HDPE Containers	0.45%	1,180
Plastics	Other Plastic Containers	1.07%	2,836
Plastics	Other Plastic Products	2.35%	6,200
Plastics	Film/Wrap/Bags	4.47%	11,826
Total Plastics		**9.77%**	**25,834**
Metals	Aluminum Beverage Containers	0.52%	1,386
Metals	Ferrous Containers	0.48%	1,277
Metals	Other Ferrous Metals	0.52%	1,374
Metals	Other Non-Ferrous Metals	0.15%	397
Total Metals		**1.68%**	**4,434**
Glass	Clear Glass	0.50%	1,311
Glass	Green Glass	0.11%	286
Glass	Blue Glass	0.02%	62
Glass	Brown Glass	0.19%	501
Glass	Other Mixed Cullet	0.14%	365
Total Glass		**0.96%**	**2,525**
Yard Waste	Grass and Leaves	2.09%	5,528
Yard Waste	Brush and Trees	0.29%	773
Total Yard Waste		**2.38%**	**6,301**
Food Waste	Food Waste	4.63%	12,237
Total Food Waste		**4.63%**	**12,237**
Wood	Non-Treated Wood	2.34%	6,181
Wood	Treated Wood	0.65%	1,718
Total Wood		**2.99%**	**7,899**
Durables	Electrical and Household Appliances	1.21%	3,210
Durables	Central Processing Units/Peripherals	0.02%	59
Durables	Computer Monitors/TVs	0.08%	219
Durables	Cell Phones and Chargers	0.00%	13
Durables	Other Durables	0.26%	677
Total Durables		**1.58%**	**4,177**
Textiles and Leathers	Textiles and Leathers	3.08%	8,143
Total Textiles and Leathers		**3.08%**	**8,143**
Diapers	Diapers	1.67%	4,415
Total Diapers		**1.67%**	**4,415**
Rubber	Rubber	1.08%	2,843
Total Rubber		**1.08%**	**2,843**
HHW	Automotive Products	0.33%	884
HHW	Paints and Solvents	0.69%	1,836
HHW	Pesticides, Herbicides, Fungicides	0.02%	62
HHW	Household Cleaners	0.02%	63
HHW	Lead Acid Batteries	0.00%	0
HHW	Other Batteries	0.02%	49
HHW	Mercury Containing Products	0.00%	4

Material Group	Material	Mean	Tons (2015)
HHW	Other HHW	0.10%	274
Total Household Hazardous Waste		**1.20%**	**3,171**
Tires	Tires	0.11%	303
Total Tires		**0.11%**	**303**
Sharps	Sharps	0.04%	101
Total Sharps		**0.04%**	**101**
Other Organic	Other Organic	4.01%	10,594
Total Other Organic		**4.01%**	**10,594**
Other Inorganic	Other Inorganic	1.00%	2,638
Total Other Inorganic		**1.00%**	**2,638**
Fines/Super Mix	Fines/Super Mix	7.17%	18,962
Total Fines/Super Mix		**7.17%**	**18,962**
Other Materials	Other	0.59%	1,569
Total Other Materials		**0.59%**	**1,569**
C&D Waste		34.72%	91,796
Total C&D Waste		**34.72%**	**91,796**
Special Waste [1]		6.32%	16,696
Total Special Waste [1]		**6.32%**	**16,696**
GRAND TOTAL		**100.00%**	**264,369**

[1] "Special Waste" includes source separated yard waste, wood waste, tires, contaminated soil, appliances, scrap metal, electronics, recyclables, and dead animals.

Figure ES-2 depicts the annualized overall solid waste composition results for the SFRSL.

Figure ES-0.2 Sioux Falls Regional Sanitary Landfill, Overall Solid Waste Composition (% by weight)



The following sections provide additional detail regarding every aspect of the waste characterization study, including methodology, data collection, analysis, and results.

1 Introduction

The City of Sioux Falls, SD (City) recently retained HDR Engineering, Inc. (HDR) to assist the City in developing a long range Solid Waste Management Master Plan. The first task in the scope of work for the Solid Waste Management Master Plan was to perform a waste characterization study of the municipal solid waste (MSW) stream and construction and demolition (C&D) debris waste stream received at the Sioux Falls Regional Sanitary Landfill (SFRSL) located at 26750 464th Avenue in Hartford, SD. The SFRSL is operated and managed by the City of Sioux Falls Public Works Landfill Division.

The objective of the waste characterization study was to provide the City with accurate, annualized composition data for the waste delivered to the SFRSL. Data was collected specific to the following generator types:

- Residential (including single-family and multi-family);
- Industrial/commercial/institutional (ICI);
- Mixed-loads (combination of residential and commercial waste); and
- Construction and demolition (C&D) debris.

The results of the characterization study will allow the City to:

- Identify the types and quantities of potentially recyclable and compostable materials in the disposed waste stream;
- Gather data on the region’s solid waste stream that can be used to help evaluate and potentially improve existing and future solid waste programs; and
- Compare 2006 waste characterization results to the 2016 study results in order to identify changes in the composition of disposed waste over the last 10 years.

2 Study Methodology

This section provides a detailed description of the study methodology developed and executed by the HDR Project Team, with input from City staff. It included the following key steps:

1. Identified the “universe” of waste included in the study;
2. Determined material categories and definitions;
3. Completed pre-sort site visit and assessment;
4. Developed detailed sampling and sorting plan;
5. Conducted sampling and sorting event;
6. Compiled, reviewed, and analyzed collected data; and
7. Completed statistical modeling.

Each of these seven steps was critical to developing a representative characterization of the materials received at the SFRSL.

2.1 Identify the "Universe" of Waste Included in the Study

The first step in planning the characterization study was to identify and define the material stream to be studied, or the "universe" of materials. For purposes of this study, the "universe" included all loads of MSW and C&D debris delivered to the SFRSL. Since the City has an open market for residential and commercial waste collection, this included waste delivered to the landfill by 34 licensed, private haulers serving a combination of residential and commercial customers throughout the City and the surrounding five county region.

Based on a review of historical tonnage data and discussions with City staff, it was determined that material brought to the landfill by residential or commercial self-haul customers would not be included in the sampling efforts related to this study. While the SFRSL does receive a substantial number of self-haul customers on a daily basis, the overall quantity of material delivered to the facility by these customers is relatively limited.

2.2 Determine Material Categories and Definitions

The material categories selected for this study were based on discussions with City staff and designed to be congruent with the material categories and definitions utilized in the City's 2006 waste characterization study. This allows for direct comparison of the 2006 study results to the 2016 study results.

A total of 49 material categories were selected for the MSW portion of this study. The specific categories and definitions associated with each material category can be found Section 4 of the Sampling and Sorting Plan included in Appendix A. As noted in the 2006 waste characterization study report, the rationale for some of the material categories included the following:

- The paper category was divided into various sub-categories of recyclable paper to better illustrate potential recycling opportunities.
- Mixed paper was categorized into the three sub-categories (recyclable, non-recyclable, and compostable) to measure opportunities for both mixed paper recycling and composting.
- Multiple sub-categories for household hazardous waste (HHW) were included to estimate the mix of different types of HHW present in the waste stream.
- Treated wood and non-treated wood were separated to allow for identification of the traditionally recoverable segment of wood waste in the MSW stream.
- C&D materials were categorized separately from other categories such as wood, metals, and old corrugated containers (OCC) because these materials are generally collected and transported separately.
- Separate categories for computer components and cell phones were included because these items are typically perceived as growing components of the waste stream.

2.3 Complete Pre-Sort Site Visit and Assessment

The next step was to conduct a site visit and assessment at the SFRSL. The purpose of the site assessment was to:

- Promote support and cooperation for the sampling and sorting event among landfill staff;

- Gather landfill disposal and transaction data and site information needed to develop a detailed Sampling and Sorting Plan;
- Discuss logistics of sampling and sorting activities including deliveries, sampling and sorting locations, equipment, and staffing needs; and
- Confirm assumptions related to the general study approach and anticipated key elements of the Sampling and Sorting Plan.

During the site visit and assessment, HDR staff reviewed and discussed facility transaction data for calendar year 2015 with City staff in order to identify: 1) annual and average weekly quantities of various material streams received at the landfill; 2) types of hauling vehicles utilizing the landfill; 3) average collection vehicle traffic at the facility by day of the week; and 4) a general overview of the scope of activity at the facility.

2.4 Develop Detailed Sampling and Sorting Plan

Based on prior discussions with City staff, information gathered during the pre-sort site visit, and industry-accepted standards for waste characterization studies and statistical sampling, the HDR Project Team prepared a detailed Sampling and Sorting Plan for the study. The sampling methodology followed industry-accepted standards, as outlined in the ASTM Standard Test Method for Determination of the Composition of Unprocessed Municipal Solid Waste (D5231-92; reapproved 2008). The final Sampling and Sorting Plan is included in this report as Appendix A.

2.4.1 Number of Samples

Conducting a successful waste characterization study requires obtaining a statistically sufficient number of samples. Based on ASTM International Standards, 50 samples were needed to determine the annualized percentage of MSW by material type in the loads arriving at the facility with a 90 percent level of confidence and desired measurement precision of 10 percent. This level of confidence is considered the industry standard for waste characterization studies.

In addition to the 50 samples of MSW selected and sorted during the study, HDR also determined that it would randomly select 10 loads of C&D debris throughout the sampling period, for a separate visual C&D debris characterization. This is discussed in more detail in Section 3.4.

2.4.2 Duration

Given that the SFRSL operates Monday through Saturday from 7:30 am to 5:00 pm daily, sampling was conducted over the course of one week with six total days of sampling. This methodology allowed HDR to ensure that samples were selected from a wide variety of areas and haulers from across the City and surrounding areas utilizing the SFRSL for disposal.

2.4.3 Seasonality

Based on discussions with City staff, seasonal differences in the solid waste and MSW stream accepted at the SFRSL were determined not to be substantial. Historically, the most seasonally-variable material in the MSW stream is yard waste. However, the landfill disposal ban of this material minimized much of its seasonal variability. As a result, all of the field data for this study was collected in May 2016.

2.4.4 Generator Types

Data was collected for the residential sector (which includes both single-family and multi-family residences) and for the industrial/commercial/institutional (ICI) sector. Only limited data is available on the proportion of residential versus ICI materials received at the SFRSL, since many of the private haulers collect both residential and ICI accounts in the same truckloads. Loads containing both residential and ICI waste were documented as “mixed load” generator type.

To gather data by residential, ICI, and mixed load generator type, the HDR Project Team relied on the sampling randomization inherent in the Nth truck approach. The Nth truck approach is based on the number of vehicles expected each day and the number of samples required for the study to yield statistically sound results. Due to limited data regarding the breakdown of residential versus ICI in incoming waste, HDR selected for sampling every Nth truck entering the facility. Based on an interview with the selected vehicle’s driver, the contents of the truck were assigned to the residential, ICI, or mixed load sector. The random selection of the vehicle loads dictated the ultimate mix of generator type samples actually sorted.

Because the primary focus of this study was on the MSW stream, the sampling protocol excluded loads that could be clearly identified as composed of non-MSW, such as C&D debris, special wastes (e.g. contaminated soil, appliances, scrap metal, electronics, or dead animals), yard waste, or other industrial processed wastes. The HDR Project Team observed some mixed loads containing non-MSW, but no loads sampled were composed exclusively of non-MSW, such as C&D. Vehicles hauling exclusively C&D were excluded from the vehicle count and sampling approach for MSW. Random C&D loads were visually assessed and characterized as a separate task. An overview and results of the C&D assessment are discussed in Section 3.4 of this report.

2.4.5 Health and Safety

HDR prepared a site specific health and safety plan that was followed by all HDR staff and contracted sorting staff throughout the sampling and sorting event. HDR worked closely with the City to ensure worker safety within the designated sorting area, at the landfill’s working face, and at the facility’s scale house. All HDR staff and contracted sorting staff were given thorough safety instructions and provided with personal protective equipment (PPE) by the HDR field supervisor to ensure safety and proper sorting. A complete description of all health and safety considerations and protocol for this study are included in Appendix A. No significant injuries or emergencies occurred during the sorting event.

2.5 Conduct Sampling and Sorting Event

The sampling and sorting event was conducted at the SFRSL beginning on Monday, May 9, 2016 and concluded on Saturday, May 14, 2016. Over the course of those six days, a total of 50 samples representing 12,959 pounds of MSW were sorted. The selection of vehicles to secure waste materials for sampling was based on the facility transaction data provided by the City and the Nth truck approach with driver interviews to determine generator types - residential, ICI, or mixed load. Whenever a load arriving at the facility was selected for sampling, the driver was directed to a specified area of the landfill’s working face to tip. A representative sample of 200-300 pounds was pulled from a pre-determined section of the load as directed by the HDR field supervisor and placed on a tarp to await sorting. Figure 2-1 depicts a typical load selected for sampling.

Figure 2.1 Load Selected for Sampling

Table 2-1 below depicts the sampling mix resulting from using the Nth truck approach to randomly select loads for sampling.

Table 2.1 Number of Samples by Generator Type and Total Weight

	Residential	ICI	Mixed Load	**Total**
Number	15	21	14	**50**
Weight (lbs.)	3,480	6,123	3,356	**12,959**

Samples were then sorted into the previously defined 49 material categories. Figure 2-2 depicts the sorting activities, which were closely monitored by the HDR crew chiefs. After the entire sample was sorted, the HDR crew chief weighed and recorded the weights of each container on a designated field data sheet. The field supervisor noted any special conditions such as weather that could impact material weights, and the crew chiefs made note of any unusual items or large quantities of certain materials in the samples.

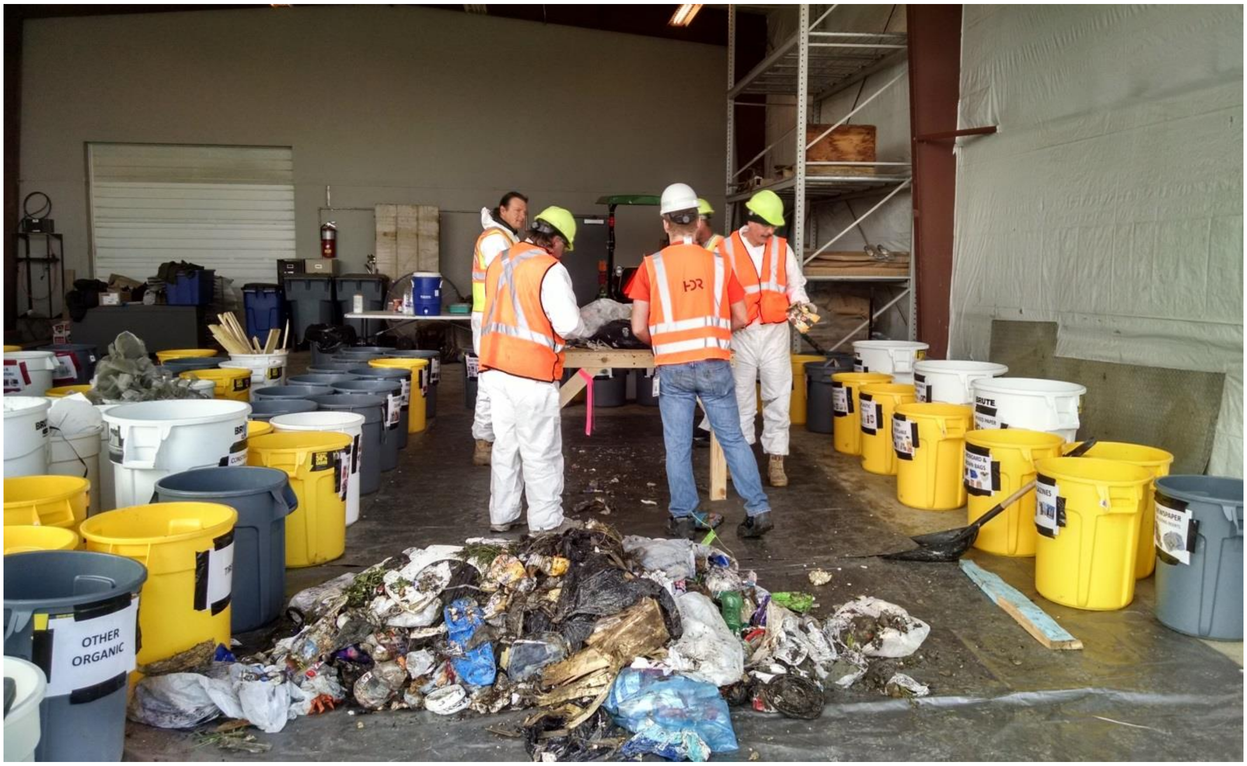


Figure 2.2 Sorting Activities

2.6 Compile, Review, and Analyze Collected Data

Upon completion of each day of the sampling and sorting event, the data sheets for each sample were reviewed to ensure the following:

- Individual entries were legible;
- Generator types were clearly identified and consistent with the types of materials recorded on the data form;
- Specific comments were recorded regarding any unusual aspects of the sample; and
- A minimum of 200 pounds, as recorded on each sample sheet, was sorted for each sample.

All sample data was then entered into a specially developed Microsoft Excel workbook for analysis. Tare weights of empty containers, recorded prior to sorting, were subtracted from the total weights of the containers to obtain the net weight for each material category and sample. Detailed information was included for each incoming load from which a sample was selected including the date, generator type, vehicle type, hauler, and vehicle identification number from which the sample was selected.

2.7 Complete Statistical Modeling

Following the sampling and sorting event, HDR calculated the weighted average (mean) for each material category in each sample. HDR then completed a statistical analysis to determine the annualized percent by weight for the overall MSW stream delivered to the SFRSL. HDR also calculated the mean, 90% confidence intervals, and standard deviation for individual material categories by generator type.

The mean represents the mathematical average or average percent of material composing the MSW stream by weight. The confidence interval is an expression of accuracy. It provides the upper and lower limits of the "actual" mean for all the MSW received at the SFRSL based upon the sorting and sampling observations of the sampled materials. For example, the 90% confidence interval represents that there is a 90% level of confidence that the true population mean falls within the upper and lower bounds of the confidence interval. The 90% confidence interval is the generally accepted industry standard for solid waste composition studies.

3 Study Results

This section presents the results of the waste characterization study. All results are expressed in percentage by weight. The percentages included in the tables and figures are the mean values for each material category. Where appropriate, the tables also provide the standard deviation and 90 percent confidence intervals for each material category. The confidence interval indicates that, with a 90 percent level of confidence, the actual arithmetic mean (the arithmetic mean obtained if an infinite number samples were sorted) is within the upper and lower limits shown. This provides an understanding of how much variation occurred in the quantity of that material category found in the samples sorted. Generally, the more homogeneous the waste stream and the greater the number of samples sorted, the higher the level of accuracy achieved and the narrower the margin between the upper and lower bounds of the confidence interval.

3.1 Overall MSW Composition

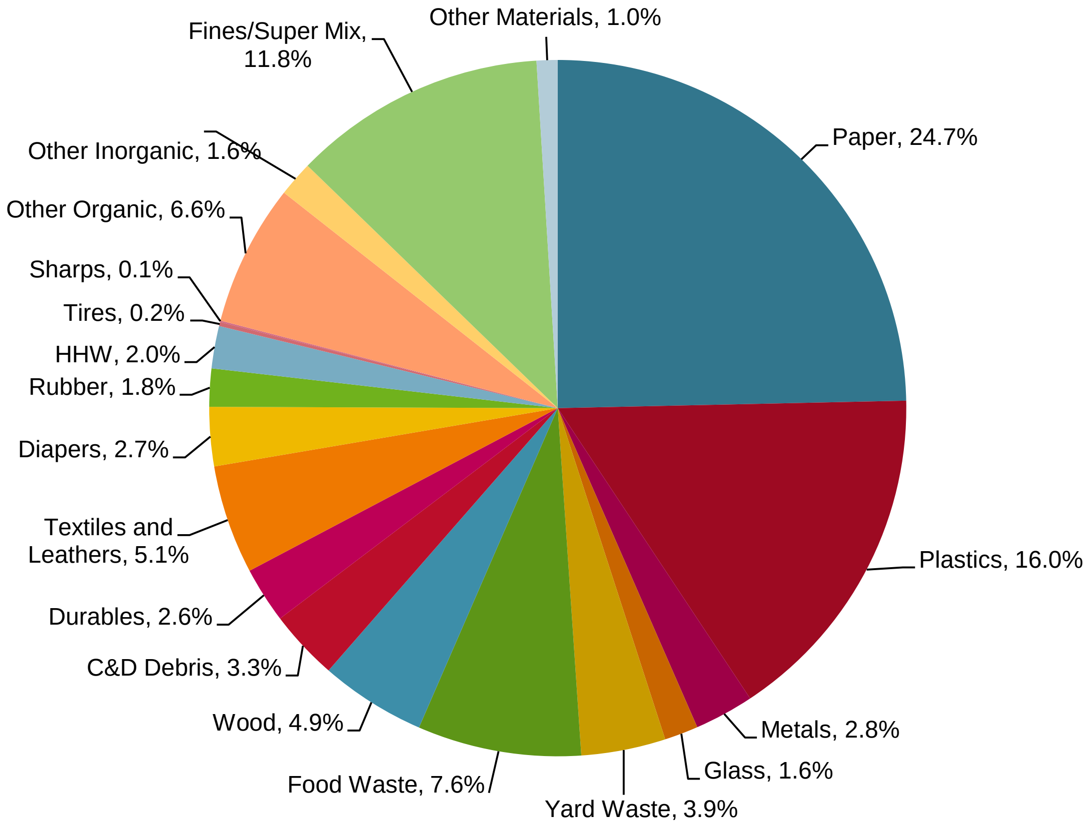
Table 3-1 presents the overall MSW composition results in a tabular format along with the standard deviation and confidence intervals for each material category. Figure 3-1 depicts the annualized MSW composition results for the SFRSL.

Table 3.1 Sioux Falls Regional Sanitary Landfill, Municipal Solid Waste Composition (% by weight)

Material Group	Material	Mean	Standard Deviation	Confidence Interval Lower Bound	Confidence Interval Upper Bound
Paper	Newsprint	0.5%	0.8%	0.3%	0.7%
Paper	Magazines	1.1%	1.7%	0.7%	1.5%
Paper	High Grade Office Paper	1.1%	2.0%	0.7%	1.6%
Paper	OCC and Kraft Bags	6.6%	8.9%	4.5%	8.8%
Paper	Mixed Recyclable Paper	4.8%	4.6%	3.7%	5.9%
Paper	Non-Recyclable Paper	2.8%	3.6%	2.0%	3.7%
Paper	Compostable Paper	7.7%	4.5%	6.6%	8.7%
Total Paper		**24.7%**	**26.1%**	**18.5%**	**30.9%**
Plastics	#1 PET Containers	2.4%	2.1%	1.9%	2.8%
Plastics	#2 HDPE Containers	0.7%	0.9%	0.5%	0.9%
Plastics	Other Plastic Containers	1.8%	1.7%	1.4%	2.2%
Plastics	Other Plastic Products	3.8%	3.9%	2.9%	4.8%
Plastics	Film/Wrap/Bags	7.3%	4.6%	6.2%	8.4%
Total Plastics		**16.0%**	**13.1%**	**12.9%**	**19.1%**
Metals	Aluminum Beverage Containers	0.9%	0.7%	0.7%	1.0%
Metals	Ferrous Containers	0.8%	1.0%	0.6%	1.0%
Metals	Other Ferrous Metals	0.9%	1.6%	0.5%	1.2%
Metals	Other Non-Ferrous Metals	0.2%	0.3%	0.2%	0.3%
Total Metals		**2.8%**	**3.6%**	**1.9%**	**3.6%**
Glass	Clear Glass	0.8%	1.2%	0.5%	1.1%
Glass	Green Glass	0.2%	0.6%	0.0%	0.3%
Glass	Blue Glass	0.0%	0.2%	0.0%	0.1%
Glass	Brown Glass	0.3%	0.9%	0.1%	0.5%
Glass	Other Mixed Cullet	0.2%	0.9%	0.0%	0.4%
Total Glass		**1.6%**	**3.8%**	**0.7%**	**2.5%**
Yard Waste	Grass and Leaves	3.4%	7.3%	1.7%	5.2%
Yard Waste	Brush and Trees	0.5%	1.1%	0.2%	0.8%
Total Yard Waste		**3.9%**	**8.5%**	**1.9%**	**5.9%**
Food Waste	Food Waste	7.6%	8.1%	5.7%	9.5%
Total Food Waste		**7.6%**	**8.1%**	**5.7%**	**9.5%**
Wood	Non-Treated Wood	3.8%	12.7%	0.8%	6.8%
Wood	Treated Wood	1.1%	2.7%	0.4%	1.7%
Total Wood		**4.9%**	**15.4%**	**1.3%**	**8.5%**
Construction & Demolition Debris	C&D Debris	3.3%	6.5%	1.7%	4.8%
Total Construction & Demolition Debris		**3.3%**	**6.5%**	**1.7%**	**4.8%**
Durables	Electrical and Household Appliances	2.0%	4.0%	1.0%	2.9%
Durables	Central Processing Units/Peripherals	0.0%	0.2%	0.0%	0.1%
Durables	Computer Monitors/TVs	0.1%	1.2%	0.0%	0.4%
Durables	Cell Phones and Chargers	0.0%	0.0%	0.0%	0.0%
Durables	Other Durables	0.4%	2.6%	0.0%	1.0%

Total Durables		**2.6%**	**8.0%**	**1.0%**	**4.5%**
Textiles and Leathers	Textiles and Leathers	5.1%	6.0%	3.6%	6.5%
Total Textiles and Leathers		**5.1%**	**6.0%**	**3.6%**	**6.5%**
Diapers	Diapers	2.7%	3.9%	1.8%	3.7%
Total Diapers		**2.7%**	**3.9%**	**1.8%**	**3.7%**
Rubber	Rubber	1.8%	2.6%	1.1%	2.4%
Total Rubber		**1.8%**	**2.6%**	**1.1%**	**2.4%**
HHW	Automotive Products	0.5%	1.8%	0.1%	1.0%
HHW	Paints and Solvents	1.1%	3.0%	0.4%	1.8%
HHW	Pesticides, Herbicides, Fungicides	0.0%	0.1%	0.0%	0.1%
HHW	Household Cleaners	0.0%	0.1%	0.0%	0.1%
HHW	Lead Acid Batteries	0.0%	0.0%	0.0%	0.0%
HHW	Other Batteries	0.0%	0.1%	0.0%	0.1%
HHW	Mercury Containing Products	0.0%	0.0%	0.0%	0.0%
HHW	Other HHW	0.2%	0.3%	0.1%	0.2%
Total Household Hazardous Waste		**2.0%**	**5.4%**	**0.7%**	**3.3%**
Tires	Tires	0.2%	1.1%	0.0%	0.5%
Total Tires		**0.2%**	**1.1%**	**0.0%**	**0.5%**
Sharps	Sharps	0.1%	0.4%	0.0%	0.2%
Total Sharps		**0.1%**	**0.4%**	**0.0%**	**0.2%**
Other Organic	Other Organic	6.6%	11.3%	3.9%	9.3%
Total Other Organic		**6.6%**	**11.3%**	**3.9%**	**9.3%**
Other Inorganic	Other Inorganic	1.6%	3.9%	0.7%	2.6%
Total Other Inorganic		**1.6%**	**3.9%**	**0.7%**	**2.6%**
Fines/Super Mix	Fines/Super Mix	11.8%	7.0%	10.1%	13.4%
Total Fines/Super Mix		**11.8%**	**7.0%**	**10.1%**	**13.4%**
Other Materials	Other	1.0%	5.4%	0.0%	2.2%
Total Other Materials		**1.0%**	**5.4%**	**0.0%**	**2.2%**
GRAND TOTAL		**100.0%**			

Figure 3.1 Sioux Falls Regional Sanitary Landfill, Municipal Solid Waste Composition (% by weight)



3.2 MSW Composition by Generator Type

The following sections present the MSW composition study results by generator type. The statistical results represent projections for the individual generator types. It is important to note that as the number of total samples decreases, confidence intervals tend to widen. This can be observed by comparing the overall MSW composition results to those for each generator type.

The primary objective of this characterization study was to characterize the landfill's overall MSW waste stream. The combined generator results for the landfill have reasonable confidence intervals. However, in some instances, caution is recommended when using the individual generator type results because of the higher level of variability.

3.2.1 Residential

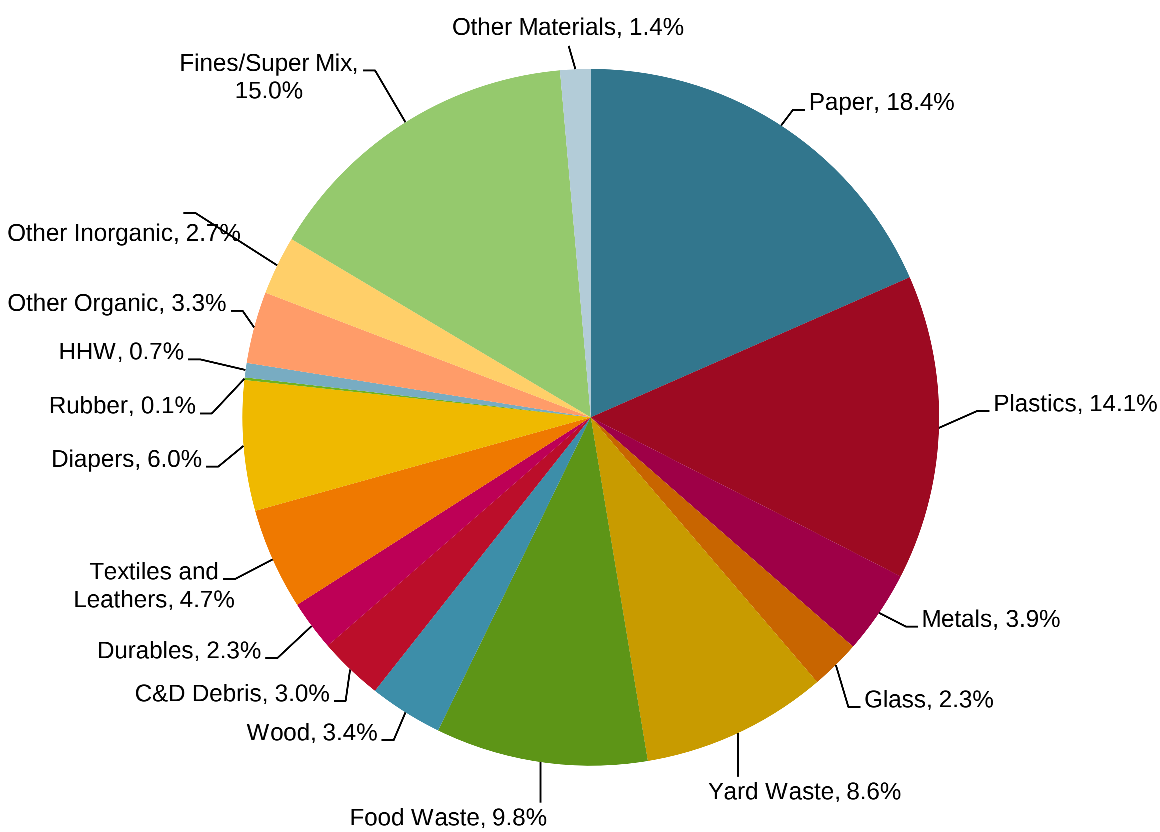
Table 3-2 presents the residential MSW composition results in a tabular format along with the standard deviation and confidence intervals for each material category. Figure 3-2 depicts the annualized residential MSW composition results for the SFRSL.

Table 3.2 Sioux Falls Regional Sanitary Landfill, Residential MSW Composition (% by weight)

Material Group	Material	Mean	Standard Deviation	Confidence Interval Lower Bound	Confidence Interval Upper Bound
Paper	Newsprint	0.7%	0.9%	0.3%	1.1%
Paper	Magazines	1.3%	1.2%	0.8%	1.8%
Paper	High Grade Office Paper	0.9%	0.8%	0.5%	1.3%
Paper	OCC and Kraft Bags	2.2%	2.3%	1.2%	3.2%
Paper	Mixed Recyclable Paper	4.1%	2.2%	3.1%	5.1%
Paper	Non-Recyclable Paper	1.9%	1.1%	1.5%	2.4%
Paper	Compostable Paper	7.3%	2.5%	6.2%	8.4%
Total Paper		**18.4%**	**10.9%**	**13.5%**	**23.4%**
Plastics	#1 PET Containers	2.7%	2.3%	1.6%	3.7%
Plastics	#2 HDPE Containers	0.7%	0.4%	0.5%	0.8%
Plastics	Other Plastic Containers	2.1%	1.2%	1.6%	2.7%
Plastics	Other Plastic Products	3.4%	1.8%	2.6%	4.2%
Plastics	Film/Wrap/Bags	5.3%	1.5%	4.6%	5.9%
Total Plastics		**14.1%**	**7.2%**	**10.9%**	**17.4%**
Metals	Aluminum Beverage Containers	1.0%	0.7%	0.7%	1.3%
Metals	Ferrous Containers	0.9%	1.1%	0.4%	1.4%
Metals	Other Ferrous Metals	1.6%	2.6%	0.4%	2.8%
Metals	Other Non-Ferrous Metals	0.3%	0.5%	0.1%	0.5%
Total Metals		**3.9%**	**4.9%**	**1.7%**	**6.1%**
Glass	Clear Glass	1.5%	1.4%	0.8%	2.1%
Glass	Green Glass	0.0%	0.1%	0.0%	0.1%
Glass	Blue Glass	0.1%	0.2%	0.0%	0.2%
Glass	Brown Glass	0.4%	0.7%	0.1%	0.7%
Glass	Other Mixed Cullet	0.3%	0.6%	0.0%	0.6%
Total Glass		**2.3%**	**3.0%**	**1.0%**	**3.7%**
Yard Waste	Grass and Leaves	7.3%	5.6%	4.8%	9.9%
Yard Waste	Brush and Trees	1.3%	1.6%	0.6%	2.0%
Total Yard Waste		**8.6%**	**7.2%**	**5.4%**	**11.9%**
Food Waste	Food Waste	9.8%	3.8%	8.1%	11.6%
Total Food Waste		**9.8%**	**3.8%**	**8.1%**	**11.6%**
Wood	Non-Treated Wood	2.1%	5.7%	0.0%	4.7%
Wood	Treated Wood	1.3%	3.9%	0.0%	3.1%
Total Wood		**3.4%**	**9.6%**	**0.0%**	**7.8%**
Construction & Demolition Debris	C&D Debris	3.0%	4.2%	1.1%	4.9%
Total Construction & Demolition Debris		**3.0%**	**4.2%**	**1.1%**	**4.9%**
Durables	Electrical and Household Appliances	2.3%	2.8%	1.0%	3.6%
Durables	Central Processing Units/Peripherals	0.0%	0.1%	0.0%	0.0%
Durables	Computer Monitors/TVs	0.0%	0.0%	0.0%	0.0%
Durables	Cell Phones and Chargers	0.0%	0.1%	0.0%	0.0%
Durables	Other Durables	0.0%	0.1%	0.0%	0.1%
Total Durables		**2.3%**	**3.1%**	**1.0%**	**3.7%**
Textiles and Leathers	Textiles and Leathers	4.7%	5.3%	2.3%	7.1%
Total Textiles and Leathers		**4.7%**	**5.3%**	**2.3%**	**7.1%**
Diapers	Diapers	6.0%	4.2%	4.1%	7.9%
Total Diapers		**6.0%**	**4.2%**	**4.1%**	**7.9%**
Rubber	Rubber	0.1%	0.1%	0.1%	0.2%
Total Rubber		**0.1%**	**0.1%**	**0.1%**	**0.2%**
HHW	Automotive Products	0.1%	0.1%	0.0%	0.1%

HHW	Paints and Solvents	0.1%	0.2%	0.0%	0.2%
HHW	Pesticides, Herbicides, Fungicides	0.1%	0.2%	0.0%	0.2%
HHW	Household Cleaners	0.1%	0.1%	0.0%	0.1%
HHW	Lead Acid Batteries	0.0%	0.0%	0.0%	0.0%
HHW	Other Batteries	0.1%	0.2%	0.0%	0.1%
HHW	Mercury Containing Products	0.0%	0.0%	0.0%	0.0%
HHW	Other HHW	0.3%	0.3%	0.1%	0.4%
Total Household Hazardous Waste		**0.7%**	**1.2%**	**0.2%**	**1.2%**
Tires	Tires	0.0%	0.0%	0.0%	0.0%
Total Tires		**0.0%**	**0.0%**	**0.0%**	**0.0%**
Sharps	Sharps	0.0%	0.0%	0.0%	0.0%
Total Sharps		**0.0%**	**0.0%**	**0.0%**	**0.0%**
Other Organic	Other Organic	3.3%	5.3%	0.9%	5.7%
Total Other Organic		**3.3%**	**5.3%**	**0.9%**	**5.7%**
Other Inorganic	Other Inorganic	2.7%	5.5%	0.2%	5.2%
Total Other Inorganic		**2.7%**	**5.5%**	**0.2%**	**5.2%**
Fines/Super Mix	Fines/Super Mix	15.0%	4.8%	12.8%	17.2%
Total Fines/Super Mix		**15.0%**	**4.8%**	**12.8%**	**17.2%**
Other Materials	Other	1.4%	3.2%	0.0%	2.9%
Total Other Materials		**1.4%**	**3.2%**	**0.0%**	**2.9%**
GRAND TOTAL		**100.0%**			

Figure 3.2 Sioux Falls Regional Sanitary Landfill, Residential MSW Composition (% by weight)



3.2.2 ICI

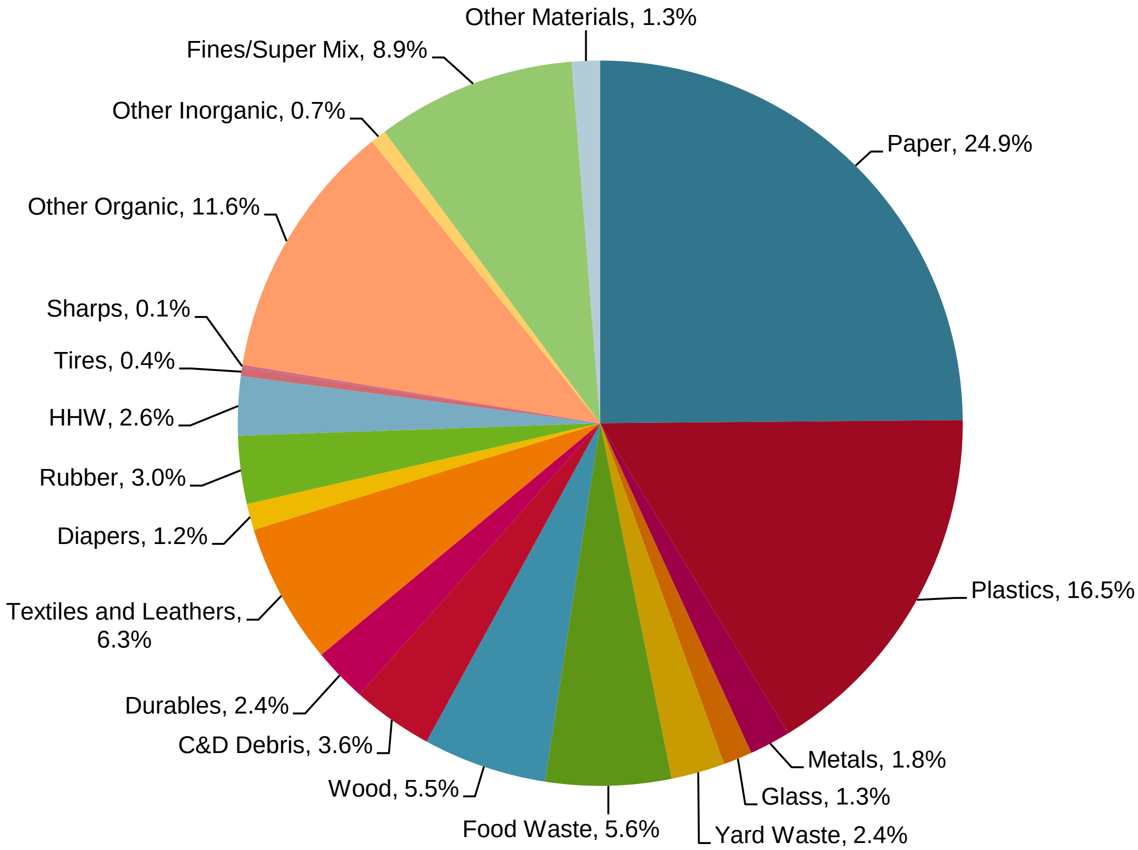
Table 3-3 presents the ICI MSW composition results in a tabular format along with the standard deviation and confidence intervals for each material category. Figure 3-3 depicts the annualized ICI MSW composition results for the SFRSL.

Table 3.3 Sioux Falls Regional Sanitary Landfill, ICI MSW Composition (% by weight)

Material Group	Material	Mean	Standard Deviation	Confidence Interval Lower Bound	Confidence Interval Upper Bound
Paper	Newsprint	0.4%	0.9%	0.0%	0.7%
Paper	Magazines	1.1%	2.2%	0.3%	1.9%
Paper	High Grade Office Paper	1.1%	1.9%	0.4%	1.8%
Paper	OCC and Kraft Bags	6.7%	8.2%	3.6%	9.8%
Paper	Mixed Recyclable Paper	5.3%	6.2%	3.0%	7.6%
Paper	Non-Recyclable Paper	3.5%	5.3%	1.5%	5.5%
Paper	Compostable Paper	6.8%	5.6%	4.7%	8.9%
Total Paper		**24.9%**	**30.3%**	**13.5%**	**36.3%**
Plastics	#1 PET Containers	2.2%	2.3%	1.3%	3.1%
Plastics	#2 HDPE Containers	0.7%	1.2%	0.3%	1.2%
Plastics	Other Plastic Containers	1.7%	2.1%	0.9%	2.5%
Plastics	Other Plastic Products	3.9%	5.4%	1.8%	5.9%
Plastics	Film/Wrap/Bags	8.0%	5.7%	5.9%	10.1%
Total Plastics		**16.5%**	**16.7%**	**10.2%**	**22.7%**
Metals	Aluminum Beverage Containers	0.7%	0.7%	0.4%	0.9%
Metals	Ferrous Containers	0.6%	0.7%	0.3%	0.9%
Metals	Other Ferrous Metals	0.3%	0.7%	0.1%	0.6%
Metals	Other Non-Ferrous Metals	0.3%	0.3%	0.2%	0.4%
Total Metals		**1.8%**	**2.4%**	**0.9%**	**2.7%**
Glass	Clear Glass	0.4%	1.0%	0.1%	0.8%
Glass	Green Glass	0.2%	0.8%	0.0%	0.5%
Glass	Blue Glass	0.0%	0.3%	0.0%	0.2%
Glass	Brown Glass	0.3%	1.2%	0.0%	0.7%
Glass	Other Mixed Cullet	0.3%	1.2%	0.0%	0.7%
Total Glass		**1.3%**	**4.6%**	**0.1%**	**3.0%**
Yard Waste	Grass and Leaves	2.3%	9.5%	0.0%	5.8%
Yard Waste	Brush and Trees	0.1%	0.7%	0.0%	0.4%
Total Yard Waste		**2.4%**	**10.2%**	**0.0%**	**6.2%**
Food Waste	Food Waste	5.6%	9.8%	1.9%	9.3%
Total Food Waste		**5.6%**	**9.8%**	**1.9%**	**9.3%**
Wood	Non-Treated Wood	5.0%	18.7%	0.0%	12.0%
Wood	Treated Wood	0.5%	1.9%	0.0%	1.3%
Total Wood		**5.5%**	**20.6%**	**0.0%**	**13.3%**
Construction & Demolition Debris	C&D Debris	3.6%	8.5%	0.4%	6.8%
Total Construction & Demolition Debris		**3.6%**	**8.5%**	**0.4%**	**6.8%**
Durables	Electrical and Household Appliances	1.5%	4.1%	0.0%	3.0%
Durables	Central Processing Units/Peripherals	0.1%	0.3%	0.0%	0.2%
Durables	Computer Monitors/TVs	0.0%	0.0%	0.0%	0.0%
Durables	Cell Phones and Chargers	0.0%	0.0%	0.0%	0.0%
Durables	Other Durables	0.9%	4.0%	0.0%	2.4%
Total Durables		**2.4%**	**8.4%**	**0.0%**	**5.6%**

Textiles and Leathers	Textiles and Leathers	6.3%	7.3%	3.5%	9.0%
Total Textiles and Leathers		**6.3%**	**7.3%**	**3.5%**	**9.0%**
Diapers	Diapers	1.2%	2.7%	0.1%	2.2%
Total Diapers		**1.2%**	**2.7%**	**0.1%**	**2.2%**
Rubber	Rubber	3.0%	3.6%	1.7%	4.4%
Total Rubber		**3.0%**	**3.6%**	**1.7%**	**4.4%**
HHW	Automotive Products	0.4%	1.3%	0.0%	0.9%
HHW	Paints and Solvents	2.0%	4.1%	0.5%	3.6%
HHW	Pesticides, Herbicides, Fungicides	0.0%	0.0%	0.0%	0.0%
HHW	Household Cleaners	0.0%	0.1%	0.0%	0.1%
HHW	Lead Acid Batteries	0.0%	0.0%	0.0%	0.0%
HHW	Other Batteries	0.0%	0.1%	0.0%	0.1%
HHW	Mercury Containing Products	0.0%	0.0%	0.0%	0.0%
HHW	Other HHW	0.1%	0.3%	0.0%	0.2%
Total Household Hazardous Waste		**2.6%**	**5.9%**	**0.5%**	**4.9%**
Tires	Tires	0.4%	1.8%	0.0%	1.0%
Total Tires		**0.4%**	**1.8%**	**0.0%**	**1.0%**
Sharps	Sharps	0.1%	0.6%	0.0%	0.3%
Total Sharps		**0.1%**	**0.6%**	**0.0%**	**0.3%**
Other Organic	Other Organic	11.6%	17.0%	5.2%	18.0%
Total Other Organic		**11.6%**	**17.0%**	**5.2%**	**18.0%**
Other Inorganic	Other Inorganic	0.7%	2.4%	0.0%	1.6%
Total Other Inorganic		**0.7%**	**2.4%**	**0.0%**	**1.6%**
Fines/Super Mix	Fines/Super Mix	8.9%	7.5%	6.0%	11.7%
Total Fines/Super Mix		**8.9%**	**7.5%**	**6.0%**	**11.7%**
Other Materials	Other	1.3%	7.9%	0.0%	4.2%
Total Other Materials		**1.3%**	**7.9%**	**0.0%**	**4.2%**
GRAND TOTAL		**100.0%**			

Figure 3.3 Sioux Falls Regional Sanitary Landfill, ICI MSW Composition (% by weight)



3.2.3 Mixed Load

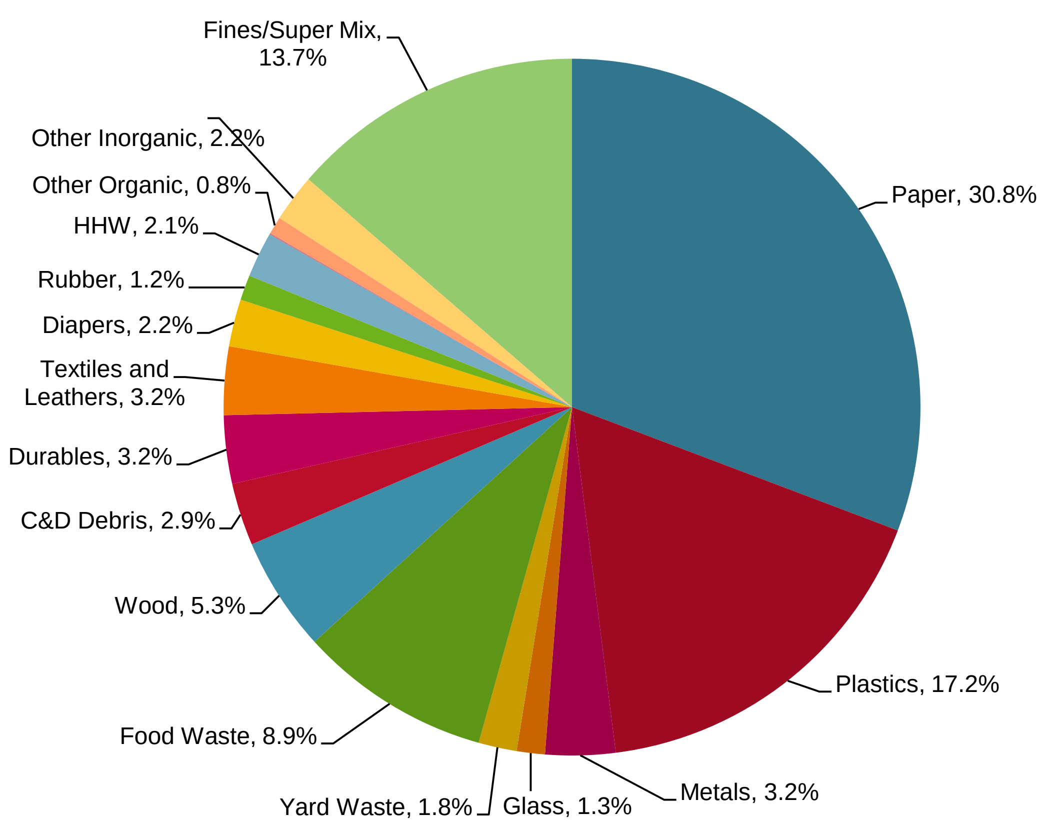
Table 3-4 presents the mixed load MSW composition results in a tabular format along with the standard deviation and confidence intervals for each material category. Figure 3-4 depicts the annualized mixed load MSW composition results for the SFRSL.

Table 3.4 Sioux Falls Regional Sanitary Landfill, Mixed Load MSW Composition (% by weight)

Material Group	Material	Mean	Standard Deviation	Confidence Interval Lower Bound	Confidence Interval Upper Bound
Paper	Newsprint	0.5%	0.7%	0.2%	0.8%
Paper	Magazines	1.0%	1.1%	0.5%	1.5%
Paper	High Grade Office Paper	1.5%	3.0%	0.1%	2.9%
Paper	OCC and Kraft Bags	11.2%	11.8%	5.6%	16.8%
Paper	Mixed Recyclable Paper	4.5%	3.5%	2.8%	6.1%
Paper	Non-Recyclable Paper	2.4%	2.3%	1.3%	3.5%
Paper	Compostable Paper	9.6%	4.3%	7.6%	11.6%
Total Paper		**30.8%**	**26.6%**	**18.1%**	**43.4%**
Plastics	#1 PET Containers	2.3%	1.7%	1.5%	3.1%
Plastics	#2 HDPE Containers	0.8%	0.7%	0.5%	1.2%
Plastics	Other Plastic Containers	1.5%	1.2%	0.9%	2.1%
Plastics	Other Plastic Products	4.3%	2.5%	3.1%	5.5%
Plastics	Film/Wrap/Bags	8.3%	4.2%	6.3%	10.3%
Total Plastics		**17.2%**	**10.3%**	**12.4%**	**22.1%**
Metals	Aluminum Beverage Containers	1.1%	0.6%	0.8%	1.4%
Metals	Ferrous Containers	1.0%	1.1%	0.5%	1.6%
Metals	Other Ferrous Metals	1.0%	0.8%	0.6%	1.4%
Metals	Other Non-Ferrous Metals	0.1%	0.3%	0.0%	0.3%
Total Metals		**3.2%**	**2.8%**	**1.9%**	**4.6%**
Glass	Clear Glass	0.8%	0.8%	0.4%	1.2%
Glass	Green Glass	0.3%	0.7%	0.0%	0.6%
Glass	Blue Glass	0.0%	0.0%	0.0%	0.0%
Glass	Brown Glass	0.2%	0.3%	0.1%	0.4%
Glass	Other Mixed Cullet	0.0%	0.1%	0.0%	0.1%
Total Glass		**1.3%**	**2.0%**	**0.4%**	**2.2%**
Yard Waste	Grass and Leaves	1.5%	3.5%	0.0%	3.2%
Yard Waste	Brush and Trees	0.3%	0.5%	0.0%	0.5%
Total Yard Waste		**1.8%**	**4.1%**	**0.0%**	**3.7%**
Food Waste	Food Waste	8.9%	8.7%	4.8%	13.0%
Total Food Waste		**8.9%**	**8.7%**	**4.8%**	**13.0%**
Wood	Non-Treated Wood	3.6%	4.9%	1.2%	5.9%
Wood	Treated Wood	1.7%	2.3%	0.7%	2.8%
Total Wood		**5.3%**	**7.2%**	**1.9%**	**8.7%**
Construction & Demolition Debris	C&D Debris	2.9%	5.4%	0.3%	5.5%
Total Construction & Demolition Debris		**2.9%**	**5.4%**	**0.3%**	**5.5%**
Durables	Electrical and Household Appliances	2.6%	5.0%	0.2%	5.0%
Durables	Central Processing Units/Peripherals	0.0%	0.1%	0.0%	0.1%
Durables	Computer Monitors/TVs	0.5%	2.3%	0.0%	1.6%
Durables	Cell Phones and Chargers	0.0%	0.0%	0.0%	0.0%
Durables	Other Durables	0.0%	0.0%	0.0%	0.0%
Total Durables		**3.2%**	**7.4%**	**0.2%**	**6.6%**
Textiles and Leathers	Textiles and Leathers	3.2%	4.4%	1.1%	5.2%
Total Textiles and Leathers		**3.2%**	**4.4%**	**1.1%**	**5.2%**
Diapers	Diapers	2.2%	3.3%	0.6%	3.7%
Total Diapers		**2.2%**	**3.3%**	**0.6%**	**3.7%**
Rubber	Rubber	1.2%	1.4%	0.5%	1.8%
Total Rubber		**1.2%**	**1.4%**	**0.5%**	**1.8%**
HHW	Automotive Products	1.2%	3.0%	0.0%	2.7%

HHW	Paints and Solvents	0.6%	2.6%	0.0%	1.8%
HHW	Pesticides, Herbicides, Fungicides	0.0%	0.1%	0.0%	0.1%
HHW	Household Cleaners	0.0%	0.1%	0.0%	0.1%
HHW	Lead Acid Batteries	0.0%	0.0%	0.0%	0.0%
HHW	Other Batteries	0.0%	0.0%	0.0%	0.0%
HHW	Mercury Containing Products	0.0%	0.0%	0.0%	0.0%
HHW	Other HHW	0.2%	0.3%	0.0%	0.4%
Total Household Hazardous Waste		**2.1%**	**6.1%**	**0.0%**	**5.0%**
Tires	Tires	0.0%	0.1%	0.0%	0.1%
Total Tires		**0.0%**	**0.1%**	**0.0%**	**0.1%**
Sharps	Sharps	0.0%	0.1%	0.0%	0.1%
Total Sharps		**0.0%**	**0.1%**	**0.0%**	**0.1%**
Other Organic	Other Organic	0.8%	1.8%	0.0%	1.7%
Total Other Organic		**0.8%**	**1.8%**	**0.0%**	**1.7%**
Other Inorganic	Other Inorganic	2.2%	3.8%	0.4%	4.0%
Total Other Inorganic		**2.2%**	**3.8%**	**0.4%**	**4.0%**
Fines/Super Mix	Fines/Super Mix	13.7%	7.3%	10.2%	17.1%
Total Fines/Super Mix		**13.7%**	**7.3%**	**10.2%**	**17.1%**
Other Materials	Other	0.0%	0.0%	0.0%	0.0%
Total Other Materials		**0.0%**	**0.0%**	**0.0%**	**0.0%**
GRAND TOTAL		**100.0%**			

Figure 3.4 Sioux Falls Regional Sanitary Landfill, Mixed Load MSW Composition (% by weight)



3.3 Overall Solid Waste Composition

The HDR Project Team also calculated an annualized solid waste characterization of all materials landfilled at the SFRSL. These results include not only MSW, but also materials such as dedicated C&D debris loads and special wastes (e.g. source separated yard waste and wood waste, contaminated soil, appliances, scrap metal, electronics, recyclables, dead animals, and other materials requiring special handling) which were not included in the sampling related to this study. To develop these annualized solid waste composition results, the HDR Project Team obtained tonnage information for all material streams accepted at the SFRSL during calendar year 2015. The MSW characterization results were multiplied by the total tons of MSW received at the SFRSL in 2015 and then weighted based on the overall solid waste tons received at the landfill during 2015, in order to arrive at the mean percentage and annual tons by material type. C&D and special waste categories were added to the material group list and their percentage of the overall solid waste stream received at the SFRSL were calculated based on the 2015 tonnage data.

Table 3-5 represents the landfill's overall solid waste characterization. Figure 3-5 depicts the annualized overall solid waste composition results for the SFRSL.

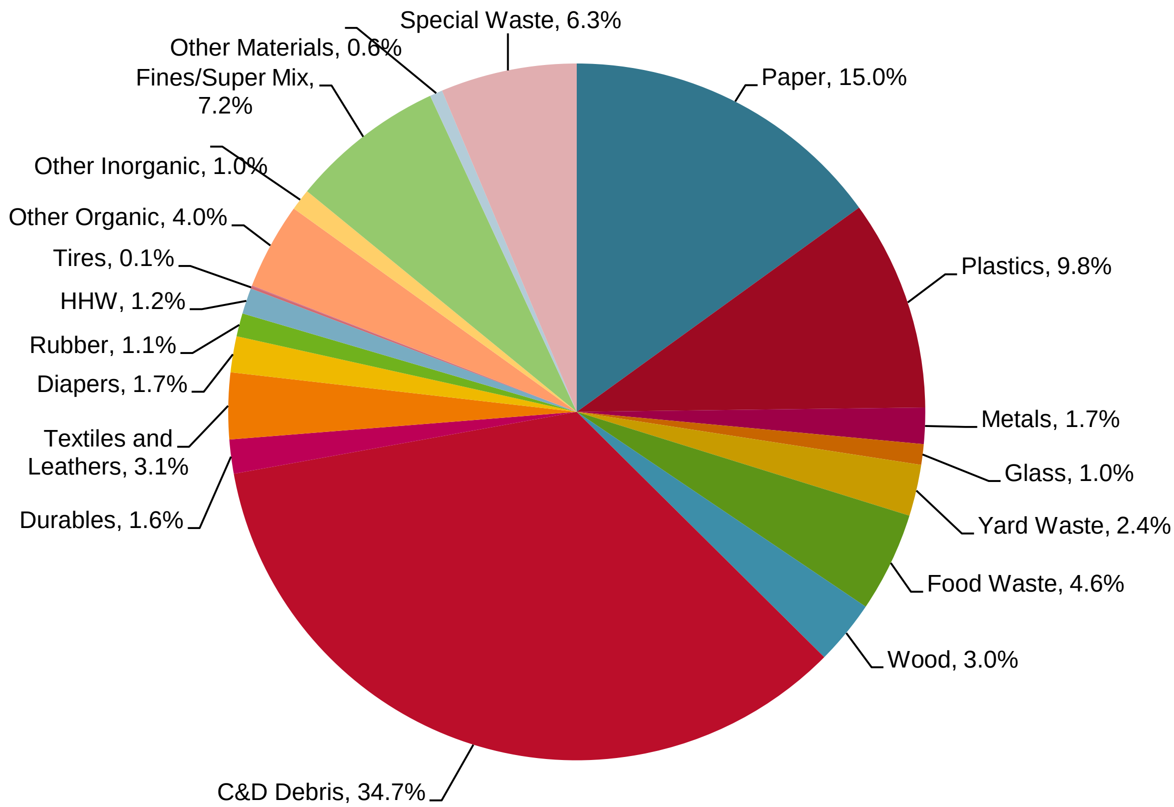
Table 3.5 Sioux Falls Regional Sanitary Landfill, Overall Solid Waste Composition (% by weight)

Material Group	Material	Mean	Tons (2015)
Paper	Newsprint	0.30%	785
Paper	Magazines	0.69%	1,812
Paper	High Grade Office Paper	0.69%	1,821
Paper	OCC and Kraft Bags	4.05%	10,714
Paper	Mixed Recyclable Paper	2.91%	7,695
Paper	Non-Recyclable Paper	1.72%	4,555
Paper	Compostable Paper	4.67%	12,348
Total Paper		**15.03%**	**39,728**
Plastics	#1 PET Containers	1.43%	3,792
Plastics	#2 HDPE Containers	0.45%	1,180
Plastics	Other Plastic Containers	1.07%	2,836
Plastics	Other Plastic Products	2.35%	6,200
Plastics	Film/Wrap/Bags	4.47%	11,826
Total Plastics		**9.77%**	**25,834**
Metals	Aluminum Beverage Containers	0.52%	1,386
Metals	Ferrous Containers	0.48%	1,277
Metals	Other Ferrous Metals	0.52%	1,374
Metals	Other Non-Ferrous Metals	0.15%	397
Total Metals		**1.68%**	**4,434**
Glass	Clear Glass	0.50%	1,311
Glass	Green Glass	0.11%	286
Glass	Blue Glass	0.02%	62
Glass	Brown Glass	0.19%	501
Glass	Other Mixed Cullet	0.14%	365
Total Glass		**0.96%**	**2,525**
Yard Waste	Grass and Leaves	2.09%	5,528
Yard Waste	Brush and Trees	0.29%	773
Total Yard Waste		**2.38%**	**6,301**
Food Waste	Food Waste	4.63%	12,237
Total Food Waste		**4.63%**	**12,237**
Wood	Non-Treated Wood	2.34%	6,181

Wood	Treated Wood	0.65%	1,718
Total Wood		**2.99%**	**7,899**
Durables	Electrical and Household Appliances	1.21%	3,210
Durables	Central Processing Units/Peripherals	0.02%	59
Durables	Computer Monitors/TVs	0.08%	219
Durables	Cell Phones and Chargers	0.00%	13
Durables	Other Durables	0.26%	677
Total Durables		**1.58%**	**4,177**
Textiles and Leathers	Textiles and Leathers	3.08%	8,143
Total Textiles and Leathers		**3.08%**	**8,143**
Diapers	Diapers	1.67%	4,415
Total Diapers		**1.67%**	**4,415**
Rubber	Rubber	1.08%	2,843
Total Rubber		**1.08%**	**2,843**
HHW	Automotive Products	0.33%	884
HHW	Paints and Solvents	0.69%	1,836
HHW	Pesticides, Herbicides, Fungicides	0.02%	62
HHW	Household Cleaners	0.02%	63
HHW	Lead Acid Batteries	0.00%	0
HHW	Other Batteries	0.02%	49
HHW	Mercury Containing Products	0.00%	4
HHW	Other HHW	0.10%	274
Total Household Hazardous Waste		**1.20%**	**3,171**
Tires	Tires	0.11%	303
Total Tires		**0.11%**	**303**
Sharps	Sharps	0.04%	101
Total Sharps		**0.04%**	**101**
Other Organic	Other Organic	4.01%	10,594
Total Other Organic		**4.01%**	**10,594**
Other Inorganic	Other Inorganic	1.00%	2,638
Total Other Inorganic		**1.00%**	**2,638**
Fines/Super Mix	Fines/Super Mix	7.17%	18,962
Total Fines/Super Mix		**7.17%**	**18,962**
Other Materials	Other	0.59%	1,569
Total Other Materials		**0.59%**	**1,569**
C&D Waste		34.72%	91,796
Total C&D Waste		**34.72%**	**91,796**
Special Waste [1]		6.32%	16,696
Total Special Waste [1]		**6.32%**	**16,696**
GRAND TOTAL		**100.00%**	**264,369**

[1] "Special Waste" includes source separated yard waste, wood waste, tires, contaminated soil, appliances, scrap metal, electronics, recyclables, and dead animals.

Figure 3.5 Sioux Falls Regional Sanitary Landfill, Overall Solid Waste Composition (% by weight)



3.4 Comparison to 2006 Study Results

In order to provide the City with an understanding of key changes observed between the 2006 waste characterization study and the current (2016) waste characterization study, HDR has developed the following tables comparing the MSW composition (Table 3-6) and the overall solid waste composition (Table 3-7) observed in each respective year.

Key changes observed in the MSW composition include:

- A notable decrease (-5.5%) in total paper in the MSW stream. All recyclable paper categories, with the exception of OCC, decreased as a percentage of the MSW stream. The largest decreases were observed in mixed recyclable paper (-4.4%) and newspaper (-1.8%).
- A notable decrease in durables (-2.4%) including e-waste present in the waste stream. All categories of durables decreased in terms of their percentage of the total MSW stream. Most notably, the quantities of e-waste observed in the samples were very limited with no CPUs, computer peripherals, or cell phones observed.
- An overall decrease in the quantity of HHW in the MSW stream. However, there was a notable increase in the percentage of paints and solvents (+1.1%) which made up the majority of HHW observed in the samples.
- An increase in the percentage of textiles and leather (+2.4%) present in the MSW stream.

- A significant increase in fines/super mix from 2.3% in 2006 to 11.8% in 2016. A large portion of this discrepancy is likely attributable to differences in how the fines/super mix material category was defined between the two studies. HDR defined this category as anything 2 inches or smaller in size, which is consistent with industry standards. The 2006 study did not provide a clear definition for fines/super mix that could be utilized for consistency among the studies.
- A significant decrease in food waste from 16.4% in 2006 to 7.6% in 2016. Some of this change may have resulted from the difference in category definitions for fines/super mix noted in the prior bullet.

The differences noted above related to the 2006 and 2016 MSW waste stream composition results also affected the overall solid waste composition results shown in Table 3-7. There were also small decreases in both C&D (-2.69%) and Special Wastes (-1.32%) as a percentage of the overall solid waste stream.

The differences noted in composition of the MSW and solid waste streams from 2006 versus 2016 may be attributable to: 1) new polices or programs that have been put in place during the intervening ten years; 2) overall changes in production or consumption patterns; or 3) differences in definitions between the two studies (as noted). For example, changes in residential recycling programs may have directly impacted the amount of paper in the waste stream. Reduced consumption of physical newspapers and down-sizing/light-weighting of other consumer items, such as plastic and metal containers, may have also impacted the composition results to some degree. Some differences between the two studies are to be expected; however, overall there were no particularly significant changes in the composition of the waste received at the SFRSL.

Table 3.6 Sioux Falls Regional Sanitary Landfill, Comparison of 2006 and 2016 MSW Composition Study Results (% by weight)

		Mean		
Material Group	**Material**	**2006**	**2016**	**Change**
Paper	Newsprint	2.3%	0.5%	-1.8%
Paper	Magazines	2.0%	1.1%	-0.9%
Paper	High Grade Office Paper	1.8%	1.1%	-0.7%
Paper	OCC and Kraft Bags	5.8%	6.6%	0.8%
Paper	Mixed Recyclable Paper	9.1%	4.8%	-4.4%
Paper	Non-Recyclable Paper	2.7%	2.8%	0.1%
Paper	Compostable Paper	6.4%	7.7%	1.3%
Total Paper		**30.2%**	**24.7%**	**-5.5%**
Plastics	#1 PET Containers	1.7%	2.4%	0.6%
Plastics	#2 HDPE Containers	0.9%	0.7%	-0.2%
Plastics	Other Plastic Containers	0.7%	1.8%	1.0%
Plastics	Other Plastic Products	5.0%	3.8%	-1.2%
Plastics	Film/Wrap/Bags	6.6%	7.3%	0.7%
Total Plastics		**15.0%**	**16.0%**	**1.0%**
Metals	Aluminum Beverage Containers	0.9%	0.9%	0.0%
Metals	Ferrous Containers	0.7%	0.8%	0.1%
Metals	Other Ferrous Metals	2.3%	0.9%	-1.5%
Metals	Other Non-Ferrous Metals	0.5%	0.2%	-0.3%
Total Metals		**4.4%**	**2.8%**	**-1.7%**
Glass	Clear Glass	1.4%	0.8%	-0.5%
Glass	Green Glass	0.2%	0.2%	-0.1%
Glass	Blue Glass	0.1%	0.0%	0.0%

Glass	Brown Glass	1.3%	0.3%	-1.0%
Glass	Other Mixed Cullet	0.2%	0.2%	0.1%
Total Glass		**3.1%**	**1.6%**	**-1.5%**
Yard Waste	Grass and Leaves	3.7%	3.4%	-0.2%
Yard Waste	Brush and Trees	1.9%	0.5%	-1.4%
Total Yard Waste		**5.5%**	**3.9%**	**-1.6%**
Food Waste	Food Waste	16.4%	7.6%	-8.8%
Total Food Waste		**16.4%**	**7.6%**	**-8.8%**
Wood	Non-Treated Wood	2.6%	3.8%	1.3%
Wood	Treated Wood	2.7%	1.1%	-1.7%
Total Wood		**5.3%**	**4.9%**	**-0.4%**
Construction & Demolition Debris	C&D Debris	3.7%	3.3%	-0.5%
Total Construction & Demolition Debris		**3.7%**	**3.3%**	**-0.5%**
Durables	Electrical and Household Appliances	2.9%	2.0%	-0.9%
Durables	Central Processing Units/Peripherals	0.2%	0.0%	-0.2%
Durables	Computer Monitors/TVs	0.2%	0.1%	0.0%
Durables	Cell Phones and Chargers	0.0%	0.0%	0.0%
Durables	Other Durables	1.7%	0.4%	-1.3%
Total Durables		**5.0%**	**2.6%**	**-2.4%**
Textiles and Leathers	Textiles and Leathers	2.7%	5.1%	2.4%
Total Textiles and Leathers		**2.7%**	**5.1%**	**2.4%**
Diapers	Diapers	2.4%	2.7%	0.4%
Total Diapers		**2.4%**	**2.7%**	**0.4%**
Rubber	Rubber	0.6%	1.8%	1.2%
Total Rubber		**0.6%**	**1.8%**	**1.2%**
HHW	Automotive Products	0.2%	0.5%	0.4%
HHW	Paints and Solvents	0.0%	1.1%	1.1%
HHW	Pesticides, Herbicides, Fungicides	0.0%	0.0%	0.0%
HHW	Household Cleaners	0.0%	0.0%	0.0%
HHW	Lead Acid Batteries	0.0%	0.0%	0.0%
HHW	Other Batteries	0.1%	0.0%	0.0%
HHW	Mercury Containing Products	0.0%	0.0%	0.0%
HHW	Other HHW	0.4%	0.2%	-0.2%
Total Household Hazardous Waste		**0.6%**	**2.0%**	**1.3%**
Tires	Tires	0.0%	0.2%	0.2%
Total Tires		**0.0%**	**0.2%**	**0.2%**
Sharps	Sharps	0.0%	0.1%	0.1%
Total Sharps		**0.0%**	**0.1%**	**0.1%**
Other Organic	Other Organic	1.6%	6.6%	5.0%
Total Other Organic		**1.6%**	**6.6%**	**5.0%**
Other Inorganic	Other Inorganic	1.3%	1.6%	0.4%
Total Other Inorganic		**1.3%**	**1.6%**	**0.4%**
Fines/Super Mix	Fines/Super Mix	2.3%	11.8%	9.5%
Total Fines/Super Mix		**2.3%**	**11.8%**	**9.5%**
Other Materials	Other	0.0%	1.0%	1.0%
Total Other Materials		**0.0%**	**1.0%**	**1.0%**
GRAND TOTAL		**100.0%**	**100.0%**	

Table 3.7 Sioux Falls Regional Sanitary Landfill, Comparison of 2006 and 2016 Overall Solid Waste Composition Study Results (% by weight)

		Mean		
Material Group	**Material**	**2006**	**2016**	**Change**
Paper	Newsprint	1.32%	0.30%	-1.02%
Paper	Magazines	1.15%	0.69%	-0.46%
Paper	High Grade Office Paper	1.02%	0.69%	-0.33%
Paper	OCC and Kraft Bags	3.31%	4.05%	0.74%
Paper	Mixed Recyclable Paper	5.22%	2.91%	-2.31%
Paper	Non-Recyclable Paper	1.56%	1.72%	0.16%
Paper	Compostable Paper	3.65%	4.67%	1.02%
Total Paper		**17.22%**	**15.03%**	**-2.19%**
Plastics	#1 PET Containers	0.99%	1.43%	0.44%
Plastics	#2 HDPE Containers	0.52%	0.45%	-0.07%
Plastics	Other Plastic Containers	0.41%	1.07%	0.66%
Plastics	Other Plastic Products	2.86%	2.35%	-0.51%
Plastics	Film/Wrap/Bags	3.79%	4.47%	0.68%
Total Plastics		**8.56%**	**9.77%**	**1.21%**
Metals	Aluminum Beverage Containers	0.51%	0.52%	0.01%
Metals	Ferrous Containers	0.39%	0.48%	0.09%
Metals	Other Ferrous Metals	1.32%	0.52%	-0.80%
Metals	Other Non-Ferrous Metals	0.30%	0.15%	-0.15%
Total Metals		**2.52%**	**1.68%**	**-0.84%**
Glass	Clear Glass	0.77%	0.50%	-0.27%
Glass	Green Glass	0.14%	0.11%	-0.03%
Glass	Blue Glass	0.03%	0.02%	-0.01%
Glass	Brown Glass	0.72%	0.19%	-0.53%
Glass	Other Mixed Cullet	0.10%	0.14%	0.04%
Total Glass		**1.76%**	**0.96%**	**-0.80%**
Yard Waste	Grass and Leaves	2.09%	2.09%	0.00%
Yard Waste	Brush and Trees	1.05%	0.29%	-0.76%
Total Yard Waste		**3.15%**	**2.38%**	**-0.77%**
Food Waste	Food Waste	9.36%	4.63%	-4.73%
Total Food Waste		**9.36%**	**4.63%**	**-4.73%**
Wood	Non-Treated Wood	1.46%	2.34%	0.88%
Wood	Treated Wood	1.56%	0.65%	-0.91%
Total Wood		**3.02%**	**2.99%**	**-0.03%**
Durables	Electrical and Household Appliances	1.66%	1.21%	-0.45%
Durables	Central Processing Units/Peripherals	0.14%	0.02%	-0.12%
Durables	Computer Monitors/TVs	0.09%	0.08%	-0.01%
Durables	Cell Phones and Chargers	0.01%	0.00%	-0.01%
Durables	Other Durables	0.96%	0.26%	-0.70%
Total Durables		**2.86%**	**1.58%**	**-1.28%**
Textiles and Leathers	Textiles and Leathers	1.53%	3.08%	1.55%
Total Textiles and Leathers		**1.53%**	**3.08%**	**1.55%**
Diapers	Diapers	1.35%	1.67%	0.32%
Total Diapers		**1.35%**	**1.67%**	**0.32%**
Rubber	Rubber	0.31%	1.08%	0.77%
Total Rubber		**0.31%**	**1.08%**	**0.77%**
HHW	Automotive Products	0.09%	0.33%	0.24%
HHW	Paints and Solvents	0.02%	0.69%	0.67%
HHW	Pesticides, Herbicides, Fungicides	0.00%	0.02%	0.02%
HHW	Household Cleaners	0.01%	0.02%	0.01%
HHW	Lead Acid Batteries	0.00%	0.00%	0.00%
HHW	Other Batteries	0.04%	0.02%	-0.02%

HHW	Mercury Containing Products	0.00%	0.00%	0.00%
HHW	Other HHW	0.20%	0.10%	-0.10%
Total Household Hazardous Waste		**0.36%**	**1.20%**	**0.84%**
Tires	Tires	0.00%	0.11%	0.11%
Total Tires		**0.00%**	**0.11%**	**0.11%**
Sharps	Sharps	0.00%	0.04%	0.04%
Total Sharps		**0.00%**	**0.04%**	**0.04%**
Other Organic	Other Organic	0.92%	4.01%	3.09%
Total Other Organic		**0.92%**	**4.01%**	**3.09%**
Other Inorganic	Other Inorganic	0.73%	1.00%	0.27%
Total Other Inorganic		**0.73%**	**1.00%**	**0.27%**
Fines/Super Mix	Fines/Super Mix	1.31%	7.17%	5.86%
Total Fines/Super Mix		**1.31%**	**7.17%**	**5.86%**
Other Materials	Other	0.00%	0.59%	0.59%
Total Other Materials		**0.00%**	**0.59%**	**0.59%**
C&D Waste		37.41%	34.72%	-2.69%
Total C&D Waste		**37.41%**	**34.72%**	**-2.69%**
Special Waste [1]		7.64%	6.32%	-1.32%
Total Special Waste [1]		**7.64%**	**6.32%**	**-1.32%**
GRAND TOTAL		**100.00%**	**100.00%**	

[1] "Special Waste" includes source separated yard waste, wood waste, tires, contaminated soil, appliances, scrap metal, electronics, recyclables, and dead animals.

3.5 Construction and Demolition Debris Characterization

In addition to characterizing the MSW and solid waste streams of the SFRSL, this study also included a visual C&D waste assessment. The HDR Project Team visually examined randomly selected, dedicated loads of C&D debris that were unloaded at the landfill's separate C&D area.

3.5.1 Methodology

Upon reviewing the landfill's transaction data, HDR utilized a sampling technique which involved estimating the total number of C&D loads entering the facility and then randomly selected samples from this pool of loads. Based on a review of landfill operations, a total of ten loads were selected for visual characterization over the six day sorting period. This methodology was consistent with that used in the 2006 characterization study.

A visual characterization of the C&D materials as they were unloaded from the vehicles was the preferred approach, as the weight and bulk of the materials being landfilled made physical sorting unfeasible. Each hauler was interviewed to gather information specific to each load including the name of the hauling company, source of waste (type of site), and origin of waste (geographic area). The actual weight of each load was provided by the landfill scale house.

A visual characterization was then performed by the HDR field supervisor to assess the relative proportion of each designated material type that made up the selected load. An estimate of the percentage by volume contained in each load was recorded on individual data forms for each vehicle.

To convert the estimated volume of materials in each load to a corresponding weight, the HDR Project Team utilized several technical references including the U.S. Environmental Protection Agency (U.S. EPA). Once the weights for each material category were calculated, the percentage that each category comprised of the entire waste stream was determined.

It should be noted that there are a number of limitations associated with this approach that can yield less than statistically accurate results:

- The limited number of samples (10) is insufficient to provide enough data to develop statistically significant composition estimates for the C&D material stream. When the number of samples is limited, it is possible (even with random selection of loads to be observed), to obtain results that are skewed and not reflective of the overall composition of the C&D waste stream as a whole.
- The use of a visual sort to estimate percent by volume for each of the specified C&D material categories present in a selected C&D load requires the observer to use their best judgment to make estimates based on what can be readily observed in the field. Even for a knowledgeable and experienced observer, this introduces a significant opportunity for error or bias as compared to physical sorts where all materials are sorted by category and weighed.
- There is further opportunity for error to arise in the conversion of the estimated percent by volume observed in the field to an estimated weight by material category. As noted above, these weight estimates were based on average density assumptions (lbs./cubic yard) for each of the different material categories as published by the U.S. EPA and other trusted industry sources. These are estimates and may not be directly reflective of the specific items present in the C&D loads observed at the SLRSL.

Based on both physical and budgetary limitations, as well as consistency with the 2006 study, it was decided to utilize this methodology to obtain anecdotal sample data regarding the C&D loads arriving at the SFRSL.

3.5.2 Results

Results of the C&D visual characterization are provided in Table 3-8. The results indicate that of the 24,609 pounds sampled, the largest material categories found in the C&D loads, by weight, were Other at 42.1 percent, followed by Treated Wood at 22.4 percent, and Durables at 19.3 percent.

Table 3.8 Sioux Falls Regional Sanitary Landfill, Overall Solid Waste Composition (% by weight)

Material	Calculated Weight (lbs)	Percent
Drywall/Gypsum	0.0	0.0%
Non-Treated Wood	844.1	3.4%
Shingles	449.9	1.8%
Durables	4,747.1	19.3%
OCC	515.1	2.1%
Treated Wood	5,507.2	22.4%
Concrete/Rubble/Bricks	641.7	2.6%
Carpet	253.5	1.0%
Metal	342.1	1.4%
Yard Waste	170.8	0.7%
Glass	266.1	1.1%
Food Waste	0.0	0.0%
Paper	299.2	1.2%
Plastic Film/Wrap/Bags	78.8	0.3%
Other Plastic	133.4	0.5%
Other [1]	10,360.3	42.1%
TOTAL	**24,609.4**	**100.0%**

[1] The "Other" category includes items such as bags of material for which the contents could not be observed, tar paper, insulation, rubber, textiles, fiberglass, filters, furniture, and other materials not otherwise classified.

Appendix A. Sampling and Sorting Plan

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City of Sioux Falls, SD
Waste Characterization Study
Sampling & Sorting Plan

1.0 INTRODUCTION

The following provides a detailed sampling and sorting plan for the waste characterization study to be conducted by HDR Engineering, Inc. (HDR) on behalf of the City of Sioux Falls, SD (City).

The objective of this waste characterization study is to provide the City with accurate composition data for the waste delivered to the Sioux Falls Regional Sanitary Landfill (SFRSL). Data will be collected specific to the following generator types:

- Residential (including single-family and multi-family);
- Industrial/commercial/institutional (ICI);
- Mixed-loads (combination of residential and commercial waste); and
- Construction and demolition (C&D) debris.

The results of the characterization study will allow the City to:

- Identify the types and quantities of potentially recyclable and compostable materials in the disposed waste stream;
- Gather data on the region's solid waste stream that can be used to help evaluate and potentially improve existing and future solid waste programs; and
- Compare 2006 waste characterization results to the 2016 study results in order to identify changes in the composition of disposed waste over the last 10 years.

2.0 GENERAL SORT LOGISTICS

2.1 Location

The study will be conducted at the Sioux Falls Regional Sanitary Landfill located at 26750 464th Avenue, Hartford, SD 57033. The SFRSL is operated and managed by the City of Sioux Falls Public Works Landfill Division.

The City will provide adequate floor space (approximately 1,500 sq. feet) at the facility for all sorting activities. The City will also provide a loader or bobcat, and equipment operator, to work with the HDR Field Supervisor to obtain the samples needed. Sorted samples will be discarded in an agreed upon location near the sorting area for removal by facility staff.

SFRSL includes space for parking vehicles of the HDR staff and sorting crew. It also includes restrooms and a break area that the sorting crew can use as needed.

2.2 Duration

Sampling will be conducted over the course of one week with six total days of sampling (Monday through Saturday). Sampling will begin on Monday, May 9th and conclude on Saturday, May 14th. Anticipated hours for sampling and sorting efforts are 7:30 am to 5:00 pm daily. This methodology will allow HDR to ensure that samples are selected from a wide variety of areas and haulers from across the City and surrounding areas utilizing the SFRSL for disposal.

It is expected that the first half-day of the sorting event will include:

- Equipment set up;
- Sorting crew debrief and safety training; and

- Getting familiar with tipping and sampling at SFRSL.

It is also expected that the last afternoon of the sorting event will include:

- Equipment break down;
- Cleaning of sorting equipment and supplies; and
- Cleaning of the sorting area.

2.3 Number of Samples

A total of 50 samples of municipal solid waste (MSW) are targeted for sorting during the study period. Based on ASTM Standards[1], 50 samples will be sufficient to calculate statistically significant characterization data for the overall disposed waste stream with a 90 percent confidence level and a 10 percent confidence interval. This level of confidence is considered the industry standard for waste characterization studies. The specific sampling procedures (discussed further in Section 3.0) will be designed to look at waste from each of the three main generator types: residential, ICI, and mixed-loads.

In addition to the 50 samples of MSW to be selected and sorted during the study, HDR will also randomly select 10 loads of C&D debris for a separate visual characterization. This is discussed in more detail in Section 6.0.

2.4 Sorting Area

Two sorting tables will be set up to accommodate four sorters and one HDR Crew Chief per table. Each table will be equipped with tongs, hand rakes, scissors, magnet, shovel, push broom, dust pan and brush, and a combination of 20-gallon and 44-gallon sorting bins with labels for each material category included in this study. There will also be a scale at each table used for weighing the sorted materials.

2.5 Sorting Crew

The sorting of all samples will be done by two sorting crews made up of four laborers (provided by HDR through the Labor Ready Sioux Falls office) and an HDR Crew Chief. All field work will be managed by an HDR Field Supervisor. The Field Supervisor will be responsible for obtaining the samples to be sorted, and providing overall guidance, training, and oversight related to the study. The HDR Crew Chiefs will oversee the sorting, weighing, and record-keeping process.

2.6 Equipment

TABLE 1 - EQUIPMENT LIST

ITEM	NUMBER	SOURCE	COMMENTS
Folding Table	1	HDR	Used for water cooler, cups, safety supplies, etc.
Sorting Tables	2	HDR	4’ x 8’ with 2-inch wire mesh
Sorting Bins (20-gal)	94	HDR	94 total
Sorting Bins (44-gal)	8	HDR	8 total
Folding Chairs	10	HDR	
Loader & Driver	1	City	
Heavy Duty Tarps	10	HDR	10’ x 15’ - used to place samples on or cover samples; also used underneath sorting tables

[1] ASTM D5231 - 92(2008) "Standard Test Method for Determination of the Characterization of Unprocessed Municipal Solid Waste."

ITEM	NUMBER	SOURCE	COMMENTS
Scale (full sample)	1	City	
Scales (sorted materials)	2	HDR	Accurate to 0.1 lb
Magnets	2	HDR	
Metal tongs	12	HDR	
Hand rakes	12	HDR	
Scissors	2	HDR	
Shovels	2	HDR	
Brooms	2	HDR	
Dust Pans with Brushes	2	HDR	
First Aid Kit	1	HDR	For 50 people
Eye Wash Kit	1	HDR	
Safety Cones / Jersey Barriers	TBD	City	Based on size and layout of sorting area
Cut and Puncture-Resistant Gloves	16	HDR	1 pair per crew member (plus 5 extra)
Nitrile Gloves	660	HDR	5 pair per crew member per day
Tyvek Coveralls	66	HDR	1 per crew member per day; optional for those who wish to wear them
Safety Glasses	7	Labor Ready to furnish for laborers; HDR to provide for field supervisor and crew chiefs	HDR will have 4 extra on hand in case needed
Safety Vests	7	Labor Ready to furnish for laborers; HDR to provide for field supervisor and crew chiefs	HDR will have 4 extra on hand in case needed
Hard Hats	7	Labor Ready to furnish for laborers; HDR to provide for field supervisor and crew chiefs	HDR will have 4 extra on hand in case needed
Steel Toe Boots	3	Labor Ready to ensure laborers have these; HDR to provide for field supervisor and crew chiefs	
Dust Masks	198	HDR	3 per crew member per day
Ear Plugs	264	HDR	4 pair per crew member per day
Antibacterial Wipes	4	HDR	Large containers
Water Cooler	1	HDR	5-gallon
Disposable Cups	264	HDR	4 per crew member per day
Water Soluble Deodorizer	1	HDR	1-gallon
Hand Held Sprayer	1	HDR	3-gallon size
Duct Tape	2	HDR	Two rolls, two colors
Batteries for Scales	6	HDR	One set of 3 back-up batteries for each scale
Garbage Bags	1	HDR	Box

ITEM	NUMBER	SOURCE	COMMENTS
Markers	3	HDR	
Pens	1	HDR	1 box
Storage Clipboard	3	HDR	
Camera	1	HDR	
Ratchet Straps	4	HDR	For transport of equipment in truck bed

2.7 Health and Safety Considerations

To ensure the health and safety of the sorting crew involved in the characterization study, a number of preventative measures will be taken. The following personal protective equipment (PPE) will be used by all members of the sorting crew and HDR staff:

- Hard bottomed, non-slip, steel toe boots;
- Safety vests;
- Hard hats;
- Safety glasses (clear plastic);
- Inner nitrile gloves; and
- Outer rubber cut and puncture resistant gloves.

The following additional, optional PPE will be available to all members of the sorting crew and HDR staff should they choose to utilize them:

- Tyvek (or equivalent) disposable coveralls;
- Dust masks; and
- Earplugs.

Safety features provided at the site will include:

- Portable emergency eyewash kit;
- First aid kit;
- Water; and
- Access to rest room facilities.

The following safety procedures will be followed:

- Do not open any containers;
- Do not touch syringes or suspicious materials (including any materials with red staining, containers taped together, or an unusual amount of ammonia bottles, cold capsules or similar containers; these items may indicate methamphetamine paraphernalia) - move these materials to the designated hazardous/special waste container using shovel (preferred) or hand tools;
- Do not touch other potentially hazardous materials - move these materials to the designated hazardous/special waste container using shovel (preferred) or hand tools;
- Manage recyclables with tongs or hand rakes;
- Work from the sorting tables instead of the ground;
- Stay inside the sorting area designated by safety cones or barricades (away from heavy equipment operation);
- Take water breaks as needed; and
- No eating in the sorting area.

3.0 SAMPLE SELECTION

As previously outlined, this characterization study involves the capture and sampling of MSW from three primary generator types: residential, ICI, and mixed-loads. Vehicles will be selected for sampling based on a systematic approach, which will consist of taking every “nth” vehicle that enters the facility after a randomly selected start time. The sampling interval (n) will be determined by dividing the day's expected number of arriving vehicles hauling MSW by the number of samples needed on that day. The expected number of arriving vehicles will be based on historical scale house transaction data. Incoming vehicles will be selected by the HDR Field Supervisor and/or the scale house attendant.

The driver of the selected collection vehicles will be interviewed to determine the generator type - residential, ICI, or mixed-load. This will ensure that sort data from each of these generators can be used to develop a waste characterization specific to each generator type, as well as a combined characterization of all disposed waste.

Vehicles hauling exclusively C&D will be excluded from the vehicle count and sampling scheme. Ten random C&D loads will be selected throughout the six day sampling event for visual assessment by the HDR Field Supervisor. This is discussed in greater detail in Section 6.0.

4.0 MATERIALS TO BE SORTED

The materials selected for sorting during the characterization study are identified in Table 3. All materials will be sorted into the following 49 pre-defined categories.

TABLE 3 - MATERIAL CATEGORIES & DESCRIPTIONS

PAPER	
Newsprint	Black and white newspaper news print including other paper normally distributed inside a newspaper such as colored advertisements, comics, fliers, tabloids.
Magazines	All magazines plus promotional materials printed on slick paper.
High Grade Office Paper	High grade continuous form computer paper, white paper including bond, photocopy or notebook paper and colored ledger paper primarily from offices.
OCC and Kraft Bags	Uncoated old corrugated containers (OCC) with a wavy core and not contaminated with other materials such as a wax or plastic coating. Includes brown paper bags.
Mixed Recyclable Paper	Box board - Uncoated; primarily used for boxes (such as cereal boxes and egg cartons), envelopes with and without windows, toilet paper cores and other mixed recyclable paper. Includes books.
Non-Recyclable Paper	Plastic or metal coated paper including cartons, photographs, and carbon paper.
Compostable Paper	Paper products including wax-coated paper, napkins, paper towels, frozen food packaging, tissues, paper plates, cups, and pizza boxes.

PLASTICS	
#1 Polyethylene Terephthalate (PET) Containers	Plastic containers coded #1 used for containing soda, water, fruit juice, sports drink, ice tea, liquor, hand soap, condiments, etc.
#2 High Density Polyethylene (HDPE) Containers	Plastic containers such as milk jugs, shampoo bottles, and laundry detergent bottles coded #2.

Other Plastic Containers	Plastic Containers coded #3, #4, #5, #6, #7.
Other Plastic Products	End-user products including molded toys, extruded pipes and hoses, clothes hangers, cleaning tools, plastic utensils, razors, and Styrofoam.
Film/Wrap/Bags	Trash bags, grocery bags, storage bags, sheet film.

METALS	
Aluminum Beverage Containers	All beverage containers made from aluminum used for containing soda, fruit juice, sports drink, ice tea, beer, soda water or similar carbonated drinks.
Ferrous Containers	Tin and steel food and beverage containers, aerosol cans, paint cans, etc.
Other Ferrous Metals	Ferrous metal besides containers, including clothes hangers, sheet metal products, pipes, miscellaneous metal scraps, and other magnetic metal items.
Other Non-Ferrous Scrap	Other aluminum scraps besides beverage containers. Also includes other non-ferrous metal scrap such as brass, copper, or other non-magnetic metal.

GLASS	
Clear Glass	All clear glass food, beverage, wine, liquor and beer containers.
Green Glass	All green glass food, beverage, wine, liquor and beer containers.
Blue Glass	All blue glass food, beverage, wine, liquor and beer containers.
Brown Glass	All brown glass food, beverage, wine, liquor and beer containers.
Other Mixed Cullet	Glass items other than food and beverage containers. Includes ceramics, drinking glasses, glass plates, cooking utensils, ash trays or mirrors.

YARD WASTE	
Grass and Leaves	Debris such as grass clippings, leaves, and garden waste. Yard waste does include tree stumps.
Brush and Trees	Brush, branches, trees.

Food Waste	Food preparation waste, food scraps, spoiled food.

WOOD	
Non-Treated	Pallets, crates, and wood not defined below as treated.
Treated	Wood that is painted, stained, treated for exterior use, or glued such as plywood.

DURABLES	
Electrical and Household Appliances	Toasters, stereos, other small appliances and electronic equipment.
Central Processing Units/Peripherals	Computer components except for monitors.
Computer Monitors/TV's	
Cell Phones and Chargers	
Other Durables	Household furniture and mattresses.

HOUSEHOLD HAZARDOUS WASTE (HHW)	
Automotive Products	
Paints and Solvent	
Pesticides, Herbicides, Fungicides	
Household Cleaners	
Lead Acid Batteries	
Other Batteries	
Mercury Containing Products	Thermostats, thermometers, light switches.
Other HHW	

Construction & Demolition Debris (C&D)	Building materials including metals and rubble from construction or demolition of structures. Includes carpets, rugs, bricks, mortar, shingles, and drywall. Wood should be sorted into the wood categories.

Textiles and Leathers	Clothing and apparel, shop rags, blankets, shoes, leather products such as wallets, purses, and belts.

Diapers	Adult or infant disposable diapers, clean or soiled.

Rubber	Rubber tubing, mats, hose, and some shoes.

Tires	Tires from cars, trucks, bicycles, and other devices.

Sharps	Hypodermic needles.

Other Organic	Organic (carbon-based) items not classified as part of the other material categories. Includes hair, leather that is not clothing, animal wastes, etc.
Other Inorganic	Inorganic items not classified as part of the other material categories. Includes inert materials such as rocks and dirt.

Fines/Super Mix	Residuals (2 inches or less in size) remaining once the sample has been sorted. Includes dirt, broken glass, shreds of paper, organics, and other difficult to identify or separate items.

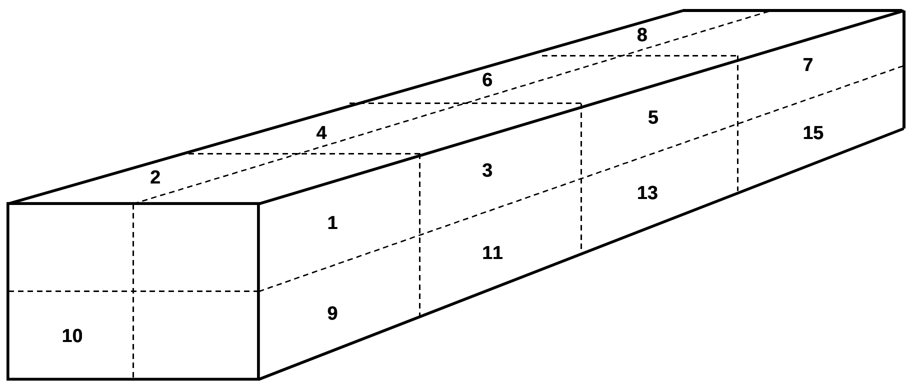
Other	Please specify.

5.0 GENERAL SORTING PROTOCOL

5.1 Sampling Procedures

The selected loads of waste will be dumped in elongated piles, typically five to eight feet high. From each selected load, a sample will be selected using an imaginary 16-cell grid superimposed over the dumped material.

FIGURE 1 - 16-CELL GRID FOR SAMPLING



The HDR Field Supervisor will identify a randomly-selected cell to be extracted from each load. A sample of waste weighing at least 200 pounds will be obtained from the selected cell and transported to the facility scale to ensure that it meets this minimum weight requirement. Only one sample will be taken from each selected load. Close supervision of sampling will be maintained in order to minimize sampling bias or other impacts on the integrity of the data, as well as to minimize impacts on facility operations.

Each sample will be placed on a clean tarp near the sorting area. The HDR Field Supervisor will record the date, sample ID number, and route information on a label and attach the completed label to the tarp with the sample. The Field Supervisor will also complete the top portion of the corresponding Field Data Sheet (see Table 4) including:

- Date;
- Sample ID number;
- Generator type (residential, ICI, or mixed-load);
- Any visual notes; and
- Weather information (as appropriate).

5.2 Sorting Procedures

Materials will be sorted by manual separation and measurement, supported by visual observation. Manual sorting will be conducted on samples taken from each selected load.

1. Workers will move all materials in the sample to the sorting tables, opening bags with a cutting tool as necessary. Once the contents are emptied onto the table, empty bags shall be placed in the specified bin for plastic film/wrap/bags for the sample so as to be included in subsequent observation and weighing.

2. Each table will have a set of empty, specifically labeled bins for sorting each of the materials identified in Table 3. Only materials associated with one material category will be placed in each bin. Tare weights

for the bins will be recorded by the HDR Crew Chief prior to the start of each day's sorting activities.

3. All workers will wear PPE (as described in Section 2.7) while in the sorting area, and will work solely from tables (versus the ground). The use of tongs or hand rakes for sorting will be strongly encouraged. Closed or sealed containers will not be opened[2]. Any suspicious, potentially dangerous or hazardous materials will not be touched directly, but moved to the designated hazardous/special waste container with shovel (preferred) or hand tools for subsequent observations and weighing.

4. The HDR Crew Chiefs will be available during the sorting process to answer questions regarding material classifications and sorting procedures. Any questionable materials will be set aside and an HDR Crew Chief will make a determination about its classification.

5. The sorting crew for each table will work on sorting only one sample at a time.

6. If a bin becomes full during sorting, the bin will be weighed by the HDR Crew Chief and the weight will be recorded to the nearest 0.1 pound on the appropriate Field Data Sheet (see Table 4). Any visual observations made by the sorters will be brought to the attention of the HDR Crew Chief at that time.

7. Once weighed, bins will be emptied in a designated location for removal from the sort area by facility staff.

8. Once each sample has been fully sorted, the HDR Crew Chief will oversee the collection and measurement of any sample residue from the sorting table and sample tarp, and from the area surrounding the sorting table. (Residue will typically include no discernable sort materials or materials that cannot be sorted due to moisture, small size or inability to identify).

9. At the completion of sorting each sample, all containers will be moved to a scale where the HDR Crew Chief will weigh each container and record the gross weight on the appropriate Field Data Sheet generated for each sample. All measurements will be made to the nearest 0.1 pound.

10. At the end of the sorting event the sorting area will be returned to its original condition. No waste will be left in the sort area unless authorized by facility staff.

During the sorting event, the HDR Field Supervisor and Crew Chiefs will confirm all visual observations and take photographs as appropriate, of key loads, samples and materials including:

- Collection vehicles selected for sampling;
- Collection vehicle loads once tipped but before they are sampled;
- Samples prior to sorting;
- Subcategories on the material list (such as types of plastics or paper); and
- Questionable materials (such as potentially hazardous waste) and contamination.

[2] However, in those cases where food or beverage containers include liquids or foods that notably increase the weight of the container itself, the fill level will be observed and noted on the Field Data Sheet for that sample.

TABLE 4 - FIELD DATA SHEET

Date: ___________________ **Sample ID #:** _______________

ROUTE INFORMATION:		
Generator Type (circle one):	**Type of Vehicle (circle one):**	**Other Notes:**
Residential	Rear-load	Hauler:
ICI	Front-load	Truck #:
Mixed Load	Side-load	
	Roll-off	

VISUAL LOAD OBSERVATION:

WEATHER INFORMATION:

MATERIAL CATEGORIES		**WEIGHTS**	**OBSERVATIONS**
PAPER	Newsprint		
	Magazines		
	High Grade Office Paper		
	OCC and Kraft Bags		
	Mixed Recyclable Paper		
	Non-Recyclable Paper		
	Compostable Paper		

PLASTICS	#1 PET Beverage Containers		
	#2 HDPE Containers		
	Other Plastic Containers		
	Other Plastic Products		
	Film/Wrap/Bags		
METALS	Aluminum Beverage Containers		
	Ferrous Food and Beverage		
	Other Ferrous Metals		
	Other Non-Ferrous Scrap		
GLASS	Clear Glass		
	Green Glass		
	Blue Glass		
	Brown Glass		
	Other Mixed Cullet		

YARD WASTE	Grass and Leaves		
	Brush and Trees		
WOOD	Non-Treated		
	Treated		
DURABLES	Electrical and Household Appliances		
	Central Processing Units/Peripherals		
	Computer Monitors/TV's		
	Cell Phones and Chargers		
	Other Durables		
HHW	Automotive Products		
	Paints and Solvent		
	Pesticides, Herbicides, Fungicides		
	Household Cleaners		

	Lead Acid Batteries		
	Other Batteries		
	Mercury Containing Products		
	Other HHW		
OTHER	Food Waste		
	C&D		
	Textiles and Leathers		
	Diapers		
	Rubber		
	Tires		
	Sharps		
	Other Organic		
	Other Inorganic		
	Fines/Super Mix		
	Other		

6.0 C&D VISUAL ASSESSMENT PROTOCOL

6.1 Sampling Procedures

In addition to the 50 samples of MSW to be selected and sorted during the study, throughout the course of the week, HDR will also randomly select 10 dedicated loads of C&D debris for a separate visual characterization.

The driver of each vehicle selected for observation will be interviewed to gather information specific to the load, including the name of the hauling company, source of waste (i.e. business waste or waste from a construction site), and origin of waste (city). The HDR Field Supervisor will also obtain both the gross and tare weights for each selected C&D load from the landfill scale house attendant.

The selected loads of C&D will be dumped in elongated piles, typically five to eight feet high, in an area designated by City staff. The HDR Field Supervisor will then visually examine the selected, dedicated load of C&D debris to estimate the percent by volume for each material category listed in Table 5. An estimate of the percent by volume contained in each load will be recorded on an individual data forms for each selected load.

During the analysis phase of the study, the estimated volumes will be converted into weights using industry-accepted conversion factors for each material category.

TABLE 5 – C&D VISUAL OBSERVATION SHEET

Date: ____________________ **Origin of Waste:** ______________________ **Sample ID #:** _____________

ROUTE INFORMATION:		
Hauler:	**Vehicle Type:**	**Source of Waste:**

VISUAL LOAD OBSERVATION:

WEATHER INFORMATION:

MATERIAL CATEGORY	ESTIMATED PERCENT BY VOLUME
Drywall/Gypsum	
Wood (Non-Treated)	
Shingles	
Durables – Electrical Appliances, Computers, TVs	
OCC	
Wood (Treated)	
Concrete/Rubble/Bricks	
Carpet	
Metal	
Yard Waste	
Glass	
Food Waste	
Paper	
Plastic Film/Wrap/Bags	
Plastic – Other	
Other – Bags of Garbage, Tar Paper, Aluminum and Tin Cans, Insulation, Tires, Etc.	
Total	**100%**

7.0 ANALYSIS OF RESULTS

Following the sorting event, the HDR Team will analyze the data collected to determine:

- The composition of each individual sample;
- The aggregate composition of all MSW delivered to SFRSL;
- The aggregate composition of MSW by generator type (residential, ICI, and mixed-load);
- The aggregate composition of C&D debris delivered to SFRSL; and
- Overall interpretation of the results.

HDR will develop a summary report of the findings including tabulated and charted annualized percentages of the defined material categories. The report will also include all raw data collected during the sorting event.

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We practice increased use of sustainable materials and reduction of material use.

City of Sioux Falls
SOUTH DAKOTA

City of Sioux Falls Solid Waste Management Master Plan

Appendix B: Task 2 – Collection System Alternatives Technical Memorandum

HDR

July 2016

Task 2 - Collection System Alternatives Technical Memorandum

Solid Waste Management Master Plan

City of Sioux Fall, SD
July 2016

City of Sioux Falls

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Appendices:

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1 Introduction & Purpose

The City of Sioux Falls (City) has initiated the development of a comprehensive Solid Waste Management Master Plan (SWMMP) to guide the continued operation and expansion of the solid waste program. The purpose of the SWMMP is to provide a 30-year road map to the City for the continued efficient, economical and environmentally responsible operation and expansion of the solid waste program.

Collection services are an integral part of any solid waste system, and therefore should be considered through the master planning process. As such, one of the tasks associated with the development of the SWMMP is to evaluate the current system and alternatives to the current collection system (Task 2 – Collection System Alternatives). The purpose of this technical memorandum (TM) is to summarize the efforts associated with Task 2.

In order to gain a better understanding of common practices and associated costs for collection services in the region, HDR conducted a benchmarking of several communities in the region to document key metrics related to their respective collection systems, in order to allow for comparisons to the City's current system. We worked with City staff to determine the most appropriate communities to use in the benchmarking and to finalize the questions/metrics to be obtained. Our evaluation includes identification and high-level analysis of potential collection system alternatives for consideration in the SWMMP.

2 Collection Services Overview

Generally, there are three main types of providers for collection services, referred to in the TM as "municipal," "open/subscription" and "franchise/contract." Each of these types of providers for collection services is explained in more detail below. Within each type of service, the provision of curbside collection services can be mandatory (also referred to as universal), meaning residents are required to pay for and receive the service, or not mandatory, meaning the residents can elect to pay for and receive curbside service but it is not required.

Whether commercial garbage collection services are included in organized collection systems varies by community, and can influence rates for services for all customer types. In communities that include commercial garbage collection as part of the organized collection service, a larger customer base can allow for greater economies of scale, which may reduce costs and rates; however, commercial collection service requires different collection vehicles and containers, and therefore does not guarantee lower costs.

Municipal Collection Service

Municipal collection service refers to a system that uses municipal crews (e.g. city employees) and municipally-owned equipment to provide collection service, and typically implies a mandatory or universal system in which residents are required to use and pay for the municipal-provided service. Commercial businesses can be included in the mandatory/universal service for garbage collection, or commercial service can be left open to competition. It is most common for commercial recyclables collection service to be left to the open market, even if municipal collection of garbage is provided to residential and commercial customers. Table 1 presents advantages and disadvantages with municipal collection.

Table 1 – Municipal Collection Advantages and Disadvantages

Municipal Collection	
Advantages	**Disadvantages**
• Provides the City with the most control over collection services	• Customers do not get a choice in service provider
• Less large vehicle traffic on streets (increased public safety, fewer emissions, less wear and tear on roads)	• Implementation could displace some haulers
• Economies of scale with one service provider could mean more efficient and therefore less expensive collection costs	

Open/Subscription Collection Service

Open/subscription collection service refers to a system in which residents and/or businesses subscribe for collection services directly with haulers that are licensed to collect in the community. Whether residents and businesses are required to subscribe for collection services varies by community. It is fairly common for a community that has either municipal or franchised collection for residential services to have an open/subscription system for commercial collection, though there are communities that include commercial garbage collection service in the municipal or franchised system (again, commercial recyclables are most commonly left to the open market). Table 2 presents advantages and disadvantages with open/subscription collection.

Table 2 – Open/Subscription Collection Advantages and Disadvantages

Open/Subscription Collection	
Advantages	**Disadvantages**
• Customer choice in service providers	• City has very little control over collection services
• Multiple haulers, including local/independent haulers, can provide service	• Multiple large vehicles traveling on the same streets (increased risk to public safety, more emissions, more wear and tear on roads)

Sioux Falls Current Collection Service

The City's current collection system is commonly referred to as an "open" or "subscription" based collection service. Chapter 110 (Licensing) of the City's code of ordinances covers the licensing requirements and fees for haulers in the City. Licenses are issued by the Public Works Department. At the time of this writing, twenty-one (21) haulers are licensed to collect municipal solid waste (MSW) and recyclables in the City. Construction and demolition debris (C&D) haulers do not currently have to hold a City-issued license, although the City is considering requiring a licensing procedure for C&D haulers as well in the near future.

While the City has an open/subscription system in place, the City's ordinances provide some control over collection services generally, as well as specific requirements designed to increase recycling. Residents and businesses in the City are required to subscribe for once per week garbage collection service, per Chapter 57 (Garbage and Recycling) of the City's code of ordinance. Residents may also self-haul their waste and recyclables directly to the landfill and/or to a recycling facility. Chapter 57 requires a minimum of every other week collection of recyclables, single stream, for those who subscribe to curbside collection service, and yard waste must be collected a minimum of once per week. Licensed haulers are required to establish a pay as you throw (PAYT) rate system in order to incentivize recycling. Section 57.033 of Chapter 57 requires that all waste generated in the City be disposed at the City's landfill. Certain materials, including certain recyclables and yard waste, are banned from disposal in the landfill. Further, licensed haulers are required to annually achieve a standard of 80% of the City's recycling goal and file required reports, per Section 57.081 of Chapter 57.

Franchise/Contract Collection Service

Franchised/contracted collection service refers to a system where a community grants a franchise to (or signs a service contract with) hauler(s) to provide collection services. There are **Exclusive Franchises**, in which one hauler is granted the exclusive rights to collect within a service area; and there are **Non-Exclusive Franchises**, in which multiple haulers are granted the right to collect within a service area. There is a wide variety of approaches for franchised systems. Table 3 summarizes the different variations and presents advantages and disadvantages for each.

Table 3 – Franchising Approaches, Advantages and Disadvantages

Name	Description	Advantages	Disadvantages
Exclusive Franchise, subscription	One hauler per service area; residents subscribe for garbage and/or recycling service	• One hauler/agreement to administer • Less large vehicle traffic on streets	• No guarantee of customer base for hauler (difficult for pricing) • No choice of hauler for residents • Implementation could displace some haulers
Exclusive Franchise, universal (mandatory)	One hauler per service area; residents required to pay for garbage (and perhaps recycling service, as a policy decision)	• One hauler/ agreement to administer • Guaranteed customer base and economies of scale • Recycling participation may increase if residents are required to pay for the service • Less large vehicle traffic on streets	• No choice of hauler for residents • Residents have to pay for service • Implementation could displace some haulers
Exclusive Franchise, hybrid	One hauler per service area; could require garbage collection (universal/mandatory), require the hauler to offer recycling collection, but let recycling collection be subscription based (resident subscribes)	• One hauler/ agreement to administer • Guaranteed customer base for garbage collection • Residents could choose to subscribe for recycling (or not) • Less large vehicle traffic on streets	• No choice of hauler for residents • Residents have to pay for garbage collection • May decrease recycling participation • Implementation could displace some haulers
Non-exclusive franchise, subscription	Let the existing haulers remain; licensing procedure becomes a non-exclusive franchise with an agreement signed by the hauler; require the haulers offer recycling as part of their non-exclusive agreement. Residents subscribe for service (are not required to have service)	• Residents can choose which hauler, if any • Similar to current system	• Less customer base than non-exclusive, universal
Non-exclusive franchise, universal (mandatory)	Let the existing haulers remain; licensing procedure becomes a non-exclusive franchise with an agreement; require the haulers offer recycling as part of their non-exclusive agreement. Residents are required to subscribe for service with one of the five.	• Residents can choose which hauler • Haulers continue to compete to provide service (good for pricing) • Larger customer base potential than non-exclusive subscription	• Residents have to subscribe for service
Non-exclusive franchise, hybrid	Let the existing haulers remain; licensing procedure becomes a non-exclusive franchise with an agreement signed by the hauler; require the haulers offer recycling as part of their non-exclusive agreement. Residents are required to subscribe for garbage, but not recycling (recycling voluntary subscription).	• Residents can choose which hauler • Haulers continue to compete to provide service (good for pricing) • Larger customer base potential than non-exclusive subscription • Residents can choose	• Residents have to subscribe for garbage service • May decrease recycling participation
Non-Exclusive franchise, limit # of haulers	For any of the non-exclusive franchise systems (subscription, universal, hybrid), the total number of haulers allowed to hold non-exclusive franchises could be limited.	• Residents still have some choice of which hauler • Less large vehicle traffic on streets	• Residents will not have as many choices in haulers as in unlimited number of hauler approach • Implementation could displace some haulers

3 Benchmarking

HDR worked with City staff to determine which cities would be included in the benchmark effort. Communities that the City commonly uses for comparison purposes in other circumstances were originally selected for benchmarking, including: Cedar Rapids, IA; Fargo, ND; Lincoln, NE; Rapid City, SD; Rochester/Olmstead County, MN; and Sioux City, IA. After the initial information was gathered for these communities, it was noted that each community either had an open system or a municipal system; therefore, it was determined that additional communities should be added to the comparison exercise in order to provide insight into a franchise/contract collection approach. (Saint Paul, MN and West Des Moines, IA were subsequently added to efforts.) Table 4 provides general demographic information and the basic approach for providing collection services for each of the eight benchmark communities, as well as Sioux Falls. The full benchmark matrix is included in Appendix A.

Table 4 – Benchmark Communities General Information

Community	Population (Census 2015)	Households (Census 2010 – 2014)	Collection Approach / Service Provider
Sioux Falls, SD	171,544	64,197	Open/Subscription
Cedar Rapids, IA	130,405	53,125	Municipal
Fargo, ND	118,523	48,958	Municipal
Lincoln, NE	277,348	106,512	Open/Subscription
Rapid City, SD	73,569	28,244	Municipal
Rochester/Olmstead County, MN	111,402/ 149,000	43,651	Open/Subscription
Saint Paul, MN	300,851	112,407	Open/Subscription, moving toward contract/franchise organized collection
Sioux City, IA	82,517	31,419	Municipal
West Des Moines, IA	64,113	25,261	Franchise/Contract

Based on these benchmark communities, it appears that organized collection is more prevalent in Iowa than the other states represented in the benchmark communities. Some of the communities with municipal collection reported that the implementation of organized collection was driven by State law and that organized collection has been in place for a very long time.

Sioux Falls is one of the largest of these cities in terms of population and number of households to have an open/subscription system, with the exception of Lincoln, NE and Saint Paul, MN. However, the City of Saint Paul is in the process of organizing collection.

Open/Subscription Systems

Table 5 summarizes some comparisons of the benchmark communities with open/subscription collection service for residential customers. Each of the communities has some form of licensing procedure, though the jurisdiction that resides over the licensing varies (city, county, state). Only one of the communities, Rochester/Olmstead County, limits the number of haulers that are allowed to be licensed to collect. When considering the ratio of haulers to households, the community that limits the number of haulers has the second highest number of households per hauler.

Table 5 – Open System Comparisons

	Sioux Falls, SD	Lincoln, NE	Rochester/Olmstead County, MN	Saint Paul, MN
Licensing procedure	Yes, City	Yes, State	Yes, County	Yes, City
Limit # of haulers	No	No	Yes	No
# of current haulers	21	44	8	14
Ratio (# of households / # of haulers)	3,057	2,421	5,456	8,029

Figure 1 compares the number of households per hauler for each of the communities benchmarked. As shown, haulers in communities with organized collection provide service to a much higher number of households than the haulers in communities with open collection systems.

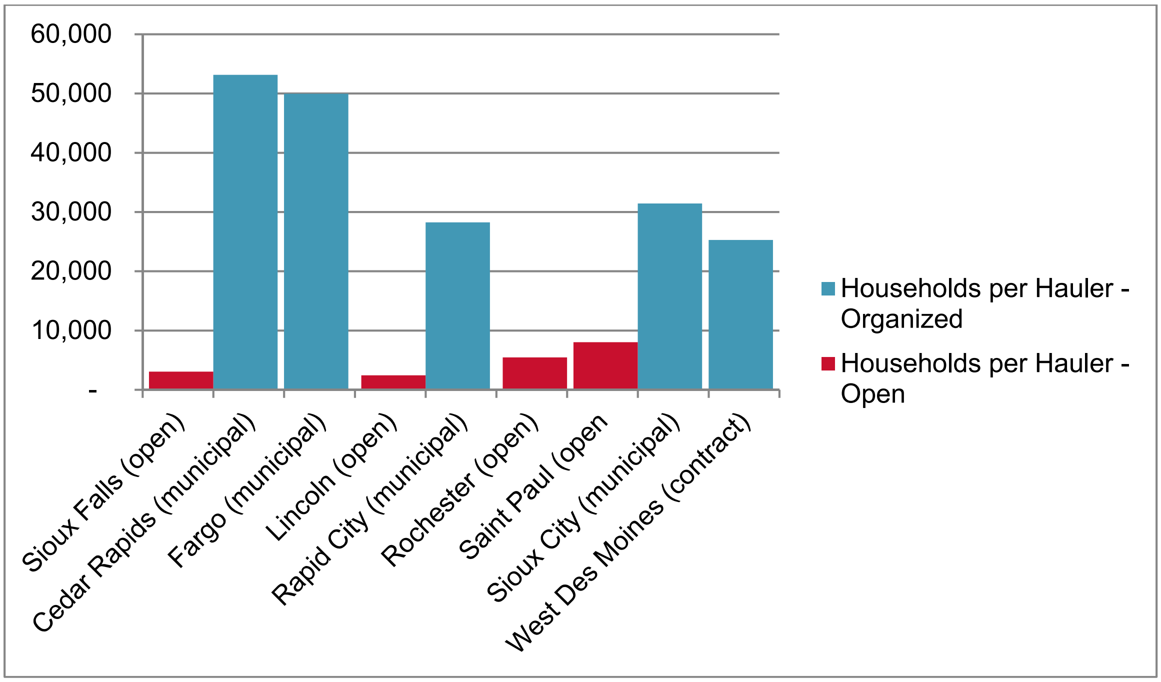

Figure 1 – Households per Hauler Comparisons

Case Study - Saint Paul, MN

With Saint Paul in the process of organizing collection, it was worth a closer look at the process they have undertaken. Saint Paul began looking into organized collection in early 2016 when the City Council passed a resolution directing the department of Public Works to solicit input from residents using a variety of techniques in order to develop draft goals and objectives for implementing a system of organized trash collection within the City. The City undertook a tremendous public information campaign including the development of a website link designed specifically to provide information and solicit feedback on the topic, called "Organized Trash Collection" (https://www.stpaul.gov/residents/live-saint-paul/utilities/organized-trash-collection). As part of this effort, residents were encouraged to participate in a residential survey and to send in their trash collection bills so that the City could evaluate current collection rates under the open system. There were also notices and updates on efforts to organize collection provided through traditional media outlets such as local newspapers as well as social media outlets. Direct mail pieces and brochures were developed, and focus group meetings and one-on-one conversations at community meetings were conducted.

Public Works staff also met with 12 of the 14 licensed, residential haulers (4 are considered to be national/regional haulers and ten are considered to be local/independent haulers). Some of these meetings occurred in groups, and some were with individual haulers. Haulers expressed their concerns associated with the potential for organizing collection including limited opportunities to grow their business and the inability of local haulers to be able to absorb lower rates in the same manner as national/regional haulers.

Nearly 2,000 residents provided input through the community survey efforts. As provided in the Organized Trash Collection Report on Community Input and Draft Goals, Table 6 summarizes the key items residents consider when choosing a trash hauler. The items are ranked by the percentage of respondents considering it important or very important.

Table 6 – Saint Paul Community Survey Results

Rank	Item	High or Very High	Neutral	Low or Very Low
1	Consistent, Quality Customer Service	89.9%	6.3%	3.1%
2	Stable, Uniform Rates	81.5%	11.5%	9%
3	Reasonable, Low Cost	79.7%	14.6%	4.8%
4	Reduction in Illegal Dumping	61.4%	19.1%	17.8%
5	Financial Incentives to Recycle More	61%	17.9%	19.5%
6	Reducing Wear & Tear From Truck Traffic	60.3%	16.8%	21.3%
7	Pollution Concerns Related to Trucks	58.7%	16.1%	24.2%
8	Options for Convenient Disposal of Bulky Items	58.1%	23.2%	17.6%
9	Opportunities for Small, Local & Minority Owned Trash Haulers	58%	22.7%	18.2%
10	Noise Concerns Related to Trucks	52.1%	17.3%	29.1%
11	Safety Concerns Related to Trucks	42.2%	20.4%	35.1%
12	Easy Access for New Residents & Non-English Speakers	41.4%	28.5%	27.6%
13	Individual Choice of Hauler	33.9%	13.1%	51.8%

Source: Organized Trash Collection in Saint Paul: Report on Community Input and Draft Goals and Objectives; Saint Paul Public Works, June 1, 2016

Twelve of the thirteen items ranked as “high or very high” by the respondents could be considered benefits or potential benefits of organized collection; the only exception being individual choice of hauler, which has a greater percentage of “low or very low” ranking than “high or very high” in this survey.

As noted on the Organized Trash Collection website, the City Council has placed a priority on maintaining opportunities for small, local haulers. The following list shows there are several different models that could be utilized to organize trash hauling in the City of Saint Paul.

- Consortium – existing licensed haulers work together to propose a new system that meets the city’s needs and priorities.
- City-wide competitive bidding – the city releases an RFP for trash collection and individual haulers are allowed to bid.
- Zoning Grid – the city is divided into several districts and haulers could bid competitively on each zone.

There are several procedural steps a city in Minnesota must take before it is authorized to adopt organized collection, which are spelled out in Minnesota State Statute 115A.94, Organized Collection. The next steps for Saint Paul are outlined on the Organized Trash Collection website and include the following:

- The City will develop a detailed scope of work that supports the new trash collection system goals and objectives. This scope of work will be the foundation for the negotiation process with current licensed haulers. Feedback from residents to date will be considered in developing these priorities.
- During the second quarter of 2016, the City will publicly announce their intent to undertake the process. This will start a minimum 60 day period where haulers can first attempt to self-negotiate a contract with the City. If all parties agree, this 60 day period can be extended.
- If this process is not successful, the City will establish an Organized Collection Options Committee, as required by MN Statute, to identify, examine, and evaluate various methods of organized collection. This committee will issue a report outlining their recommendations to the City Council.
- The City Council will consider the report and recommendations of the Organized Collection Options Committee. They must provide public notice and hold at least one public hearing before deciding whether to implement organized collection.
- If, after a reasonable period of time and good faith efforts to negotiate fail, the City can release a RFP for collection services.
- Organized collection may begin no sooner than six months after the effective date of the decision of the City Council to implement organized collection.

South Dakota Relevant State Law

Should the City of Sioux Falls decide to organize collection, it appears that the City would have the legal right to do so. Based on a preliminary review of South Dakota Legislature (in particular Chapter 34A-6: Solid Waste Management), a municipality has the right to grant a franchise for collection, though the franchise cannot be granted for a period longer than ten years. Section 34A-6-24 explicitly provides such authority:

> *34A-6-24. Municipal grant of franchises--Maximum period. Any municipality may grant and regulate franchises for the purpose of collection and disposal of solid waste, as defined in subdivision 34A-6-1.3(17), if the solid waste originates in the municipality or in a zone adjacent to the municipality that is not a part of another municipality, and does not exceed two miles around the boundaries of the municipality. The franchise may not be granted for a longer period than ten years.*

State law also allows for the establishment of districts, which could allow the City to form a collection district including more than just the City boundaries, if it is determined to be desirable to involve surrounding areas. Relevant sections of Chapter 34A are included below.

> *34A-16-1. Creation of a regional recycling and waste management district. Any municipality, county, or portion of a county within this state and any one or more other municipalities, counties, or portions of counties within this state may create a regional recycling and waste management district, which may provide facilities and services pursuant to this chapter for the management of solid waste as defined in § 34A-6-1.3. A district may exercise its powers upon filing with the secretary of state a notice of incorporation pursuant to chapter 6-10. A county may be divided into more than one regional recycling and waste management district; however, a municipality may only be included in a district if the entire area of the municipality lies within the district. No geographical area may be included in more than one regional recycling and waste management district, and the lands within a district need not be contiguous, provided that no more than one hundred twenty miles may intervene between noncontiguous areas. The creation of a regional recycling and waste management district shall be authorized by approval of the district's proposed articles of incorporation through a resolution of the*

governing body of each county and municipality listed in the proposed articles as being necessary for incorporation of the district. No county or municipality may be included in a district unless its governing body has adopted an authorizing resolution pursuant to this chapter.

34A-16-7. Powers of each district. The powers of each regional recycling and waste management district are vested in the commissioners of the district. Each district shall adopt procedures for its own operation not inconsistent with its articles of incorporation and this chapter. The articles of incorporation may provide for an executive board with the power to conduct the business of the district. The issuance of bonds and the adoption or modification of ordinances shall be approved by the full governing body. Each regional recycling and waste management district shall organize and elect officers for terms of office to be fixed by the board of commissioners. There shall be elected a chairman and vice-chairman from among the commissioners. A district may employ an executive director, secretary, technical experts or such other officers, agents and employees, permanent and temporary, as it may require, and shall determine their qualifications, duties, and compensation. A district may employ or contract for its own legal counsel, legal staff, engineering, or other professional services.

Based on a preliminary review of State law, it does not appear that regulations regarding procedural steps for implementing organized collection exist. However, further research should be conducted to ensure there are no State rules or regulations that require certain steps and timelines, as was the case in Minnesota described in the Saint Paul case study section of this TM.

Comparison of Curbside Collection Rates

Table 7 summarizes curbside collection rate information obtained from each of the benchmark communities, expressed in dollars per household per month. The primary level and style of garbage collection for each community is once per week and most commonly uses automated carts. For communities with open/subscription collection, either ranges of rates or an average of rates have been provided, as available. Bulk waste collection rates are not included in the table, as it is most common for bulk waste to be at an additional fee on an on-call basis, if the service is offered.

When comparing rates, it is important to remember that there are a variety of factors that can impact cost and rates. However, comparing collection rates can provide some insight. As shown in Table 7 and Figure 2, the communities with organized collection have lower rates than the open/subscription system rate ranges.

Table 7 – Curbside Collection Service Rate Comparisons

Community	Provider [1]	Garbage Rate [2]	Recycling Rate [2]	Yard Waste Rate [2]	Total [2]
Sioux Falls, SD	O	Range: $15 to $35	Included with Garbage	Range: $13 to $18 (seasonal)	Range: $28 to $53
Cedar Rapids, IA	M	$16.02 35-Gal Cart; $1.50 for Additional Stickers	$4.30	Included with garbage	$20.32
Fargo, ND	M	42-gal $6 64-gal $9 96-gal $14	No additional charge (optional)	Not included	$6 to $14
Lincoln, NE	O	$20 avg.	$10 avg.	Included with garbage	$30
Rapid City, SD	M	35-gal $14.99/month 64-gal $16.83/month 96-gal $18.68/month	Included with garbage	Included with garbage	$14.99 to $18.68
Rochester/Olmstead County, MN	O	$30 avg.	Included with garbage	Not included	$30
Saint Paul, MN	O	30-38 gallons: avg. $22; 50 to 68 gallons: avg. $27.19; 90 to 96 gallons: avg. $27.23	Unknown	Unknown	$22 to $27.23
Sioux City, IA	M	$16.30 + $1 per extra bag	Included with garbage	Not included	$16.30
West Des Moines, IA	C	$7.96 48 gal. $8.66 96 gal.	$2.59	PAYT – stickers and bags	$10.55 to $11.25

Note: [1] M = municipal; O = Open/subscription; and C = contract/franchise. [2] Rates expressed in dollars per household per month.

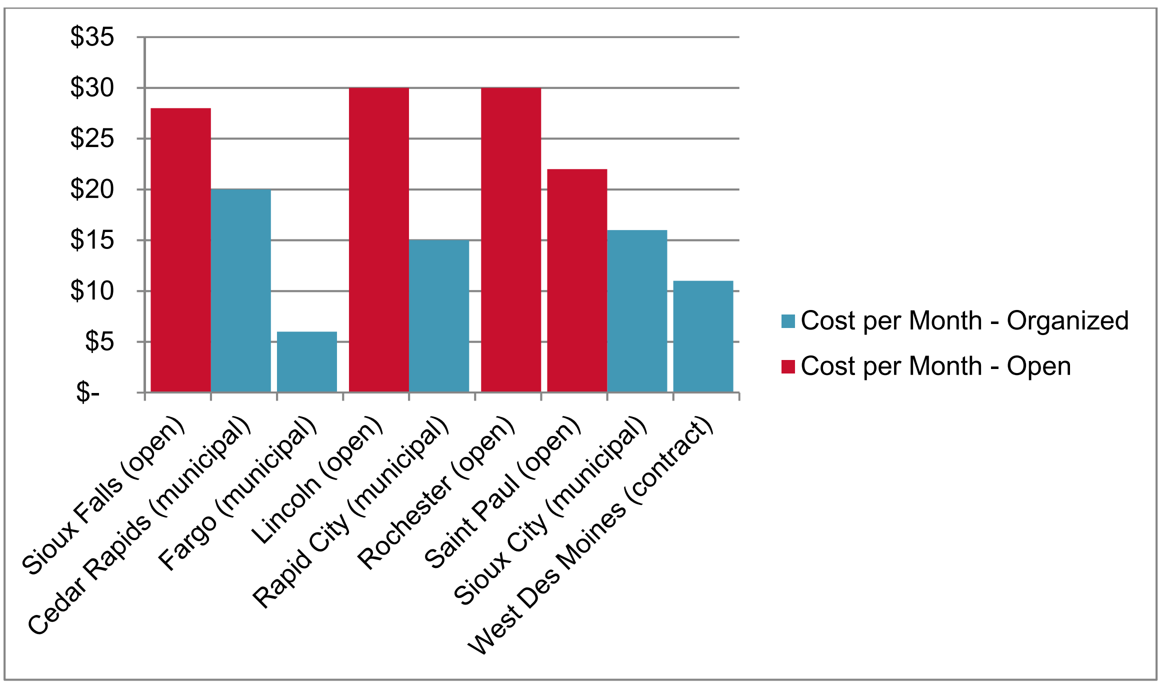

Figure 2- Curbside Collection Rate Comparisons

Although Sioux Falls has some haulers offering rates as low as $15 per household per month for garbage collection, the garbage and recycling rates can be as high as $35 per household per month. Among the other community with open/subscription systems, the lowest rate for garbage collection is in Lincoln at $20 with another $10 for recycling collection; the highest rate is in Rochester at $30 per household per month for garbage, but recycling is included. Conversely, communities with organized collection, have garbage and recycling collection rates ranging from as low as $6 (Fargo), and as high as $20.32 per household per month. Among these benchmark communities, organized collection systems are at least $10 less expensive than open/subscription systems per month.

4 Key Findings

The following summarizes key findings resulting from this Task 2 effort.

- The City currently has 21 different haulers providing collection services, which equates to 3,057 households per hauler. Organized collection typically results in higher economies of scale, and a much higher number of households served per hauler.
- Organized collection advantages outnumber disadvantages; however, organizing collection may displace some haulers and limits the residents' choice in service provider.
    - Main Advantages:
        - Provides the City with the most control over collection services
        - Less large vehicle traffic on streets (increased public safety, fewer emissions, less wear and tear on roads)
        - Economies of scale with one service provider could mean more efficient and therefore less expensive collection costs
    - Main Disadvantages
        - Customers do not get a choice in service provider
        - Implementation could displace some haulers
- Open/subscription service allows residents to choose their hauler and would not displace haulers.
    - Main Advantages
        - Customer choice in service providers
        - Multiple haulers, including local/independent haulers, can provide service
    - Main Disadvantages
        - City has little control over collection services
        - Multiple large vehicles traveling on the same streets (increased risk to public safety, more emissions, more wear and tear on roads)
- Sioux Falls is one of the largest cities in the region, in terms of population and number of households, to have an open/subscription system, with the exception of Lincoln, NE and Saint Paul, MN.
- Although Sioux Falls has some haulers offering rates as low as $15 per household per month for garbage collection, the garbage rates can be as high as $35 per household per month.
- Among the other community with open/subscription systems, the lowest rate for garbage collection is $20 with an additional $10 charge for recycling, and the highest garbage collection rate is $30 per household per month.
- Communities with organized collection included in the benchmark have collection rates ranging from as low as $6 and as high as $20.32 per household per month.
- If the City implemented organized collection (municipal or franchise/contract), revisions to the City Code of Ordinances, Chapters 57 and 110, would need to be drafted and adopted to reflect the changes.
- Based on an initial review, it does not appear State rules or regulations would prohibit or limit the City's ability to organize collections.

5 Recommendations

Given the size of the City and its anticipated continued growth, it is recommended that the City further explore the possibility of organizing collection services. Steps that are recommended for the City include the following:

- The City should conduct a more thorough review of State laws and regulations to ensure there are not certain procedures or timelines that must be followed in order to organize collection.
- Using the efforts of the City of Saint Paul as an example, rigorous community outreach to determine opinions of the residents should first be undertaken. Political will is necessary to undertake such a change, and determining the preference for organized collection among residents should be a first priority.
- Haulers currently serving the City should be included in the outreach to allow their opinions to be heard, and allow them to be a part of the process. Similar to Saint Paul, it may be possible to organize collection with the cooperation of the licensed haulers.
- While this task conducted a high-level evaluation of collection service rates in the different communities included in the benchmark efforts, the City should conduct a more thorough review and evaluation of current collection rates paid by residents in the City, as well as additional comparisons to other jurisdictions with municipal and franchised/contracted collection service to better anticipate the likely impact on rates in an organized collection system.

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Appendix A:

Benchmark Matrix

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	Sioux Falls, SD	Cedar Rapids, IA	Fargo, ND	Lincoln, NE	Rapid City, SD	Rochester, MN/Olmstead County	Saint Paul, MN	Sioux City, IA	West Des Moines, IA
Population (Census 2015)	171,544	130,405	118,523	277,348	73,569	111,402/149,000	300,851	82,517	64,113
Number of Households (census 2010-2014)	64,197	53,125	48,958	106,512	28,244	43,651	112,407	31,419	25,261
Collection service provider *(municipal, contract/franchise, open/subscription)*	Open/subscription	Municipal	Municipal	Open/Subscription	Municipal	Open/Subscription	Currently open, moving toward Franchise/Contract	Municipal	Franchise/Contract (thru Metro Waste Authority)
If Open/Subscription:		Yes - Commercial	Yes - Commercial			Yes	Currently	N/A	No
Is there a licensing procedure in the City?	MSW haulers have to be licensed through the City	N/A	Yes, $1,000 per year for a license.	No, licensing is completed through the State. City collects a surcharge tax on collection to cover the costs of recycling, compositing and other services.	NA	County has a licensing procedure	Yes	NA	NA
Does the City limit the number of haulers that are allowed to collect?	No	N/A	No	No	NA	Yes	No	NA	NA
How many haulers are currently providing collection services in the City?	21	N/A	3	44	NA	8 + School District County is broken into collection zones	14	NA	NA
What collection services are typically included? (e.g. 1 x week garbage, 1 x week recycling)	1 x wk garbage, EOW or 1 x wk recycling, seasonal yard waste	N/A	Commercial Dumpsters/Roll Offs	City ordinance requires weekly collection. Companies offer waste, yard debris and recycling. In 2013 approximately 24% of the residents were recycling.	NA	1 x week garbage Haulers are Required to Offer Recycling	City ordinance requires a minimum of 1 x week garbage collection (Ch. 34)	NA	NA
What is the average (or range of) rate paid per household?	Garbage: $15 to $35 per mo; Recycling: included w/ garbage; YW: $13 to $18 per mo, some PAYT	N/A	N/A	$20/month Garbage $10/month Recycling	NA	$30/month average + 29% residential surcharge	small (30-38 gallons): median price of $22/mo; medium (50 to 68 gallons: median price of $27.19; large (90 to 96 gallons) median price of $27.23	NA	NA
If Municipal or Contract/Franchise:	NA	Municipal		N/A	Yes - Residential	N/A	Moving toward		Yes
In what year was organized collection implemented?	NA	For a long time, driven by the State regulation	For a long time, driven by the State regulation	N/A	Unknown	N/A	Perhaps 2017	Unknown	A very long time ago. Collection was municipal many years ago, and then franchised, but organized collection has been the norm.
What were the main drivers for organizing collection?	NA	City always completed collection.	City always completed collection.	N/A	Unknown	N/A	Consistent, quality customer service. Likely reduces fees for a majority of residents. Stable and uniform rates for residents - eliminates the need for residents to research and negotiate their own fees. Improves efficiency	Unknown	Unknown

	Sioux Falls, SD	Cedar Rapids, IA	Fargo, ND	Lincoln, NE	Rapid City, SD	Rochester, MN/Olmstead County	Saint Paul, MN	Sioux City, IA	West Des Moines, IA
What were the main obstacles to implementing organized collection, if any?	NA		None, required by the State.	N/A	Unknown	N/A	Maintaining opportunities for small, local haulers	Unknown	Unknown
Residential Curbside Garbage:	NA	Yes	Yes	NA	Yes	N/A	NA	Yes	Yes
style of collection	NA	Automatic with Set-Out Restrictions	Variable Rate Automated	N/A	Variable Rate Automated	N/A	NA	Automated with Set-out Restrictions	Automated
frequency of collection	NA	1 x week	1xweek	N/A	1 x week	N/A	NA	1xweek	Weekly
mandatory or optional?	NA	mandatory	mandatory - charged automatically	N/A	mandatory - charged automatically	N/A	Would be mandatory	optional	Mandatory
rate ($) per household	NA	16.02 for 35-Gal Cart $1.50 for Additional Stickers	42-gal $6/month 64-gal $9/month 96-gal $14/month	N/A	35-gal $14.99/month 64-gal $16.83/month 96-gal $18.68/month	N/A	NA	$16.30 + $1 per extra bag	$8.66 96 gal.; $7.96 48 gal.
How is the resident billed? (utility bill, annual tax bill, billed by hauler)	NA	Utility Bill	Utility Bill	N/A	Utility Bill	N/A	NA	Utility Bill	Water bill

	Sioux Falls, SD	Cedar Rapids, IA	Fargo, ND	Lincoln, NE	Rapid City, SD	Rochester, MN/Olmstead County	Saint Paul, MN	Sioux City, IA	West Des Moines, IA
Residential Curbside Recyclables:	NA	Yes	Yes		Yes	N/A			
style of collection	NA	Automatic 95-Gal Cart	Manual	N/A	Manual	N/A	NA	Automated Single Stream	Automated
frequency of collection	NA	1 x week	Every Other Week	N/A	1 x week	N/A	NA	1xweek	Every other week
mandatory or optional?	NA	mandatory	optional	N/A	optional	N/A	NA	optional	Mandatory
rate ($) per household	NA	$4.30	$0	N/A	Included in Garbage	N/A	NA	Included in Garbage	$2.59 per mo.
How is the resident billed? (utility bill, annual tax bill, billed by hauler)	NA	Utility Board	Included in Garbage Rates and Subsidized by Landfill Tipping Fees	N/A	Included in Garbage Rates on Utility Bill	N/A	NA	Utility Bill	Water bill
Residential Curbside Yard Waste:	NA	Yes	No		Yes			N/A	
style of collection	NA	Automatic 95-Gal Cart Can Include Food Organics	N/A	N/A	Manual	N/A	NA	N/A	Automated carts and bags outside of carts
frequency of collection	NA	1 x week	N/A	N/A	1 x week	N/A	NA	N/A	1 x week
mandatory or optional?	NA	mandatory	N/A	N/A	Optional	N/A	NA	N/A	Optional
seasonal?	NA	No	N/A	N/A	Yes	N/A	NA	N/A	Yes, April-Nov w/ 2 week winter collection
rate ($) per household	NA	included in garbage	N/A	N/A	included in garbage	N/A	NA	N/A	User based (PAYT)
How is the resident billed? (utility bill, annual tax bill, billed by hauler)	NA	Utility Bill	N/A	N/A	Included in Garbage Rates on Utility Bill	N/A	NA	N/A	Purchase of stickers and bags from retailer or cart from city
Residential Curbside Bulk Waste:	NA	Yes	Yes		No			No	Thru Garbage Agreement
style of collection	NA	Manual	Manual	N/A	N/A	N/A	NA	N/A	Manual, with stickers
frequency of collection	NA	On-Call	On-Call	N/A	N/A	N/A	NA	N/A	Weekly; appliances on-call
mandatory or optional?	NA	Optional	optional	N/A	N/A	N/A	NA	N/A	Optional
rate ($) per household	NA	Matrix	Fee by Size	N/A	N/A	N/A	NA	N/A	$1 Bag; $5 Bulky; $35 Appliance
How is the resident billed? (utility bill, annual tax bill, billed by hauler)	NA	Added fee to Utility Bill	Charged a pick-up fee. City uses two times per year clean-up day where bulk items at the curb are collected with the garbage service.	N/A	N/A	N/A	NA	N/A	Purchase stickers from retailer
If municipal or contract collection, is **commercial collection service included?**	NA	No, commercial is open/subscription	City has private hauler agreements for commercial. City ordinance requires all waste to stay in Fargo.	N/A	No, commercial is open/subscription	Flow control of the waste in the county. Integrated solid waste plan. Waste to energy disposal. $85/ton plus a surcharge	NA	Unknown how commercial service is handled. (Unresponsive)	No, commercial is open/subscription

City of Sioux Falls
SOUTH DAKOTA

City of Sioux Falls Solid Waste Management Master Plan

Appendix C: Task 3 – C&D MRF Feasibility Review Memo

HDR

September 2016

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Memo

Date:	Friday, September 30, 2016
Project:	Sioux Falls Solid Waste Management Master Plan
To:	Dustin Hansen - Landfill Superintendent
From:	Bob Rella, P.E., Time Raibley, P.E., Doug Decesare, P.E. - HDR Engineering, Inc.
CC:	Allison Trulock - HDR Engineering, Inc.
Subject:	Task 3 – C&D MRF Feasibility Study Report Review

As recently discussed, the scope of work for Task 3 has been modified to include a high-level review of the Feasibility Study for the Construction and Demolition Material Recovery Facility prepared by R.W. Beck in September 2011. This memorandum serves as a summary of comments from our review.

1. **Section 2 – Waste Stream Analysis**
   The waste stream characterization was developed by R.W. Beck based on a visual estimation based on percentage of total volume during a one-day observation of the landfill operations in 2010. This data was then compared to information obtained from two other studies completed in 2006 in Georgia and Texas. The compositional comparison to the two referenced municipalities may also be inconsistent based on area factors. The information is based on a one-day observation six years ago correlated to information in a different region a full decade ago.

   Note that as part of Task 1 of the Solid Waste Management Master Plan, HDR conducted a waste characterization study, including visually examining randomly selected, dedicated loads of C&D debris, using a similar methodology to what was used in 2011. In the May 2016 characterization study, a total of ten loads were selected for visual characterization over the six day sorting period.

   The results of the 2016 study indicated that of the 24,609 pounds sampled, some of the largest material categories found in the C&D loads, by weight, were “Treated Wood” at 22.4 percent and “Durables” at 19.3 percent, while Non-treated Wood was only 3.4 percent. Conversely, Table 2-1 in the R.W. Beck report shows “Treated Wood” at 3.1 percent and “Non-treated Wood” at 25.6 percent, and “Durables” at 8.7 percent. As noted in the 2016 characterization study report, there are a number of limitations associated with the visual inspection and estimation approach that can yield less than statistically accurate results.

2. **Section 4, Table 4-1**
   There seems to be an inconsistency in the description of footnote #5 and the cost information presented in the table. The table shows the construction cost of the building as $2,121,770. Section 3.1 describes a 24,180 square foot building, which equates to a

building cost of approximately $90 per square foot. We are seeing building costs (inclusive of push walls, dust suppression/sprinklers, air management systems for sorters, etc.) in the range of $125 to $140 per square foot. These differences could be due to the age of the report; however, updating the cost section is needed.

3. **Section 4, Table 4-2**
   The table footnote #4 indicates that the capital cost of the wood grinder was not included in the processing equipment capital cost requirements since the City had already procured that piece of equipment; however, it does not mention if the replacement cost for that piece of equipment has been included in the financial pro forma. Also Table 4-2 and 4-3 describe the annual payment based on a 4% interest rate. While this interest rate may be reasonable for capital improvements, equipment loans typically have higher interest rates.

4. **Section 4, Personnel Expenses**
   This section references the use of contract employees as laborers, and payment by the City as a function of only the actual time worked. It should be noted that several municipalities have identified that it has been difficult to maintain a consistent workforce of this nature due to conditions and potentially inconsistent work hours (62% of a typical 40 hour work week). This inconsistency can ultimately effect operations and material quality.

5. **Section 4, Table 4-4**
   The estimated annual salaries utilized in this analysis may need to be re-evaluated based on current conditions.

6. **Section 4, Table 4-5**
   The C&D MRF Operating and Maintenance Expenses seem low in comparison to other similar sized facilities. This is a very harsh environment and maintenance costs can be significant. Also, the reserves for equipment replacement are usually included in the O&M expenses, which are not included in this table.

7. **Section 4, Table 4-6**
   As all are aware, the revenue for commodities has recently sharply dropped. This is not to say that the current low revenue potential should be utilized for this feasibility analysis; however, it should be noted that the pricing can be cyclical, and that the operation needs to be capable of sustaining itself through low market pricing conditions. Also, about 40% of the revenue illustrated on this table is from clean wood ($252K of the $629K total) based on $20/ton for wood. We are observing biomass facilities closing throughout the U.S. as renewable energy contracts originating in the mid 1990's begin to expire. In some areas of the country, this situation has resulted in no market value for wood. However, the City has a partner in Poet that is a more reliable source of revenue for the wood waste stream, who recently increased their wood price to $45/ton, which would improve the revenue illustrated in Table 4-6.

8. **Section 4, Table 4-8**
   This table may need to be revised and/or re-evaluated based on previous comments regarding market conditions. This table concludes the cost of operating the C&D facility is $5 per ton, however if the revenue for wood were to decline from Poet (see item 7 above), the resulting operating cost could double to $10 per ton. This situation indicates a sensitivity analysis of the key cost and revenue factors may be useful to determine the likely low and high range of the C&D facility cost.

9. **Section 4, Table 4-9**
   The document is unclear if the cost of landfilling residues from the C&D MRF is included. It appears there will be approximately 16,000 tons of residue (56,000 tons processed with 40,600 tons recovered plus fines). Also, the recommendation to close the C&D Landfill does not address the cost of managing residues. While we would assume the C&D residues would be landfilled at the MSW landfill, further clarification of this issue is needed.

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City of Sioux Falls
SOUTH DAKOTA

City of Sioux Falls Solid Waste Management Master Plan

Appendix D: Task 4 – Landfill Facility Evaluation & Operations Review Technical Memorandum

July 2016

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Task 4 - Landfill Facility Evaluation & Operations Review Technical Memorandum

Solid Waste Master Plan

City of Sioux Fall, SD
July 2016

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Table of Contents

List of Figures

1 Introduction & Purpose

The City of Sioux Falls (City) has initiated the development of a comprehensive Solid Waste Management Master Plan (SWMMP) to guide the continued operation and expansion of the solid waste program. The purpose of the SWMMP is to provide a 30-year road map to the City for the continued efficient, economical and environmentally responsible operation and expansion of the solid waste program.

The Sioux Falls Regional Landfill (Landfill) is the cornerstone for the solid waste services that the City provides to its communities. Wise management of this resource will ensure economically and environmentally sound solid waste management now and in the future. The City has been a leader in solid waste management for decades, and operates the Landfill at a high level; however, it is a good practice to avoid complacency by looking for opportunities for improvement. As such, one of the tasks associated with the development of the SWMMP is to conduct an evaluation of the landfill operations in order to identify opportunities for improvement and/or efficiencies (Task 4 – Key Landfill Operational Issues). The purpose of this technical memorandum (TM) is to summarize the efforts of Task 4, which focuses on evaluating and assessing the existing operations at the landfill facility to identify opportunities for improved operational efficiencies (big or small).

To gather data in support of this evaluation, the HDR project team requested and reviewed a variety of Landfill engineering, tonnage, and traffic reports, and completed a one-day observation of landfill operations which included a detailed interview with Mr. Dustin Hansen, the Landfill Superintendent. Observations included daily cell opening and closing, active fill operations in both the municipal solid waste (MSW) and construction and demolition waste (C&D) landfills, fill sequencing, cover soil borrow and hauling operations, public drop off area use, scale house procedures, and overall customer and operational vehicle trafficking. As the focus of this TM is on landfill operations, limited background is provided on the landfill facility layout, design, and long-term development plan.

2 Data & Observations

The Landfill is the largest permitted landfill in the State of South Dakota and is located on 709 acres approximately five (5) miles west of Sioux Falls at the intersection of 41st St. and 464th Ave. Approximately 260,000 people across a five county region contribute to the disposal of approximately 160,000 tons per year of MSW and 87,000 tons per year of C&D waste. The City operates the Landfill for simultaneous disposal of MSW and C&D as two separate waste streams in two discrete landfills. Other waste management services, programs, and facilities at the Landfill include a scale house, a maintenance shop and offices, a public drop off area, an appliance recycling building, wood waste recycling, a compost pad, a landfill gas blower and flare system, and a gas conditioning building.

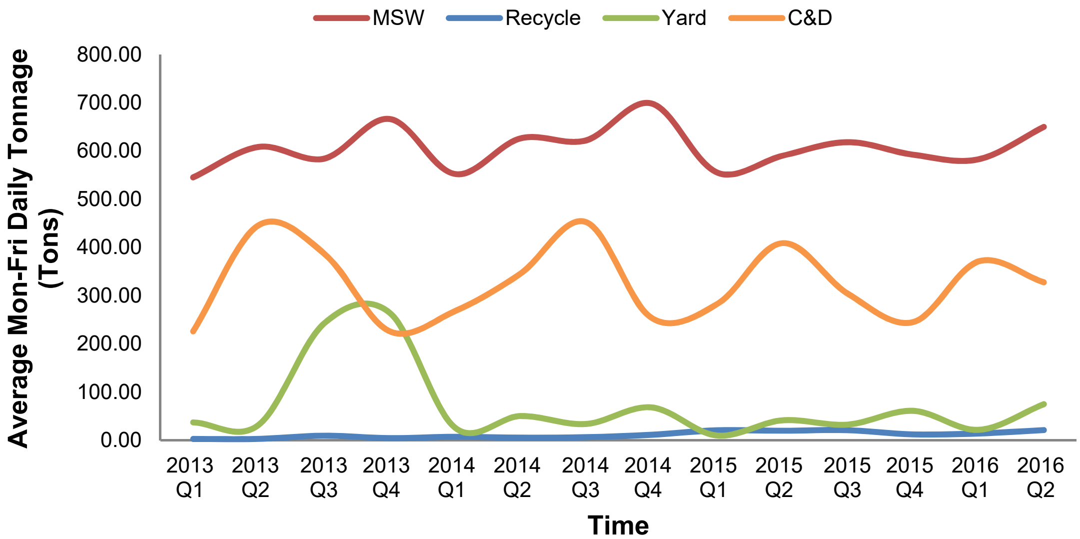
The public drop off area is located near the scale house and includes the collection of MSW and recyclables such as white goods (stoves, refrigerators, microwaves, freezers, dishwashers, washers and dryers, hot water heaters, water softeners, etc.), yard waste, wood palettes, lawn mowers, scrap metal, tires, and non-artificial Christmas trees. Eight roll-off bins are available in the public drop off area with the capability to receive waste from vehicle sizes ranging from compact cars to pickup trucks with trailers; however, some public customers choose to unload the waste at the active face of the MSW landfill and/or C&D landfill.

Yard waste is composted on a portion of the property north of the closed landfill and east of the public drop off area. There is also a wood recycling area south and adjacent to the compost pad area. Household hazardous waste (HHW) is not accepted at the Landfill, but can be dropped off by residents at the HHW Facility located at 1015 E. Chamber Street.

Landfill gas from the closed MSW landfill and portions of the active MSW landfill is collected through a series of vertical and horizontal wells and processed at the gas conditioning building before being directed to the POET ethanol plant in Chancellor.

As shown in Figure 1, historic trends show a generally flat rate of growth for the average daily inbound tonnage of all waste streams accepted at the Landfill from 2013 to present. Seasonal peaks observed in the C&D waste stream during the second quarter of each year exhibit a steady decline, presumably due to diversion efforts, which will be further evaluated during other portions of the SWMMP focused on diversion opportunities and feasibility or necessity of a City-owned C&D Material Recycling Facility (MRF). Daily MSW tonnage has held approximately constant over the sample period (2013 through 2016) at 600 tons per day, with the observed annual fluctuations in MSW and yard waste streams peaking in the third and early fourth quarters each year, which are expected occurrences consistent with industry norms. Yard waste has remained consistent with the exception of a spike in 2013 due to a large ice storm.

Figure 1 – Landfill Historic Average Daily Inbound Tonnage (2013-2016)

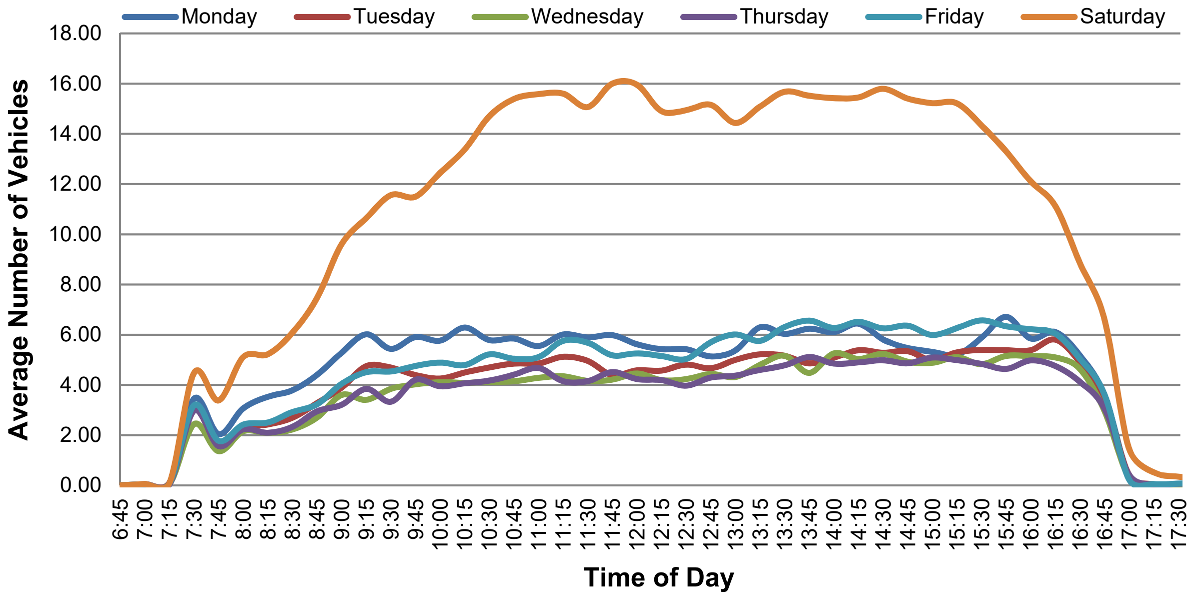


Public Drop-Off Area

The public drop off area consists of eight roll-off bins and recyclable unloading areas, which are located immediately east of the scales and scale house. These bins are intended to be utilized by small vehicle users in an effort to keep this predominantly residential traffic separate from commercial vehicles and off of the working faces at the landfills. However, some residential customers prefer to unload their waste at the working faces of the landfills. Quite often, the residential customers that opt to utilize the public drop off area tend to not follow directions on which bins to unload their waste while the City attempts to segregate certain waste or recyclables. The lack of conformance to directions by the residential customers, results in commingled waste bins, increased operational challenges for Landfill employees, and frustrated City employees. Saturdays are the most difficult days for City staff to control the residential customers in this area and queuing of vehicles is difficult. In support of this, additional staff is assigned to the public drop off area during the summer months.

The existing area is approximately 83,000 square feet to serve, on average, approximately 160 small vehicles each weekday (comprising about 50% of the total vehicles at the facility), with approximately five (5) small vehicle users at the drop-off facility every 15 minutes beginning at 9:00 and remaining constant until 16:30. Typical turnaround times for small vehicle users are approximately 10 minutes, with ranges from just a few minutes to as much as an hour. On Saturdays, the number of users nearly triples that of an average weekday, with 350 total average vehicles per day and 13 vehicles every 15 minutes. On Saturdays in the fall, peak vehicle flow can exceed 40 small vehicles per 15 minute interval attempting to simultaneously use the public drop-of area. The time series average number of small vehicles per day from 2013 to present is summarized in Figure 2.

Figure 2 - Average Small Vehicle Customer Traffic Flow (2013-2016)



Although it is typical industry-wide to see significantly higher residential (i.e. small vehicle) customers on Saturdays, the number of public drop-off area users consistently experienced by the Landfill is considerably above average when compared to similarly sized Midwestern municipalities. In order to improve the drop-off area functionality, service provided to the City's customers, and operational burden on Landfill staff, revisions to the existing process should be considered.

In order to limit capital costs associated with expanding the existing "z" wall where customers place waste in roll-off bins, other portions of the large public drop-off area should be reconfigured to encourage slow but steady traffic progression and to accommodate peak traffic flow periods occurring on Saturdays during fall cleanups. This can be accomplished by leaving the area in the center of the drop-off area open for traffic with bright clearly distinguishable traffic paint and signage directing customers where to go based on materials to be dropped off. Additionally, creating large concrete bunkers for customers to place separated material streams with rear access for emptying would get customers in and out faster by maintaining consistent customer disposal access and minimizing cross-contamination. In any case, alternatives to the collection of public customer waste could be considered, as this is a primary pinch point for Landfill operations.

The collection of mattresses is another recyclable service the City provides its customers. Mattresses are collected at the Landfill and hauled to an end user at a cost of $9 per mattress, while the City charges customers $8 per mattress. City staff hauls the mattresses to the end user seven to eight times per week and each trip requires about an hour of staff time. To reduce costs, the City should consider a collection point at or nearer the end user, with the potential for contracting out the hauling service to a third-party.

Scale House

The scale house area includes two inbound scales and one outbound scale with over 2,300-feet of queuing distance from the inbound scales to the facility entrance. This distance is a great asset to the Landfill and provides enough queueing capacity to handle the 100 vehicle per hour flow rate the Landfill routinely experiences on Saturdays in the fall. There are two scale attendants on a regular basis with a third part time scale attendant on Saturdays. Commercial vehicles with a RFID tag use the west inbound scale to access the facility. Residential and public vehicles utilize the east inbound scale for weighing and communicating with scale attendants. The scale attendants direct the vehicles toward where to unload.

During times when citizens utilize the 'Free Pass' option, the scale house and queuing area can get congested. The 'Free Pass' provided to the citizen's replaces the free disposal day the City previously provided its customers and is an attempt to spread the number of citizens over time rather than one day of free disposal that exceeds the City's resources at the Landfill. One alternative the City could implement to alleviate the congestion of the 'Free Pass' customers is to develop a program with local haulers to provide several temporary free collection points spread throughout the community. For example, the City could provide 6-8 collection points with one to two packer trucks at each location. These collection points would be available during designated times on a Saturday three to four times a year. A program similar to this example would replace 'Free Pass' program and eliminate the 'Free Pass' vehicles at the Landfill.

Landfill Operations

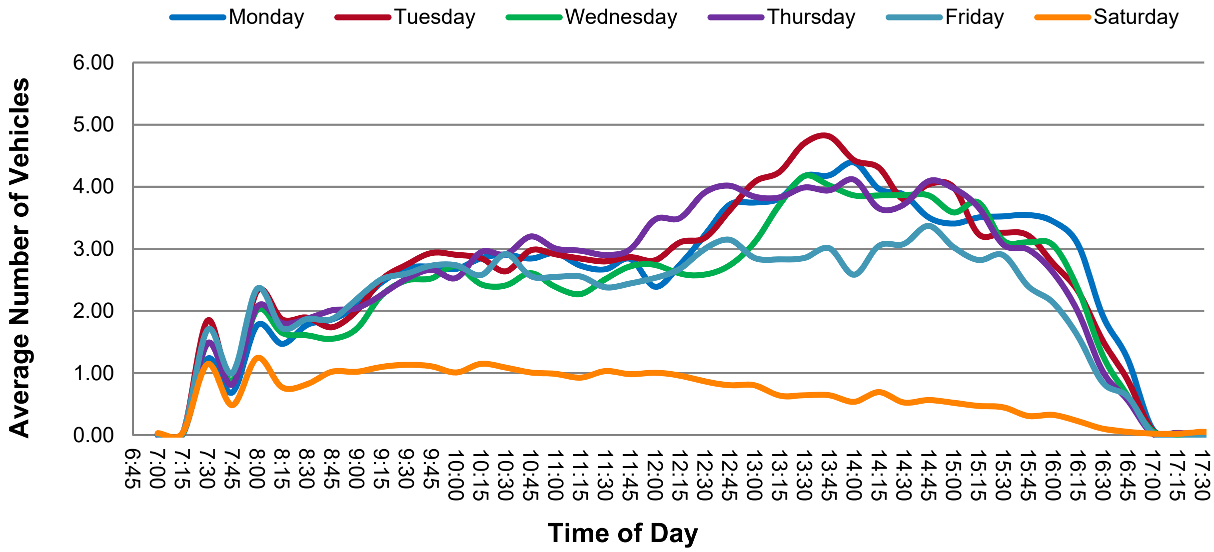
Currently, the permitted Landfill includes two separate landfills, a MSW landfill and a C&D landfill. Each landfill shares the same primary access road from the scale house to the active faces, with the entrance to the MSW landfill further north of the entrance to the C&D landfill.

Active Face Operations and Fill Sequence

Both landfills' working faces were within close proximity of the shared access road during site observations. With both working faces so close to the access road, there was very limited queuing space resulting in a back up of vehicles waiting on the access road for both landfills. Although operations of the two landfills are generally similar, they both have their own distinct operational challenges.

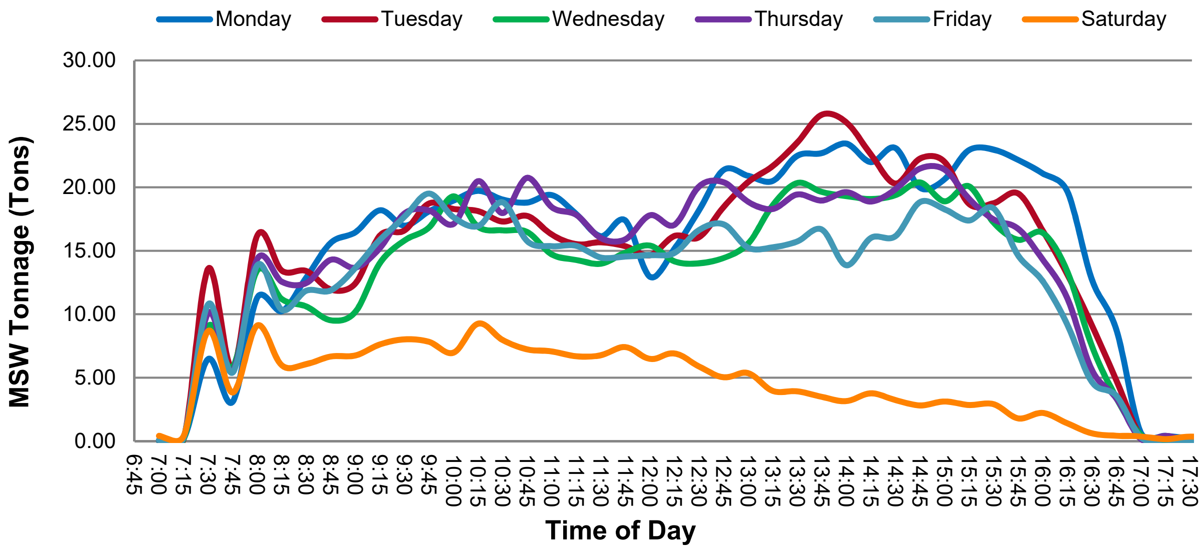
The working face of the MSW landfill was located in the eastern portion of Cell 3 because of the wet weather experienced at the landfill during prior weeks. This area was at a higher elevation than the western portion of Cell 3, and thought of as better suited for wet weather unloading. However, the available spatial requirements were limited and were mainly consumed by the compactor and the dozer, resulting in only three to four tipping slots for haul trucks and extremely tight conditions for landfill personnel to operate around customers. Based on an analysis of the observed maximum number (14) of MSW haul trucks arriving at the landfill active face and the average number of MSW haul trucks tipping at the landfill active face over a given 15 minute period from 2013-present, shown in Figure 3, an optimal landfill active face would be sized to provide a minimum of eight (8) tipping slots (six (6) haul trucks plus two for special wastes, and overflow capacity) at one time. Additional details on optimized active face geometry and procedures are included in Section 4 of this TM.

Figure 3 - Average MSW Customer Traffic Flow (2013-2016)



It was observed that operations at the MSW working face consisted of one compactor operator and one dozer operator. Each piece of equipment was pushing the waste away from the unloading area just to keep up with maintaining a clean and accessible tipping area at the rate of inbound vehicles. Generally, in an optimal scenario, the compactor should focus on compacting the waste while the dozer spreads and pushes the waste accordingly. The need for the compactor to push the waste could have been a result of the small wet weather area and the frequency of vehicles accessing the working face; however, based on an analysis of the average inbound tonnage to the MSW landfill active face, shown in Figure 4, the data indicates normal Landfill operating conditions push the upper limits of the push production capacity of a Cat D8 dozer. A second dozer could provide some relief to help control the working face while allowing an optimized fill placement strategy, and should therefore be evaluated as part of the Landfill's long-term capital planning process.

Figure 4 - Average Inbound Tonnage to MSW Landfill Active Face (2013-2016)



The scraper operator alternated hauling soil to both landfills. At times, the scraper would unload soil in areas where waste was being unloaded. It was difficult to determine if the soil was being placed due to lack of stable access road to this area or if it was being misplaced and not stockpiled for use at the end of the day. However, a small soil stockpile was being created by the scraper adjacent to the working face for use at the end of the day. The second dozer that could assist with spreading waste could also be utilized to assist with controlling the stockpile. The west portion of Cell 3 had adequate spatial requirements for waste unloading but did not have an all weather access road leading to this area. It was observed that landfilling had occurred in this area, but lifts were not completed and covered adequately, which is likely due to the wet weather incurred during the prior weeks and the aforementioned challenges with supplying and spreading adequate soil at both landfills with the currently available resources.

Similar to the working face of the MSW landfill, the working face of the C&D landfill was close to the shared access road, but more likely due to filling sequence rather than wet weather aspects. A single operator alternates between the compactor and dozer for the C&D working face. Customers unload the waste in an area below the equipment. Often times, residential customers take an extra amount of time to unload their vehicles, resulting in a back up of vehicles and causing safety concerns. Considering the lesser tonnage received at the C&D landfill, the single operator and shared scraper are adequately meeting existing operational needs. The average daily C&D tonnage data, shown in Figure 5, suggests a staggered peak in inbound tonnage and operational needs (daily cell opening and closing) between the C&D landfill and the MSW landfill. It also appears the current allocation of operational resources is adequately balanced between the C&D landfill's needs and those of the Landfill facility as a whole. However, any additional C&D tonnage would require an additional operator.

The immediate need is to sequence the fill operation to allow adequate space for the slow unloading by residential customers while providing adequate queuing, or to simply direct all residential customers to the public drop-off area and prevent them from accessing the C&D working face altogether. The average C&D tonnage per vehicle, calculated from data shown in Figures 5 and 6, is approximately half that of the average MSW tonnage per vehicle. This indicates approximately 50% of all C&D vehicles are classified as small or residential customers, and provides support for the option to relegate all residential users to the public drop-off area only to reduce congestion at the C&D landfill active face.

Figure 5 - Average Inbound Tonnage to C&D Landfill Active Face (2013-2016)

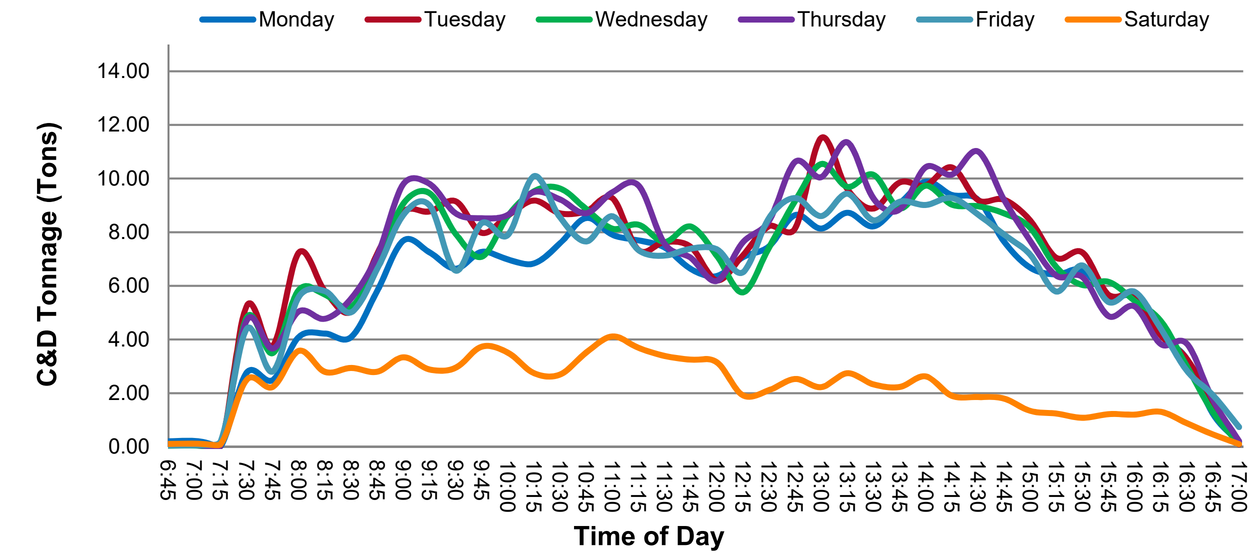
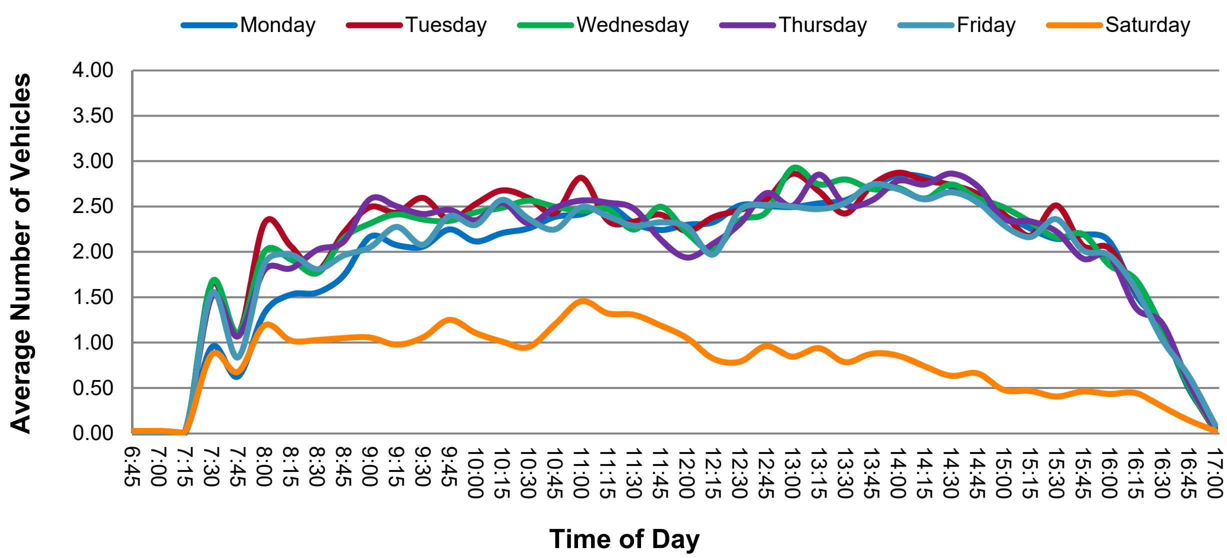


Figure 6 - Average C&D Customer Traffic Flow (2013-2016)



It should be noted that an additional operator is provided to assist both landfills on Wednesdays and Thursdays through a shift overlap. Typically the Landfill staff rotates every two months during a shift overlap. The rotation of staff allows each operator to be trained on all the services provided by the City. From a big picture standpoint, City Landfill staff are doing a commendable job operating both landfills facilities with a full-time equivalent well below that of other regional public landfill facilities with comparable daily tonnages.

Vehicle Trafficking and Support Facilities

Approximately 400 vehicles utilize the main access road between the scale house and the landfill access roads on a daily basis. It is a heavily traveled road with minimal shoulders and inadequate space for roll-off truck bin turning and untarping. This is the same access road the City uses to haul daily and intermediate cover material from the current soil borrow area north of the MSW landfill to the two active landfill cells.. Furthermore, haulers tend to clean out the trucks along the access road when there is not adequate space or internal access roads in the waste footprint at or near the working face. On wet weather days, the shared access road accumulates a significant amount of mud and debris. The distance from the active landfills to the outbound scale is a benefit and aids in removing soil and debris, but the collected materials continues to be deposited on the outbound road north of the outbound scale. These challenges are not uncommon at landfills and can be addressed relatively easily with adequate planning and funding allocation. Designated pull-off areas adjacent to the access road with pavement or gravel dressing would permit roll-off trucks to turn bins and untarp in a controlled environment. Providing adequate space within the waste footprint would allow trucks to clean out their vehicles in an area where the cleaned out debris would not become litter. A designated location outside the footprint would increase undue burdens on personnel to clean at the end of each day, and therefore would be more appropriate near the working face. Portable rumble strips and/or a truck wash would be helpful in preventing muddy road surfaces along the outbound road and facility entrance. Wet mud on roads can contribute to vehicle accidents and impairment to the Landfill's storm water discharge quality.

A portable toilet is available for waste haulers just north of the maintenance building and offices adjacent to the access road. Several haulers will utilize this area for breaks, untarping, and other purposes that require a vehicle to pullover. There are conflicts with operations in this area with its proximity to parked City equipment, and therefore relocating the toilet a little further north would provide additional distance from the City parked equipment. The area would need to be further prepared (grading and surfacing) prior to taking this action.

Leachate Management

Ponding of leachate is occurring adjacent to the northern boundary of the waste slope but within the containment area. It is possible that the excessive precipitation in the weeks prior to the site visit contributed to the accumulation of leachate as well as how the waste terminates prior to reaching the north containment berm. Typically, a smaller intermediate containment berm is constructed as part of the base liner system for the waste to terminate with future liner tie-in on the other side of the berm; this would prevent trapping of storm water and allowing storm water to contact waste or seep into the waste mass to become leachate in between the toe of the waste slope and the perimeter containment berm.

The quantity of leachate requiring management outside the landfill in the leachate management system is also a challenge for Landfill staff. Multiple rainfall events have impacted the capacities of the leachate lagoons that require staff time to both utilize recirculation lines and utilize the Neptune evaporator. Simultaneously, tanker trucks haul leachate to the local publicly owned treatment works (POTW). The City is handling and disposing of leachate utilizing methods that are effective and efficient, but is having a significant challenge keeping up with the quantities of leachate being generated. The most effective method of reducing the quantity of leachate being managed is to prevent storm water from becoming leachate in the first place. This can be accomplished by improving storm water runoff via increasing the grades of areas being filled, improving compaction of intermediate cover soils, and enhancing waste slope terminations. Several specific strategies for incorporating operational strategies to minimize storm water infiltration are included in Sections 3 and 4.

3 Design Evaluations & Enhancements

While the primary scope of this task of the SWMMP is not to review existing design and planning documents, an evaluation of design enhancements that will support Landfill operations by reducing ongoing maintenance and infrastructure management needs and providing a more resilient daily working area are vital to any evaluation of landfill operations. A significant amount of time, effort, and funding have been invested in the current design and permitting of the Landfill to date, and a review of the permit documents indicate the facility has been adequately planned for the final build out by maximizing the long-term waste footprint and areas available to place waste. However, there are several smaller components of the design and planning of the Landfill that may be enhanced in future construction projects that, if implemented, will provide benefits to landfill operations by increasing efficiencies and decreasing maintenance. Design enhancement considerations falling into this category include, but are not limited to, the following items:

- Increase in leachate sump capacity. Based on the cell areas and drainage patterns of the future designed sumps, the dimensions of the sumps in the permit drawings appear undersized. It is important to have adequate capacity in the sumps such that the leachate pumps have adequate run times and remain submerged. Inadequate sump capacity can result in frequent on-off times for a pump which is an inefficient means of transferring large volumes of liquid and tends to burn out pumps.
- Leachate collection trench columns should be exposed to be in intimate contact with the waste. Biological clogging of sand drainage layers and geotextiles can occur in base liner systems. Having larger aggregate in a leachate collection trench can offset the biological clogging and provide both better drainage and a contingency in case leachate piping collapse or buckle. Thus, at times having the larger aggregate in direct contact with waste provides enhanced collection efficiencies.
- Intermediate containment berms can be better utilized to stabilize and provide a ballast point for waste slopes. Rather than construct a large 10-foot tall containment berm to prevent off-site storm water runoff from entering the landfill cell, a smaller excavated channel with a smaller diversion berm could be constructed with a considerable reduction in construction costs. Additionally, a smaller intermediate containment berm can be installed with the base liner system for the waste slope to begin while allowing future tie-in on the other side of the berm. This type of berm would prevent trapping storm water run-off within the containment area and the associated generation of additional leachate. Furthermore, the tie-in point can be prepared with a rain flap to prevent storm water intrusion into the leachate collection system during construction of the next cell, thereby avoiding the large influx of leachate into the leachate management system inherent during the first phases of filling in a new landfill cell.
- Geogrid in the side slope liner system on 3H:1V slopes may be excessive. Without reviewing the stability calculations for the designed side slope, it is difficult to determine whether or not geogrid is necessary. However, a 3H:1V side slope is not overly difficult to place drainage sand, and it is rare for a geogrid to be utilized on base liner slopes more gradual than 2H:1V. It is possible that a cost savings exists if the side slope liner system was re-evaluated to remove the geogrid. Additionally, since there is a geocomposite on the side slope, the drainage sand could be replaced by a more cohesive soil which would reduce cost and improve stability without the geogrid.
- The use of riprap to line diversion berms on side slopes and letdowns in the final cover system could become difficult to maintain. As vegetative growth increases on final cover slopes and/or sediment gets trapped in the riprap, letdown structures of this style commonly become difficult to clean and maintain over time. There are other materials available to armor the erosive areas that provide better efficiencies for maintenance.

- The general fill portion (36 inches) of the final cover system may be reduced, which would reduce construction costs and provide additional waste capacity over the entire landfill footprint. Section 74:27:12:17 of Article 74.27 of the South Dakota Regulations requires final covers of MSW landfills to include 18 inches of compacted soil material and 6 inches of topsoil.
- While the MSW landfill's permitted final cover plateau geometry is consistent with traditional industry design methodology, recent experience suggests an opportunity to revise this geometry to generate a significant increase in permitted airspace. For example, by implementing a herringbone-style grading pattern for the landfill plateau (a strategy that has been permitted successfully at other regional public landfill facilities), the City could potentially realize an additional 1.35 million cubic yards of airspace, 4.5 years of site life, and $29.1 million in life-cycle revenue, all without steepening the final sideslopes or raising the maximum final elevation. A more detailed evaluation should be undertaken to develop a conceptual design for this revised final cover grade concept add to provide a more accurate and site-specific analysis of the associated benefits and potential challenges. One challenge associated with implementation of this particular grading plan is the increased complexity of the geometry of the final waste surface when compared to the current permitted plateau geometry. With implementation of a GPS machine control system in landfill operational equipment, however, this challenge becomes significantly less influential.

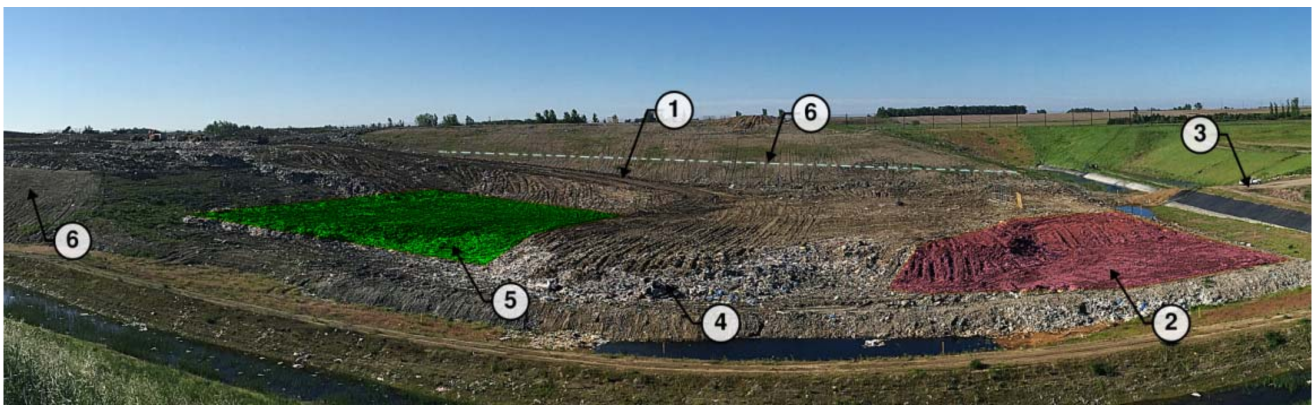
4 Recommendations

Overall, the Landfill provides a significant amount of services to its customers, and the City is doing a commendable job managing the waste with the resources available. Based on our observations and experiences at other landfill sites, we offer the following recommendations as opportunities for improvement to capitalize on the existing capabilities and successes of the Landfill.

Immediate Steps for Safety, Environmental Compliance, and to Set Stage for Future

As a priority set of actions to undertake, the following list is recommended based on opportunities to quickly and cost-effectively improve onsite safety (both for Landfill operators and customers), environmental compliance and resource management, and to prepare the active landfill areas for future recommended actions related to operational fill sequence and daily cell filling strategies.

Figure 7 – Immediate Recommended Actions at Landfill Active Cells



1. Improve surface of existing customer access road leading to lower elevations of landfill to create a long-term all-weather road. At the base of the road, construct a temporary 60-ft by 160-ft rock pad for temporary use in wet weather tipping operations. Since this road will serve as the primary access point for all customers for the duration of cell operation, it is recommended to be constructed of 8-inch Macadam road base underlain by a 5-ounce road base geotextile, with a 2-inch thick interlocking surface course as the top layer. As an alternative, generally clean and uniform rubble may be diverted from the C&D landfill for use as the road base material.
2. Move all dry weather fill operations to the northwest corner of the cell to bring the area at a lower waste elevation (with only the fluff lift currently in place) up to the plateau elevation of surrounding waste. Ensure area maintains surface water drainage to the perimeter drainage channel, and cover with approximately one foot of well compacted soil for intermediate cover.
3. Begin use of the existing west access road leading to the soil borrow area as the exclusive route for soil hauling equipment. Doing so will physically separate customer and operational traffic, resulting in a safer operation and more efficient haul route. If needed, improve the surface of the soil haul road leading into the cell using a clean and well graded 2-inch road stone.
4. Using the recommended soil haul road, place soil cover over exposed or flagging trash. Doing so is a requirement of the Landfill's solid waste disposal permit with SDDENR and will help to eliminate contamination to the perimeter storm water channel.

5. After completing fill placement as described in Item 2, transition to the area north of the existing customer haul road at the toe of the west slope of the existing active face. Begin placing waste in wide and flat lifts (refer to the below sub-section for additional detail) approximately 15-feet tall per week, with sequential fill placement working south to north, beginning at the eastern limits of the highlighted area and proceeding west. Continue filling in this fashion until reaching the western limits of the cell, or until an alternate sequence is identified through development of an Operational Fill Plan (refer to “Implement an Operational Fill Plan” item below for additional detail).
6. To preserve in-place soil cover and reduce the quantity of storm water entering the cell as leachate, install a soil diversion berm on the existing south sideslope (approximate location shown) and seed the existing south and north sideslopes.

Develop Operations Plans to Increase Landfill Efficiency

After implementing the above priority actions, the Landfill will be ready to shift gears towards developing a clear, intentional, and fact-based daily and intermediate-term cell filling operation.

Implement an Operational Fill Plan

The number of landfill staff is lean given the quantity of services provided. As such, every day operations become more reactive than proactive, and it becomes difficult to plan ahead due to lack of time and resources. However, developing a plan can provide a road map for operators to follow and to see what lies ahead. An Operational Fill Plan for both the MSW and C&D landfills could increase efficiencies and help minimize operational challenges. Operational fill plans provide details on where to fill, time it takes to fill an area, identifies wet weather areas, how to control storm water, and minimizes construction of all weather access roads. These plans are used with great success by private and public landfills alike to gain consensus between managerial staff and landfill operators, to improve capital planning and budgeting, and to reduce the amount of time landfill management is required to spend each day on directing staff and developing fill strategies. It is recommended that each landfill have an Operational Fill Plan to increase efficiencies and to provide a road map for staff to follow.

Implement a Soil Borrow Area Development Plan

Similar to the Operational Fill Plan concept, a Soil Borrow Area Development Plan is recommended to assist with controlling soil usage and management of resources. A landfill operation requires soil for a variety of uses such as daily operations and capital projects. It is an important resource that should be utilized wisely. A Soil Borrow Area Development Plan identifies sequence of soil excavation while controlling storm water runoff, access roads, haul routes, and management of the different soil types for multiple uses on the site.

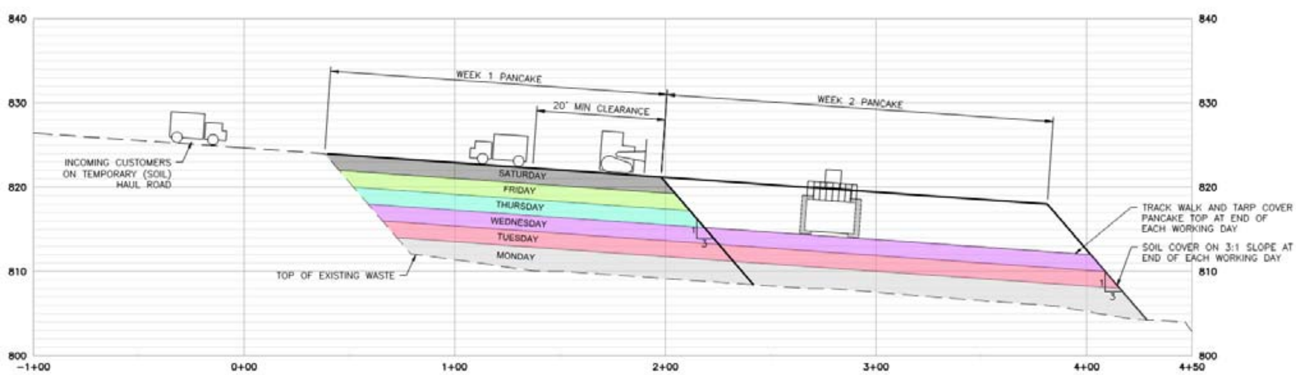
Implement Pancake Fill Method

In an effort to reduce soil usage, improve waste densities, increase efficiencies of the site equipment, and effectively reduce leachate generation, it is recommended to adjust the placement of waste at the working face to a pancake fill method. This method has been proven to improve soil usage and waste density almost immediately. The pancake method is based on the concept of constructing weekly cells that consist of daily horizontal layers – or ‘pancakes’. A diagram of the pancake method is shown in Figure 8, and a description of general operational components is as follows:

- The working face would be configured based on the volume of solid waste anticipated for the week (5 to 6 days). A stack of thin ‘pancake’ cells placed in daily lifts approximately two (2) to four (4) feet thick would be constructed each week. Dimensions may vary depending on actual waste quantities received and the specific area in which active disposal is taking place. An evaluation of tonnage and traffic volumes completed concurrent with an operational fill plan would determine the exact cell dimensions.

- At the beginning of the next week (or when the current stack is completed), previously-placed soil and/or alternative daily cover (ADC) (i.e., what was placed on top of the previous lift) would be stripped for the next footprint. The stripped soil would be stockpiled at the side of the cell for re-use throughout the week.
- Solid waste would be spread horizontally across the stripped area and compacted. It is estimated that each day's 'pancake' would be approximately two (2) to four (4) feet deep. The horizontal dimensions would vary depending on actual waste quantities received and the specific area in which active disposal is taking place. At the end of the day, the solid waste would be covered with a tarp. Only the sideslope edge of the weekly pancake working area receives cover soil or other type of ADC.
- At the end of the week, the stacked pancakes would be approximately the same depth as the traditional daily cells (12 to 16 feet high). It is important to match the tie-in depth of the surrounding waste with each weekly pancake cell, and as such the timing on reaching the surrounding grade may vary. However, upon completion, the top of the weekly cells would be covered with soil, the side would be covered with soil or other form of ADC, and the face would be covered with a tarp.

Figure 8 – Depiction of Pancake Fill Operation



Additionally, it is recommended that the adjustments of waste placement should include an additional dozer at the working face due to the frequency of waste being delivered as well as retooling the use of the compactor to focus on compaction of the lifts of waste.

Implement Design Enhancements for Cost Savings & Operational Efficiencies

As identified during onsite observations, leachate disposal and handling methods are stressing operations through the use of a multitude of options (recirculation, evaporation, hauling to POTW, and storage). Due to the stress on staff availability and the cost of hauling over time, it is recommended to install a direct discharge from the leachate ponds via a pipeline into the City's sanitary sewer collection system. This would free up valuable resources to perform other duties resulting in a more efficient operation. It should be noted that, when appropriate, the City should continue to recirculate leachate automatically to gain the benefit of landfill gas production.

Prior to the next cell construction, the potential design modifications discussed in Section 3 should be reviewed and refined to identify cost savings. It is recommended to conduct this exercise well in advance of the next cell construction to allow time for a permit modification if the cost savings are shown to be significant enough to justify modifications, as it is believed they will be.

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City of Sioux Falls
SOUTH DAKOTA

City of Sioux Falls Solid Waste Management Master Plan

Appendix E: Task 5 – Waste Generation and Disposal Projections

HDR

January 2017

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Comparison		5-Yr Hist. Avg. [2]	10-Yr Hist. Avg. [3]	
Per Capita Generation Rates by Material [1]		**Tons per Year**	**Tons per Year**	Difference
MSW	Per capita generation rate	0.67	0.71	-0.03
Yard Waste	Per capita generation rate	0.03	0.03	0.00
C&D	Per capita generation rate	0.32	0.34	-0.03
Wood Waste	Per capita generation rate	0.03	0.02	0.00
Mattresses	Per capita generation rate	0.00	0.00	0.00
Asbestos	Per capita generation rate	0.00	0.00	0.00
Contaminated Soil	Per capita generation rate	0.04	0.03	0.01
Tires	Per capita generation rate	0.00	0.00	0.00
Total	Per capita generation rate	1.09	1.14	-0.04

Notes:

[1] MSW tons for 2016 were updated to reflect actual tonnage data, based on tonnage data provided by the City in January 2017.

[2] MSW per capita generation rate is based on average of 2010 through 2016 (6 years) actual tonnage data.

[3] MSW per capita generation rate is based on average of 2005 through 2016 (11 years) actual tonnage data.

Using Five-Year Historical Average:

Year	Total Population [2]	MSW	YW	C&D	Wood Waste	Mattresses	Asbestos	Contaminated Soil	Tires	Total Tons [1]
2015	265,851	161,116	8,819	86,557	2,090	266	89	834	368	**260,139**
2020	300,292	201,892	10,018	94,711	7,673	316	198	11,810	581	**327,199**
2025	333,882	224,476	11,139	105,305	8,531	351	221	13,131	646	**363,799**
2030	371,353	249,668	12,389	117,123	9,489	390	245	14,604	718	**404,628**
2035	413,717	278,150	13,802	130,484	10,571	435	273	16,270	800	**450,787**
2040	461,941	310,572	15,411	145,694	11,804	486	305	18,167	894	**503,332**
2045	516,950	347,556	17,246	163,044	13,209	543	342	20,330	1,000	**563,271**

Notes:

[1] Total tons is sum of individual material tonnage data provided by City.

[2] Total population based on Census Data and Shape Sioux Falls Data for Sioux Falls MSA; Lake County population based on Census Data and SDSU data.

Using Ten-Year Historical Average:

Year	Total Population [2]	MSW	YW	C&D	Wood Waste	Mattresses	Asbestos	Contaminated Soil	Tires	Total Tons [1]
2015	265,851	161,116	8,819	86,557	2,090	266	89	834	368	**260,139**
2020	300,292	211,919	9,606	102,302	6,217	316	283	8,300	562	**339,506**
2025	333,882	235,624	10,681	113,745	6,913	351	314	9,229	625	**377,482**
2030	371,353	262,068	11,880	126,510	7,688	390	350	10,264	696	**419,846**
2035	413,717	291,964	13,235	140,942	8,566	435	389	11,435	775	**467,742**
2040	461,941	325,997	14,778	157,371	9,564	486	435	12,768	865	**522,263**
2045	516,950	364,818	16,537	176,111	10,703	543	487	14,289	968	**584,456**

Difference in tons:

Year	Total Population [2]	MSW	YW	C&D	Wood Waste	Mattresses	Asbestos	Contaminated Soil	Tires	Total Tons [1]
2015	271,672	0	0	0	0	0	0	0	0	0
2020	300,292	-10,027	412	-7,591	1,456	0	-84	3,509	18	-12,306
2025	333,882	-11,149	458	-8,440	1,619	0	-94	3,902	21	-13,683
2030	371,353	-12,400	509	-9,387	1,800	0	-104	4,340	23	-15,219
2035	413,717	-13,814	567	-10,458	2,006	0	-116	4,835	25	-16,955
2040	461,941	-15,425	633	-11,677	2,240	0	-129	5,398	28	-18,931
2045	516,950	-17,261	709	-13,067	2,506	0	-145	6,041	32	-21,185

City of Sioux Falls
SOUTH DAKOTA

City of Sioux Falls Solid Waste Management Master Plan

Appendix F: Task 7 – Public Education Program Benchmark Analysis

HDR

December 2016

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Task 7 – Public Education Program Benchmark Analysis

City of Sioux Falls

Solid Waste Management Master Plan (SWMMP)

December 2016

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Introduction

The City of Sioux Falls (City) has initiated the development of a comprehensive Solid Waste Management Master Plan (SWMMP) to guide the continued operation and expansion of the solid waste program. The purpose of the SWMMP is to provide a 30-year road map to the City for the continued efficient, economical and environmentally responsible operation and expansion of the solid waste program.

As part of the Solid Waste Management Master Plan (SWMMP), the City wanted to take a closer look at its public education techniques compared to other similar communities. As such, HDR conducted a benchmark analysis to learn about and consider methodologies and tools employed by similarly sized and geographically located municipalities for public education of solid waste and recycling management efforts. As municipalities around the country work to improve their solid waste management practices, interest in improving community education of recycling procedures and policies is of increasing interest. HDR worked with City staff to determine appropriate benchmark communities, which ultimately included: Sioux City, IA, Saint Paul, MN; Fargo, ND; and Lincoln, NE.

The analysis reviewed existing solid waste and recycling public education and outreach programs in each city. This analysis reviews each city's existing program vision, education tactics, online presence, and interactive tools in use. Additionally, benchmark municipalities discussed successes and challenges faced in terms of recycling education. HDR conducted telephone interviews with recycling or environmental coordinators from each of the identified benchmark cities. The interviews provided insight to each city's overarching program goals and education efforts. Research and analysis was conducted in municipalities with the population between 150,000 to 250,000 people, including Sioux Falls. See Appendix A for benchmark city contact information.

In addition to the solid waste and recycling programs research in other communities, HDR collaborated with the City of Sioux Falls to visit and identify improvements of the City-owned and operated Household Hazardous Waste and Educational facility and to provide information regarding their current practices for the benchmark analysis. The findings from this analysis provide the basis for the generation of recommendations for improving Sioux Fall's current education program to meet the goals as part of the Solid Waste Master Management Plan.

Benchmark Study

City of Sioux Falls, South Dakota

The City of Sioux Falls has an established recycling program, known as The Leading Green initiative, operated by the Sustainability Program. The Leading Green initiative is a guiding program that creates a more sustainable community by proposing and assisting with the implementation of measurable solutions to environmental, social and economic concerns. Sioux Falls has mandated recycling for all residents and businesses. The program is single stream recycling. The city ordinance bans certain materials from being disposed of as waste in the landfill, and items such as plastics, metal containers, paper and cardboard are accepted in the recycling program. Twenty-one licensed haulers provide services to residential customers throughout five counties in the Sioux Falls area. The City requires haulers to lessen the burden on the landfill by working towards meeting an annual recycling goal.

The education and outreach activities of the recycling program are led by a sustainability coordinator. Since the 2012 mandatory shift in the program to single-stream recycling, a new education campaign focuses on how to properly recycle materials in the new system. Sioux Falls has committed to improving community health and safety by providing programs, education and leadership on how to reduce waste in the community. The public education program is a coordinated effort between the City, haulers, and the community.

Solid Waste Planning Board: Sioux Falls has a planning board for its recycling program. The members of the board are selected by the mayor and are tasked with improving recycling and solid waste issues in Sioux Falls. The board meets quarterly and the public is welcome to attend the meetings. Membership is comprised of city employees, representatives from the hauling industry, representative from the South Dakota Multi-Housing Association, the business community, citizens of Sioux Falls, and representatives of each of the five counties.

Programming: Sioux Falls has developed a classroom education program and recycling education kits that meet state core curriculum standards. The curriculum is developed to target students in three grade ranges; K-2, 3-5, and 6-8th grade. Schools are encouraged to reserve a kit and use in their own classrooms. The city offers landfill tours for residents or groups interested in learning more about the program. They also have dedicated space for public meetings and resources for solid waste management. Sioux Falls hosts several events throughout the year dedicated to recycling and solid waste management.

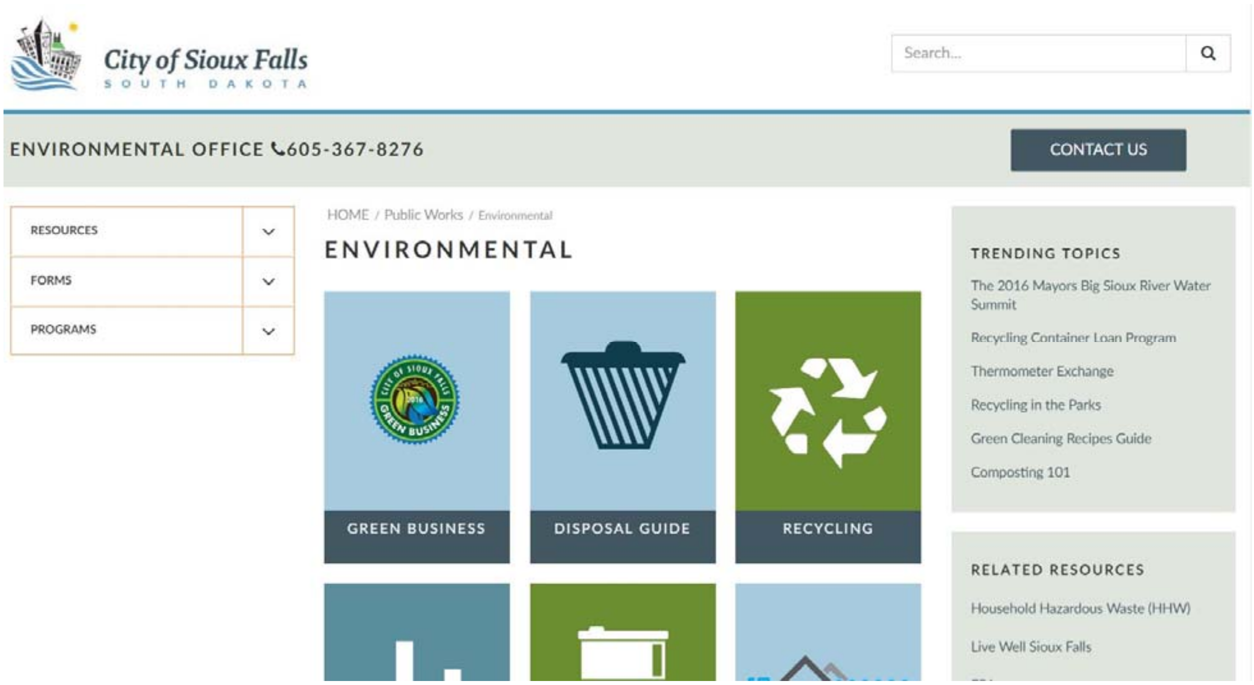
Sioux Falls hosts an event each year called Magic of Recycling. The program occurs in elementary schools and teaches children about the importance of recycling through an interactive magic show. The program covers how to properly recycle, reduce and reuse, and the program introduces students to the landfill and the importance of reducing the amount of waste brought to the landfill.

Annual recycling events such as Christmas tree, leaf, and pumpkin composting boost participation in waste diversion and continued interest in the promotion of a more sustainable community. Sioux Falls also accepts year-round household hazardous waste and electronics from residents at their HHW facility. The HHW facility works to identify HHW items that have been collected and determines if they can be redistributed in the reuse room.

Branding: Sioux Falls has a developed brand identity for its recycling program. The Leading Green brand is used with some consistency across all media platforms and outreach/education materials.

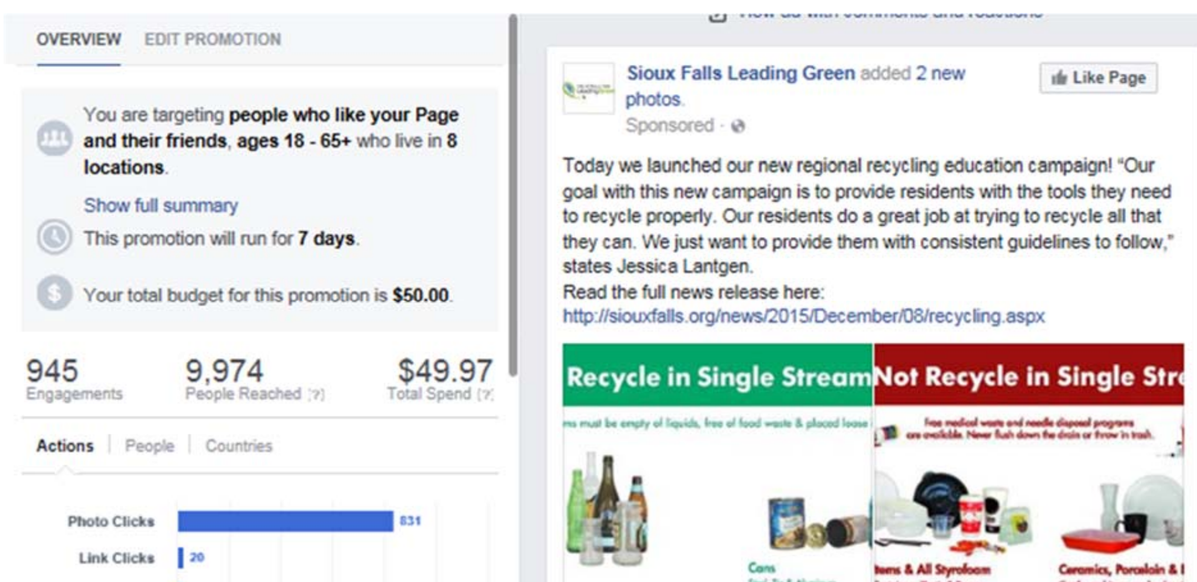
Website: Sioux Falls hosts program resources on their environmental page of the City's website. The site offers links to program details, recycling guides, downloadable education materials, news releases, and videos. The site is sufficient in providing access to information, but is not intuitively accessible.

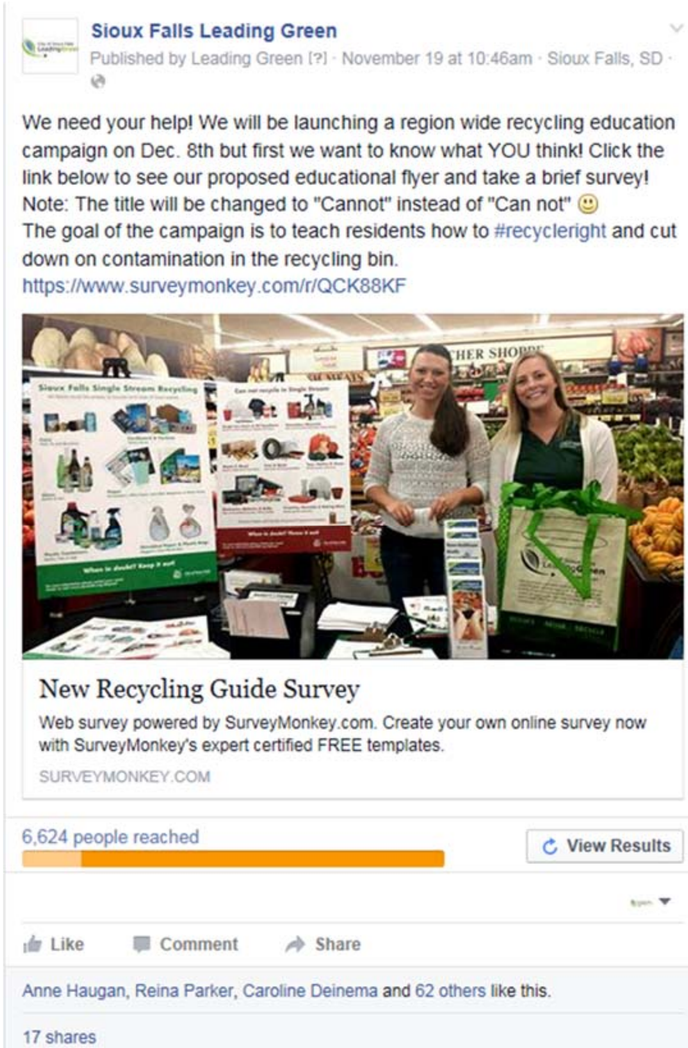
Image 1.0 Sioux Falls Environmental Website



Social Media: The City of Sioux Falls has an active presence on both of their Facebook and Twitter accounts. The city's Public Works Sustainability Program -Leading Green, also has an active presence on both Facebook and Twitter. Leading Green social media posts include topics such as water quality, water flow, the city landfill, lawn watering and upcoming events. The program also posts about the Parks and Recreation, Public Works and Mayor's departments. Leading Green's social media posts include photos, videos and infographics highlighting upcoming events and education tools for visitors. Various departments in the city have their own social media pages and often will *tag team* social media efforts on departmentally related events or notices. The Leading Green Facebook page hosts public service announcement videos. Two videos in particular have higher viewership - a new pet waste station with over 8,000 views and an earth day public service announcement with over 1,500 views. Those same videos have approximately 50 likes. Social media is used often for program alerts, updates, and event notifications.

Images 2.0 - 4.0 Social Media – Sioux Falls Leading Green





Video Outreach: The city has a YouTube channel with playlists dedicated to different city offices. There are educational videos about the landfill and where trash goes. With more than 1.4 million views, the YouTube channel has 868 subscribers and almost 40 playlists. There are playlists for Sioux Falls Park and Recreation and Environmental. The Environmental playlist is where Leading Green videos are located. There are videos with press conferences/interviews and some educational videos. The press conference/interview videos are longer in length with the educational videos around 30 seconds long. The nine videos on this playlist are on average seven minutes long. Video promotions are used often for the recycling program.

Other Tools: The city publishes recycling fliers to all Sioux Falls households twice a year to remind residents of what can and cannot be recycled. The city provides other promotional items such as stickers and green cleaning recipe books to help create more awareness and encourage residents to create less waste by reusing bottles and make their own green cleaning products, rather than purchasing new. Waste haulers were provided with stickers indicating proper materials that can be collected in single stream recycling. These stickers are intended to be placed on the recycling bins. The city provides the haulers with the educational materials, providing a standardized approach and messaging to be used by all haulers.

Successes: Sioux Falls strengths and successes exist in the relationship building with local haulers and the support and encouragement by the Mayor's office. They city enjoys strong relationships with the private haulers throughout the community. They work well with the sustainability coordinator and see her as resource, rather than a policing agent. The haulers involvement in the planning board provides them a seat at the table and encourages open dialogue about the goals and implementation of the program.

The city sets recycling goals each year. In 2014, Sioux Falls had a record setting year and surpassed their desired goal for the year. Enforcement of requirements helps to meet this goal. Individual haulers are required to meet at least 80 percent of the city's recycling goal or fines will be imposed. Haulers who exceed the goal can qualify for incentives provided by the city.

Challenges: Sioux Falls' material recycling facilities face a challenge with contamination. Since transitioning to single-stream, contamination has remained a concern. The city has worked to combat the issue with education and outreach regarding contamination. The city attempts to explain of how waste is properly sorted on the back end through earned media opportunities, social media, and public service announcements.

City of Sioux City, Iowa

The City of Sioux City has a recycling program and its overall messaging it geared towards sustainability. However, currently there is not a formal sustainability program in place for the municipality. The benchmark interview primarily focused on the education efforts for the solid waste reduction program. The recycling program has been in place since 2008, with community education programming beginning in 2010. The recycling coordinator noted that a strong thrust in community education and outreach has taken hold within the last four years.

The City feels as though there is an overall success in education among residents and businesses. Roughly 45% of households in Sioux City have a recycling container. While this statistic is impressive, the recycling coordinator felt that those not aware of the program may be uninformed as a result of several reasons: personal preference to not participate, not aware of the program, and/or language barriers. Currently the city does not advertise and educate about the recycling program in Spanish, despite the larger population base of Spanish-speaking residents.

Gill Hauling is the City's hauler and fields most of the incoming calls for recycling and waste pickup. Gill Hauling also helps to receive calls for nuisance or complaints due waste removal.

Environmental Advisory Board: Sioux City has an Environmental Advisory Board that assists in the educational efforts throughout the city.

Image 1.0 Sioux City Environmental Advisory Board

The board consists of nine members that are appointed by the city council after self-nomination for membership. The advisory board's membership currently consists of residents, but business owners have been members in the past.

Programming: The City publishes a guide to recycling and solid waste management. The City sponsors several outreach events throughout the year to advocate waste reduction and recycling. A "Re-Event" is hosted twice a year. This event provides opportunities for the collection of electronics, hazardous materials, plastic bags, and other items that are not included in curbside pick-up. "Re-Event" charges a fee to recycle items, but the Board uses the profit to help fund further education materials and activities.

Image 2.0 Re-Event Advertisement

"Re-Event" provides the City with an opportunity to measure success of education and recycling programming. Each item that is collected is accounted for. Data has been collected since 2014, and with each year passing, collection numbers increase. Collection statistics have double since 2014. The recycling coordinator attributes this increase with the increased advertising efforts for the "Re-Event."

While "Re-Event" is the City's largest event, and is held twice a year, Sioux City also engages in the City's *National Night Out*, when residents have the opportunity to learn more about the services provided by the City. *Beyond the Bell* is a summer program geared toward 6th grade students that takes place during *Riverfication* in the fall, and helps to educate students about STEM topics (science, technology, engineering and math), including recycling. The city also will conduct a class-room based program in elementary schools. Sioux City hosts these classes an average 15 times per year.

Social Media: Facebook is used by both the Board and the City to help promote activities and education efforts. Social media has been used effectively in conjunction with other outreach tools to promote activities and giveaways.

Website: The city does have a dedicated page to the recycling program and public education. The city's Growing Green Environmental Services page help to provide information regarding solid waste management, recycling, the City's stormwater program, events, awards, and glass recycling. The page also provides access to the Recycling Guide.

This page can be located at www.sioux-city.org/environmental-services.

Image 3.0 City of Sioux City Growing Green Recycling Webpage

Overall Success: Sioux City recycling coordinator noted overall communication and education efforts by the City are perceived to be successful. The coordinator noted that generally speaking, the residents of Sioux City understand what items will be collected, are aware of the various programs and events offered by the city in terms of recycling.

Currently, there are no incentives for businesses and large apartment complexes to institute recycling programs or services, thus it is difficult to assess the success of commercial recycling efforts.

Community Challenges: It was noted that litter and illegal dumping are two of Sioux City's most pressing challenges in terms of solid waste management. Resident or community reporting is the typical method for notification of areas of concern. Additionally, when a resident is in violation of a recycling ordinance, he or she is sent a direct mailing which includes a flier detailing requirements for the City's solid waste and recycling procedures. Over the past year (2016) approximately 200 violations were noticed. Approximately 95% of the complaints received are resident reported. Sioux City handles violations in a reactive manner, once a violation has been reported.

City of Saint Paul, Minnesota

The City of Saint Paul, MN does not currently have a formal recycling education program. The county oversees the commercial sector recycling effort and the City handles the residential recycling program. Saint Paul provides a recycling program, but it is not free. Residents are charged s fee as part of their county property taxes. Residents are not required to subscribe to participate; instead they simply need to pick-up a recycling bin from the City. The City has a dedicated position for an environmental policy director. This position is part of the Mayor's office and their responsibilities cover a wide range of initiatives, including recycling and sustainability. Saint Paul doe not currently have a formal engagement plan for recycling. The educational efforts for the recycling program are currently handled by a private hauler that holds the City's contract. Eureka Recycling is currently responsible for all education, outreach, and communications regarding the recycling program. The city's recycling program has been in place for nearly 30 years.

Saint Paul began a recycling branding initiative in 2014 and has since attempted to be more focused on developing a communication plan that work towards the State's targeted goals for increasing organic collections and recycling in residential and commercial areas. The City developed their own Solid Waste Management Plan to help meet those targeted goals. In 2012, they conducted a community assessment and asked residents about how they recycle, what they recycle, what barriers inhibit recycling, and trash and organic collections. Additionally, the City conducted focus groups and phone surveys to help inform their brand development process.

Saint Paul is in a transition phase for their solid waste management program. Since the completion of their community assessment and the development of the brand identity, the City is also changing their program over from curbside/bin pick-up to alley/wheeled, lidded cart pick-up. Their public education approach will change with the roll out of this change.

Current Programming: The City of Saint Paul has begun utilizing "pop-up" meetings to help promote the City's recycling program. The City's environmental coordinator noted that the goal of this method allows the City to interact with the community in spaces and during times that are convenient for the public. They go to physical locations that are where the community is naturally gathering; parks, community centers, street corners, etc. and use give-aways to help spur participation and interest. For example, the City will take and ice cream cart out to the community and give out popsicles to anyone who will answer 4-5 questions about solid waste management and recycling. Additionally, the City targets community awareness opportunities at community events. The environmental coordinator noted that this approach has been very successful for a variety of the City's divisions, including the solid waste management.

Saint Paul provides residents with information regarding recycling and composting during events at home, in large venues, and businesses. The information provides ordinance requirements and "how to" information for reserving the proper containers for events.

The City of Saint Paul currently has an ordinance that requires recycling for both residential and commercial community members. However there is little that is done to enforce the ordinance.

When an issue is reported that relates to the ordinance, such as illegal dumping, the individual trash haulers typically handle the complaints. The city does provide an online mechanism for individuals to file a complaint.

Website: The City's Public Works Division hosts a Recycling and Waste Reduction page on the City's website. This page provides basic information regarding the recycling program, contact information, upcoming events, changes in the program, and the City's commitment to "Be All In." The website notes "The City of Saint Paul has been recognized as a national leader in environmental and recycling program. The City continues to work towards increasing recycling, reducing waste, and implementing an organics collections program by increasing education and making participation easier."[1]

[1] https://www.stpaul.gov/departments/public-works/recycling-and-waste-reduction

Image 4.0 Saint Paul Recycling and Waste Reduction Webpage

Future Programming Changes and Implementation: In January of 2017, Saint Paul will support Eureka Recycling in their switch to automated collection from recycling carts. With the recycling cart transition the City will utilize Public Service Announcements to help educate the public about the changes. The City's website is currently serving as early forum for education and awareness of the upcoming changes. The site boasts that Saint Paul is planning to make recycling easier with their "Ready. Set. Roll!" program. The City has developed several infographics to help communicate the changes that will be occurring, as well as the timing of implementation.

Image 5.0 Recycling Location Pick-up Infographic

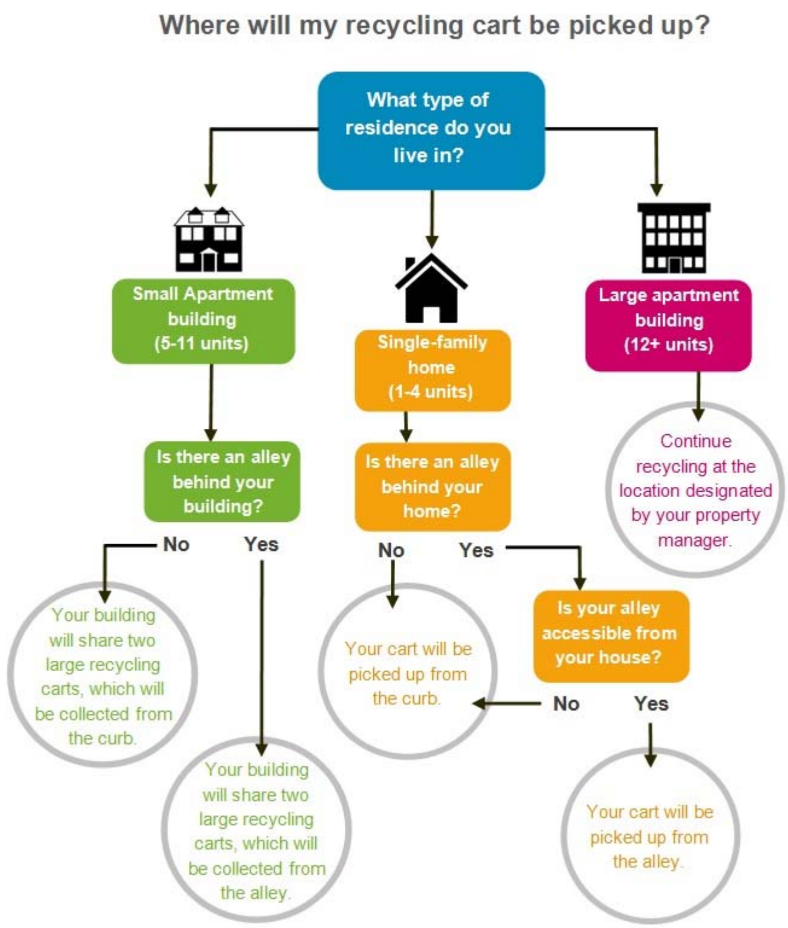


Image 7.0 Implementation Schedule Graphic

Media: While Saint Paul has not traditionally used media such as radio, newspaper, and television to promote the recycling program, the City is planning on adapting their educational efforts during the program switch to include more media tools for outreach. Current efforts do include minimal radio outreach to local/neighborhood stations and earned media opportunities by local/neighborhood newspapers.

Other Outreach Tools: The City's hauler, Eureka produces an annual recycling guide that is sent out to all residents. They produce bi-lingual posters and post in larger apartment complexes. Additionally, they use education tags/notifications if residents have not followed the proper recycling procedures. Also individual collectors will place thank you cards on bins when residents recycle correctly. Again, moving into 2017, the City will begin taking over all education and community outreach activities from Eureka.

Successes: Saint Paul has had flat recycling rates over the past recent years, according to the City's environmental coordinator. There are observed pockets throughout the City that have high participation rates, but others that don't participate at all. The coordinator suggests that there needs to be more focus on programs for apartment dwellers.

The mayor and city council of Saint Paul were commended for their commitment to sustainability and the implementation and improvement of programs that work towards a more sustainable community.

Challenges: Flat recycling rates were noted as the City's greatest challenge. The City has seen relatively little growth in the recycling program. Language barriers also prove to be a challenge for Saint Paul. Finally, illegal dumping is a ongoing issue for the community. The environmental coordinator urges other communities to avoid making generalizations or assumptions regarding the type of messaging that each part of a community may be persuaded or influenced by. The use of targeted messaging that is adaptive may prove to assist get the message to the intended audiences.

City of Fargo, North Dakota

Fargo offers free curbside recycling to residents in the community. There are 27 drop-off locations throughout the City for the collection of recyclables. The recycling program is transitioning to an all-in one program in July of 2017. The city will begin charging a $3.00 per month fee for this service. There will be an opt-in or out of the program during a window of time prior to the all in program role out. Admittedly, the City of Fargo has an informal education and outreach program. The City notes that the community is fairly informed about recycling and the program in the community. This education and awareness campaign has been in place for three years.

There has been an increased effort for outreach to the business sector in the past several years. This outreach has focused on awareness and encouraging participation. The recycling coordinator for the City was hired in the past several years and has focused more of the City's efforts on business outreach. She works with the billing department to create targeted mailing lists for various business sectors (bars and restaurants, apartments, daycares, industrial parks, contractors, etc.). Outreach in the form of direct mailings is created to adapt messaging to each type of business. For instance, daycares are messaged to encourage education and promotion of recycling habits for children. The City's education program is primarily direct mailing-based for commercial users. Direct mailings are sent to the business sectors approximately three times per year.

On the residential side, yearly postcards are sent by the City to residents with an accompanying collection calendar, and an accepted items list for collection. The City utilizes a website for promotion and education and the recycling coordinator conducts elementary school education programs upon request. Typical targeted age for this education program is third grade students.

Program Branding: The City of Fargo does not have a program brand, but does use a program specific logo "Fargo Recycles" and blue collection bins with the logo included to signify to the City's recycling program. The recycling coordinator uses the logo on any materials that are developed that relate to the recycling program. She believes that the use of this logo has helped the community to recognize the program. The Fargo Recycles logo is not easily identifiable on the City's recycling page.

Image 8.0 Fargo Recycles Logo on Collection Bin

Website: Fargo hosts a dedicated recycling page that provides collection information, recycling policies and services, and videos about the program. The recycling site is a sub section of the Solid Waste Department. The site is easy to navigate and is focused on the varying types of recycling services available in Fargo. Several resources are made available to users including curbside collection calendars and route maps.

Image 9.0 City of Fargo Recycling Website

Promotional Tools: The City utilizes video, online surveys, and the City's social media pages on Facebook and Twitter for promotion of recycling news. The solid waste/recycling department does not have its own social media pages, but employ the City's sites for promotional activities.

The city has produced videos to promote the recycling program. Videos are also used to educate the public, including a targeted 3rd grade educational program about the life cycle of recycling. The video explains what happens to an item when it is picked up, how it gets back on your shelf in another form. The video also explains how to properly sort/separate items to be collected and how to set them out for collection. Videos are made available on the City's recycling site and YouTube channel.

Local media is used to promote events such as the annual cleanup week and free electronic recycling day. While the city does not use traditional media tools on a regular basis, their use for specialized events has proven effective. If the City issues a press release, typically local media will cover an event, providing earned media. They City rarely utilizes the media for paid coverage. However, as the recycling program transitions to all-in collection, the City plans to use public forums and paid advertising to help update and educate the community about changes. This outreach will again be specialized for the program roll-out and likely will not continue.

Success: The recycling coordinator noted that the tools of communication have been successful as “they do what the City needs them to do.” The primary goal for the education program is to get people to follow directions regarding how to separate and set out recycling. The coordinator noted that direct mailings to local businesses focusing on cardboard recycling was received well and resulted in an increase number of calls regarding the program. The public commented how surprised they were about price and ease of implementation in their business.

Inquiries about the recycling program are tracked by the recycling coordinator. There is a general positive sentiment about the program and the City has observed an in crease of participation in the commercial sector. It was noted that the residential sector/curbside pick-up has likely topped out as the numbers have plateaued over the last six years. Since the current recycling program requires separation, many users do not want to participate, or choose to haul their recycling to the drop sites themselves.

Challenges: Fargo’s greatest challenges in terms of solid waste management include general education about separating and sorting recyclables. The community is generally unaware of the many programs, events, and options available in Fargo.

Typical ordinance violations are reported by individual drivers. The response typically involves sending a letter notification of violation, and a follow up call. The direct calling is generally the best method for communication. There is no required recycling ordinance for the City, rather it is completely voluntary. The City has made the recycling program affordable, and typically when residents understand cost and savings on their garbage collection bill, interest generally is spiked.

City of Lincoln, Nebraska

Lincoln ha a residential and commercial recycling program. The City of Lincoln utilizes a subscription based curbside service for recycling. In 2012, the City conducted a survey that indicated 56% of households use the community’s drop-off sites and 24% use curbside pick-up. Curbside recycling costs residents $5 to $10 per month depending on the private hauler that is selected. In terms of public education, the Recycling Coordinator noted the current program is “rather passive.” The city of Lincoln has approximately $20,000 allocated for a public awareness campaign, which will be supplemented with grant funding for public education materials and tools.

The City contracts with private haulers for collection. The haulers look to the City to establish the overall messaging and branding for the recycling program. To date, the City has not been able to obtain additional program funding to establish a brand. The city council must approve this expenditure. The City has been unsuccessful thus far.

Programming: Lincoln offers a waste reduction, reuse and recycling grant program where the Solid Waste Management Division of the Public Works and Utilities Department will distribute up to $40,000 in FY 2016-2017. The program's goal is to assist political jurisdictions, schools, non-profits, and businesses with recycling programs that significantly reduce waste. This reduction helps to alleviate strain on the current landfill resources.

The City has a contract with the University of Nebraska Lincoln Extension and has developed a "garbology" curriculum which Lincoln Public Schools has integrated as part of its core curriculum for all 2nd grade students. Parochial and private schools may also use this program on a subscription basis. The city maintains three outdoor classrooms with sponsored, regular classes taught by master gardeners. The focus of the classes is on backyard composting and recycling. Additionally, the City hosts approximately 7-9 hazardous waste collection events for residential users between March and November.

Lincoln uses visual medium such as infographics in their educational materials. The city also has developed a recycling character or "champion" that serves as a face for the recycling program. Dr. R.E. Cycle acts as a spokesperson.

Image 10.0 Dr. R.E. Cycle – Spokesperson

Website: Lincoln's Solid Waste Management Division hosts recycling specific pages dedicated to residential, commercial, and event recycling. The site also provides information regarding yard waste and grant opportunities. Resources such as the Solid Waste Management Plan are available for the public to review. The site employs the use of interesting statistics and facts that help frame the recycling narrative for the city. The information is related directly to Lincoln and Lancaster County.

Summary of Findings

The following matrix illustrates a benchmark comparison of tools and tactics each city employs in their current communication practices for education and outreach. It should be noted, that several city's indicated recent changes in the recycling program and future changes will likely be made to the approach for education and outreach.

Figure 1.0 Communication Tactic Matrix

Communication Tactic	Sioux Falls, SD	Sioux City, IA	Saint Paul, MN	Fargo, ND	Lincoln, NE
Dedicated Recycling Webpage	x	x		x	x
Public Works/Environmental Webpage or Other	x		x		
Dedicated Social Media	x	x			x
City Social Media			x	x	x
Paid Advertising	x		x	x	x
Public Service Announcements	x		x		x
Meetings	x	x			x
Primary Education Curriculum	x			x	x
Video	x			x	
Recycling Guide	x	x	x	x	x
Stickers	x				
Television/Radio	x				
Tours/Classes	x	x		x	x
Special Events	x	x	x	x	x
Direct Mailings	x		x	x	x
Infographics			x		
Advisory Board	x	x			
Survey			x	x	
Branding				x	
Earned Media	x	x	x	x	x
Pop-up/Mobile Events			x		

Each city included in this analysis acknowledged the need for a dedicated recycling program and the importance of using outreach and educational materials to better prepare residents for use.

Recommendations: The immediate question – what is the overall vision and scope of the recycling education program? This analysis investigates this question on a subjective basis. Criteria used to assess in this analysis are malleable and often largely dependent on organizational structure and personnel, context and need for an effort will broadly determine what approaches would serve well.

Based on the findings of the benchmark analysis and Sioux Fall's current recycling education program, the following recommendations are offered to provide future value and benefits to the community.

Adopt Core Values for Recycling Education: Identify and adopt core values for the Sioux Falls recycling education program. These values should be a result of community based conversation and engagement that allows varying stakeholders and users the opportunity to contribute and weigh-in on what is important to them. The Solid Waste Planning Board might champion this initiative.

Brand Identity: Understanding the power of branding is essential to managing how your program is perceived by the public. It is the sum total of experiences, impressions, and knowledge a person has about the program. Development of a brand identity would serve well to communicate the recycling program's vision. Using consistent brand and program voice across all communications will help to ensure the public is accurately informed. It is recommended that the solid waste management division work with the City to identify a clear vision and mission for the brand. Brand development should involve an assessment of the strengths and challenges and identification of mission, vision and tone (personality) of the brand. Good design and brand will help audiences identify and relate while inspiring action. Brand identity should be more than a logo and color scheme, rather is should be about vision and personality.

Information Delivery: A movement away from primarily traditional forms of communication such as direct mailings, flyers, and paper-based educational materials is recommended. In a drive for more sustainable practices, reliance on these traditional tools potentially sends the wrong message. In a digital world, communities are more reliant on mobile devices for alerts, notifications, and engagement opportunities that are accommodating to a flexible schedule. Hosting pop-up events in spaces where the community is naturally converging provides access to information in a convenient way.

Frequent Engagement: Developing a consistent relationship with haulers and residents; key to behavioral change. When there is a relational investment, people are more likely to have ongoing follow-through. Coupled with a prominent brand identity, programming and education efforts will be easily recognizable. This identification breeds loyalty and an affinity for the desired behavior.

Dedicated Tools: A branded, dedicated recycling program website will offer a central clearing house for all tools and resources of the program.

Access and Ease-of-use: The website offers a variety of resources however; organization and accessibility could be strengthened. Minimizing the number of "clicks" a user will have to go through to access their desired resource allows for a more gratifying user experience.

Visual Communications: Visual communications are becoming the most commonly used method of education with the general public. Humans are visual in nature and are more likely to relate and remember information when presented in visual mediums. Continued use of videos and graphical materials is encouraged. Tools should use consistent and targeted messaging to allow the visual story to emerge. Videos should be developed with a more succinct message and should be delivered shorter in length. Typical PSA's should run no longer than 45 seconds.

Videos used on social media should be 15 to 30 seconds long. Commercial and radio spots need to have simplified messages that target one primary educational goal.

Earned Media/Social Media vs. Paid Media: Earned media or the opportunities for media coverage that is not paid for, is often the result of providing easy access to messaging, the story, and the hook to media outlets. This allows the City to help control the message, while gaining the media attention. This is a cost effective way to communicate about your program.

Additionally, social media is a common mechanism for news and information gathering. Communities turn more often to what is being communicated on social media than to traditional news coverage. Considerable costs can be saved by developing a social media framework for communication and creating targeted messaging and visuals to generate online interest. Actively engaging followers on social media help to confirm accessibility and demonstrates commitment on the part of the city to the program. Keep posts timely, relevant, and interesting.

Use social media as a platform for education and dissemination of ideas and knowledge. Social media sites have a way to reach a more diverse group of users and provide a mechanism for simple and succinct messaging.

Appendix A: Benchmark City Contact Information

City	Name	Title	Phone Number
Sioux Falls, SD	Jessica Lantgen	Sustainability Coordinator	(605)367-8187
Sioux City, IA	Melissa Campbell	Recycling Coordinator	(712)279-0151
Saint Paul, MN	Kris Hageman	Environmental Coordinator	(651)266-8866
Fargo, ND	Jen Pickett	Recycling Coordinator	(701)241-1449
Lincoln, NE	Gene Hanlon	Recycling Coordinator	(402)441-7043

City of Sioux Falls
SOUTH DAKOTA

City of Sioux Falls Solid Waste Management Master Plan

Appendix G: Task 8 – Landfill Alternatives and Emerging Technologies Technical Memorandum

HDR

October 2016

Task 8 – Landfill Alternatives and Emerging Technologies Technical Memorandum

Solid Waste Management Master Plan

City of Sioux Fall, SD
October 2016

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1 Introduction & Purpose

The Sioux Falls Regional Sanitary Landfill (Landfill) accepts waste from a variety of generators, and as a result many materials that could be recycled or otherwise processed end up in the Landfill. The purpose of this Technical Memorandum is to provide the City with an overview of multiple types of waste processing/conversion technologies and alternatives to landfilling, including commercially proven technologies and emerging technologies.

General Description

Waste processing and conversion technology options can be grouped into the following main technology classes:

- Thermal Technologies
  - Direct Combustion (various forms of traditional waste-to-energy)
  - Gasification
  - Plasma Arc Gasification
  - Pyrolysis
- Biological Technologies
  - Aerobic Composting
  - Anaerobic Digestion with biogas production for electricity or fuel generation
- Chemical Technologies
  - Hydrolysis
  - Catalytic and Thermal Depolymerization
- Mechanical Technologies
  - Autoclave/Steam Classification
  - Advanced Materials Recovery
  - Refused Derived Fuel (RDF) Production

It's important to note that there are also waste conversion technologies that are a combination of two or more technology classes. For example, Mechanical Biological Treatment (MBT) technologies combine mechanical separation and treatment with biological processing, while Waste-to-Fuel Technologies combine mechanical pre-processing with thermal and chemical conversion processes.

2 Alternative and Emerging Technologies Description of Process/ Methodology

Thermal Technologies

Thermal technologies are designed to either combust, gasify or pyrolyze the carbonaceous combustible materials in MSW feedstocks to recover the caloric energy contained in the waste to produce an energy product. Traditional thermal processes (such as traditional waste-to-energy (WTE) technologies) use a boiler to make steam by recovering the latent heat in the exhaust gas formed from combusting the waste. The steam produced is then sent to a turbine generator to generate electricity. Some thermal facilities may also sell the steam directly to a commercial/industrial user, or send it to a district energy system. Thermal processes that convert the waste to produce a fuel or synthesis gas (e.g. gasification, plasma arc gasification and pyrolysis) can either combust that gas directly in a boiler to make steam and electricity (similar to a traditional WTE technology), or the gas produced can be cleaned and refined to be combusted in an engine or gas turbine to make electricity.. There are also technologies, such as waste-to-fuel, that use gasification to produce a gas that is cleaned and refined into a commercial grade product or liquid fuel. However, these technologies are highly complex and less commercially developed than traditional WTE or gasification technologies.

Regardless of the specific thermal process used, combustion or gasification of waste produces air emissions at certain levels that must be controlled or removed. In theory, the emissions from gasification and pyrolysis technologies are lower than traditional WTE technologies that directly combust the waste; however, modern emission control systems can reduce emissions from both types of technologies below any regulatory emission standards. Thermal technologies can yield gases such as CO_2, water vapor, nitrogen oxides (NOx), sulfur dioxide (SOx); particulates and particulate-related emissions such as heavy metals; as well as trace amounts of products of incomplete combustion, such as carbon monoxide (CO) and dioxins/furans. New thermal technologies are expected to utilize modern air pollution control (APC) devices for emissions clean-up, which include many new advances developed in Europe for air emissions control. The array of APC equipment available for use in minimizing air emissions are quite diverse and include but may not be limited to: selective catalytic reduction (SCR), selective non-catalytic reduction (SNCR) for NOx emissions reduction; spray dryer absorbers (SDA), scrubbers and sorbent injection for acid gas reduction; activated carbon injection (CI) for mercury and dioxins reduction; and a fabric filter baghouse (FB) for particulate and heavy metals removal. Depending on the thermal technology used and the desired end use of the gases produced by the process, the complexity of the APC and gas cleanup systems may vary.

Direct Combustion

Direct combustion of waste, referred to herein as traditional WTE or Energy from Waste (EfW), involves the complete oxidation of a fuel by combustion under controlled conditions utilizing more than stoichiometric levels of oxygen (also known as excess air combustion). The latent heat generated from the combustion process is recovered in a boiler to generate steam which can be used directly for heating/industrial purposes or passed through a steam turbine-generator to create electricity. There are several types of direct combustion technologies used on a commercial scale in

North America, Europe and Asia; the most common include: 1) mass burn grate systems; 2) refused derived fuel (RDF) fired boilers; 3) modular starved air systems; and 4) fluidized bed combustion.

The majority of the 80+ thermal waste conversion facilities operating in North America today utilize direct combustion technology. The construction of traditional WTE facilities stopped in the late 1990s, but there have been a number of recent expansions of existing WTE facilities in Minnesota, Florida and Hawaii. There has also been two new greenfield facilities constructed using modern WTE combustion technology; 1) a 3,000 ton per day (tpd) mass burn facility in West Palm Beach, Florida (2015), and 2) a 480-tpd mass burn facility in Clarington, Ontario, Canada.

Photo #1: Durham York Energy Centre (Ontario, Canada)

Gasification

Gasification has been used for over two hundred years starting with “coal gas” in the 1790’s used for factory lighting. During World War II in the 1940’s, gasification of various types of biomass (e.g. woody wastes) was used to power vehicles and some stationary internal combustion engines. The gasification process involves the conversion of carbonaceous material in the MSW feedstock into a raw gas that is called producer gas that contains principally CO, hydrogen, methane, and other light hydrocarbons, as well as water, carbon dioxide (CO_2) and nitrogen (N_2). The conversion of the feedstock using gasification typically occurs in a reducing environment (i.e. in the presence of limited or substoichiometric amounts of oxygen) under high temperatures and in some cases steam is added to the process. The relative concentration of producer gas components depends upon the composition of the feedstock and process operating conditions. The latent heat in the raw producer gas can be recovered in a boiler to create steam that can be used to generate electricity through a steam condensing turbine (as in the traditional WTE technology described above). Synthesis gas (or “syngas”) can be derived from the producer gas by removing impurities and contaminants through appropriate cleaning and reforming processes to produce a gas composed primarily of CO and H_2. The syngas can be used to generate electricity by direct firing in a combustion turbine, or fired in an internal combustion engine-generator (similar to a landfill gas-to-energy system). The syngas generated can also be used as a chemical building block in a catalytic process for the synthesis of liquid fuels (e.g. methanol, ethanol), but only after considerable gas cleanup.

There are a wide variety of technology designs that can be defined as gasification. The feedstock for most gasification technologies must be prepared from the incoming MSW through shredding and pre-sorting to pull out bulky materials, household hazardous waste, as well as recyclables and inert materials such as dirt, glass/grit, and metals. These materials must be separated and removed to prevent the formation of slags that can cause process upsets or potential operating issues. Some modular combustors use a two-stage combustion process in which the first chamber operates in a low-oxygen environment and the combustion is completed in the second chamber.

Photo #2: Homan Gasification Plant (Fukuoka, Japan)

Plasma Arc Gasification

Plasma Arc Gasification is a subset of thermal gasification. Plasma arc melting technology has been in operation in the metal industry since the late 19th century and modern Plasma Arc Gasification (PAG) technology has been used for a range of industrial and disposal applications (such as, the gasification of hazardous waste, auto shredder, and other types of homogeneous wastes, mostly overseas). It has only been within the last 15 to 20 years that this technology has been considered as a method to treat MSW feed stock at demonstration and pilot-scale level applications.

Plasma arc technology uses carbon electrodes to produce a very-high-temperature arc ranging between 5,000 to 12,000 degrees Fahrenheit that "vaporizes" the feedstock. The high-energy electric arc that is struck between the two carbon electrodes creates a high temperature ionized gas (or "plasma"). The intense heat of the plasma breaks the MSW and the other organic materials fed to the reaction chamber into basic elemental compounds. As the feedstock gasifies, a low-Btu synthesis gas or syngas is generated that could be suitable for combustion and the heat recovered in a boiler, or the producer gas can theoretically be cleaned with its temperature reduced and combusted directly in an internal combustion engine or gas turbine to produce electricity and/or thermal energy (i.e. steam, hot water), or the gas can be cleaned and used for a chemical process. The inorganic fractions (glass, metals, etc.) of the MSW stream are melted to form a liquid slag material which when cooled and hardened to form an inert vitrified slag. Recyclable and contaminated materials can be recovered through a pre-processing system. Metals may be recovered from both feedstock pre-processing and from post-processing the solid slag material.

There have been some recent attempts at commercially applying PAG technology in North America and in the U.K., including the Plasco project in Ottawa, Ontario, Canada and the Tees Valley 1 and 2 projects in England. However, both of these projects ran into technical and financial issues that eventually resulted in Plasco being shut down and sold-off, and the Tees Valley project is currently looking for a buyer. Pyrogenesis, based out of Quebec, Canada, has had some success selling their PAG technology to commercial cruise ships and the U.S. Navy.

Photo #3: Alter NRG 1,000-TPD Plasma Gasification Reactor (Tees Valley, England, U.K.)

Pyrolysis

Pyrolysis technologies are closely related to gasification and some facilities could fall into either technology category depending on how they are operated. Pyrolysis is defined as the process of heating material to high temperatures (700° to 1500°F) in an oxygen-free environment to produce a combustible gas and a liquid product (i.e. pyrolytic oils) and a carbon-rich solid residue. This is similar to what is done to produce coke from coal or charcoal from wood. The feedstock used in pyrolysis technologies has typically been more homogeneous, such as coal, biomass (woody wastes) or even waste tires; however, mixed municipal waste has been used in some operations with pre- processing to obtain a refuse-derived fuel (or RDF) which is a relatively more homogeneous feedstock. Similar to gasification, the Pyrolysis process can be designed to optimize the production of gases or liquids. Syngas can be produced and used as fuel in boilers, or theoretically used in internal combustion units or gas turbines, provided that the gas is adequately cleaned. As discussed, the pyrolysis process is performed in an air- or oxygen-free environment, and therefore the system usually must have a complex design and control system to prevent air or oxygen from intruding into the process, or a provision must be incorporated into the design to purge air from the reaction chamber. However, some pyrolysis processes allow very small amounts of air/oxygen into the system. This allows the feedstock to partially combust to supplement the heating process.

Air emissions from pyrolysis systems are primarily those discharged from combustion of the producer gas or syngas (and possibly char). The treatment of syngas produced from pyrolytic processing of MSW for use in energy conversion equipment and emissions control of syngas constituents has little history but is similar to the process of Gasification described above. Facilities using the pyrolytic oil and other products as fuel could have some of the same air emissions issues as Direct Combustion. Less SOx might be generated in the gas or oil, because most of the sulfur is expected to stay with the char. However, if the char is combusted, the sulfur could be released to form SOx. Units that heat the feedstock in an oxygen-deficient environment would produce fewer emissions. Mercury would be expected to be largely driven off with the gas and would have to be dealt with from the exhaust of the gas combustion device. Other metals and particulate could remain with the char and could largely be separated from the char prior to combustion with a suitable processing system. These emissions can theoretically be controlled using modern air pollution control devices to meet local, state and national regulatory standards.

Biological Technologies

Aerobic Composting

Aerobic Composting has been successfully employed on source separated organics and yard/agricultural wastes and wastewater biosolids. Aerobic Composting can include a number of different processes, however the two most common are aerobic windrow composting and forced aerated static pile composting. Windrow style composting is usually conducted outdoors, while forced aerated static pile composting is usually employed indoors. However, some forced aerated static pile composting is conducted outdoors in areas that are isolated from odor receptors. Other outdoor operations use a bag system to contain the materials. In windrow composting the materials (generally green material) are placed in elongated piles called windrows that are aerated naturally through a “chimney effect” or by mechanically turning the piles with a machine or forced aeration to improve porosity. Frequent turning of the pile introduces oxygen, accelerates physical degradation of feedstocks and provides an opportunity to adjust the moisture content to the optimum level. This technology can be particularly odorous if food waste is included in the feedstock. The average time required for active composting is 8 to 12 weeks.

The aerated composting process refers to any of a number of systems used to biodegrade organic material without physical manipulation during primary composting. It may be in windrows, open or covered, or in closed containers (in-vessel). In an enclosed forced aerated static pile composting technology, fresh air is forced into the pile to speed up the process and to try to ensure that the system remains aerobic. This method is suited to producing large volumes of compost in relatively smaller areas. This technology can be particularly odorous if the composting pile is allowed to have pockets of anaerobic activity. The blended mixture is usually placed on perforated piping or trenches, providing air circulation for controlled aeration.

In most facilities using the aerated compost process a series of perforated pipes draws air down through the windrows to an air collection manifold that runs under the windrows. The compost-air can be drawn through the compost using a blower system which then pushes the air through a biofilter that acts as an emission and odor control system. Alternatively, air can be injected into the windows; however, this results in dispersing the potentially odorous air and therefore is not recommended.

Photo #4: Example of a Windrow Aerobic Composting Facility

Anaerobic Digestion

Anaerobic digestion (AD) is commonly used to treat wastewater biosolids; however, it has also been used as a way of treating the organic fraction of the MSW waste stream, such as food wastes. The processes that mechanically separate the organic fraction of MSW for use in an AD process were first employed in the 1980's under the term Mechanical Biological Treatment (MBT). A few facilities were developed in the U.S. using these AD and MBT technologies; however, for the most part, these facilities ceased to operate years ago due to a variety of technical and financial issues. However, evolution of the technology in parts of Europe, particularly in Germany, Italy and the U.K., has renewed interest in this technology in North America. AD facilities using source separated organics and even in a few cases mixed MSW are successfully operating in Europe due to landfill ban policies, high tipping fees and high prices paid for energy. In parts of California and in Canada, processing food and source separated organic waste streams with the use of AD in combination with aerobic composting to bio-stabilize the process residue has been developed on a commercial scale.

The AD process occurs when organic matter is decomposed using bacteria in the absence of oxygen. By consuming the organic materials, the bacteria produce a biogas (primarily methane and carbon dioxide). Feedstocks for AD vary according to the type of technology but in broad terms could include MSW-derived organics, manure, food waste, grass clippings, and for some technologies, yard waste, brush and wastewater treatment plant biosolids. Biologically inert materials that might be contained in the digestion feedstock, such as metals, glass, and plastics are undesirable and considered contamination and either must be removed prior to digestion (for wet type systems) or be screened-out during or after digestion (for dry type systems). Odors can be a significant issue for AD systems particularly when food waste is incorporated and even more so if a mixed MSW processing system is incorporated upfront of the AD process.

There are several factors that influence the design and performance of AD systems. Some of these factors include: the concentration and composition of nutrients in the feedstock, temperature of the digesting mass, and retention time of the material in the reactor, pH, acid concentration, and oxygen level.

Photo #5: Zero Waste Energy Development Co. AD Plant, San Jose, California

Mechanical Biological Treatment (MBT)

As described above, Mechanical Biological Treatment (MBT) is a variation on composting and materials recovery that incorporates a two-stage process of mechanical and biological treatments. The term commonly used for MBT in North America is *Mixed Waste Processing with Organics Recovery*, but the approach and desired end products are generally the same for both technologies. During the mechanical stage the entire feedstock is sorted to remove recyclables and contaminants and then shredding or grinding takes place for size reduction of the materials prior to the biological stage. The biological stage includes a digestion step in an enclosed vessel which generates a bio-gas that is used to produce energy in addition to heat to dry the feedstock thereby making it ready for processing into a refuse-derived fuel (RDF) product as described below. If no fuel markets are available, the product could be further composted to render the material inert for landfilling.

This technology is designed to process a fully mixed MSW stream. Materials usually derived from the process include marketable metals, glass, and other recyclables. Limited composting is used to break the MSW down and dry the fuel. As for other composting and digestion systems the process must be designed to manage potential odor issues. The order of mechanical separating, shredding, and composting can vary. It is an effective waste-management method and can be built in various sizes. The RDF produced by an MBT process can either be landfilled or converted into energy via a thermal conversion process. In Europe, it is common for the RDF and residue produced by an MBT process to be fired directly in a boiler at a traditional WTE combustion facility, or sold directly to a third party (e.g. Cement Kiln). Consequently, similar to RDF, the MBT process produces a compost and a fuel product that’s dependent on the sale of that product for economic viability.

Chemical Technologies

Hydrolysis

There is much interest and development in the area of cellulosic ethanol technology to move from corn based ethanol production to the use of more abundant cellulosic materials. Hydrolysis is part of that development. The Hydrolysis process involves the reaction of the water and cellulose fractions in a feedstock (e.g., paper, yard waste, etc.) with a strong acid (e.g., sulfuric acid) to produce sugars. In the next process step, these sugars are fermented to produce an organic alcohol. This alcohol is then distilled to produce a fuel-grade ethanol solution which can be burned in energy conversion devices such as heaters and engines.

Hydrolysis is a multi-step process that includes four major steps: Pre-treatment; Hydrolysis; Fermentation; and Distillation. For MSW the pre-treatment step would include separation of the feedstock stream as necessary to remove any inorganic/inert materials (glass, plastic, metal, etc.) from the organic materials (yard waste, paper, etc.). Feedstock materials that are appropriate for hydrolysis/fermentation of the cellulosic components of MSW include wood, green waste and paper. This process does not handle or convert mixed MSW directly and is best suited for clean source-separated cellulosic waste components. The organic material is shredded to reduce the size and to make the feedstock more homogenous. The hydrolysis step places the shredded organic material into a reactor where it is introduced to the acid catalyst, with the cellulose in the organic material converted into simple sugars as discussed above. The fermentation step utilizes these sugars to be fermented and converted into an organic alcohol. The distillation step takes the organic alcohol and distills it into fuel-grade ethanol. The by-products from this process are carbon dioxide (from the fermentation step), gypsum (from the hydrolysis step) and lignin (non-cellulose material from the hydrolysis step). Since the acid acts only as a catalyst, it can usually be extracted and recycled back into the process.

Catalytic and Thermal Depolymerization

The depolymerization, or cracking, process converts long-chain hydrocarbon polymers present in some waste materials into intermediate products that can be processed into fuels such as diesel and gasoline. Pressure and heat are used to decompose long-chain polymers composed of hydrogen, oxygen, and carbon into shorter chains of petroleum-like feedstock. This process is somewhat similar to that used at an oil refinery to convert crude oil into usable products, including the use of distillation to segregate the desired hydrocarbon liquids (such as diesel fuel). The typical feedstocks proposed for depolymerization are plastics, waste oils, grease, and offal (i.e., processed animal soft tissue), although the technology vendors are representing that this technology can theoretically use MSW and biomass as feedstocks. This has not been shown as feasible except at extremely small scale. There are two depolymerization methods that can be used to convert organic materials into fuel: thermal and catalytic.

Thermal depolymerization utilizes temperature (temperature ranges from 1,000° to 1,400° Fahrenheit) and pressure to crack the large hydrocarbon molecules within the feedstock. Once the hydrocarbon molecules are broken into shorter chains, additional refining steps are required to convert the molecules into oil. The high temperature and additional refining steps in the thermal process require the input of a significant amount of energy, as compared to the catalytic depolymerization approach. The energy balance data for thermal depolymerization of waste-derived organic materials are lacking with regard to commercial scale processing.

The Catalytic Depolymerization process uses lower temperatures (ranging from 500° to 700°F) and lower pressures than thermal depolymerization. In order to achieve adequate product yields and qualities at the lower temperatures and pressures, a catalyst is employed to aid in the process of breaking down or cracking the large molecules efficiently. Zeolite, silica-alumina, and bauxite are common types of catalysts used in the process. In a Catalytic Depolymerization process, the plastics, synthetic-fiber components and water in the feedstock react with a catalyst under pressure and temperatures to produce a crude oil. This crude oil can then be distilled to produce a synthetic gasoline or fuel-grade diesel.

Waste-to-Fuel Technologies

The generation of liquid fuels from wastes is an evolving technology. The use of biomass and organic wastes as a feedstock appears to be advancing in demonstration/pilot projects with a couple projects moving towards commercialization. However, the use of an MSW feedstock is still being tested in laboratories and demonstration/pilot projects. There is a commercial-scale waste-to-fuel facility being developed in Edmonton, Alberta, Canada by a technology developer called Enerkem, but this facility is still in a commissioning phase.

There are several proposed methodologies to convert MSW into fuels. The first step in the most prevalent MSW-to-fuel technologies requires the use of a process to generate a syngas, typically a thermal conversion process such as gasification. The syngas is then cleaned to remove impurities (tars, hydrocarbons, contaminants, etc.). The next step involves a Fischer-Tropsch (FT)-type process, which is defined as a collection of chemical reactions that converts a mixture of carbon monoxide and hydrogen into liquid hydrocarbons. The FT process was first developed in Germany in 1925 as a process of converting gases to a synthetic liquid fuel. The chemical reactions produce a variety of hydrocarbon molecules with the more useful reactions producing alkanes. Most of the alkanes produced tend to be straight-chain, suitable as diesel fuel. Use of the proper catalyst in the FT process is essential to garner the highest quality fuel while not deteriorating the catalyst. In this technical industry there are many forms of catalyst including cobalt and ferrous based. This is the area that syngas from MSW gasification is having the greatest issues because of the contaminants in the MSW syngas and low of ratios of H2 to CO. This FT process is usually followed by a hydro-cracking process. Hydro-cracking is required as part of the FT process to break up the long-chained hydrocarbons. The very long-chained hydrocarbons are waxes, which are solid at room temperature. Therefore, for production of liquid transportation fuels it is usually necessary to crack some of the FT products.

Alternatives to the FT process include using a bio-catalytic process where biological organisms are used to breakdown the elemental components in the syngas produced by a thermal process into a biofuel. The Indian River Bioenergy Facility in Vero Beach, Florida employed this technology to convert mostly agricultural wastes into ethanol, but this facility is no longer operating.

Photo #6: Enerkem Alberta Biofuels Facility, Edmonton, Alberta, Canada

Mechanical Technologies

Autoclave/Steam Classification

Autoclaving is classified as a “mechanical” process that uses heat and pressure in a mechanical rotating cylinder that can be used to separate the cellulosic and organic material from other portions of the municipal solid waste stream. The basic Autoclave technology has been in use for sterilization of hospital wastes and equipment and other related applications for many years.

Autoclaves are large rotating vessels that have steam injected and kept at a certain temperature and pressure over a 2 to 4 hour period to convert the MSW. Most Autoclaves are currently operating in batch mode accepting from approximately 1 to 25 tons per batch (2-3 hour). The Autoclave process has the potential for a 40% to 60% reduction in waste volume with the cellulose recovery having the potential to be used as feedstock for: paper production; ethanol production feedstock; compost feedstock; or digester feedstock for methane production.

Like AD and MBT technologies, Autoclaving may be best applied when it addresses only a portion of the waste stream, namely the cellulose-fiber-containing portion, which is usually 40% to 60% of the total MSW input stream. However, this technology can accept mixed MSW which contains a large organic fraction (just not inerts from a C&D mix) to be used as a “front-end” separation system for many of the other emerging technologies such as Hydrolysis for production of a fuel product, Gasification or Pyrolysis for energy generation, Anaerobic Digestion for energy and compost production, or for fiber recovery for the pulp/paper industry. A trommel screen is usually utilized after the autoclave to separate the fibrous organic materials produced from Autoclaving and other materials (such as inorganic materials, plastics, and recyclables such as glass, metals). If the goal for the Autoclaving technology is recovery for paper production, because the fibers are a mixed grade, the main product that can be produced is a lower-grade cardboard.

Mixed Waste Processing and Advanced Materials Recovery

There are a number of types of materials recovery facilities (MRFs) in operation in the U.S. and around the world. Most can be classified into two groups; 1) those that accept and process source separated recyclables, sometimes referred to "clean" MRFs, and 2) those that take a mixed MSW stream, referred to as a "Mixed Waste Processing Facility" or sometimes as a "dirty" MRF. This purpose of this section is to describe Mixed Waste Processing facilities (MWPFs) and their potential commercial applications.

A MWPF begins with mixed solid waste from residential and/or commercial collection vehicles being off-loaded onto a tipping floor. Materials are first sorted on the floor using manual labor and mobile equipment to remove larger or bulky items such as appliances, dimensional wood, metal, or large pieces of plastics that might clog or interrupt operations of the processing system. Loaders or grapples then load a conveyor or surge hopper to convey the material to the sort lines and mechanical equipment for separation. In most cases either a mechanical device or manual labor is used to open bags and containers prior to screening and sorting.

Material is usually processed through multi-stage screens to separate fiber (cardboard, newspaper, and mixed paper), plastic, metal and glass containers, and small contaminants. This is usually accomplished through the use of mechanical, optical or pneumatic screening equipment and/or labor to separate materials into size classifications and/or light versus heavier materials. Fiber is usually hand sorted off elevated conveyor platforms into commodities and dropped into bunkers below. Containers are processed through ferrous magnets, eddy current magnets, air screens and hand sorting. The small contaminant stream (dirt, rocks, broken glass and ceramics, bottle caps, etc.) may be further processed by optical/pneumatic sorting. Sorted material is moved from bunkers and baled (fiber, plastic, metal) or loaded directly into roll-off trucks (glass, wood, scrap metal). Some MWPFs also isolate the organic fraction of the MSW stream to be used in a composting or AD process. The remaining residue material from a MWPF is shipped to a local landfill or another appropriate waste reduction application. The main purpose of this type of MWPF is to remove recyclable materials and even organics from the mixed MSW. These types of facilities usually recover about 10% to 25%, although some facilities have reported recovery of up to 50% or more. There is a wide range of MWPF capacities operating throughout the world. The optimal capacity is between 200 tpd and 1,500 tpd using multiple sort lines and operating additional shifts. MWPFs can have a useful operating life of 20 to 30 years if proper maintenance is provided. Many MWPFs are retrofitted throughout their life with new processing equipment as applicable.

There has been a number of recent commercial scale MWPFs implemented in North America. The most notable examples are in Montgomery County, Alabama, San Jose, California, and in Edmonton, Alberta. It should be noted that the current downward trend in commodity pricing and acceptance of the processing approach has impacted the financial viability of some of these projects.

Photo #7: Newby Island Resource Recovery Park, California

Refuse Derived Fuel (RDF) Production

An RDF processing system prepares MSW by using separation, shredding, screening, air classifying and other equipment to produce a fuel product, such as coarse shred, fluff, or pellets, for either on-site thermal processing, off site thermal processing, or use in another conversion technology that requires a prepared feedstock. The goal of this technology is to derive a more homogeneous fuel product that can be used in specified thermal equipment or as a supplement to coal-fired power generating facilities, and even cement kilns in some cases. The fuel goes by various names but generally is categorized as a refuse-derived fuel (RDF).

Non-recovered discards can be processed by this technology. Facilities can range in size from several hundred tons per day to more than 3,000 tons per day. Recycling processes can also be built into an RDF facility such as in a MRF or MWPF, metals can usually be sorted and removed by magnets and eddy current separators. In some cases other recyclables such as cardboard or even plastic containers may be recycled. An RDF facility strives to develop a consistently sized fuel with a relatively constant heating value for thermal technologies. These facilities can employ multiple shredding stages, large trommel screens or other types of screens for sizing, several stages of magnets, and possibly air separation and eddy current magnets. The product would typically have a nominal particle size of 3 to 4 inches (although the sizing of final product RDF can be controlled for a specific technology), have the grit and metals largely removed, and be ready to market.

EPA has encouraged processing to produce a Non-Hazardous Secondary Material (NHSM) for use in industrial boilers or other applications that are subject to Section 112 of the Clean Air Act as opposed to Section 129 which waste combustors must follow. The fuel must meet the requirements for a Non-Hazardous Secondary Materials (NHSM) as defined by the US EPA in 40 CFR Section 241.3 of the Clean Air Act. .These processing facilities require more processing and ongoing sampling to meet strict requirements for residual chlorine content, chlorine to sulfur ratio, heating value, moisture and ash content in the resultant fuel than are required for combustion of waste in a waste boiler. Refer to Section 5 for additional discussion of the NHSM program.

Some RDF facilities can be classified as a “shred and burn” style, which shred the material and magnetically remove ferrous metals without removing fines. Fines usually consist of material two inches in diameter or smaller that include organic material such as paper, dirt and food particles as well as inorganics such as glass, plastics and metals. Some RDF facilities have converted to shred and burn through blanking the small holes in trommels. The purpose for this is to reduce the overall amount of residue (fines) landfilled. Many of the existing RDF combustion facilities in the U.S. (e.g. Miami-Dade, West Palm Beach, Detroit, Honolulu, Norfolk, VA, etc.) employ these practices to process the fuel.

There are also RDF technologies that form the remaining MSW stream, after removal of recyclable and bulky and inert materials, into a pellet or briquette. The intended use of these pellets or briquettes varies by technology developer and regulation, but some examples include use as a supplement to coal at a conventional fossil fuel power plant or cement kiln. Some technology providers also offer the pellets for use as a soil amendment in greenhouses. However, the quality and integrity of the pellets or briquettes produced and the willingness of the local market to accept this product factor significantly into the economic viability of the project. A recent commercial-scale MSW pelletizer facility in York Region, Ontario (just north of the City of Toronto) was shutdown due to operating issues and limited available markets for the pellets.

3 Comparisons of Technology Options

The following table presents a comparison of direct combustion, gasification and plasma arc gasification, showing criteria including commercial viability, capability of processing feedstock, technology capacity level, diversion potential, marketability of end products and bi-products, useful operating life, environmental benefits and drawbacks, local economic benefits, and range of operating and capital costs (high, medium, low).

	Criteria	Direct Combustion	Gasification	Plasma Arc Gasification
1. Commercial Viability (Development Stage)				
a	Status of technology in North America	Commercial	Demo/Pilot on MSW	Demo/Pilot on MSW
b	Years of commercial operating history in North America	30 plus years	Limited to none on MSW	Limited to none on MSW
c	Number of commercial continuously operating facilities in North America	80 plus facilities	None on MSW	None on MSW
d	Status of technology worldwide	Commercial	Commercial (mostly in Asia)	Limited Commercial on MSW in Asia
2. Capability of Processing Feedstock				
a	Type of MSW Processed	Handle Entire MSW Stream	Handle Entire MSW Stream	Ideal for hazardous and high carbon fraction (e.g. plastics) of MSW Stream
3. Technology Capacity Level				
a	Processing Unit Capacity (tpd)	500 to more than 3000 tpd Modular less than 500 tpd	Less than 500 tpd	Less than 500 tpd
4. Diversion Potential of Technology				
a	Potential Landfill diversion (weight percent)	70%-90%	Claimed greater than 90%	Claimed greater than 90%

	Criteria	Direct Combustion	Gasification	Plasma Arc Gasification
5. Marketability of End- and By-Products				
a	Availability and feasibility of markets for recovered materials	Good for metals and mixed ash for LF cover (as permitted)	Unknown for vitrified ash/slag for aggregate	Unknown for vitrified ash/slag for aggregate
b	Availability and feasibility of markets for energy produced	Good	Good	Good
c	Undesired By-Products	Fly ash if not mixed with bottom ash	Ash/Slag if not sold/given away as aggregate	Ash/Slag if not sold/given away as aggregate
6. Useful Operating Life				
a	Facility Life (yrs)	Greater than 25 years	Currently about 20 years	Currently about 10 to 15 years
7. Typical Environment Benefits/Drawbacks				
a	Benefits	Produces energy, metals for market and ash for cover (mixed)	Produces energy, possible aggregates from slag (need mkts)	Produces energy, possible aggregates from slag (need mkts)
b	Drawbacks	Air emissions to be mitigated by APC equipment	Air emissions to be mitigated by APC equipment	Air emissions to be mitigated by APC equipment
8. Local Economic Benefits				
a	Permanent Full-time Jobs	40 to 80 permanent jobs	40 to 80 permanent jobs	40 to 80 permanent jobs
9. Financial				
a	Range of Capital and Operating unit cost	Moderate to High	Moderate to High	High

The following table presents a comparison of pyrolysis, aerobic composting, and anaerobic digestion, showing criteria including commercial viability, capability of processing feedstock, technology capacity level, diversion potential, marketability of end products and bi-products, useful operating life, environmental benefits and drawbacks, local economic benefits, and range of operating and capital costs (high, medium, low).

	Criteria	Pyrolysis	Aerobic Composting	Anaerobic Digestion
1. Commercial Viability (Development Stage)				
a	Status of technology in North America	Demo/Pilot on MSW	Commercial (particularly for source separated organic streams)	Commercial (particularly for source separated organic streams)
b	Years of commercial operating history in North America	None on MSW	Many on green/yard waste feedstock	Less than ten years
c	Number of commercial operating facilities in North America	None on MSW	Numerous	About 5 (More under construction)
d	Status of technology worldwide	Demo/Pilot on MSW	Commercial	Commercial
2. Capability of Processing Feedstock				
a	Type of MSW Processed	Handle Entire MSW Stream	Ideally suited to process green/yard waste and food waste portions of MSW	Can treat only organic portion of MSW
3. Technology Capacity Level				
a	Processing Unit Capacity (tpd)	Under development; ~ 10 to 100 tpd	Usually 200 to 400 tpd, but can be larger	Wide range from 5-10 tpd to 300 tpd

	Criteria	Pyrolysis	Aerobic Composting	Anaerobic Digestion
4. Diversion Potential of Technology				
a	Potential Landfill diversion (weight percent)	Not known	Sioux Fall's total yard waste and food scraps less than 10% according to Waste Characterization Study (2016)	Sioux Fall's total yard waste and food scraps less than 10% according to Waste Characterization Study (2016)
5. Marketability of End- and By-Products				
a	Availability and feasibility of markets for recovered materials	Depends if gases, liquids and char can be used	Most materials can be cured into a marketable compost	Digestate after process can sometimes be turned to compost and it may be possible to convert biogas to pipeline grade natural gas
b	Availability and feasibility of markets for energy produced	Depends if gases, liquids and char can be combusted	N/A	Biogas can be used to create energy
c	Undesired By-Products	Liquids, tars, chars and other by-products	Screened overs, such as bottle caps, glass and other small objects	Digestate must be assessed if compostable
6. Useful Operating Life				
a	Facility Life (yrs)	One small facility operating in Germany since 80's	Life is 30+ years depending on equipment replacement	Operating internationally since the 80's
7. Typical Environment Benefits/Drawbacks				
a	Benefits	Potentially create energy and useful by-products	Create useable compost	Create energy and potentially useable compost

	Criteria	Pyrolysis	Aerobic Composting	Anaerobic Digestion
b	Drawbacks	Air emissions to be mitigated by APC equipment	Can create odor, noise and dust	Air emissions need mitigation & digestate may not be composted; can create odors
8. Local Economic Benefits				
a	Permanent Full-time Jobs	Not known	About 2 to 10 jobs, depending on the size of the operation	About 10 to 25 jobs, depending on the size of the operation. More jobs required if a MWPF is required for mixed MSW stream.
9. Financial				
a	Range of Capital and Operating unit cost	High	Low	Medium

The following table presents a comparison of mechanical biological treatment, hydrolysis, catalytic and thermal depolymerization, and waste-to-fuels, showing criteria including commercial viability, capability of processing feedstock, technology capacity level, diversion potential, marketability of end products and bi-products, useful operating life, environmental benefits and drawbacks, local economic benefits, and range of operating and capital costs (high, medium, low).

	Criteria	Mechanical Biological Treatment	Hydrolysis	Catalytic & Thermal Depolymerization	Waste-to-Fuels
1. Commercial Viability (Development Stage)					
a	Status of technology in North America	Demo/Pilot	Demo/Pilot	Demo/Pilot	Demo/Pilot on MSW
b	Years of commercial operating history in North America	None Commercialized	None Commercial-ized	None Commercialized	None Commercialized
c	Number of commercial operating facilities in North America	None Commercialized	None Commercial-ized	None Commercialized	One facility in hot startup and commissioning. One facility recently shutdown.
d	Status of technology worldwide	Commercial	Demo/Pilot	Demo/Pilot; one facility claimed in Spain	R&D/pilot on MSW

	Criteria	Mechanical Biological Treatment	Hydrolysis	Catalytic & Thermal Depolymerization	Waste-to-Fuels
2. Capability of Processing Feedstock					
a	Type of MSW Processed	Entire waste stream	Wood, green waste and paper	Plastics & oils	Entire or biomass portion of MSW
3. Technology Capacity Level					
a	Processing Unit Capacity (tpd)	Needs more research	Needs more research	Needs more research	Needs more research
4. Diversion Potential of Technology					
a	Potential Landfill diversion (weight percent)	This is a feedstock pre-process; recover recyclables	Estimated 25%-30%	Estimated 10%-12%	If gasification is used, can be up to 90%
5. Marketability of End- and By-Products					
a	Availability and feasibility of markets for recovered materials	Markets for recyclables and possibly fuel product	Markets for gypsum & lignin will need to be established	Needs more information on the bio-diesel created	Needs more information on the liquid fuel created
b	Availability and feasibility of markets for energy produced	There are markets for the potential biogas produced	There has not been a market for this fuel established	There has not been a market for this fuel established	There has not been a market for this fuel established
c	Undesired By-Products	None known if markets are available for fuel	Potentially the CO_2, gypsum & lignin	Needs more research	Needs more research
6. Useful Operating Life					
a	Facility Life (yrs)	Most probably 15 to 25 years	Needs more evaluation	Needs more research	Needs more research
7. Typical Environment Benefits/Drawbacks					
a	Benefits	Separates feedstock for recycling, digestion& thermal	May be able to produce a fuel with more evaluation	May be able to produce a fuel with more evaluation	May be able to produce a fuel with more evaluation

	Criteria	Mechanical Biological Treatment	Hydrolysis	Catalytic & Thermal Depolymerization	Waste-to-Fuels
b	Drawbacks	Odors, dust & noise	Methane emissions and possible chemical spills	Hydrocarbons could be emitted; catalysts or solvents needed	Hydrocarbons could be emitted; catalysts or solvents needed
8. Local Economic Benefits					
a	Permanent Full-time Jobs	20 to 40 jobs	Not known	Not known	Not known
9. Financial					
a	Range of Capital and Operating unit cost	Medium	Medium	Medium	Medium/High

The following table presents a comparison of autoclave, materials recovery, and RDF processing, showing criteria including commercial viability, capability of processing feedstock, technology capacity level, diversion potential, marketability of end products and bi-products, useful operating life, environmental benefits and drawbacks, local economic benefits, and range of operating and capital costs (high, medium, low).

	Criteria	Autoclave	Mixed Waste Processing	RDF Processing
1. Commercial Viability (Development Stage)				
a	Status of technology in North America	Demo/Pilot on MSW components	Commercial	Commercial
b	Years of commercial operating history in North America	None on MSW components	30 + years	30 + years under MWC EPA requirements;, about 5 years under Boiler MACT EPA requirements[1]
c	Number of commercial operating facilities in North America	None on MSW components	Numerous	Approximately 20 to 30. One facility producing pellets in Ontario, Canada was shutdown due to financial issues (i.e. no market for pellets)

	Criteria	Autoclave	Mixed Waste Processing	RDF Processing
d	Status of technology worldwide	Demo/Pilot on MSW components	Commercial	Commercial
2. Capability of Processing Feedstock				
a	Type of MSW Processed	Handle only organics but can process entire MSW stream	Handle entire MSW stream	MWC handle entire MSW stream; NHSM cannot handle chlorine containing materials
3. Technology Capacity Level				
a	Processing Unit Capacity (tpd)	At this time only smaller 100-300 tpd available	~200 to 1,500 tpd	Up to about 1,000 tpd
4. Diversion Potential of Technology				
a	Potential Landfill diversion (weight percent)	~35-40% of the MSW possibly more if combined with other technologies	~10-25% of the MSW	~60-90% of the MSW depending on the process
5. Marketability of End- and By-Products				
a	Availability and feasibility of markets for recovered materials	Metals can be marketed; fiber product may only be used for low grade cardboard; market needs to be developed for plastics	Recyclables can be marketed	Recyclables can be marketed; Markets are project specific if pellets or briquettes are produced. Possible use as soil amendment but no clear markets available.
b	Availability and feasibility of markets for energy produced	Market needs to be developed for fuel	N/A	RDF can be converted to energy under either MWC or Boiler rules.
c	Undesired By-Products	Non-fiber unless a market can be developed for plastics	Grit/ fines, trash, low grade plastics and glass unless markets are available	Bulky items, grit/glass; for NHSM PVC and other chlorine containing materials

	Criteria	Autoclave	Mixed Waste Processing	RDF Processing
6. Useful Operating Life				
a	Facility Life (yrs)	Not known at this time	20 to 30 years with periodic equipment upgrades	20 to 30 years
7. Typical Environment Benefits/Drawbacks				
a	Benefits	Possibly create low grade fiber or fuel product; recover metals; output materials are sterilized	Recover recyclables	Preparation of feedstock for other processes; NHSM can be processed in Industrial Boilers
b	Drawbacks	Risks of Autoclaving are not known; fiber product is low quality	Odors, noise & dust to be mitigated	Odors, noise & dust to be mitigated; NHSM must meet strict fuel requirements and sampling
8. Local Economic Benefits				
a	Permanent Full-time Jobs	Not known at this time	20 to 60 jobs	20 to 100 jobs
9. Financial				
a	Range of Capital and Operating unit cost	Medium	Medium	Medium; NHSM produced for a boiler costs are higher than for RDF production for an MWC facility, however the boiler costs are lower

Footnotes

1. **Solid Refuse Fuel (SRF) production as a Non-Hazardous Secondary Material (NHSM) where the fuel is combusted in an Industrial Boiler subject to 40 CFR Section 112 of the Clean Air Act has been completed commercially in the US only in the last five years. Refer to Section 5 for further discussion of SRF. Municipal Solid Waste (MWC) facilities combusting RDF are subject to 40 CFR Section 129.**

4 Benefits and Obstacles

Thermal Technologies

Direct Combustion

Benefits of this technology are the production of local energy and potential uses of the byproducts of ferrous metals and ash as landfill cover or as an aggregate in the construction industry. In addition, direct combustion technologies have a long history of reliable commercial-scale operation and are flexible enough to handle a variety of feedstocks with little to no pre-processing requirements. Development of the technology can create a number of construction jobs over the one to three years of construction and 40 to 80 permanent jobs over the life of the project. In addition, although the technology recycles and re-uses water on-site, it also requires a moderate use of water. However, high capital and operating costs, particularly for smaller scale facilities, and strong opposition from environmental groups make implementing projects very difficult. The current low pricing for electricity and natural gas makes the energy produced from these technologies (steam and/or electricity) of low value.

Gasification

Gasification operators assert one of the benefits of many gasification technologies is that very high diversion levels (above 90%) can be achieved because the slag is not leachable. Other benefits include the production of energy and potential uses of the by-products of ferrous metals and ash as landfill cover or as an aggregate in the construction industry. Local benefits include the creation of construction jobs over the one to three years of construction and 25 to 75 permanent jobs over the life of the project. Theoretically the emissions should be lower than that from Direct Combustion and the vendors of this technology claim this is true. However, due to the limited operating history of this technology on mixed MSW in North America, actual emissions from operating facilities have been difficult to obtain or difficult to translate. In addition, the technology may only process a specific subset of waste materials (not just MSW as reviewed in this document) such as wood waste, tires, carpet, scrap plastic, or other waste streams. Some technologies may require extensive pre-processing increasing capital and operating costs. The current low pricing for electricity and natural gas makes the energy produced from these technologies (steam and/or electricity) of low value.

Plasma Arc Gasification

Similar to the Gasification and Pyrolysis processes, the MSW feedstock will need preprocessed to remove the larger, bulky waste and household hazardous waste as well as dirt, glass/grit, and metals to prevent these materials from forming slag and causing potential operating issues. Vendors of this technology claim efficiencies that are higher than Direct Combustion and Gasification technologies. These higher efficiencies may be possible if a combined cycle power system is proposed; however, little operating experience and no commercial experience in North America is available for this technology.

Vendors of this technology claim to achieve lower concentrations of emissions than more conventional technologies, like Direct Combustion. However, APC equipment similar to other thermal technologies would still be required for the clean-up from the combustion of the syngas as these facilities generally have similar air emissions issues as other Gasification, Pyrolysis and Direct Combustion facilities. Mercury and some other more volatile metals are expected be driven off with the gas and would have to be dealt with from the exhaust of the gas combustion device.

Pyrolysis

Pyrolysis of MSW has had limited operational history and no commercial success to date, therefore there is little information regarding long-term operating experience. As there are not many Pyrolysis units functioning at a high level of capacity using MSW as a feedstock, the industry needs more time developing this technology.

Benefits include a claimed over 90% diversion of waste from landfills, the production of energy and potential uses of the by-products, if marketable. Other local benefits include the creation of construction jobs over the one to three years of construction and a certain amount of permanent jobs over the life of the project. This figure cannot be estimated as the technology requires additional development.

Biological Technologies

Aerobic Composting

Benefits include diversion of waste from landfill and the local production of beneficial use compost and mulch which can be used in the community. In addition, local benefits include the creation of construction jobs over the short period of construction and about 2-10 permanent jobs over the life of the project, depending on the size and complexity of the facility. The main drawback is the potential for creating odors, noise and dust. This can be mitigated with proper operations and facility siting. Aerobic Composting also only addresses certain segments of the waste stream.

Anaerobic Digestion

Benefits of this technology include diversion of waste from landfill, the production of energy and potential uses of the by-products. In addition, other local benefits include the creation of construction jobs over the year or so of construction and about 10 to 25 permanent jobs over the life of the project, depending on the size and complexity of the facility. The biogas produced can also be cleaned and compressed into CNG for vehicles, or cleaned and sold directly to a natural gas pipeline. The drawbacks of AD technology include the limitation of the technology to process the limited feedstock appropriate for the technology (organics), as well as the potential for creating odors, noise and dust. The management of odors, noise and dust can be mitigated with proper operations and facility siting.

Mechanical Biological Treatment (MBT)

A benefit is the post-collection separation of feedstocks to divert material from landfill while preparing a feedstock for digestion and thermal consumption. Another benefit is the creation of construction jobs over the construction period and approximately 10 to 50 permanent jobs over the life of the project. The primary drawback is the necessity for the process to rely upon the sale of the fuel product for economic viability. As much as 40-50% of the incoming waste stream winds up as non-digestible residue that either requires processing from another thermal technology and/or landfilling. Other operating drawbacks include the potential for creating odors, noise and dust. This can be mitigated with proper operations and facility siting.

Chemical Technologies

Hydrolysis

The process of chemical Hydrolysis is well established for some organic feedstocks, such as in the conversion of wood to paper pulp, but has only been applied to MSW-derived organics on a conceptual basis, or limited to laboratory- or pilot-scale. There has been no sustained commercial application of this technology using MSW as a feedstock in North America and little information from abroad.

Similarly, the environmental risks are not well defined. In addition to the environmental risks of any associated technology, there would be some emissions risks related to methane emissions or issues dealing with potential chemical spills. It is also expected that significant quantities of water and wastewater use would be required.

Benefits include the diversion of organic waste from landfill, the production of a cellulosic ethanol that can be used as a fuel product and the creation of construction jobs over the construction period and a certain amount of permanent jobs over the life of the project. This figure cannot be estimated as the technology requires additional development.

Catalytic and Thermal Depolymerization

Benefits include the diversion of plastic and oil waste from landfill, the production of an oil or fuel product that can be used as fuel and the creation of construction jobs over the construction period and a certain amount of permanent jobs over the life of the project. This figure cannot be estimated as the technology requires additional development. The drawback is that the environmental risks are not well defined. Catalytic cracking could emit some hydrocarbons from the process. There could also be some other risks resulting from the handling of the catalysts or solvents and related compounds that might be required for the process. Water and wastewater use is also not known.

Waste-to-Fuel Technologies

Given the emerging status of this technology with MSW, there is minimal information available on this technology. This is a two step process: 1) producer gas will need to be generated through gasification or another technology and 2) the producer gas will then need to be cleaned and conditioned with the proper chemical catalytic process used to synthesize the syngas into a liquid fuel.

Benefits include the potential production of an ethanol based fuel and the creation of construction jobs over the construction period and a certain amount of permanent jobs over the life of the project. Drawbacks include air emissions impacts associated with the thermal gasification and syngas conditioning process and the potential for only being able to produce fuel from a biomass only feedstock. In addition, there are solid and liquid wastes associated with this technology. The current low oil pricing in the U.S. also makes the sale of the liquid fuel less valuable and may impact the financial viability of the project.

Mechanical Technologies

Autoclave/Steam Classification

Benefits include the potential diversion of materials from landfill, the production of a cellulose and plastic products that can be used as feedstock for many of the technologies as described above and the creation of construction jobs over the construction period and a certain amount of permanent jobs over the life of the project. This figure cannot be estimated as the technology requires additional development. A drawback is that the environmental risks of Autoclaving are not known. This technology could be used primarily as a front-end system to prepare materials for other processes such as fiber recovery, and thermal technologies and relies on the additive technology for most diversion potential. Water and wastewater use is also not known.

Mixed Waste Processing and Advanced Materials Recovery

Benefits include the diversion of recyclables from landfill, preparation of feedstock for thermal, chemical or biological processes and the creation of construction jobs over the one to two year construction period and approximately 20 to 60 permanent jobs, depending on the size and complexity of the project. A drawback is that certain environmental impacts must be mitigated such as noise, dust and odor. The diversion rate for this technology alone is lower unless coupled with another technology for management of the non-recyclable materials. In addition, some of the commodities recovered from a MRF of this type may be more contaminated than a “clean” MRF. Current commodity pricing also impacts the financial viability of these projects.

Refuse Derived Fuel (RDF) Production

Benefits include the preparation of the MSW into a feedstock that is acceptable by other processes allowing them to be more effective and efficient, removal of recyclable and reusable materials for beneficial use and the creation of construction jobs over the one to two year construction period and approximately 10 to 100 permanent jobs, depending on the size and complexity of the project. A drawback is that RDF facilities will have some air emissions directly from the processing (dust) as well as from the combustion of the RDF (this is discussed in the thermal technologies section). An economic drawback of RDF is that it produces a solid fuel similar to coal. So, production of the RDF product presumes a local appetite for a coal-substitute to be economically viable. For most plants looking for a coal substitute, the fuel produced must also achieve the requirements for a Non-Hazardous Secondary Material (NHSM) if the plant wants to be regulated under Section 112 of the Clean Air Act. To distinguish this application from RDF production, processing required for a boiler subject to Section 112 is called solid refuse fuel (SRF) in this report. Refer to Section 5 for further discussion. Fugitive particulates from the process must be controlled. In addition other environmental impacts must be mitigated such as noise and odor. Costs for this type of facility are greatly based on the amount of revenues garnered from sale of the RDF product.

5 Alternative Technologies Design and Implementation Considerations for Sioux Falls

HDR's findings from previous review and evaluation of the alternative technologies indicate that some technologies appear to be less attractive than others, mostly due to the level of commercial development with respect to being capable of processing MSW as the feedstock. The technologies which are the least developed and therefore not recommended for further consideration include:

- Plasma Arc Gasification
- Pyrolysis;
- Hydrolysis;
- Catalytic and Thermal Depolymerization; and
- Autoclaving.

Our previous findings also concluded that some of the technologies are considered to have limitations with respect to the types of feedstock they can process. For example, biological technologies such as anaerobic digestion and composting can only affect the organic portion of the non-recyclable discards. These types of technologies achieve much less diversion unless they are coupled with another technology that addresses other parts of the waste stream. As such, we find that while some technologies are not suited to process the entire spectrum of waste discards, the use of MWPF's or Mechanical Biological Treatment in waste management systems raise the possibility to develop feedstock materials that are subsets of MSW which may create opportunities for alternative technologies that are otherwise not commercially viable (e.g. certain types of Gasification).

A unique and new opportunity for Sioux Falls may be the development of a Solid Refuse Fuel (SRF) Production process. While there are no nearby Thermal Technology (Municipal Waste Combustor) facilities (regulated under Section 129 of the Clean Air Act (CAA)) that might be interested in purchasing the fuel product for their facility, there may be Industrial Boilers that may be interested in using the fuel as a substitute for coal, oil, wood or biomass fuels used at the facility. These facilities are regulated under the CAA Section 112 and would most likely want to remain with that designation. Under the recently developed rules in Section 241 of the CAA, the EPA is encouraging the development of Non-Hazardous Secondary Materials (NHSM) that can be used as a fuel substitute for traditional fuels. Under the NHSM provisions and certain management practices, certain materials usually considered to be wastes can be used as a traditional fuel substitute without causing the boiler to be subject to the provisions of Section 129 of the CAA and the unit would remain regulated under Section 112. This provision is often used for materials such as pulp and paper wastes at a paper mill, or even for combustion of certain other materials such as tires or railroad ties. To distinguish this process from RDF production, this report uses the term SRF for the fuel produced that achieves the requirements of Section 241.3 of the CAA.

Section 241.3 has several provisions that must be demonstrated. First, the process must be more than just shredding. The rule will likely require removal of fines, glass, metal and other inert materials, as well as certain other undesirable components of the waste stream such as moisture and chlorine. These provisions will demonstrate a "legitimacy criteria" demonstrating that a viable SRF is produced and used and it no longer is a waste. The SRF must be managed as a valuable commodity. This can often be demonstrated through the existence of contract agreements for sale and use of the SRF.

The SRF must have meaningful heating value and be used as a fuel to recover energy (or as a process input). Lastly the SRF must be comparable to the traditional fuel in regard to the contaminant levels contained in the fuel.

When applied to mixed municipal waste, the requirements require more processing than is typically used for a standard RDF production plant at a Municipal Waste Combustion facility. The SRF fuel produced must be more consistent and more close resemble the traditional fuel(s) that are displaced. SRF properties must be comparable or better than the traditional fuel(s) that are to be replaced. For example, pelletizing or forming the SRF into briquettes may be required.

Other requirements may include provisions such as:

- Consistently maintain a heating value greater than 5,000 Btu/lb
- SRF moisture content must be less than 15%
- SRF ash content must be less than 15%
- SRF chlorine content must be less than 0.3%
- Sulfur to chlorine ratio must be less than 1:1

The processing system to generate the SRF must be capable of achieving these requirements consistently as demonstrated by daily composite sampling. Of the typical requirements, generally one of the most difficult to achieve is low chlorine content. This requirement may require the use of optical sorters or other screening measures to remove PVC plastics and other chlorine containing materials. Metals and inert fines such as glass and grit will need to be removed to reduce the ash content. Removal of some items such as fine organics will help reduce the moisture content and may also reduce the chlorine content of the SRF. Incorporation of the equipment necessary to make the SRF properties comparable or better than the traditional fuel displaced increases the complexity of the processing system. This process coupled with a long term agreement with a local Industrial Boiler facility may offer the greatest potential for waste diversion for Sioux Falls.

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City of Sioux Falls
SOUTH DAKOTA

City of Sioux Falls
Solid Waste Management
Master Plan

Appendix H: Task 9 – Household Hazardous Waste and Problem Materials Evaluation Technical Memorandum

HDR

December 2016

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Task 9 – Household Hazardous Waste and Problem Materials Evaluation Technical Memorandum

Solid Waste Master Plan

City of Sioux Fall, SD
December 2016

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1 Introduction & Purpose

The City of Sioux Falls (City) has initiated the development of a comprehensive Solid Waste Management Master Plan (SWMMP) to guide the continued operation and expansion of the solid waste program. The purpose of the SWMMP is to provide a 30-year road map to the City for the continued efficient, economical and environmentally responsible operation and expansion of the solid waste program.

One of the critical components to an environmentally sustainable solid waste management system is the landfill diversion and handling of hazardous wastes and problem materials. The City of Sioux Falls Household Hazardous Waste Facility (HHW Facility) is an essential function of the solid waste services that the City provides to its communities. Moving forward with the development of the SWMMP, it is important to understand the existing HHW Facility and what has worked, what hasn't worked, what limitations have been observed, operational costs, capacity of the facility, and what could be changed based on having operated the facility for some time (Task 9 Household Hazardous Waste and Problem Materials Management).

HDR worked with City and HHW Facility Contractor staff to understand the existing HHW Facility. Current operating costs for the existing the HHW facility were reviewed. In addition, the handling of tires, appliances, and carpet received at the Sioux Falls Regional Landfill (Landfill) have been reviewed and evaluated for alternative management options. This technical memorandum has been prepared to summarize alternate management options, identify opportunities for improved operational efficiencies at the HHW Facility and with problem materials management, and provide recommendations for consideration.

2 Overview

In December of 2004, the City of Sioux Falls (City) opened a year–round permanent Household Hazardous Waste Facility (HHW Facility). The HHW Facility is open to the public Tuesday through Friday 8:00 a.m. to 5:00 p.m. and Saturday 8:00 a.m. to 12:00 noon. The facility accepts HHW materials free of charge from individual residents of Lake, Lincoln, McCook, Minnehaha and Turner counties, with identification. Household hazardous wastes (HHW) are products that contain ingredients that are toxic, flammable, reactive or corrosive. If disposed of improperly, these products can be harmful to humans, wildlife and the environment. Proper disposal prevents HHW from entering the environment; damaging soil, groundwater and streams; or causing harm to people and animals. For acceptance at the HHW Facility materials must be in containers of 5 gallons or less. Larger containers/quantities may be accepted by calling ahead. The HHW Facility does not currently accept waste from businesses, farms, nonprofit organizations, churches, schools or government entities.

In 2009, the City added an electronic recycling program to provide daily collection of electronics including televisions, computers, video players, gaming devices, handheld electronics, printers, stereo systems and other electronic devices.

Customers from the five county service area drive up under the facility awning where they are greeted by an HHW Facility staff member who then takes some basic information, screens the waste, and unloads the vehicle for the resident. The materials are then sorted for reuse, recycling or disposal per chemical compatibility for safe storage based on Department of Transportation and the Environmental Protection Agency regulations. The HHW Facility is currently operated under contract by Veolia ES Technical Services (Veolia or Contractor).

The City operates a Reuse Room, adjacent to the HHW Facility, at the City of Sioux Falls Environmental Center, that redistributes household and automotive chemicals in good, usable condition back to the public. Residents of the five-county region may pick up three items per week for free.

The City is considering the possibility of obtaining a permit to allow the acceptance of conditionally exempt small quantity generator (CESQG) hazardous waste. In the interim, the City has developed a CESQG program that allows generators to register for pickups that are provided by Veolia at the generator's location. The cost for the CESQG service is currently split between the City and the local business participating in the program.

Household Hazardous Waste

As part of the Veolia contract requirements, Veolia provided a Facility Operating Plan, and is required to maintain a Standard Operations Procedures manual for accepting, unloading, segregating, packaging, labeling, storing, preparing for shipment, and transportation of HHW for final disposal. Updating these Plans with the goals and outcomes for landfill diversion and recycling incorporated, current facility layout, Standard Operating Procedures (SOP) for each waste stream entering the HHW facility, the waste handling processes and procedures, re-use program and equipment operational processes and procedures would be beneficial for both the City and the Contractor. An electronic copy of detailed annual operations is required under the contract and was not fully available at the time of this review.

Operationally, as customers enter the HHW Facility, they are greeted by contractor staff who operates a handheld scanner provided by the City to record facility visits. Contractor staff record customer name, address and product accepted into the scanner which is then downloaded to the City IT Department. City staff noted that the scanner malfunctions on occasion and experiences operational discrepancies. In 2015, approximately 10% of the customer visits were blank in the system. The **Table 1** depicts adjusted customer visits to the HHW facility.

Table 1 – HHW Facility Customers

Year	Customers Recorded	Scanner Discrepancies	Adjusted Customer Count	Average Daily Customers
2015	28,212	(2,630)	25,582	98
2014	27,054	(2,516)	24,538	94

The Landfill is currently operating the Paradigm software system at the scale-house to record customer scale crossings and calculate fees. This same software system, which has scanner capabilities, could be modified for use at the HHW facility to assist in eliminating discrepancies, and to access fees for CESQG waste if the City decides to accept CESQG hazardous waste at the HHW Facility.

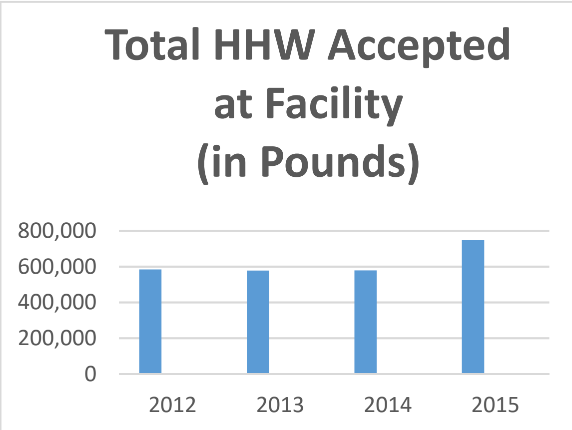


Figure 1 – Total HHW Accepted at Facility

The HHW Facility experienced a 23% increase in pounds of HHW materials accepted from 2014 to 2015, as exhibited in **Figure 1** and **Table 2**. This is a significant increase in materials accepted through the facility.

The increase is attributable to an increase in latex paint and oil based paint product acceptance at the HHW Facility.

Once materials are accepted at the HHW Facility, contractor staff segregate the materials, by DOT hazard classification, for shipping to a treatment, storage and disposal facility, recycling or removal to the Re-Use Room. **Table 2** identifies HHW collected by material type and segregation of the materials in 2014 and 2015.

Table 2 – HHW Collected/Disposition by Material Type (in pounds)

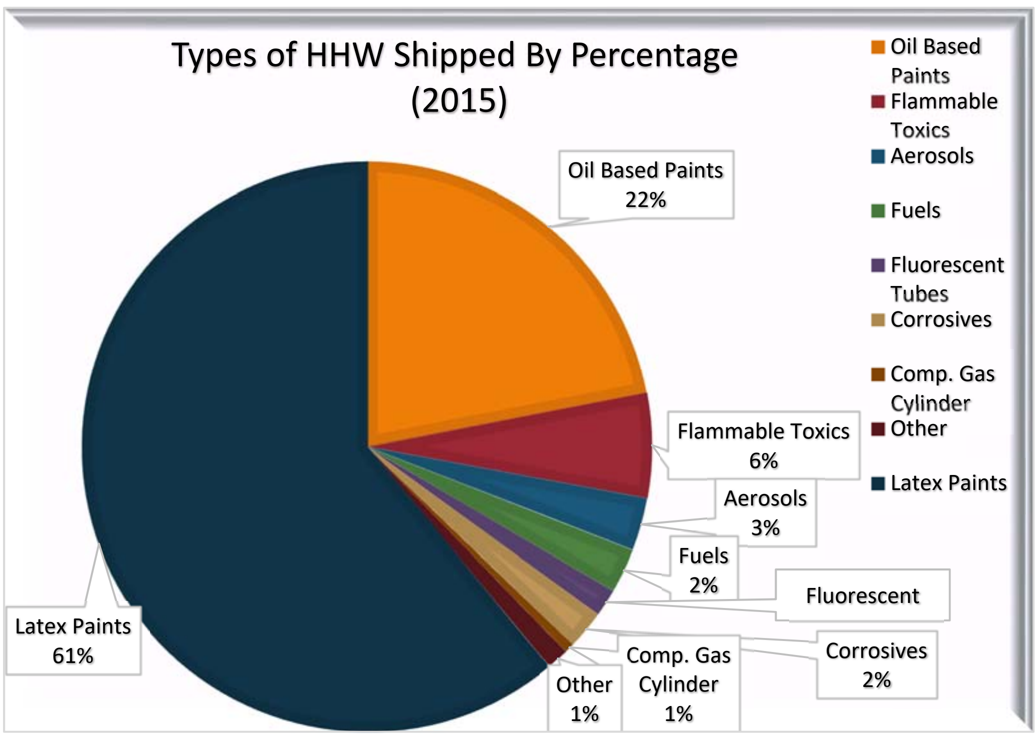
	2014	**2015**	**% Difference**
Toxic Flammable	24,505	27,495	+11%
Corrosive	10,564	10,150	-4%
Aerosol	12,009	13,785	+13%
Fuels	10,950	11,600	+6%
Oil Based Paints	82,757	101,254	+18%
Latex Paints	191,875	281,731	+32%
Compressed Gas Cylinders	1,695	2,525	+33%
Fluorescent Tubes	6,274	7,181	+13%
Other	2,942	5,753	+49%
Total HHW Shipped to Veolia	**343,571**	**461,474**	**+26%**
Re-Use Room Total	**155,545**	**188,996**	**+18%**
HHW Out to Other	**79,012**	**97,046**	**+19%**
Total HHW Accepted	**578,128**	**747,516**	**+23%**

The Re-use Room was recently relocated from the HHW Facility to the Environmental Center Building. The contractor redistributes reusable products that are dropped off at the HHW Facility to the Reuse Room. There is a three item limit per person for customers to take products at no charge from the Re-use Room. Although the staff cannot guarantee the quality of the products, each item is inspected before it is made available to the public. In 2014, there were 4,875 reported Re-use Room customers and in 2015, 6,529 customers.

The City is currently staffing the Re-Use Room with volunteers, on occasion, although the contract with Veolia requires the Contractor to operate the program. There is currently limited oversight for this program.

HHW is manifested and shipped from the HHW Facility by Veolia staff. In 2015, latex paint and oil based paint accounted for 83% of the waste stream shipped to a Veolia facility. These waste streams are not currently volume reduced and are shipped in the paint containers that customers bring in. **Figure 2** depicts HHW shipped from the facility, by percentage, in 2015 by material type.

Figure 2 – HHW Collected/Disposition by Material Type



Paint can crushers, such as the TeeMark brand pictured (**Figure 3**), are available for installation into the HHW facility.

Figure 3 – Tee Mark Can Crusher

By volume reducing the latex and oil based paints into 55 gallon drums for shipment, the City could see a cost savings for waste transfer and disposal in addition to freeing up space in the facility for acceptance of CESQG waste. The Landfill currently uses latex paint as an alternate daily cover and could use additional paint in the Posi-Shell mix, further reducing latex paint shipped.

TeeMark also has available aerosol can crushers that could be purchased to volume reduce aerosols shipped. Another waste stream that could be volume reduced is propane compressed gas cylinders. A company called Red Dragon currently sells propane flare systems that multiple propane cylinders can be attached to and propane flared. Once the propane cylinders are empty, the metal can be recycled.

Table 3 provides an overview of HHW pounds shipped in 2014 and 2015 as well as payments to the Contractor for facility operations, supplies and recycling and/or disposal.

Table 3 – HHW Shipped for Recycling/Disposal (in pounds)

Year	Pounds Shipped	Paid to Contractor
2015	461,474	$443,658.55
2014	343,571	$390,721.05

Electronics

In May 2004, the City passed Ordinance No. 38-04 amending City Ordinance Chapter 18, which banned a specific list of electronic waste from the Landfill in order to extend the life of the Landfill, avoid the negative impacts of electronic waste, and put a stronger emphasis on recycling. The City of Sioux Falls currently accepts regional household electronic waste at its HHW Facility. The following is a list of electronics that are accepted for recycling at the HHW Facility:

- **Computer Units**, including: Monitors, CPUs, Keyboards, Mice, Modems, Hard drives, CD ROM/ZIP/Tape drives, Laptops, USB ports/USB sticks, UPS (uninterrupted power supply).
- **Printers** (laser & ink jet) and similar items, including: Copy machines, Fax Machines, Scanners.
- **Stereos** and similar items, including: Radios, Speakers, Portable CD players, MP3 Players, Record Players.
- Battery Chargers
- **Phones** and similar items, including: Cell phones, Pagers, CBs/ two way radios, Answering machines.
- **Televisions** (Flat, Tube, Projection, and Console) and accessories, including: Cable boxes, DVD players, VCRs, Laser disk players, Remote controls, Video game systems, Video game controls/joysticks.
- **Misc. Home Office Equipment** and similar items, including: Typewriters, Adding machines, Calculators, Palm organizers, Word processors, Paper shredders.
- Cameras, Camcorders, and Home Video Equipment
- **Cords, Cables, and Holiday Lights** (Must not be attached to trees, ornaments, or displays).

The City currently contracts with Bargain Bytes, Inc. for recycling of electronic waste for a fee of .07 cents per pound for monitors and .08 cents per pound for televisions. All other electronic waste is recycled free of charge to the City under the contract with Bargain Bytes, Inc. (Bargain Bytes).

Electronics are collected at the HHW Facility and stored in trailers owned by the Bargain Bytes. When sufficient quantity is collected, Bargain Bytes transfers the trailer to their facility where the electronics are recycled and/or repurposed. **Table 4** provides an overview of electronics collected and shipped in 2014 and 2015 including expenses for payments to Bargain Bytes for recycling and/or repurposing the materials. The cost for accepting electronics through the HHW Facility is included in the operating costs for the facility and is not directly allocable to the electronics program.

Table 4 – Electronics Collected (in pounds)

Year	Pounds Collected	Paid to Bargain Bytes
2015	1,486,649	$101,867.16
2014	1,482,830	$91,929.55

HHW Facility staff segregate working electronics, test them, and hold a drawing for customers to receive the product, free of charge, on a monthly basis. In 2014, 1,767 pounds and in 2015, 2,239 pounds of electronics were given away through this electronics program. In order to implement this program, the HHW facility layout was reconfigured and the Re-Use room was moved to the City of Sioux Falls Environmental Center. Approximately 15 to 20 percent of the HHW Facility is currently utilized for testing of electronics, contractor office space and break room. (See Appendix A for current HHW Facility layout.)

Conditionally Exempt Small Quantity Generator Waste (CESQG)

The City, in coordination with the HHW Facility Contractor, has developed a Business Hazardous Waste Management Program (BHWMP). This program is designed to give area businesses and institutional facilities an economical option to dispose of small quantities of hazardous wastes while diverting these waste streams from the Landfill and sanitary sewer.

To be eligible for the program:

- The business must be classified as a Conditionally Exempt Small Quantity Generator (CESQG), per the State and Federal Hazardous Waste Regulations.
- The business must be located within the five counties of Lake, Lincoln, McCook, Minnehaha, and Turner.
- The business must first confirm that they are a CESQG by completing and returning a CESQG Verification Form to the City.
- Once the City approves the CESQG Verification Form, the HHW Facility Contractor contacts the business directly for additional information about the disposal request, and all cost estimates for disposal services are provided by the HHW Facility Contractor prior to collection.
- If the quote is agreeable, the HHW Facility Contractor schedules a pickup at the business.
- Businesses are only invoiced for the disposal costs associated with the material. The City provides the resources to cover mobilization, transportation, and any labor costs of the HHW Facility Contractor associated with these efforts.

There are currently 90+ CESQG's registered with the City through return of the CESQG Verification Form for this program. In 2015, 15 CESQG's participated in the program at a cost to the City of $5,460.00. No records of waste shipped are currently available.

By modifying HHW facility operating hours for homeowners and volume reducing latex paint, oil base paint, aerosols and propane cylinders, facility space and contractor staff time would be available for acceptance of CESQG waste on an appointment only basis. Implementing a fee schedule for acceptance of CESQG waste would offset costs for operations of the HHW Facility as well.

Tires

Tires are currently accepted at the Landfill for a fee as outlined in **Table 5**.

Table 5 – Landfill Tire Fees (2016)

Tire Size	Fee Charged Per Tire	Fee Charged Per Ton
Up to 17"	$2.00	$135.00
Over 17"	$7.00	$135.00

There is currently no limit to the number of tires customers can bring to the Landfill, but they may only bring a limited quantity of tires on rims. The scale-house attendant at the Landfill determines either the number of tires per load for the per-tire fee charged, or weighs the load and assesses the per ton fee.

In 2016, the South Dakota Department of Environment and Natural Resources (DENR) obtained a grant authorizing it to issue sub grants for eligible projects for the collection and disposal of waste tires. The City of Sioux Falls used the sub grant for waste tire collection and disposal, which offset $100,000 in costs. The Landfill began accepting tires, in part to avoid standing water and eliminate breeding areas for mosquitoes. The City committed to match 20% of the grant. Grant funding is expected to expire in November 2016.

The City currently contracts with Liberty Tire Recycling for disposal and recycling of waste tires for a fee of $147.00 per ton. Tires are collected on an asphalt pad at the Landfill. When sufficient quantity is collected, Liberty Tire loads the tires into trailers and transfers them to their facility where they are reused for energy. In addition, the Landfill is authorized, under their operating permit, to chip tires and reuse as an alternate daily cover. The chipped tires are then mixed 4:1 with soil and reused as landfill daily cover. It is the Landfill's goal to reuse 20% of the tires collected in this method.

Table 6 provides an overview of tires collected in 2014 and 2015 including expenses for operating the tire program.

Table 6 – Tires Collected (in tons)

Year	Tons Collected	Paid to Liberty Tire
2015	368.23	$49,120.17
2014	525.28	$64,832.17

Appliances

Appliances, also known as “white goods”, including stoves, refrigerators, freezers, dishwashers, washers, dryers, air conditioners and hot water heaters, are currently accepted at the Landfill for a fee of $18.00 per unit. Refrigerators, freezers and air conditioning units contain refrigerants, commonly known as Freon, that deplete the ozone layer. Since 1992, Federal Law prohibits the release of Freon into the atmosphere and requires that Freon be removed from appliances before they are disposed.

Appliances are collected at the Landfill and landfill personnel recover (remove) the Freon. The scrap metal from these appliances and other white goods is then recycled through a contract with TJN Enterprises. Appliances are stockpiled on an asphalt pad and TJN Enterprises mobilizes to the Landfill every three to four weeks to bale and ship the metal for recycling.

The TJN pays the City for scrap metal material at the Landfill based on the American Metals Market using a formula outlined in their current contract.

Table 7 provides appliance tonnage baled and recycled for 2014 and 2015:

Table 7 – Metals Recycled (in tons)

Year	Tons Recycled
2015	835.24
2014	823.81

Carpet

Carpet is currently accepted at the Landfill in both the municipal solid waste portion of the Landfill and the C&D portion of the Landfill for the current waste disposal fee.

HDR conducted a Waste Characterization Study for the City of Sioux Falls in June of 2016 which estimated that 253.5 pounds of the waste stream consisted of carpet going into the C&D portion of the Landfill. However, it should be noted that the limited number of samples (10) conducted during the Waste Characterization Study is insufficient to provide enough data to develop statistically significant composition estimates for the C&D material stream. When the number of samples is limited, it is possible (even with random selection of loads to be observed), to obtain results that are skewed and not reflective of the overall composition of the C&D waste stream as a whole.

The U.S. is currently seeing growth in the carpet recycling industry, as national negotiations are beginning to stimulate more business interest in processing and end-market demand. Existing end-markets for carpet derived materials include carpet fiber, auto parts, and wood-plastic composites. The Carpet America Recovery Act (CARE) website provides information on the current state of the carpet recycling industry in the U.S. In South Dakota, there are currently few opportunities for recycling of carpet, none of which appear to be within a reasonable proximity to the City.

3 Recommendations

The HHW Facility is an essential function that the City of Sioux Falls provides to the customers as part of the overall solid waste system. The following recommendations are opportunities for the City to consider regarding the HHW Facility and problem materials, organized by material type.

Household Hazardous Waste Recommendations

1. Update the Operations Plan specifically for the City of Sioux Falls HHW Facility. This Operations Plan should be specific to the current facility operations and should incorporate the goals and outcomes for landfill diversion and recycling.
2. Develop and Implement Standard Operating Procedures (SOP) for each waste stream entering the HHW facility, the waste handling processes and procedures, re-use program and equipment operational processes and procedures.
3. Implement a volume reduction program for latex paints, oil base paints and aerosols with the purchase, installation and operation of a latex can crusher, oil base paint can crusher and aerosol can crusher for bulking these waste streams.
4. Research the feasibility of implementing a volume reduction program for small propane cylinders with the purchase and operations of a Red Dragon Propane flare system.
5. Evaluate the purchase and installation of a computer tracking system for the HHW Facility with the ability to track customers (scanning capabilities), waste streams and quantities.
6. Implement a weigh in/weigh out protocol to track waste entering and leaving the HHW Facility, in order to be able to verify and audit materials coming in and out of the facility.
7. Revise the current operational hours of the facility for acceptance of HHW to Wednesday through Saturday, 9:00 a.m. to 5:00 p.m. to increase Saturday hours for households and allow contractor staff the ability to ship waste and schedule acceptance of CESQG waste by appointment only on Tuesdays.
8. Consider relocating the Re-use Room back to the HHW Facility so it is staffed full time, or staff it full time in its current location. Implement a weigh out system to track waste, by customer and weight, leaving the Re-use Room.
9. Review the current contract for operations of the HHW Facility for potential cost savings to the City, as well as to ensure liability to the City is as limited as is reasonably possible.

Electronics Recommendations

1. Continue the current program of diverting electronics from disposal in the Landfill through the HHW Facility.
2. Continue contracting for electronics recycling with an outside vendor.
3. Discontinue the current practice of the HHW Facility contractor staff segregating electronics, testing for operability and redistributing to customers, as the current electronics recycling contractor repurposes and sells usable electronics. In addition, discontinue this program could save space in the facility as well as avoid third party liability.
4. Review the current contract for electronics recycling for potential cost savings or revenue generation to the City in the future.

Conditionally Exempt Small Quantity Generator Recommendations

1. Verify requirements for permitting the HHW Facility for acceptance and CESQG waste and begin the permitting process, if the City decides to allow CESQG waste to be delivered directly to the HHW Facility.
2. Develop an Operations Plan for acceptance of CESQG Waste.
3. Designate that CESQG waste will be accepted by appointment only on Tuesdays at the HHW Facility (relates to recommendation number 6 under the Household Hazardous Waste Recommendations section).
4. Adopt a rate structure for acceptance of CESQG waste that recovers the full cost of handling, transportation and disposal of the materials.

Tire Recommendations

1. Continue the current program of diverting tires from disposal in the Landfill.
2. Continue contracting for tire recycling/re-use with an outside vendor.
3. Work with the State of South Dakota Department of Environment and Natural Resources for future grant funding of tire diversion and recycling.
4. Continue the current permitted use of chipping tires for use as an alternate daily cover.
5. Review the tire tipping fee in comparison to tire recycling costs on a yearly basis and modify the tire tipping fee as necessary to cover costs.

Appliance Recommendations

1. Continue the current program of diverting appliances from disposal in the Landfill.
2. Continue contracting for appliance recycling with an outside vendor.
3. Continue the current practice of Landfill staff removing Freon from appliances prior to recycling.
4. Consider requiring that doors be removed from refrigerators and freezers prior to entering the Landfill, as a safety precaution.

Carpet Recommendations

1. Continue the current practice of disposing of carpet waste in the Landfill, until viable recycling opportunities can be identified and implemented.
2. In cooperation with the State of South Dakota Department of Environment and Natural Resources, review the potential of grant funding a pilot project to recycle carpet waste.
3. Open discussion with the South Dakota Department of Environment and Natural Resources staff on a collaborative strategy to convene a coalition of stakeholders to review regional carpet recycling infrastructure and end-markets for carpet waste.

APPENDIX A: FACILITY LAYOUT DRAWING

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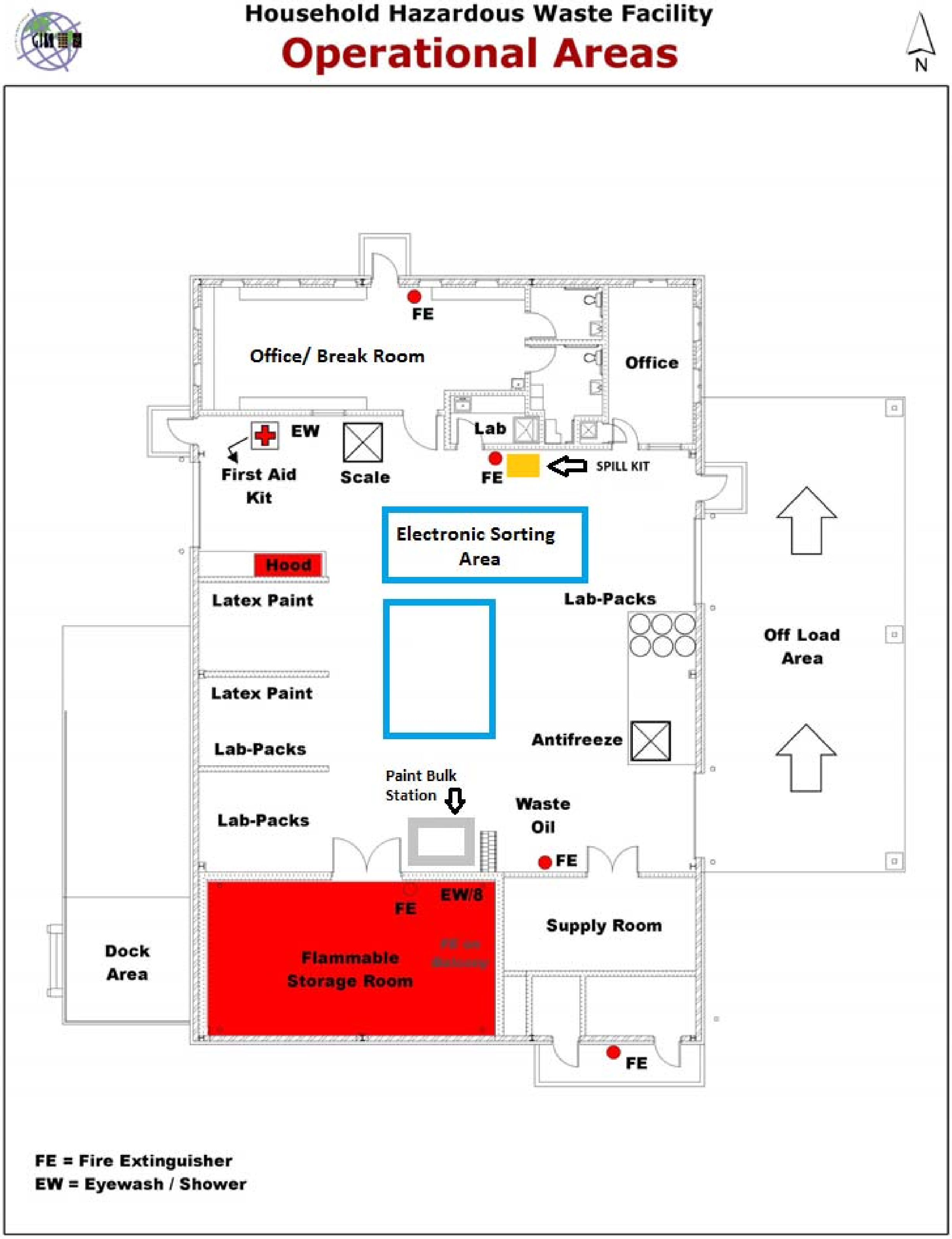
Household Hazardous Waste Facility

Operational Areas



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City of Sioux Falls
South Dakota

City of Sioux Falls Solid Waste Management Master Plan

Appendix I: Task 10 – Identify Innovative Green Projects Technical Memorandum

HDR

Revised April 2017

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Task 10:

Identify Innovative Green Projects

Technical Memorandum

Solid Waste Management Master Plan

City of Sioux Fall, SD
Revised April 2017

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Table of Contents

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1 Introduction & Purpose

The City of Sioux Falls (City) has initiated the development of a comprehensive Solid Waste Management Master Plan (SWMMP) to guide the continued operation and expansion of the solid waste program. The purpose of the SWMMP is to provide a 30-year road map to the City for the continued efficient, economical and environmentally responsible operation and expansion of the solid waste program. As a part of the master planning process, a review of potential innovative green-oriented projects was identified.

The purpose of this technical memorandum (TM) is to describe, evaluate, and prioritize potential innovative green projects for the City's consideration. A preliminary list of potential projects were identified and provided to City staff for comment, and a final list of potential innovative green projects was determined with City staff feedback. This effort could help support progress towards the City's Sustainability Master Plan's goals related to the solid waste system. As the City and the surrounding communities continue to grow, the projects may help the promotion of innovative sustainable projects that have the potential to be cost effective. Some of the projects identified in this TM overlap with the Task 8 Emerging Technologies TM, which provides an overview of multiple types of waste processing/conversion technologies and alternatives to landfilling, as well as the Task 12 Long-Term Landfill Gas Options TM, which provides an overview of potential long term options for landfill gas.

The remainder of this TM provides a description for each identified project, as well as a summary of rankings for the identified projects. For each project, a brief overview is provided, discussing certain issues related to the technology validation/feasibility for the City system. The sustainability elements addressing key goals from the sustainability master plan is discussed, addressing how each project potentially helps reach certain goals and, where feasible, an estimate of the impact in terms of reduced tons landfilled, clean energy produced, emissions reduced and/or other metrics are provided, as appropriate. Issues related to impacts on City operations including not only the solid waste program but other areas such as the wastewater treatment plant that may be responsible for assisting with the project are noted, both positive and negative, and potential opportunities for public-private partnership are briefly discussed. Potential regulatory and legal issues are also identified. Lastly, the timing and a rating of the projects is provided, addressing whether the respective project has the potential to be a quick win, a realistic intermediate term project, a possible long-term project, or whether for one reason or another, the project appears to not be feasible and therefore not recommended for further consideration.

2 Potential Innovative Green Projects

The following subsections provide potential innovative green projects that the City may wish to consider.

2.1 Anaerobic Digestion

2.1.1 Project Definition. Anaerobic digestion (AD) is described in more detail in the Emerging Technologies TM from Task 8. It may be possible to develop an innovative green project where food waste and certain other organic materials may be processed in conjunction with ongoing operations at either the wastewater treatment plant (WWTP) or the Sioux Falls Regional Landfill (Landfill). This may be implemented in several ways and be taken to varying levels of biogas processing. Based on the Waste Characterization study conducted in Task 1 of the SWMMP process, food waste and other organic materials represent approximately 5.6 and 11.6 percent of industrial/commercial institutions (ICI) municipal solid waste, respectively. Some of these source separated materials may be possible to concentrate by targeting specific regional food processing facilities, dairy operations, restaurants and cafeterias, and possibly food retailers.

AD processing of food waste and concentrated organics is successfully operating in several projects in the US and around the world, and has been in place for several years. Key to any project is the independent capture of the feedstock food waste and organics. This may require the establishment of specialized routes designed to capture the target materials. About 150 - 200 cubic meters of raw gas (low quality) can be produced per ton of food waste, although the production for this system would need to be further evaluated. Odor is always a concern for food and organic AD operations, and careful consideration of these needs and issues would be required.

2.1.2 Technology Validation/Feasibility. There are two areas where AD may be completed, the WWTP or the Landfill.

2.1.2.1 Wastewater Treatment Plant AD. The WWTP already completes a similar process producing and using biogas generated from the wastewater sludge. The biogas generated at this location would be combined with the wastewater biogas and be utilized for their applications. The digestate residuals could potentially be composted and managed in the same manner as municipal sludge, or could be returned to the Landfill for management.

To increase yield, there is equipment in the industry designed to extract organics and liquids from municipal solid waste by squeezing the selected waste to drive off the liquids and associated organics. This equipment could be installed and operated at the Landfill allowing the remaining non-organic wastes to be disposed in the Landfill. The concentrated organics would need to be trucked to the WWTP. The existing wastewater anaerobic systems are designed for the anticipated wastewater treatment demands. Space would need to be available for another line with capacity for the additional food waste and organics. Whether the new line would just process the food waste and organics or whether a blend would be applied to each of the processing systems would need to be investigated. The quality of the biogas produced is expected to be similar to the gas already generated through the WWTP AD processing, and could be combined with the gas produced from the WWTP, increasing the quantity of biogas used to offset the use of natural gas.

2.1.2.2 Landfill AD. It may be possible to develop an AD system where the food waste and certain other organic materials may be processed entirely at the Landfill. A wet AD system, as described above, could be constructed at the landfill where the source separated food waste and organics would not require transportation to the WWTP, and the digestate left after processing as well as the biogas would be produced at the Landfill. The biogas could be combined with the Landfill gas. In almost all cases, however, the food waste and organic material will have contaminants that would need to be removed. If a traditional wet AD system is used, this removal occurs prior to gas generation and the required press or other separation equipment is expensive to purchase and operate and may mean some gas production is lost.

A slightly different approach would be to use a modular dry anaerobic digestion for AD processing. Modular dry AD processing of food waste and concentrated organics is a relatively new approach quite different from wet AD, although some mechanical biological treatment systems use a similar approach. With a modular dry AD system, the biogas is generated from the food waste and organic material first without the use of the extraction press, and contaminates are removed as a secondary step. Instead of the large reaction vessel used in wet AD systems, a modular building designed to store the food waste and organics in an air tight enclosure is used in modular dry AD. These differences may make this approach more economical, and keeps all the waste materials at the Landfill, rather than transferring material to and from the WWTP.

The SmartFERM Facility located in San Jose, California is an example of a modular dry AD system and consists of a series of air tight modular chambers where organic material is processed for biogas production. With this approach, selected loads high in organic material, such as from restaurants and food retailers, would be redirected at the scale house from disposal in the Landfill to the dry AD system where the material would be inspected and deposited in an air-tight chamber of the SmartFERM or other modular dry AD system. The modular system would have a number of chambers allowing one chamber to be filled while others are in standby or in various stages of biogas production. The source separated materials may still contain certain contaminants. In addition, certain rejected materials from an engineered fuel production producing Solid Refuse Fuel (SRF) line may be suitable for a dry AD system. Thus, more materials may be available for the modular dry AD approach. A small amount of previously processed material containing naturally occurring microorganisms would be mixed with the fresh feedstock to accelerate the biogas production.

The organic material remains in the sealed chamber until gas production has subsided. The gas produced could be combined with the landfill gas to increase quantity and quality. After the material is removed from the chamber, the remaining material can be landfilled or composted. If composted, once the composting step is complete, contaminants are removed prior to use of the compost. Often, this approach to removal of the contaminants is easier than removal of the contaminants prior to gas recovery. This approach to AD composting allows for use of a wider range of non-compostable materials that may contain contamination such as film plastic, glass and metal, and does not require a press to concentrate the organics. Thus, the cost for the modular dry AD system may be reduced. In addition, since it is modular, it is easier to build limited capacity initially and increase capacity as markets and demand rise.

Space would need to be available for the system at the Landfill, and expansion of the composting area would likely be required if the organics are composted. The combined landfill gas and biogas could potentially be used in the current manner if POET is able to utilize the increased quantity. About 150 to 200 cubic meters of raw gas (low quality) can be produced per ton of food waste, although the production for this system would need to be further evaluated.

Certain additional steps could be included with an AD process to improve the quality of the biogas produced and increase options for energy recovery. The biogas from an AD system could be further processed by drying, cleaning, and conditioning to achieve a higher use such as renewable natural gas (RNG), compressed natural gas (CNG), or liquefied natural gas (LNG) and then used as fuel in specially equipped vehicles. The Long-Term Landfill Gas Options TM completed for Task 12 provides a discussion of potential uses of the landfill gas and processes to condition the gas. AD biogas could be processed and used in a similar manner, and if the AD biogas is generated at the Landfill it could be processed in conjunction with the landfill gas conditioning process. Biogas cleanup is a developed technology and has been implemented at multiple facilities in the US and around the world. This project may be somewhat more unique by combining the product of the biogas from the AD processing system with the available landfill gas. The combined processing may make this approach more economical to produce the higher quality biogas product. A study should be completed to evaluate the impacts on the landfill gas production trends if a high percentage of the food waste and organics are diverted from the Landfill and used to produce biogas. The AD process generates a similar gas but in a more rapid manner, thus increasing the overall biogas production rate over the short term.

The biogas from an AD system could be used directly along with any available landfill gas to produce electricity in a commercially available process. Some cleaning of the gas as described above by drying, cleaning, and conditioning may be necessary; however the level of conditioning may not be as restrictive as required for sale of the biogas. Control of siloxane and hydrogen sulfide (H_2S) may be required. Reciprocating engines, gas turbine, or microturbines could be used to generate electricity for internal use at the landfill with the excess power sold to the local utility. These are developed technologies and have been implemented at many facilities in the US and around the world. An example project is the Sauk County Landfill near Madison, Wisconsin. This facility uses 24 microturbines that generate electricity that is sold back to the local utility. It would most likely be more feasible to complete this process at the Landfill rather than shipping the organics or piping the biogas to another location. Use of internal combustion turbines or microturbines would provide for some scalability for the project if the implementation of the landfill gas and biogas were to occur at different times and to allow for growth and change in the production of both gases. A study should be completed to evaluate the impacts on the landfill gas production trends if a high percentage of the food waste and organics are diverted from the landfill and used to produce biogas. This process would be the same as the process described in Section 4.2 of the Long-Term Landfill Gas Options TM completed for Task 12 for management of landfill gas.

2.1.3 Sustainability Element. An AD approach could help address many goals for the City. First, operation of the system could be arranged in a public-private partnership arrangement, bringing the skills of specialized companies to assist the City while the City focuses on the services it currently provides including waste acceptance, disposal of the residue, and operation of the WWTP. The private partner may construct, operate, and maintain the organics generation plant and possibly the AD system. Landfill diversion would be increased, potentially fifteen percent or more waste diversion may be possible if composting is completed. The anticipated amount of diversion would need to be determined by evaluating the potential for participants such as regional food processing facilities, dairy operations, restaurants and cafeterias, and possibly food retailers, route configurations to collect from participants, and based upon studies of the ability to extract organics from the waste. In addition, the carbon footprint for the City would be reduced due to the availability of the biogas to offset fossil fuels.

If the AD system is entirely located at the Landfill, an advantage for this project could be reduced transportation costs since no material would need to be collected at the Landfill then transported to WWTP. Education programs for how to dispose of food waste and organics and other measures may be easier for haulers and residents since there is less concern about contaminants.

If the biogas is cleaned and processed, benefits of offsetting fossil fuels or electricity are possible. The electrical production may be more useful since there is no need to convert vehicles to use of the biogas.

2.1.4 Impact to the City. Several changes would be required for development of an AD project. Solid waste collection systems and routing would need to be reviewed, and some additional equipment may be needed to optimize separate collection and recovery of organics and food waste (i.e. dedicated routes for participants). Facilities would need to be constructed and operated at the Landfill, regardless of which form and location of AD is implemented. If a wet AD system was installed at the WWTP, the WWTP would also see changes with the need for construction of additional capacity and processing equipment for the food waste and organics. Generally, if composting is completed, the compost uses are restricted to non-food projection applications such as application at golf courses. If the WWTP already composts residual solids, it may be possible to blend these materials; however, some additional space, equipment, and costs may be necessary for the composting operation. If enough users for the compost cannot be identified, the residual may need to be landfilled. Fewer changes would be required for modular dry AD than for the wet AD approach, as facilities would only be needed to be constructed and operated at the landfill.

Operation of a gas conditioning system would raise process complexity and increase operating and capital costs for the Public Works Department. Facilities would only need to be increased in size and capacity over what would be provided for a landfill gas only system. If the City were to use the cleaned biogas internally, a sufficient number of vehicles would need to be converted to operate on biogas. It would be most cost effective to convert vehicles that are operated largely at or near the Landfill, and fleet demand would need to be evaluated. If the biogas is sold or electricity is generated, the capital and operating costs of the biogas processing and, if needed, electricity production equipment would be necessary, but it would not require the conversion of any vehicles to biogas fuel.

2.1.5 Potential Regulatory and Legal Impacts. This project would require a review and modification to the permits for the systems and operation at the Landfill and the WWTP if the project includes this facility. Construction contracting would also be required. Operation and maintenance agreements may also be required if contracting with a private partner. Use of the biogas may also result in changes to agreements if the biogas or electricity is sold such as a power purchase agreement (PPA) with the local utility. If the project includes composting of the residuals, a review and revision may be necessary for full disclosure of the compost properties to potential users.

2.1.6 Timing and Rating. Planning and construction of AD operations is a realistic intermediate project, subject to economic justification. Similar projects have been completed in other locations, demonstrating the technology is mature, although not without risks. The modular dry AD may allow a smaller pilot operation to test the technology initially, and once demonstrated and as demand increases, the operation could be expanded. If additional processing of the biogas is completed or energy sales occur, the project complexity and costs will increase and likely would not have an economic benefit if recovery of the unconditioned Landfill and biogas is feasible. Composting would also increase costs but would increase diversion. The increased complexity of adding conditioning gives these approaches a lower potential economic viability but would still be a realistic intermediate project, subject to economic justification. Further analysis would be required to confirm the economics and capacities of the project.

2.1.7 Next Steps. To further evaluate this project, the City should consider an analytical study of the full lifecycle capital and operating and maintenance cost impacts, taking into consideration the benefits of preventing these materials from being disposed in the landfill, impacts on the landfill gas energy products, ability to get the suitable food waste and other organic materials collected separately from other waste including any incentives, ability to process the wastes in the AD system selected and handle any residues and inert materials, impacts on the digestate and gas production, the systems and technologies proposed, the associated uses and markets for the biogas and compost produced, and consideration of any adverse environmental issues. The equipment required in addition to the AD may include a specialized compression extraction system designed to separate the organic fraction from other inert materials as well as gas cleaning and drying systems and power production or piping systems.

2.2 Onsite Solar Energy Generation

2.2.1 Project Definition. Onsite solar energy generation can be completed through the installation of conventional photovoltaic or thin-film solar panels. Electricity generation could be used onsite and excess electricity sold back to the grid. Panel systems can be installed on the large open areas of capped portions of the Landfill using ballasted systems for an alternative compatible use of the Landfill. Ballasted anchoring is slightly more expensive but does not penetrate the landfill final cover system. On-going minor landfill settlement can be accommodated by the thin-film panels will little impact to electrical power production. Buffer zones around the Landfill may also be provided with solar panels. These Landfill areas are ideal for solar generation due to the limited vehicles and structures in the large surface area. Flexible thin-film photovoltaic solar panels can be directly adhered to an exposed geomembrane and adapt to the landfill contours and settlement. Consideration for access to landfill gas collection systems and for the potential risk of fire should be considered in the design and layout. Use of thin film panels on areas of the Landfill that will be capped may require less maintenance of vegetation on the south and west sides of the Landfill which offer better sun exposure.

2.2.2 Technology Validation/Feasibility. Alternative solar cover systems are becoming more popular and have been applied at a few landfills. The costs for the technology continue to decrease and present certain advantages that improve the economics, in some cases due to reduced maintenance costs, and cover soil savings. Some of these savings may be possible to include for this potential project. Currently, thin film panels are slightly less efficient than traditional rigid panels. Rigid panels produce about one MW for every 10 acres and cost about $210 to $250 per watt. A well designed solar system should have a useful life of 20 years. The current return on investment (ROI) is about 15 to 20 years, largely due to the low cost of electrical power in the area. Thin film panels could be installed at a later date when economics justify. GHG reduction benefits are generated from the electrical power produced. Analysis of the costs and revenues would need to address changes to the cover design, landfill operation and maintenance costs, capital costs for the panels and associated equipment, impacts to landfill systems such as gas collection systems, and revenue projections.

2.2.3 Sustainability Element. This project could help address many goals for the City. A public-private partnership arrangement could be arranged if the City wants to bring the skills of a specialized company to assist the City with operation and maintenance of the solar panel systems. The private partner may construct and if desired, often such projects have a long-term contract where the partner will operate and maintain the solar energy generation system for ten years or longer. The carbon footprint for the City would be reduced due to the use of the electricity produced to offset power purchases.

2.2.4 Impact to the City. City impacts may mean less maintenance is required for those parts of the Landfill where solar panels are located, particularly where thin film panels are applied to exposed geomembrane. If frame mounted panels are employed, mowing and other management would be required in buffer areas around and between panels. Access to landfill gas collection systems would require planning, and the panel arrangement design would need to accommodate this and other needs.

2.2.5 Potential Regulatory and Legal Impacts. This project would require review and modification to the permits for the landfill cover system and use after closure. Construction and operation and maintenance agreements would be needed for the solar panels and power conditioning and inverter equipment. A power purchase agreement (PPA) with the local utility may be necessary for sale of excess electricity produced.

2.2.6 Timing and Rating. Installation and production of electricity from the solar panel systems would begin only once landfill cells have been closed and final grade and cover has been placed. The project can be expanded in incremental steps. Costs for solar panel systems have been decreasing while performance efficiency has been increasing. Use of solar panel systems is a realistic intermediate project, subject to economic justification. Similar projects have been completed in other locations demonstrating the technology is mature. Further analysis would be required to confirm the economics and capacities of this project.

2.2.7 Next Steps. Refine cost analysis conducted for the City in 2012, and review implementation at other landfills. Develop economic analysis to determine if costs appear to be within a reasonable payback, and if so, pursue proposals for existing closed surfaces.

2.3 Onsite Wind Energy Generation

2.3.1 Project Definition. Onsite wind energy generation in a wind farm can be completed through the installation of conventional turbines, arrays of small vertical-axis wind turbines, or other emerging wind-energy technologies. Electricity generation could be used onsite and excess electricity sold back to the grid. Landfills include large open areas of land particularly for the capped portions of the landfill. Conventional wind turbines require an extensive foundation which would be very difficult and complex to design if installed within a landfill, and would require special provisions for liners, and thus would not be feasible. A more practical arrangement may be to consider installation of wind energy towers in buffer areas around the actual landfill where foundation may be placed in undisturbed land or at least not above the area used for the Landfill. Depending on the contours for the Landfill, accessibility, and other issues, some of these buffer areas may not be available for use of conventional wind turbines. Use of smaller vertical axis wind turbines or other emerging wind technologies may reduce some of these issues. Any systems located on a closed landfill cell would need to be able to operate without deep foundations and potential settling, limiting the suitability of these areas. Access to maintain wind turbines and transmission lines for the power produced would also be limited. Consideration for access to landfill gas collection systems and for the potential risk of fire should be considered in the design and layout.

2.3.2 Technology Validation/Feasibility. Installation of wind turbines on the Landfill site has been previously reviewed in 2012 in the Sioux Falls Landfill Renewable Energy Assessment, and was determined to not be practical. No significant changes that improve the potential for wind turbine applications have been recognized to change this conclusion. Therefore, at this time, it is not recommended to be considered further.

2.3.3 Sustainability Element. This project would help address many goals for the City. A public-private partnership arrangement could be arranged if the City wants to bring the skills of a specialized company to assist the City with operation and maintenance of the wind farm. The private partner may construct and have a long-term contract to operate and maintain the wind farm for ten years or longer. The carbon footprint for the City would be reduced due to the use of the electricity produced to offset power purchases.

2.3.4 Impact to the City. City impacts may mean mowing and other management of the closed cells and buffer areas would require work around the wind turbines. Access to landfill gas collection systems would require planning, and the panel arrangement design would need to accommodate this and other needs.

2.3.5 Potential Regulatory and Legal Impacts. This project would require review and modification to the permits and use after closure. Construction and operation and maintenance agreements would be needed for the wind generators and power conditioning equipment. A power purchase agreement (PPA) with the local utility would be necessary for sale of excess electricity produced.

2.3.6 Timing and Rating. Use of wind farm has been determined to be infeasible at this time, and is not recommended for further consideration. Further review of any technology developments could be considered in the future.

2.3.7 Next Steps. Not recommended for implementation at this time. Continue to monitor changes in wind technology and applications.

2.4 Industrial Waste Composting

2.4.1 Project Definition. Industrial waste composting could be pursued, and based upon the Waste Characterization study results, there could be the potential to increase diversion. To accomplish this objective, specific materials and sources such as food processing by-products, food waste, Publicly Owned Treatment Works (POTW) wastes, and other organic materials generated by regional food processing facilities, dairy operations and possibly food retailers would be targeted for special handling. Composting operations may be expanded to address more than yard waste, diverting additional materials from the Landfill. As described in Section 2.1, the use of the AD digestate solids remaining after recovery of the biogas is additional material that potentially could be composted.

2.4.2 Technology Validation/Feasibility. No unique equipment not already used by the City would be required to complete industrial composting although as the project grows, additional equipment may be needed. To further evaluate this program, the City should consider an analytical study to understand the full lifecycle impacts, taking into consideration the benefits of preventing these materials from being disposed of in the Landfill, impacts on any potential landfill gas energy projects, changes required to composting operations and the additional fuel and energy use required for collection and processing of industrial organic waste. Consideration of potential odor and vermin issues would need to be addressed for some of the materials targeted.

2.4.3 Sustainability Element. This project would help address the City's landfill diversion goal. Based on the Waste Characterization study, food waste and other organic materials represent approximately 5.6 and 11.6 percent of industrial/commercial institutions (ICI) municipal solid waste, respectively.

2.4.4 Impact to the City. Operational adjustments to capture these industrial compostable materials would increase the composting operation activity. This may require some changes to the composting operation, limit uses for certain products, and increase operating and capital costs for the Public Works Department.

2.4.5 Potential Regulatory and Legal Impacts. This project may require review and modification to the permits for the Landfill composting operations. A review and revision may be necessary for any compost analysis, as well as description to provide full disclosure of the compost properties to potential users.

2.4.6 Timing and Rating. Implementation of this green project could begin almost immediately, serving as a quick win once any permitting necessary is completed. Incentives may be necessary to encourage haulers to modify routes or otherwise aid in the capture of these materials. Some types of material could potential be targeted from rich loads at the Landfill but this would require additional manpower, equipment, and facilities. The project could grow and expand as specific materials are identified and added to the program. As needed, the composting operation could be expanded to address the additional materials. This project could also serve as a first step to isolating and collecting organic and food waste materials for an AD-related project, as described in Section 2.1.

2.4.7 Next Steps. Identify haulers and industries to open discussions.

2.5 Zoo Waste (Manure) Composting

2.5.1 Project Definition. Zoo waste (manure) composting, could be implemented as a means of increasing landfill diversion. A project such as that successfully implemented and maintained at the Oregon Zoo since 1988 could be developed. Zoo Doo is produced from herbivore manure and bedding at an on-site aerated static pile and used throughout the facility as plant bedding and mulch. The product is also made available to the public for free.

2.5.2 Technology Validation/Feasibility. Organic waste from the Great Plains Zoo is estimated at approximately 700 tons per year. To further evaluate this program, the City should coordinate with the Zoo, and consider an analytical study to understand the full lifecycle impacts, taking into consideration the benefits of preventing these materials from being disposed of in the Landfill, the cost and feasibility of setting up operations at the zoo or changes required to landfill composting operations, impacts on any potential landfill gas energy projects, and the additional fuel and energy use required for collection and processing of Zoo Doo. Consideration of potential odor issues would need to be addressed for some of the materials targeted.

2.5.3 Sustainability Element. This project would help address the City's landfill diversion goal. If operations occur at the zoo, some transportation costs may be reduced. The unique public awareness offers community vitality benefits and an opportunity to promote public awareness of other projects.

2.5.4 Impact to the City. This project could be implemented at the zoo to minimize transportation of materials. This novel product may be given away or in some cases may be sold at a premium, helping to offset any extra costs for handling separately or processing at the zoo.

2.5.5 Potential Regulatory and Legal Impacts. This project may require review and modification to the permits for the Landfill composting operations if completed on site, or a permit for operations at the zoo. A review and revision would be necessary for compost analysis and description to provide full disclosure of the compost properties to potential users. Some licensing or copyright protection requirements for a trade name may be needed of the product is sold.

2.5.6 Timing and Rating. Implementation of this green project could be completed almost immediately, serving as a quick win once discussions with the zoo and any permitting is completed.

2.5.7 Next Steps. Open discussions with the Great Plains Zoo.

2.6 Incentivize Recycling

2.6.1 Project Definition. As a means of increasing recycling participation and community involvement, residential recycling could be incentivized through an established program. Programs such as Recyclebank, a private company, encourages participation in curbside recycling programs by offering discounts and rewards based on collected volume. Programs like these would encourage a greater capture rate of materials currently included in curbside recycling services. However, one of the licensed haulers in the City currently provides a curbside recycling incentive program, and the feedback received through focus group workshops revealed that incentive programs do not seem to entice more recycling. Instead, it was discussed to look for ways to incentivize commercial recycling. Potentially, a program could be developed to help incentivize commercial recycling as well. A commercial recycling incentive program would likely need to include waste audits for individual businesses to identify specific materials that could be targeted for recycling. Demonstrating a potential cost savings through lower waste collection and disposal costs by recycling more materials could be used to provide economic incentive for businesses. Because the nature of businesses varies widely, as does the waste generated by those businesses, the audit approach would allow specific, targeted recycling assistance that makes the most sense for the respective business. (E.g. an office building would generate more office paper materials that could be recycled; a retail store likely generates more cardboard than office paper; a restaurant generates more food scraps and bottles.) Commercial recycling incentive programs tend to be more successful when a technical assistance approach, such as waste audits and education on recycling programs that make the most sense for specific businesses, is taken. Some communities begin with a technical assistance and education program before mandating recycling.

2.6.2 Technology Validation/Feasibility. With the current open collection system including over 20 different haulers, administering an incentive program through the collection process would be more challenging, although incentive program administrators such as Recyclebank could work with residents, businesses and individual haulers. Should the City decide to organize residential collection, an incentive program could be administered through a franchise agreement, as part of the service required to be provided by the hauler(s), which may provide more consistent messaging and potentially greater results. Focusing on a technical assistance program for commercial customers may provide greater increases in recycling for the City, given the current collection system. Programs would need to be developed and promoted properly to manage costs, and would likely include the need for the City to hire one or two dedicated recycling technical assistance advisors that could visit with each business over time.

2.6.3 Sustainability Element. Incentivizing recycling would help address the City's landfill diversion goal by increasing recovery of more traditional higher value recyclables as well as potentially more difficult to recycle materials. Based on the Waste Characterization study, traditional recyclables represent nearly 13 percent of materials currently landfilled (8.6% recyclable paper, nearly 2% #1 and #2 plastics, 1% metal containers, nearly 1% glass) of municipal solid waste. Community vitality and public awareness could potentially be addressed by promoting recycling through civic organizations such as the girls and boy scouts, school challenges, senior centers and other ways. The commercial recycling incentive program could include promoting the businesses that reach certain recycling goals to show commitment to sustainability.

2.6.4 Impact to the City. Increased recycling volume may improve economics for haulers and businesses, while increasing diversion. Program costs and publicity would need to be monitored carefully. The City may need to hire up to two dedicated recycling technical assistance advisors.

2.6.5 Potential Regulatory and Legal Impacts. If a residential incentive program through a company like RecycleBank is selected, an agreement with RecycleBank would need to be established, most likely through the City but working with all the licensed haulers. Revisions to haulers requirements may also be required. A commercial recycling technical assistance program is not anticipated to have any regulatory or legal impacts, as it is assumed to be on a voluntary basis, rather than mandatory.

2.6.6 Timing and Rating. Implementation of these projects could be implemented as an intermediate term project once details are developed. Changes to the current residential collection system could drive the implementation schedule of a residential recycling incentive program, but the incentive program for the commercial sector would not be impacted, assuming commercial collection remains open.

2.6.7 Next Steps. To further evaluate this program, the City should consider an analytical study to understand the full lifecycle impacts, taking into consideration the benefits of preventing additional materials from being disposed of in the Landfill, the cost and impact to recycling operations for the private sector, impacts on any potential landfill gas energy projects (especially if organics are recycled instead of landfilled), the additional fuel and energy use required for collection and processing of additional recyclables and residue, and the additional energy savings associated with using recycled content in new products.

2.7 Food Waste Rescue

2.7.1 Project Definition. Food waste rescue, by collaborating with local stakeholders is a means to prevent food waste at the source. Food waste has earned a place in the current spotlight, at a critical intersection of economic, social, and environmental concerns. The City can play an important role in influencing policies and community programs to rescue food before it enters the municipal waste stream. The City's support of such an initiative would be akin to utilities investing in demand-side management programs: The easiest waste to manage is what is never generated at all. This project would consist of a study of the major food waste generators to help them find ways to reduce their waste. The activities may go in many directions such as:

- Finding ways to distribute excess food through charitable organizations
- Reducing portion sizes or ways food is served
- Promoting a business-run composting operation
- Developing a composting program interested businesses can support for their advertising benefit.

2.7.2 Technology Validation/Feasibility. No new equipment or systems are likely to be required on the part of the City. However, dedicated City staff to research and promote food rescue opportunities may be required. It is recommended that if the commercial recycling technical assistance program described in 2.6 is implemented, food rescue elements could be incorporated, and the same City staff could be used to promote food rescue. To the extent composting programs are supported, and it makes the most sense for the City to provide composting of food waste, this project could relate back to the wet and dry AD projects described in Section 2.1, and could include expanding current composting activities at the Landfill, requiring permit modifications and potentially more space requirements.

2.7.3 Sustainability Element. This project would help address the City's landfill diversion goal by decreasing food waste landfilled. Community vitality and public awareness could potentially be addressed by promoting through restaurants, cafeterias and similar businesses, possibly setting up public/private partnerships.

2.7.4 Impact to the City. The City may incur some implementation costs and manpower to investigate and kick start this program, and costs should be monitored closely. The same staff recommended for the commercial recycling technical assistance program could be used to promote food rescue. If composting efforts on the part of the City are expanded, permitting and space requirements would need to be addressed. This may require some changes to the composting operation limiting uses for certain products and increasing operating and capital costs for Public Works.

2.7.5 Potential Regulatory and Legal Impacts. This project may include certain regulatory restrictions, depending on the food rescue means employed. It may also require permit modifications for composting, and limitations for end use of compost materials.

2.7.6 Timing and Rating. There is a lot of public awareness at the current time related to food waste. Implementation of this green project could be completed almost immediately, serving as a quick win once business review and buy-in is completed. It could grow and expand as businesses and promotions are added to the program. As needed, the composting operation could be expanded to address the additional materials. This project could also serve as a first step to isolating and collecting organic and food waste materials for an AD-related project like the ones described in Section 2.1.

2.7.7 Next Steps. To further evaluate this program, the City should consider an analytical study to understand the full lifecycle impacts, taking into consideration the benefits of preventing these materials from being disposed of in the Landfill, the cost and feasibility of setting up and promoting the food rescue programs, composting operations, impacts on any potential landfill gas energy projects, and the additional fuel and energy use required for collection and processing of the food waste.

2.8 C&D Material Rescue and Reuse

2.8.1 Project Definition. Similar to food waste rescue, construction and demolition (C&D) material rescue can be promoted by collaborating with local stakeholders as a means to prevent C&D material that can be reclaimed and repurposed from being sent to the Landfill. This project could collaborate with Habitat for Humanity to expand capacity and improve effectiveness of building material and home goods recovery. The project could convene stakeholders to understand current barriers, opportunities, and challenges of salvaging reusable building materials. An incentive to recycle C&D material or alternatively a mandate that requires a certain percentage be recycled could also be established. The Landfill could begin C&D sorting operations to reuse or recycle certain C&D materials with viable uses or markets, after it is delivered to the Landfill.

2.8.2 Technology Validation/Feasibility. No new equipment or systems are likely to be required for the City, unless sorting operations are completed on site. Programs would need to be developed and promoted properly to manage costs but have additional benefits. It is recommended that if the commercial recycling technical assistance program described in 2.6 is implemented, C&D rescue elements could be incorporated, and the same City staff could be used to promote C&D rescue.

2.8.3 Sustainability Element. This project would target the reuse of a variety of materials that generally fall within the C&D Waste category, which based on the Waste Characterization study represent approximately 34.7 percent of total materials coming into the Landfill. This project would help address the City's landfill diversion goal. Community vitality and public awareness could potentially be addressed through promotional programs, possibly setting up public/private partnerships.

2.8.4 Impact to the City. The City may incur some implementation costs and manpower to investigate and kick start this program and costs would need to be monitored closely. The same staff recommended for the commercial recycling technical assistance program could be used to promote/enforce C&D rescue. If the City opted to begin sorting operations at the Landfill, a public-private partnership could be established where a private company conducts the additional sorting and recycling of C&D materials.

2.8.5 Potential Regulatory and Legal Impacts. This project may require review and modification to the permits for the Landfill if any sorting operations are completed on site. If the City elected to move forward with a mandatory recycling/diversion goal for C&D, ordinance revisions would be necessary.

2.8.6 Timing and Rating. Implementation of this green project could begin almost immediately, serving as a quick win once business review and programs are complete. It could grow and expand as businesses and promotions are added to the program.

2.8.7 Next Steps. To further evaluate this program, the City should consider an analytical study to understand the full lifecycle impacts, taking into consideration the costs and benefits of preventing these materials from being disposed of in the Landfill, the cost and feasibility of setting up and promoting/enforcing the C&D material rescue programs, and, if any, the additional fuel and energy use required for collection and processing of the C&D material, as well as energy savings from using recycled materials.

2.9 DOW Energy Bag Program

2.9.1 Project Definition. A DOW Energy Bag program could be proposed for the City. This program is currently piloted in Citrus Heights, California. The program is designed to fill the gap between traditional curbside recycling and composting programs, capturing often non-recycled plastics (such as chip bags, candy bar wraps, film plastic, Styrofoam, and drink pouches). Instead of putting these items in a landfill, consumers in these select markets can collect these plastics into the Hefty Energy Bags, which local haulers collect from regular recycling bins and carts. The Energy Bags are sorted at the local recycling facilities, and directed to regional waste-to-energy facilities.

2.9.2 Technology Validation/Feasibility. No new equipment or systems are likely to be required on the part of the City; however, the current curbside recycling processors may need an area to store the collected plastics until there is an adequate quantity to ship. The processor would also need additional manpower to recover the bags from the waste stream. The nearest waste-to-energy plants are in Minnesota, and an agreement would be needed. Programs would need to be developed and promoted properly to manage costs, and the likeliness of implementing such a program may depend on the success of the programs currently being pilot tested in other communities.

2.9.3 Sustainability Element. Based on the Waste Characterization study, plastic film/wrap/bags represent approximately 5.3 percent of residential municipal solid waste. This project would target the recovery of energy from the hard to recycle plastics. This project would help address the City's landfill diversion goal, and would be used to create renewable energy. Community vitality and public awareness could potentially be addressed through promotional programs, and would require setting up public/private partnerships.

2.9.4 Impact to the City. The City may incur implementation and administrative costs to run this program. The same staff recommended for the commercial recycling technical assistance program could be used to assist in administering this project.

2.9.5 Potential Regulatory and Legal Impacts. An agreement would be required with the haulers and the processing facility to ensure acceptability of the program. An agreement with nearby waste-to-energy facility would also be necessary.

2.9.6 Timing and Rating. Implementation of this green project would take some investigation to determine the feasibility and to implement the program. The potential landfill diversion is likely to be low and acceptance would need to be studied. It may be advisable to wait on implementation until information can be obtained from the pilot cities to see what lessons have been learned. Thus, this project is considered a long-term project at this time, and feasibility is not yet known.

2.9.7 Next Steps. Continue to monitor the success of the pilot studies and availability of the program.

2.10 Plastic Bag and Styrofoam Ban or Tax

The City could consider banning or taxing certain types of plastics and uses of plastics such as Styrofoam clamshells for food storage or a grocery store style bag ban. Both programs reduce hard to recycle materials from the Landfill.

2.10.1 Project Definition.

Legislation relating to taxing or banning bags is commonly enacted at the State level, although the District of Columbia has enacted D.C. specific legislation. Some examples include:

- The State of California, in August of 2014, became the first state to enact legislation imposing a statewide ban on single-use plastic bags at large retail stores. There is also a 10¢ minimum charge for recycled paper bags, reusable plastic bags, and compostable bags.
- The State of Delaware, in 2009, enacted legislation that encourages the use of reusable bags by consumers and retailers, and requires a store to establish an at-store recycling program that provides an opportunity for a customer to return clean plastic bags.
- Washington DC, in 2009, enacted legislation that protects its aquatic and environmental assets, to ban the use of disposable non-recyclable plastic carryout bags, to establish a fee on all other disposable carryout bags provided by grocery stores, drug stores, liquor stores, restaurants, and food vendors, to give the Mayor the authority to implement rules and procedures to collect the fee, and to establish a non-lapsing recurring Anacostia River Cleanup and Protection Fund.

Legislation or regulation of Styrofoam, which is DOW Chemical's brand name for polystyrene, is commonly enacted at the local government level.

- Starting July 1, 2015, New York City began its ban on single-use EPS products including cups, bowls, plates, takeout containers and trays and packing peanuts, which are not allowed to be possessed, sold, or offered in New York City. Companies have six months to comply or face a fine. Some legal actions are on-going regarding the ban.
- Other communities that have banned the use of polystyrene foam food containers include:
    - Albany County, NY
    - Portland, OR
    - San Francisco, CA
    - Seattle, WA
    - Amherst, MA

2.10.2 Technology Validation/Feasibility. No new equipment or systems are likely to be required on the part of the City; however, enforcement of a material ban would require manpower.

2.10.3 Sustainability Element. This project could reduce the amount of the hard to recycle plastics in the waste stream. Though not on a large scale, this project would help address the City's landfill diversion goal. Community vitality and public awareness could potentially be addressed through promotional programs and enforcement of bans.

2.10.4 Impact to the City. The City would incur implementation and administrative costs to enforce a ban on materials or to collect a tax on materials. It may be possible for existing code enforcement staff to assist in administering a materials ban.

2.10.5 Potential Regulatory and Legal Impacts. Ordinance revisions/additions would be necessary for either a tax or a ban of plastic bags and/or Styrofoam.

2.10.6 Timing and Rating. Implementation of this green project would take some investigation to determine the feasibility and to implement the program. The potential landfill diversion is likely to be low, and acceptance would need to be studied. Impacts to businesses should also be considered and studied.

2.10.7 Next Steps. To further evaluate this program, the City should consider an analytical study to understand the full lifecycle impacts, taking into consideration the costs and benefits of preventing these materials from being disposed of in the landfill, the cost and feasibility of setting up and adopting the program, participation potential, and impacts to businesses. The possibility of a cooperative purchase of alternative food storage containers should also be investigated, to potentially offset the costs to businesses to discontinue use of Styrofoam.

3 Results of the Evaluation

The following table summarizes the various Green Innovative Projects described in this TM in a concise manner for the City's review and consideration. It addresses the potential timeframe for project implementation using three intervals:

- Short term, meaning implementation could occur within about a year
- Intermediate term, meaning initial steps could start within a year but a project would potentially take five to ten years to complete, and
- Long term meaning certain conditions may need to change before a project could be completed or it is likely to require more than ten years to implement a successful project.

A feasibility rating of each project is also provided, indicating the likelihood further analysis will demonstrate the project will have a reasonable rate of return and is implementable. Relevant goals from the City's current Sustainability Master Plan that are addressed are listed, as well as a summary of recommended next steps for each of the projects.

Table 1: Green Innovative Projects Conclusions and Recommendations

Innovative Green Project	Timing of Project	Feasibility Rating	Goals Addressed	Recommendations for Follow-up
Anaerobic Digestion at Wastewater Treatment Plant	Intermediate term	Potentially feasible	• Renewable energy • Public-Private Partnership • Landfill Diversion • Landfill Reduction per Capita	Complete additional discussions with wastewater and engineering analysis to further evaluate economics
Landfill Wet or Modular Dry Anaerobic Digestion	Intermediate term	Potentially feasible	• Renewable energy • Public-Private Partnership • Landfill Diversion • Landfill Reduction per Capita • Reduced Transportation	Complete additional engineering analysis to further evaluate economics
Biogas and Landfill Gas to Biogas Applications (AD End Use)	Intermediate term	Potentially feasible but a more complicated AD project and presumes a vehicle fleet to use biogas	• Renewable energy • Public-Private Partnership • Landfill Diversion • Landfill Reduction per Capita • Reduced Transportation	Complete additional engineering analysis to further evaluate economics as needed, if current markets close
Modified Landfill Gas Direct Use (AD End Use)	Intermediate term	Potentially feasible but a more complicated AD projects	• Renewable energy • Public-Private Partnership • Landfill Diversion • Landfill Reduction per Capita • Reduced Transportation	Complete additional engineering analysis to further evaluate economics as needed, if current markets close
Onsite Solar Energy Generation	Intermediate to Long term	Potentially feasible; could be completed in phases	• Renewable energy • Public-Private Partnership	Complete additional engineering analysis to further evaluate economics
Onsite Wind Energy Generation	Long Term	Infeasible at this time	• Renewable energy • Public-Private Partnership	Re-evaluate in future

Innovative Green Project	Timing of Project	Feasibility Rating	Goals Addressed	Recommendations for Follow-up
Industrial Waste Composting	Short Term	Potentially feasible; needs industry buy-in	• Landfill Diversion • Landfill Reduction per Capita	Complete additional marketing analysis to further evaluate economics
Zoo Waste (Manure) Composting	Short Term	Potentially feasible; small number of potential tons	• Landfill Diversion • Landfill Reduction per Capita • Potentially transportation reduction	Complete additional discussions with zoo and engineering analysis to further evaluate economics
Incentivize Recycling	Intermediate term	Potentially feasible; needs well publicized and managed program	• Landfill Diversion • Landfill Reduction per Capita	Complete additional marketing and engineering analysis to further evaluate economics
Food Waste Rescue	Intermediate term	Potentially feasible; needs industry buy-in	• Landfill Diversion • Landfill Reduction per Capita • Potentially transportation reduction	Complete additional marketing analysis to further evaluate economics
C&D Material Rescue and Reuse	Intermediate term	Potentially feasible; needs industry buy-in	• Landfill Diversion • Landfill Reduction per Capita • Potential for transportation reduction	Complete additional marketing analysis to further evaluate economics
DOW Energy Bag Program	Long Term	Only feasible if pilot in other communities are successful and program gains acceptance	• Landfill Diversion • Landfill Reduction per Capita • Renewable energy	Re-evaluate in future when more data is available from pilot program
Plastic Bag and Styrofoam Ban or Tax	Short Term	Low feasibility; requires ordinance revisions; may have low acceptance	• Landfill Diversion Landfill Reduction per Capita	Complete additional marketing analysis to further evaluate economics and implementation issues

City of Sioux Falls
SOUTH DAKOTA

City of Sioux Falls Solid Waste Management Master Plan

Appendix J: Task 11 – Transfer Station Technical Memorandum

HDR

Revised February 2017

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Task 11:

Transfer Station

Technical Memorandum

Solid Waste Management Master Plan

City of Sioux Fall, SD
Revised February 2017

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Table of Contents

ATTACHMENTS:

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1 Introduction & Purpose

The City of Sioux Falls (City) has initiated the development of a comprehensive Solid Waste Management Master Plan (SWMMP) to guide the continued operation and expansion of the solid waste program. The purpose of the SWMMP is to provide a 30-year road map to the City for the continued efficient, economical and environmentally responsible operation and expansion of the solid waste program. Collection services are an integral part of any solid waste system, and therefore should be considered through the master planning process. As such, one of the tasks associated with the development of the SWMMP was to evaluate the current system and alternatives to the current collection system (Task 2 – Collection System Alternatives). A separate technical memorandum was prepared to summarize results of the collection system evaluation (see Task 2 - Collection System Alternatives Technical Memorandum, dated July 2016).

Related to the collection system, the purpose of this technical memorandum is to summarize the results of evaluating the need for, and viability of, a transfer station in the City. As the City and the surrounding communities continue to grow, the need for more efficient waste collection becomes more evident. The cost of waste collection and hauling can increase with increase in population, the growth in collection routes, and the increase in traffic congestion. Providing a centrally located collection location (i.e. a transfer station) can increase route efficiencies and reduce haul costs, especially in circumstances where final disposal is a greater distance; however, there are many elements that can impact efficiency and cost of a collection system that includes a transfer station beyond distance to final disposal. The entire waste management system needs to be considered, and in this particular case, collection services to residents and businesses in the City are provided in an “open” collection system, meaning the residents and businesses subscribe directly with one of the 25 licensed haulers in the City, which may have less impact on efficiencies.

The activities of this Task 11 include analyzing the waste stream data to determine the material fractions that could be received at a proposed transfer station, the sizing and orientation of the facility to safely and efficiently process the material (see Attachments A and B), and the development of an opinion of probable construction cost (see Attachment C). All of this information was utilized as inputs to develop the financial pro forma (see Attachment D) to determine the estimated annualized and per-ton operations and maintenance costs for the proposed transfer station facility. Furthermore, this technical memorandum includes opinions obtained from hauler interviews and stakeholder workshops conducted as part of Task 13 (Stakeholder Input) on the topic of siting a transfer station in the City, as well as our professional opinion regarding the feasibility of a City-owned transfer station in your current waste management system.

2 Evaluation Approach

Based on the population and waste projection data prepared in Task 5 (Waste Generation and Disposal Projects), the following summary table was developed to evaluate the materials to be received and transferred from the proposed transfer station:

Table 1: Materials to be Received and Transferred

Year	Total MSW	Total C&D	Total Yard Waste	Total Annual Tonnage Processed	MSW tons/day	C&D tons/day	Yard Waste tons/day
2015	161,116	86,557	8,819	256,492	525	282	29
2016	174,109	85,906	9,087	269,102	567	280	30
2020	201,892	94,711	10,018	306,621	658	309	33
2025	224,476	105,305	11,139	340,920	731	343	36
2030	249,668	117,123	12,389	379,180	813	382	40
2035	278,150	130,484	13,802	422,436	906	425	45
2036	284,301	133,370	14,107	431,778	926	434	46

NOTES:

1. Daily tonnage calculations based on 307 days of operation.
2. Data is based on 5-year historical data

As noted in Table 1, the waste quantities proposed to be received and transferred and hauled from the transfer station are based on the municipal solid waste (MSW), construction and demolition debris (C&D) and yard waste quantities projected to be generated in City and the surrounding five-county region. These materials are assumed to be the only materials to be handled at the proposed transfer station. Since these materials are currently being delivered from the five-county region and City directly to the landfill, it was assumed that this practice of delivery would continue, and that all of the waste would be received at the transfer station, then transferred and hauled to the existing landfill. Although the population and waste generation projections were based on a 30-year planning period, the facility sizing and implementation costs were calculated based on a 20-year outlook. This approach was selected since it was thought to present a more reasonable estimation of facility needs that can be re-evaluated and/or expanded in the future, as required.

Using the 20-year projections, the facility sizing calculations were prepared for the peak daily tonnage of MSW, C&D and yard waste quantities, and storage of that quantity of material on the tipping floor. In addition, the sizing was confirmed respective of the maximum hourly and daily number of vehicles anticipated based on historical vehicle counts at the landfill. This was done to ensure there would be a sufficient number of unloading bays provided within the overall building envelope. As noted above, the sizing calculations and physical arrangement sketch are provided in Attachments A and B to this memorandum.

An opinion of probable construction cost (Attachment C) was prepared by itemizing and estimating the major facility elements related to the construction of the overall transfer station facility. Recent bid tabulation information from similar projects and pricing guides were utilized for estimation of the material and labor costing. A contingency of +30% was applied to the total base cost to account for inaccuracies due to the conceptual level of the design and miscellaneous ancillary features of a transfer station not quantified at this time. In addition to the contingency line item, an allowance of 15% of the estimated overall capital cost was added for permitting, engineering and design services, and an additional 10% for construction administration services. This information was incorporated into the pro forma model (Attachment D).

3 Results of the Evaluation

Cost Evaluation

The sizing calculations and cost information developed were used as input for the pro forma model (Attachment D). In addition, estimates were made regarding rolling stock and staffing requirements for the facility and hauling operations. The pro forma generated estimated annual costs and per-ton costs for operation and maintenance of the proposed transfer facility for a 20-year planning period. Based on the model output, the average 2016 present value operating cost for the proposed transfer station is $15.94 per ton. This cost includes the transfer and haul operations from the transfer station to the landfill, and the equipment required; all other collection, haul and disposal costs (e.g. tipping fees) are not included in this value.

The City should consider the operating cost information provided herein to evaluate the impact to the overall waste management system operating budget, as well as cost to customers, as one of many factors to consider before making a decision on whether to build a transfer station at this time. As previously stated, the operating cost presented above would be in addition to current costs of your waste management system.

Siting

As part of this Task, HDR did not perform specific siting analyses or evaluation of available property for the siting of a transfer station facility. However, in review of aerial maps of the City and the surrounding area, it appears that the population concentration is in the east-southeast. As such, it could be assumed that the results of a siting analysis would suggest an east-southeast location for a proposed transfer station to balance the travel distance for a majority of the collection routes. A detailed siting study would need to be undertaken should the City elect to initiate the development of a transfer station.

Implementation

As noted previously, the cost of waste collection and hauling can increase significantly when the population grows, as collection routes increase and traffic congestion increases. The incorporation of a transfer station into the system can increase route efficiencies and reduce overall haul costs. This is certainly applicable when an entity (municipality or private) is responsible for collection, haul and disposal services. For situations similar to Sioux Falls, where collection is provided by a variety of licensed haulers, the potential reduction in costs cannot be directly realized or predicted. With a collection system based on subscription services by multiple providers, some may benefit from the transfer station and others may not, therefore any reductions in costs may not be realized by the City. This was evident in the results of the hauler surveys recently conducted by HDR for a separate task of the SWMMP for the City. When asked if a transfer station would be helpful, a majority of the responses indicated that rate increases would result due to the additional handling and transport. Some haulers indicated that it would not make routes more efficient and would add more heavy truck traffic to City streets. (Note that hauler responses have not been substantiated.)

The implementation process for a new transfer station facility would likely need to include some type of public notice and/or meetings related to zoning and use of property selected for siting the transfer station, depending on City protocol. These types of projects inherently result in some form of public opposition. This reaction was evident in the recent workshops conducted regarding solid waste management within the City. Participants in the workshop expressed opinions of “not in my backyard” (NIMBY) and concerns of littering and other environmental impacts to the surrounding area. Others expressed concern related to added costs that would ultimately be transferred to the taxpayers.

Conclusions and Recommendations

Municipalities and private solid waste management companies who do not “control” the collection of the waste streams tend to have a difficult time justifying the additional operational and capital costs of a transfer station, since the cost is basically a “pass-through” or added cost to the customers. Further, with the relatively short distance to the Landfill (current final disposal location) from collection points in the current system, the efficiencies that could potentially be gained may be minimal. However, if the final disposal location was a further distance from collection points throughout the City, the desire for a transfer station could increase. Given the current landfill life estimated through 2075, it does not appear to be in the City’s best interest to move forward with siting a transfer station in the City during the 30-year planning horizon of the SWMMP.

Should future changes to the waste management system and/or waste market result in the desire/need to proceed with siting a transfer station, it is recommended that the City utilize the operating cost information provided herein to evaluate the impact to the overall waste management system operating budget, as one of the many factors to consider before making a final decision on whether to build a transfer station.

Attachment A

HDR

HDR Engineering, Inc.
of the Carolinas

Computation Form

HDR Project No.	10029756	Task No.	011

Project	**Sioux Falls**	Computed	R. J. Rella	Date	11/18/16
Subject	Transfer Station	Checked	D. Frye	Date	11/18/16
Task	Size Review of Transfer Station	Sheet	1	of	

TYPES OF ANALYSIS

- Building Dimensions and Sizing for Receiving, Storage and Processing

CRITERIA – PRIMARY

Sioux Falls Waste

Year	Total MSW	Total C&D	MSW tons/day	C&D tons/day	Yard Waste tons/day
2015	**161,116**	**86,557**	**525**	**282**	**29**
2016	**174,109**	**85,906**	**567**	**280**	**30**
2020	**201,892**	**94,711**	**658**	**309**	**33**
2025	**224,476**	**105,305**	**731**	**343**	**36**
2030	**249,668**	**117,123**	**813**	**382**	**40**
2035	**278,150**	**130,484**	**906**	**425**	**45**
2036	**284,301**	**133,370**	**926**	**434**	**46**

Note: Daily tonnage based on 307 days/year of operation

Peak daily tonnage = 926 tpd x 1.2 = 1,112 tpd

- Peak Waste Tonnage – 1,112 tpd
- Accommodate Peak Weekday Traffic
- One Day Storage – Floor Sizing
- Transfer Operation – 8 Hours/Day (8:00am – 4:00pm)
- Zero Queue
- Exterior Maneuvering of Waste Hauling Vehicles

ASSUMPTIONS

- Open Top Trailer Loading – full grade separation
- Monday through Saturday receive waste from 8:00AM to 4:00PM
- Average Payloads = 25.0 tons/trailer

Estimated Peak Hour of Deliveries (MSW)
The maximum number of large vehicles delivering MSW during a one hour period has been 43 historically. Since the design tonnage is 176% the current tonnage (926/525 = 1.76), 43 * 1.76 = 75.7 vehicles/hour - Use 76 vehicles/hour.

SIZE UNLOADING AREA

Estimated:

Unloading Time Packers = 8 minutes

Unloading Bay – Packer (two times vehicle width) = 16 feet

Required Area for Unloading Bay Based on Zero Queue

Packer Bays = 76 vehicles/hr x 8 min/vehicle x 1 hr/60 min = 10.1 Bays
Provide 11 bays for Packers to Unload

Therefore, space for Packer Trucks to Unload = 11 bays @ 16' each = 176 FT

SIZE WASTE STORAGE AREA (MSW)

Assume: Store Waste Disposal = 400 lbs/CY = 15 lbs/CF
Peak Stacking Height = 12 FT
Side Slopes are = 1:1 (horizontal to vertical)
Access Corridor Around Waste Pile = 12 feet wide

Avg Area$_{\text{@ center of stack}}$ x Height
Area of Base = 12 feet longer, and 24 feet wider than A_{top}
Area Base = 6 feet longer, 12 feet wider than A_{avg}

Volume Required:

For one day of storage at Peak Throughput: 1120 tons for one day storage

Volume = 1,112 tons x 2000 lbs/ton x 1 CY/400 lbs x 27 FT3/CY
Volume = 150,120 FT3

Avg Area = Volume/12 FT high = 150,120 / 12 = 12,510 FT2

Area = 175 x 72 = 12,600 FT2

Add corridors to define storage area (add 12 feet for slope and 12 feet for corridor on three sides):

A = 200 x 100 = 20,000 FT2

Check Loadout Area Requirements

Assume 2 loaders working the tipping floor loading trailers
Assume 25 mins/trailer load time

1112 TPD x trailer/25.0 tons = 45 trailers/day

Each loader does approx. 24 trailers/day:
24 trailers x 25 min = 600 mins x hr/60 mins = 10 hours

Therefore, utilizing 2 loader operators @ 1112 TPD (peak) can be processed during a 10 hour operating day.

MSW Tipping Floor Area = 20,000 SF

Estimated Peak Hour of Deliveries (C&D)
The maximum number of large vehicles delivering C&D during a one hour period has been 44 historically. Since the design tonnage is 154% the current tonnage (434/282 = 1.54), 44 * 1.54 = 68 vehicles/hour. For Saturday deliveries, the MSW side can be employed due to minimum large vehicle deliveries.

SIZE UNLOADING AREA

Estimated:
Unloading Time Trucks = 9 minutes

Unloading Bay – Packer (two times vehicle width) = 16 feet

Required Area for Unloading Bay Based on Zero Queue

Truck Bays = 68 vehicles/hr x 9 min/vehicle x 1 hr/60 min = 10.2 Bays
<u>Provide 11 bays for Packers to Unload</u>

Therefore, space for Trucks to Unload = 11 bays @ 16' each = 176 FT (same as MSW)

SIZE WASTE STORAGE AREA (C&D)
Assume: Store Waste Disposal = 0.24 tons/CY = 480 lbs/CY
Peak Stacking Height = 12 FT
Side Slopes are = 1:1 (horizontal to vertical)
Access Corridor Around Waste Pile = 12 feet wide

Avg Area$_{\text{@ center of stack}}$ x Height
Area of Base = 12 feet longer, and 24 feet wider than A_{top}
Area Base = 6 feet longer, 12 feet wider than A_{avg}

Volume Required:
<u>For one day of storage at Peak Throughput</u>: 434 tons x 1.2 = 521 tons for one day storage

Volume = 521 tons x 2000 lbs/ton x 1 CY/480 lbs x 27 FT3/CY
Volume = 58,613 FT3

Avg Area = Volume/12 FT high = 58,613 / 12 = 4,885 FT2

SIZE WASTE STORAGE AREA (Yard Waste)
Collected Yard Waste Bulk Density = 350-930 lbs/CY – Use 700 lbs/CY

Assume: Store Waste Disposal = 700 lbs/CY
Peak Stacking Height = 12 FT
Side Slopes are = 1:1 (horizontal to vertical)
Access Corridor Around Waste Pile = 12 feet wide

Avg Area$_{\text{@ center of stack}}$ x Height
Area of Base = 12 feet longer, and 24 feet wider than A_{top}
Area Base = 6 feet longer, 12 feet wider than A_{avg}

Volume Required:
For one day of storage at Peak Throughput: 46 tons x 1.2 = 55 tons for one day storage

Volume = 55 tons x 2000 lbs/ton x 1 CY/700 lbs x 27 FT3/CY
Volume = 4,243 FT3

Avg Area = Volume/12 FT high = 4,243 / 12 = 354 FT2

Using a 200 feet long tipping floor, split the storage area for C&D and Yard Waste. Assume a 20 feet long Yard Waste pile base to start.

Area YW = 354 FT2, with length of 20 feet, width = 17.7 or 18 feet

Accounting for 12 feet slope for each pile and a corridor of 15 feet, pile length for C&D = 140 feet
(200' – (20' + 12' + 12' + 15') = 141')

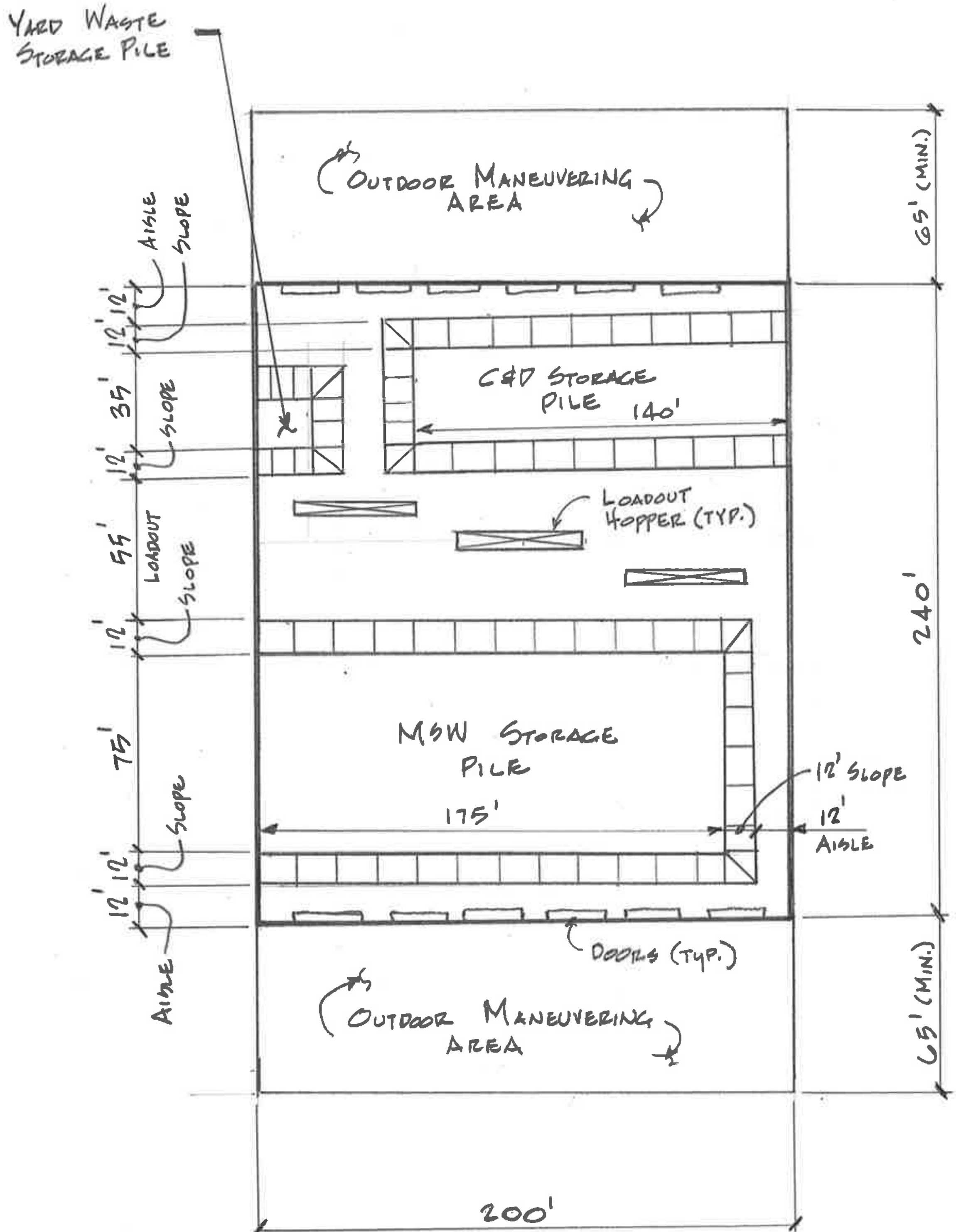
Area C&D = 4885 FT2, with length of 140 feet, width = 34.9 or 35 feet

Since the C&D pile width governs, building width required = 12' + 35' + 12' + 12' = 71'

ATTACHMENT B

HDR

Project:	SIOUX FALLS	Computed:	RJR	Date:	
Subject:	TRANSFER STATION	Checked:	DF	Date:	
Task:		Page:		of:	
Job #:		No:			



SCALE = 1" = 60'

BUILDING AREA = 200' x 240' = 48,000 SF

Attachment C

Engineering Opinion of Probable Construction Cost

Sioux Falls - Proposed Transfer Station

1112 TPD MSW + 521 TPD C&D + 51 TPD Yard Waste Facility

				ESTIMATED COST	
	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE
	Transfer Building				
1	Bonds, Mobilization and Insurance	4%	of WORK	$10,896,300	$454,000
2	Clearing and Grubbing	15	AC	$4,000	$60,000
3	Earthwork/Structural Fill	18,000	CY	$15.00	$270,000
4	Concrete:				
	Aprons	615	CY	$350	$215,300
	Retaining Wall (1.5cy/LF)	570	CY	$600	$342,000
	Foundations	200	CY	$600	$120,000
	Tipping Floor	1,800	CY	$450	$810,000
	Tunnel Exterior Wall	450	CY	$600	$270,000
5	Roadway Paving	10,000	SY	$35	$350,000
6	Pre-engineered Building	48,000	SF	$75	$3,600,000
7	Mechanical & Fire Protection	48,000	SF	$16	$768,000
8	Electrical	48,000	SF	$20	$960,000
10	Steel Hoppers/Chutes/Liners	3	LS	$125,000	$375,000
11	Utilities	1	LS	$200,000	$200,000
12	Surveying	1	LS	$35,000	$35,000
13	Erosion Control/Storms	1	LS	$250,000	$250,000
14	Yard Lighting	15	EA	$1,500.00	$22,500
15	Roll-up doors	18	EA	$3,000.00	$54,000
16	Administration Area	2,400	SF	$200.00	$480,000
	Scalehouse				
17	Pre-engineered Building	400	SF	$75	$30,000
18	Concrete Slabwork	8	CY	$600	$4,800
19	Concrete Footings	6	CY	$350	$2,100
20	Interior Treatments	400	SF	$200	$80,000
21	Scales	4	LS	$75,000	$300,000
22	Mechanical	400	SF	$20	$8,000
23	Electrical	400	SF	$24	$9,600
	Equipment				
24	Tamping Crane	1	EA	$175,000	$175,000
25	Loader	3	EA	$350,000	$1,050,000
26	Skid Steer	1	EA	$55,000	$55,000
				SUBTOTAL	**$11,350,300**
				Contingency (30%)	**$3,405,090**
				Subtotal	**$14,755,390**
				Permitting, Engineering & Design (15%)	**$2,213,309**
				Construction Administration (10%)	**$1,475,539**
				TOTAL	**$18,444,238**

ATTACHMENT D

Sioux Falls, SD
**** Transfer Station ****
Cost Estimate (1112 TPD)
One way Haul of 15 miles

Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
Tonnages	291,986	299,205	306,621	313,136	319,818	326,674	333,706	340,920	348,191	355,647	363,294	371,137	379,180	387,393	395,819	404,464	413,335	422,436	431,778	441,365
CAPITAL COSTS																				
Pre Development Costs	266,600	266,600	266,600	266,600	266,600	266,600	266,600	266,600	266,600	266,600	266,600	266,600	266,600	266,600	266,600	266,600	266,600	266,600	266,600	266,600
	148,546	148,546	148,546	148,546	148,546	148,546	148,546	148,546	148,546	148,546	148,546	148,546	148,546	148,546	148,546	148,546	148,546	148,546	148,546	148,546
EQUIPMENT COSTS																				
Transfer Station EQUIPMENT	272,875	272,875	272,875	272,875	272,875	272,875	272,875	412,744	412,744	412,744	412,744	412,744	412,744	412,744	624,299	624,299	624,299	624,299	624,299	624,299
OTR EQUIPMENT	710,842	710,842	710,842	710,842	710,842	710,842	710,842	710,842	1,034,600	1,034,600	1,203,928	1,203,928	1,203,928	1,203,928	1,203,928	1,203,928	1,589,072	1,589,072	1,589,072	1,589,072
Annual Debt Service Subtotal	1,398,863																			
OPERATING COSTS																				
EQUIPMENT COSTS	909,200	936,500	964,600	993,600	1,023,400	1,054,100	1,085,700	1,118,300	1,151,800	1,186,400	1,221,900	1,258,600	1,296,400	1,335,300	1,375,300	1,416,600	1,459,100	1,502,800	1,547,900	1,594,400
Operation Costs (Facilities)	2,623,100	2,701,800	2,782,800	2,866,300	2,952,300	3,040,900	3,132,100	3,226,100	3,322,800	3,422,500	3,525,200	3,630,900	3,739,900	3,852,100	3,967,600	4,086,700	4,209,300	4,335,500	4,465,600	4,599,600
TOTAL COSTS																				
Annual Costs	4,931,163	5,037,163	5,146,263	5,258,763	5,374,563	5,493,863	5,616,663	5,883,132	6,337,090	6,471,390	6,778,917	6,921,317	7,068,117	7,219,217	7,586,272	7,746,672	8,296,916	8,466,816	8,642,016	8,822,516
Cost/Ton	$16.89	$16.84	$16.78	$16.79	$16.81	$16.82	$16.83	$17.26	$18.20	$18.20	$18.66	$18.65	$18.64	$18.64	$19.17	$19.15	$20.07	$20.04	$20.01	$19.99
2016 PRESENT VALUE COSTS																				
Pre Development Costs	251,300	244,000	236,900	230,000	223,300	216,800	210,500	204,300	198,400	192,600	187,000	181,500	176,300	171,100	166,100	161,300	156,600	152,000	147,600	143,300
	140,000	135,900	132,000	128,100	124,400	120,800	117,300	113,800	110,500	107,300	104,200	101,200	98,200	95,300	92,600	89,900	87,300	84,700	82,200	79,900
Transfer Station EQUIPMENT	257,200	249,700	242,400	235,400	228,500	221,900	215,400	316,300	307,100	298,200	289,500	281,100	272,900	264,900	389,000	377,700	366,700	356,000	345,700	335,600
OTR EQUIPMENT	670,000	650,500	631,600	613,200	595,300	578,000	561,100	544,800	769,800	747,400	844,400	819,800	795,900	772,800	750,200	728,400	933,400	906,200	879,800	854,200
EQUIPMENT COSTS	857,000	857,000	857,000	857,100	857,100	857,100	857,100	857,100	857,000	857,100	857,000	857,000	857,100	857,100	857,000	857,100	857,100	857,000	857,000	857,100
Operation Costs (Facilities)	2,472,500	2,472,500	2,472,500	2,472,500	2,472,500	2,472,500	2,472,500	2,472,500	2,472,500	2,472,500	2,472,500	2,472,500	2,472,500	2,472,500	2,472,500	2,472,500	2,472,500	2,472,500	2,472,500	2,472,500
Total Annual Costs	4,648,100	4,609,700	4,572,400	4,536,300	4,501,100	4,467,000	4,433,800	4,508,900	4,715,400	4,675,100	4,754,600	4,713,100	4,672,900	4,633,700	4,727,500	4,686,900	4,873,600	4,828,500	4,784,900	4,742,500
Cost/Ton	$15.92	$15.41	$14.91	$14.49	$14.07	$13.67	$13.29	$13.23	$13.54	$13.15	$13.09	$12.70	$12.32	$11.96	$11.94	$11.59	$11.79	$11.43	$11.08	$10.75
Cost/Ton Average	$15.94																			

City of Sioux Falls
SOUTH DAKOTA

City of Sioux Falls
Solid Waste Management
Master Plan

Appendix K: Task 12 – Long Term Landfill Gas Options Technical Memorandum

HDR

April 2017

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HDR

Task 12:

Long Term Landfill Gas Options

Technical Memorandum

Solid Waste Management Master Plan

City of Sioux Fall, SD
April 2017

City of Sioux Falls

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1 Introduction & Purpose

The City of Sioux Falls (City) has initiated the development of a comprehensive Solid Waste Management Master Plan (SWMMP) to guide the continued operation and expansion of the solid waste program. The purpose of the SWMMP is to provide a 30-year road map for the continued efficient, economical and environmentally responsible operation and expansion of the solid waste program. One of the tasks associated with the development of the SWMMP is to evaluate alternative uses of the landfill gas. The purpose of this technical memorandum (TM) is to quantify the expected landfill gas that may be available for alternative uses based or varying tonnage and waste management strategy scenarios and to provide a general exploration of the regulations, technologies and end users available for revenue-positive landfill gas to energy (LFGTE) projects. To gather information in support of this evaluation, the HDR project team requested and reviewed data provided by Mr. Dustin Hansen, Landfill Superintendent.

The Sioux Falls Regional Sanitary Landfill (Landfill/Facility) is the largest permitted landfill in the State of South Dakota and is located on 709 acres approximately five (5) miles west of Sioux Falls at the intersection of 41st St. and 464th Ave. Approximately 260,000 people across a five-county region contribute to the disposal of approximately 160,000 tons per year of MSW and 87,000 tons per year of C&D waste. The City operates the Landfill for simultaneous disposal of MSW and C&D as two separate waste streams in two discrete landfills. Other waste management services, programs, and facilities at the Landfill include a scale house, a maintenance shop and offices, a public drop off area, an appliance recycling building, wood waste recycling, a compost pad, a landfill gas blower and flare system, and a gas conditioning building.

Landfill gas (LFG) from the closed MSW landfill and portions of the active MSW landfill is collected through a series of vertical and horizontal wells and processed at the gas conditioning building before being directed to the POET ethanol plant in Chancellor. The facility also houses a backup flare. An overview of the LFG collection system and associated landfill footprint is provided below:

- **Closed MSW Landfill**: This closed area consists of approximately 88-acre footprint. HDR reviewed historic Greenhouse Gas (GHG) reports and gas collection system coverage drawings (received in AutoCAD format).
- **Active MSW Landfill – Cells 1 and 2**: This active area consists of approximately 19-acre footprint. HDR reviewed historic GHG reports and gas collection system coverage drawings (received in AutoCAD format).
- **Active MSW Landfill – Cell 3**: This active area consists of approximately 15-acre footprint and currently does not have landfill gas coverage.

The contract between the City and POET is currently set to expire in 2019, but there is a five-year option for extension. HDR understands that the City is currently planning to renew, or at least utilize the five-year extension on this contract - although the extension may result in a lower revenue for the City after re-negotiation. This action is already accounted for in the City’s solid waste fee model.

2 Landfill Gas Generation and Collection Method

LFGTE projects are based on the anaerobic decay of solid waste that naturally occurs in landfills, which generates LFG at various rates based on particular site variables. To appropriately design beneficial end uses for the LFG, engineering estimates must be developed regarding the future generation of LFG at a particular site, or from a particular waste mass – known as LFG generation modeling. The Environmental Protection Agency (EPA) LandGEM model is one tool that is used for LFG generation modeling. This program allows for input of waste receipt tonnages, methane content of LFG, two kinetic variables, and the NMOC content of the LFG. These variables can be based on Clean Air Act (CAA) requirements, EPA's Inventory default values, and/or site-specific data. Typically, CAA values are used to determine a facility's compliance with regulatory requirements, and inventory or site-specific values are used for emission calculations for collection and beneficial use.

Many site characteristics have significant impacts on LFG generation. To determine the specific variables that govern the LFG generation modeling, HDR has first compiled the LFG collection data reported in the GHG reports provided by the City. This data is utilized to adjust the LandGEM model parameters by comparing modeling results (at varying input parameters) to LFG collection data. This methodology provides for a more detailed calibration of the LFG models with actual LFG collection data, increasing the accuracy of future estimates. The following subsections describe the parameters used to develop and calibrate the LandGEM model.

Waste Receipt and Methane Content

Historical MSW landfill disposal tonnages and future anticipated landfill disposal tonnages are required to complete any LFG generation model. These past tonnages (through year 2015) have been obtained from the GHG reports. Landfill disposal tonnage for 2016 is obtained from the file named "LANDGEM 2016" obtained from City staff. A future annual growth rate of 2.2% is assumed based on population projections to calculate future landfill disposal tonnages. Methane content of LFG was assumed to be 50% based on site-specific landfill gas collection data and lab analysis reports received from City staff.

Observed Collection Efficiency

To calibrate the LFG generation model for use into the future, it is necessary for HDR to make an estimate of the observed collection efficiency (CE). HDR has estimated the observed collection efficiency (CE) at the landfill based upon both industry-standard guidance provided in 40 CFR Part 98, Subpart HH, Table HH-3, as well as HDR experience with similar landfills and collection systems. Based on the landfill footprints and associated LFG collection system coverage, the average CE was estimated to be approximately 80%, which is a value consistent with historic GHG reports submitted for this Landfill. This CE is used to calibrate the estimates of LFG generation and collection in the subsequent sections.

Generation Rate Variable (k)

The Methane Generation Rate, k, determines the rate of methane generation for a unit mass of waste in the landfill. The higher the value of k, the faster the methane generation rate increases and then subsequently decays over time. The value of k is primarily a function of four factors:

- Moisture content of the waste mass;

- Availability of the nutrients for microorganisms that break down the waste to form methane and carbon dioxide;
- pH of the waste mass; and
- Temperature of the waste mass.

In the absence of site-specific data for the above parameters, EPA recommends using LandGEM defaults as these values are based on nationwide averages for landfill facilities. EPA's LandGEM model includes a range of values depending on site climate conditions and model purpose. These values range from 0.02 $year^{-1}$ (for arid locations) to 0.7 $year^{-1}$ (for wetter locations). Per EPA's LandGEM model guidelines, arid landfills are sites located in areas that receive less than 25 inches of rainfall per year. A review of actual rainfall data in the landfill vicinity indicates that the actual rainfall values are slightly above 25 inches per year. Based on high landfill gas collection and rainfall information, a "k" value of 0.04 $year^{-1}$ has been chosen for the LandGEM model.

Potential Methane Generation Capacity Variable (L_o)

The Potential Methane Generation Capacity, Lo, depends only on the type and composition of waste placed in the landfill. The higher the cellulose content of the waste, the higher the value of Lo. The default Lo values used by LandGEM are representative of a large spectrum of municipal solid waste. The Lo value, as it is used in the first-order decomposition rate equation, is measured in metric units of cubic meters per megagram (m3/Mg).

HDR's methodology for choosing this variable involves LandGEM calibration by comparing modeling results to LFG collection data and observed CE. Based on LFG collection and observed CE, following values for LFG generation were expected in previous years:

Year	Collected LFG		Observed CE	Expected LFG Generation	
	scf	scfm	%	scf	scfm
2013	1,022,283,260.53	1,944.98	80%	1,277,854,075.66	2,431.23
2014	1,059,750,951.21	2,016.27	80%	1,324,688,689.01	2,520.34
2015	965,577,341.46	1,837.10	80%	1,206,971,676.83	2,296.37
2016	891,600,990.00	1,696.35	80%	1,114,501,237.50	2,120.44

HDR used this actual flow rate data to model various LandGEM scenarios and perform a best-fit comparison of curves to determine the Lo value. The Lo value that provided the most accurate results (based on this comparison) was 170 m3/Mg (see Figure 1). Therefore, Lo value of 170 m3/Mg is used to develop the LandGEM model for future LFG generation. This is a relatively high Lo value and typically used in regulatory reporting, but less often used for actual LFG estimation. However, for the Landfill, this Lo is most accurate based upon the calibration methodology. In addition, this is consistent with current Landfill operations, where a portion of the waste stream can be routed to a designated construction and demolition debris (CD&D) landfill which removes a large component of the inert waste mass from the MSW landfill where gas is collected in addition to the closed MSW landfill.

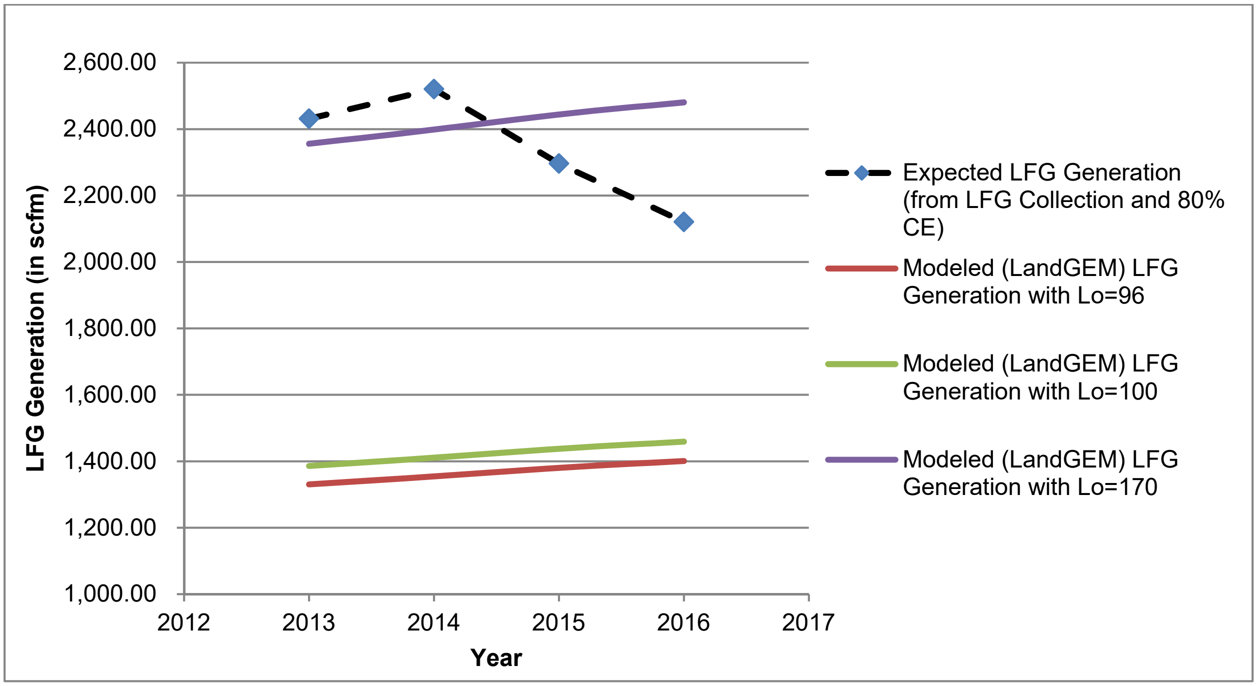

FIGURE 1. VARYING LO VALUES AND ASSOCIATED LFG GENERATION RATES

Modeling results are discussed in the next section and detailed LandGEM model output is provided as Attachment 1.

3 Landfill Gas Generation and Collection Estimates

LandGEM modeling results are provided as Attachment 1. The LFG generation curve (past, present and future) is provided as Figure 2. "Available LFG" is estimated using generated LFG and the continuing achievement of an 80% assumed CE.

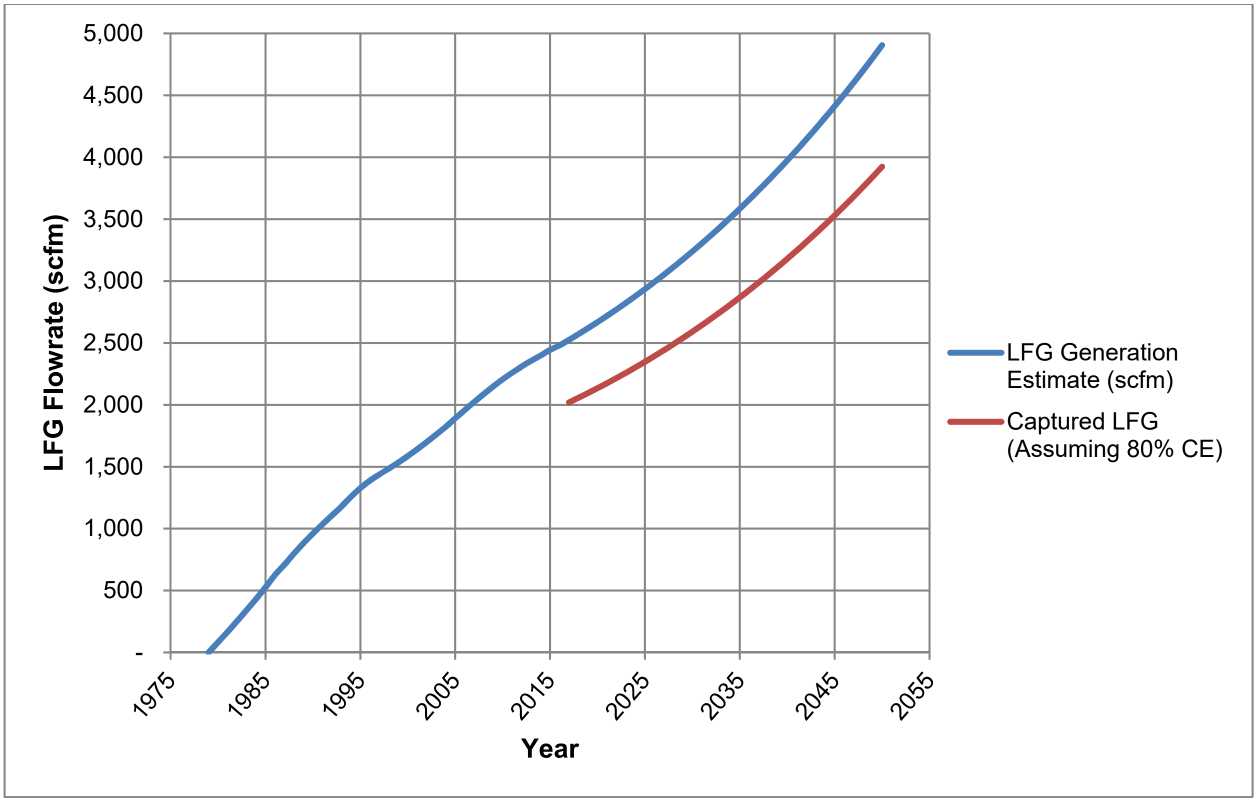

FIGURE 2. LFG GENERATION AND LFG AVAILABLE FOR ALTERNATIVE USE (FROM 2017 ONWARDS)

As shown in Figure 2, the "LFG Available for Alternative Use" (i.e. the total collected LFG) is greater than 2,000 scfm average flow rate in 2017, and increases to approximately 3,900 scfm average flow rate in 2050. These values assume an average methane concentration of 50% and <u>continued expansion of the LFG collection system</u> to achieve 80% collection efficiency. It is also important to note that the "LFG Available for Alternative Use" does NOT subtract any LFG currently (or future) contracted for delivery to POET. This obligation could serve to decrease the available LFG until this contractual obligation expires in 2019. Of note is that all (over 95%) of the LFG flow rate collected at the Landfill was sold to POET in 2015.

Comparison with Current LFG Generation and Collection Model

The LFG generation rate estimated by HDR and shown in Figure 2 (and in detail in Attachment 1) is within 5% of the current LandGEM estimate provided by City staff. This is based upon comparison of 2016-2017 LFG generation. This is generally consistent with the use of similar k and Lo variables in the City model. The LandGEM provided by the City did not include future tonnage estimates, so future generation is not calculated and cannot be compared to the HDR estimates in Figure 2.

Material Recovery Facility (MRF) and/or Solid Refuse Fuel (SRF) Facility

According to City staff, there is some discussion regarding the development of a MRF and/or a SRF facility in the area. Similar to the CD&D diversion discussed previously, these actions would have some effect on the organic material in the waste mass available for generation of LFG. These effects are difficult to quantify without knowing exactly the waste materials that would be diverted. Specifically, if paper products (cellulosic materials) are diverted, this would tend to reduce both the k and Lo values, and thereby reduce the LFG generation rate. However, if non-organic recyclable materials are removed from the waste mass, this can have an effect of yielding a higher percent of organic materials in the overall waste mass – thereby having the opposite effect. There are recognized models of Lo and k values for specific waste characterizations, and these could be incorporated into the LFG generation models when specific material diversion rates are estimated for these potential new facilities.

Notwithstanding, it is important to realize that most of the LFG generation in a waste mass takes place in waste that is approximately 5 years of age and older (depending upon site conditions). This is the time it takes for a unit of waste to become completely anaerobic and start to contribute meaningfully to the LFG generation at a site. Therefore, diversion or addition of specific waste streams have relatively little effect in the shorter term, but effect changes in the long term.

EPA 2030 Food Loss and Waste Reduction Goal

From the EPA website: *"In the United States, EPA estimates that more food reaches landfills and incinerators than any other single material in our everyday trash, about 21 percent of the waste stream. Reducing food waste will help the United States address climate change, as 20 percent of total U.S. methane emissions come from landfills. By keeping wholesome and nutritious food in our communities and out of our landfills, we can help address the 42 million Americans that live in food insecure households."*

On September 16, 2015, the United States Department of Agriculture (USDA) and EPA announced a goal to reduce food loss and waste by half by the year 2030. The EPA is planning to work with communities, organizations and businesses along with state, tribal and local governments with a goal to reduce food loss and waste by 50 percent over the next 15 years.

As it relates to LFG generation estimates, food waste is a quickly-decomposed waste. Large amounts of food waste (relative to the total waste acceptance) serve to increase the k value of a given waste mass. Conversely, a reduction in food waste serves to decrease the k value of a given waste mass. In practice, this is highly dependent upon the percent of the waste mass that is food waste. In most landfills, the difference is negligible, difficult to quantify, and/or within the margin of error. In addition, (as stated in the previous section), it is important to realize that most of the LFG generation in a waste mass takes place in waste that is approximately 5 years of age and older (depending upon site conditions).

4 New NSPS/EG Regulations Overview

In the Federal Register / Vol. 81, No. 167 / Monday, August 29, 2016, the EPA published amendments to 40 CFR Part 60 – Standards of Performance for New Stationary Sources. Specific to the Landfill, the following regulations are amended:

- Subpart XXX – Standards of Performance for Municipal Solid Waste Landfills That Commenced Construction, Reconstruction, or Modification After July 17, 2014.
- Subpart Cf – Emission Guidelines and Compliance Times for Municipal Solid Waste Landfills

The following are overall highlights of the rule changes:

New Source Performance Standards (NSPS)
The new NSPS are 40 CFR Part 60, Subpart XXX, effective October 28, 2016 (60 days after publication in the Federal Register). Landfills are subject to the rule if they have a design capacity of 2.5 million metric tons and 2.5 million cubic meters of waste or more. This remains unchanged from prior regulations. For a landfill to fall under the "new landfill" category (and be regulated by this rule), it would have had to have commenced construction, reconstruction or modification after July 17, 2014. Note that modifications are defined as expansions that increase the design capacity of the landfill, but that the determination of when a modification occurs is based on the date of commencement of construction (i.e., either physical construction or entering into a contract for the physical construction) of the modification. This rule is expected to affect only a small portion of landfills at this time. All new landfills, as well as existing landfills that are expanded in the future, will have to comply with this rule

Emission Guidelines (EG)
The new EG are 40 CFR Part 60, Subpart Cf. This is a federal guideline that informs states and local jurisdictions that if they accept delegation of Subpart Cf from EPA, they need to develop a rule that is at least as stringent as this federal guideline. The states and local jurisdictions have until May 30, 2017 (nine months from publication in the Federal Register) to submit their updated EG rule for approval by the EPA. The EPA then has until September 30, 2017 (four months from due date) to approve it. The rule only goes into effect after the EPA gives its approval to each jurisdiction.

Alternatively, EPA is expected to propose and finalize updates to 40 CFR Part 62, Subpart GGG (the federal rule that implements the requirements of the new EG) to implement the requirements of Subpart Cf. The updated federal rule will only apply after it becomes effective (i.e., 30 days after it is published final in the Federal Register) and will only apply to landfills located in states and local jurisdictions that do <u>not</u> have an EPA-approved rule in place as of the effective date of the federal rule.

Therefore, landfills across the country will have different dates for compliance with the new rule. Landfills will be subject to the rules finalized to implement Subpart Cf if they commenced construction, reconstruction, or modification on or before July 17, 2014.

Specific requirements applicable to the Landfill
Based upon analysis of the rule changes, the Landfill does <u>not</u> fall under the category of a "new landfill" subject to 40 CFR Part 60, Subpart XXX. Specifically, the Landfill has not had construction, reconstruction or modification that commenced after July 17, 2014.

The Landfill therefore <u>will</u> be regulated by the rule required by 40 CFR Part 60, Subpart Cf that will be implemented by the South Dakota Department of Environment and Natural Resources (DENR) or US EPA. As stated, the DENR has until May 30, 2017 to submit their updated EG rule for approval by the EPA. The EPA then has up to four months until September 30, 2017 to approve it. The rule only goes into effect after the EPA gives its approval.

Subpart Cf lowers the NMOC emission rate threshold for GCCS installation from 50 Mg/yr to 34 Mg/yr. The most recent Tier II testing (performed in 2013) for the Landfill reported an NMOC emission rate of 36.1 MG/yr, with the projected 2018 emission rate of 42.6 MG/yr. Therefore, the Landfill's current "voluntary" GCCS will likely be subject to the new EG regulations when they become effective in South Dakota. Since a GCCS is already in place, the major adjustment associated with the new EG regulations for the Landfill will include additional monitoring and reporting requirements for GCCS operations. These regulations will require some changes in the Landfill's standard operating procedures. Most notably: monthly wellhead monitoring, exceedance tracking, reporting requirements (including semiannual NSPS and annual emissions reporting), and quarterly surface emissions monitoring/reporting.

None of these changes will be expected to affect the LFG generation or collection estimates as presented.

5 LFGTE Technology Overview

Based on LandGEM modeling results (and the POET contractual obligation caveat), the LFG available for alternative use is approximately 2,000 scfm LFG in 2017, and 3,900 scfm in 2050. Based on this available LFG, the following provides an overview of alternative uses for the collected LFG. It is important to note that, currently, POET receives all the collected LFG from the Landfill; and is contracted to do so until 2019. This overview of LFGTE technologies can assist the City in understanding alternative or supplemental options (depending upon contractual obligations to POET).

Medium-BTU Gas

This option is familiar to the City and involves direct thermal utilization of the LFG as a medium-Btu fuel by piping the LFG to a nearby thermal energy-user (to offset natural gas or other fossil fuel usage). The City currently conditions LFG in an on-site building and then directs the LFG to the POET ethanol plant. As the infrastructure is already in place for this particular medium-BTU option, there are a few options to boost revenues: (a) re-evaluate existing contracts with POET (as currently planned by the City); and (b) explore the possibility of identifying another end user for which the existing piping infrastructure could be utilized (in whole or in part).

Electricity Generation

Producing electricity from LFG is the most common LFGTE application in the U.S., accounting for about three-fourths of all U.S. LFGTE projects. Electricity can be produced by using LFG as a fuel source in an internal combustion engine, a gas turbine, or microturbines. Irrespective of the technology employed to convert LFG fuel to electricity, the electricity can be sold to utility companies both locally and to non-local companies by means of “wheeling” power over the shared grid. The following is a listing of applicable details that should be considered when analyzing potential sales of electricity:

- Commonly, electric utility companies will pay based on contractual agreement with the electricity seller. The payment is generally quantified in terms of “avoided cost” – cost of electricity that the utility would have to produce. These avoided costs tend to fluctuate and can vary significantly based on various factors, such as plant capacity, on-site loads, or excess generation, and type of energy source the utility uses for electricity production.
- Interconnection with the local utility company (or other purchasing entity) is required for all electrical generation projects. These costs are generally based on the scale of the project and arrangements with the electricity purchasing entity. These interconnection costs may vary significantly based on arrangements with the purchasing entity.
- Renewable Energy Credits (RECs) and other similar state-specific incentive programs are additional sources of potential revenue from sales of electricity generated by LFG. Given the current administrative environment and generally low value of RECs, it is currently recommended to carefully consider counting on future revenue from REC’s in exploring the financial viability of LFGTE projects.

Specific to the landfill, the “LFG available for alternative use” could support two primary electricity generation technologies: Engine generators and turbines.

Engine Generators

Electricity generation can be achieved by means of reciprocating engine generators. These can require some minor pretreatment processes (depending on LFG quality) and specific O&M procedures to address the contaminants commonly found in LFG. Control systems, switchgear and a step-up transformer are also required to increase generated voltage and maintain synchronization to the local electric transmission lines. Depending on the growth of a landfill, LFG fueled engine generators are usually installed in increments, as additional units are installed to take advantage of higher quantities of LFG available. There can be situations in which more LFG is being collected than can be utilized by the generators installed (in which case the excess LFG would be flared).

Many engine manufacturers provide excellent products for LFGTE use. For example, Caterpillar engine (model 3520 with 1966 kW output) is an ideal selection for the available flow rates at the landfill. The CAT 3520 engine is a 20-cylinder reciprocating engine with a lower heating value requirement of 17,794,080 British thermal units per hour (Btu/hr). Allowing for parasitic loading, percent availability, and contingency for dips in methane content of the LFG, the CAT 3520 requires approximately 650 scfm of LFG (with 50% methane and 455 BTU/SCF lower heating value) for full utilization. Given the available LFG for alternative use (see POET contractual caveats, as stated), an LFGTE project could be started with three engines in 2017; and expanding to a total of six CAT 3520 engines by 2050. Alternatively, the City could commission the use of one CAT 3520 (or a smaller engine) for electricity generation with LFG collected that is in excess of the volumes contractually obligated to POET. Major costs associated with engine-based LFGTE projects are identified below:

- Capital Cost: Capital costs are dependent upon equipment selection, pretreatment requirements and interconnection with purchasing entity. Based upon the LFG lab analysis results provided by City staff, pretreatment of the LFG is likely required for the engine generator option at the landfill. It is important to note that each manufacturer typically performs their own analysis of feed gas prior to providing a warranty for their installations.
- Operations and Maintenance (O&M) Cost: Routine maintenance on the engine generators such as oil changes, filter replacements and general tuning are important to continue to maximize electricity output and revenue. These costs are usually modeled on a $/kWh basis.
- Overhaul Cost: Every 40,000-45,000 operational hours (approximately every 5 years), the engines require a complete overhaul, restoring the engines to like-new condition. This is usually modeled as an amortized cost.

Turbines

Gas turbines are a technology option typically utilized in LFGTE projects in which LFG flow rates exceed approximately 1,600 SCFM of available gas. This is due to the economies of scale available for this technology. The cost per kW of generating capacity drops as the size of the gas turbine increases, and the electric generation efficiency generally improves as well. However, the economics, and the physical conversion efficiency of gas turbines drop substantially when running at partial load. Advantages of gas turbines are that they are more resistant to some forms of corrosion damage than internal combustion engines and have lower nitrogen oxides (NOx) emission rates. Additionally, gas turbines are relatively compact and have relatively low O&M costs as compared with internal combustion engines. However, gas turbines have strict requirements on Siloxane thresholds, and pretreatment costs may be even higher compared to the engine generator technology discussed above.

Similar to engines, control systems, switchgear and a step-up transformer are also required to increase generated voltage and maintain synchronization to the local electric transmission lines. Depending on the growth of a landfill, gas turbines can be installed in increments, as additional units are installed to take advantage of higher quantities of LFG available. However, since the turbine has a larger capacity than the engine, the incremental capacity additions will be larger for the turbine. This may require that some LFG is directed to a flare until sufficient flow is available to justify the additional units.

Many turbine manufacturers provide excellent products for LFGTE use. One such example is Solar Turbines, specifically the *Mercury 50* unit with 4,707 kW rated output that would be appropriate for the available LFG at the landfill. This unit has a lower heating value fuel inlet requirement of 42,400,000 Btu/hr. Calculating parasitic loading, percent availability, and contingency for dips in methane content of the LFG, the Mercury 50 requires approximately 1,550 scfm of LFG (with 50% methane and 455 BTU/scfm net heating value) for full utilization. Given the available LFG for alternative use, a project could be started with one turbine after expiration of the POET contract in 2019; and expanding as more LFG becomes available for this technology. Major costs associated with turbine-based LFGTE projects are identified below:

- Capital Cost: Capital costs are dependent upon equipment selection, pretreatment requirements and interconnection with purchasing entity. Based upon the LFG lab analysis results provided by City staff, pretreatment of the LFG is likely required for the turbine option at the landfill. It is important to note that each manufacturer typically performs their own analysis of feed gas prior to providing a warranty for their installations.
- O&M Cost: Routine maintenance on the turbines is important to continue to maximize electricity output and revenue. However, O&M costs are relatively lower compared to engine generator technology. These costs are usually modeled on a $/kWh basis.
- Overhaul Cost: Similar to engine generators, turbines will require overhaul per manufacturer recommendations. This is usually modeled as an amortized cost.

High-BTU Gas

LFG can also be processed to the equivalent of pipeline-quality high-Btu gas (RNG), CNG, or LNG. Pipeline-quality gas can be injected into a nearby natural gas pipeline and the energy and/or environmental attributes sold to the local utility or other buyer(s) at other locations. If the energy is sold to the utility and the environmental attributes are retained, these can be sold once the equivalent RNG is converted into CNG or LNG. CNG and/or LNG can be used on-site to fuel vehicles at the landfill, fuel refuse-hauling trucks, and possibly supply the general commercial market, or delivered to a remote location by displacement on the natural gas pipeline system. The following are the typical processes that are commercially employed in the United States: Water Scrubbing; Amine Scrubbing; Molecular Sieve; and Membrane Separation. In general, these high-Btu processes can result in product gas with an equivalent heating value to natural gas. This RNG product gas is commonly utilized (sold) by either direct injection into a nearby natural gas pipeline, or further processing (compression) to produce alternative transportation fuels such as compressed natural gas (CNG).

High-BTU Pipeline Injection

The following is a listing of applicable details relating to potential sales of high-BTU gas for pipeline injection:

- Every utility or purchasing entity has certain specification requirements for gas to be injected into their pipeline. The selling price for high-Btu product gas will vary depending on contractual arrangements with the purchasing entity.
- USEPA's RFS2 program: This program is a potential source of revenue along with high-BTU gas sales for projects that result in verified transportation fuel. Note that if pipeline quality gas is made it can be delivered "off-site" to a third-party CNG facility for sale as transportation fuel. Although this program generally provides high-BTU projects with an alternate revenue stream (separate from the sale of the gas on a $/MMBtu basis), the duration of this program in the future is dependent upon federal policies that may change given the current administrative environment.
- Along with RFS2 program, other state specific programs can provide some potential revenue. Additionally, California's Low Carbon Fuel Standard (LCFS) program may provide another viable option for additional revenue stream. This program is available for projects developed in any state, as long as a verified physical pathway (pipeline connections) is identified between generator and purchaser. This is done by certified marketers with the expertise to perform and verify these routings as required by the program.
- Some vendors that develop infrastructure for high-BTU projects include Xebec Adsorption USA, Inc., and Air Liquide. Costs are relatively high for this technology option, due to the complicated processes involved in refining LFG to useful high-Btu fuel. Use of high pressures, organic solvents (in some cases), carbon media, and highly specialized filtration vessels results in relatively high O&M costs.
- After processing the LFG into pipeline-quality natural gas, it must be transported to the distribution pipeline. The feasibility of this option also greatly depends on the distance from project site to nearby high-BTU pipeline (distribution pipeline) and arrangements with the purchasing entity.

On-Site CNG Production

The following is a listing of applicable details relating to potential on-site production of CNG for fuel use:

- It is important to note that the on-site CNG technology option is highly dependent upon the available "market" or end-users that would purchase the product CNG. Specific to the City, approximately 2,000 scfm of the total LFG available in 2017 would be able to generate 10,210 gasoline gallon equivalents (GGEs) of CNG per day. This is an extremely large amount of GGEs for any fleet to consume daily.
- The unknowns in determining feasibility of this technology include if the City owns a CNG vehicle fleet or plan to retrofit existing fleet, if the fuel generation rate is

consumable within the City owned vehicles, and/or if establishing a retail CNG fuel station is feasible, etc.

- BioCNG and Xebec Adsorption USA, Inc. are vendors providing CNG conversion technologies. Unlike electricity generation and pipeline high-Btu projects, the costs for constructing and operating a CNG processing plant do not end with the production of the CNG product gas. The economics of this option also require capital investment to retrofit existing gasoline/diesel fueled fleet vehicles to CNG-fueled vehicles and/or purchase of new CNG vehicles.

6 Summary and General Recommendations

Based on LandGEM modeling results (see Figure 2), the LFG available for alternative use is approximately 2,000 scfm LFG in 2017, and 3,900 scfm in 2050. These values assume an average methane concentration of 50% and continued expansion of the LFG collection system to achieve 80% collection efficiency into the future. It is also important to note that the "LFG Available for Alternative Use" does NOT take into account any LFG currently (or future) contracted for delivery to POET. This obligation could serve to decrease the available LFG until this contractual obligation expires in 2019. Of note is that all (over 95%) of the LFG flow rate collected at the Landfill was sold to POET in 2015.

Although the Landfill has potential new avenues of waste diversion in the future, i.e. MRF, SRF, and/or EPA 2030 Food Waste Goal; these are generally difficult to quantify individually. In summary, as these new facilities come on-line or these new community practices are engaged in, it would be most appropriate for the City to re-create the LFG generation and collection calibration procedure described in this memo to holistically adjust the models in the future. As stated, these changes in waste stream take approximately five years to affect noticeable changes in LFG generation/collection.

In summary, the following LFGTE options are available to the City for the expected LFG flow rates as presented. These options would require a more detailed financial evaluation to fully determine the net present value of each option and determine true financial feasibility:

- **Medium-BTU Gas Option**: As the City is already aware of this option and have the existing infrastructure and relationship in place, this option may be more suitable for the City, as it maintains status-quo. To boost the revenues from this option, the City can consider evaluating another end user (that could utilize the existing piping infrastructure) or pursue re-negotiation of the existing contract with POET.
- **Electricity Generation**: Engines generators would be appropriate as either a supplemental project, or as a stand-alone project (in lieu of selling LFG to POET). This technology can be planned to modularly match the increasing available LFG curve into the future.
- **High-BTU Gas**: If the City currently operates or plans to purchase CNG vehicles or retrofit an existing fleet, CNG might be a viable technology – although the amount of available fuel a project like this would generate would require a very large fleet of vehicles retrofitted for CNG use. Otherwise, high-BTU pipeline injection could provide a project with more operational flexibility to the City. However, some unknowns will dictate the feasibility of such a project: identifying purchasing entity, distance from project location to purchasing entity's distribution pipeline and contractual arrangements with the purchasing entity.

Each of the above options are technically feasible, and might be economically feasible under an array of different ownership options (i.e. City investment and operation versus City contracts with a Developer for investment and operation). To further investigate the technical and financial feasibility of these technologies (specific to the landfill), HDR would recommend that the City conduct a complete financial feasibility study comparing these viable options. HDR can assist in this task by expanding upon the preliminary LFG generation/collection findings developed for this memo. The complete feasibility study would include the following additional analyses:

- Review of existing contracts;
- Determining estimated costs associated with expansion of the LFG collection system and how those costs will be allocated;
- Exploring potential purchasing entities and end users for both electricity and RNG;
- Determining pricing and market values for electricity sales, RNG sales, CNG sales, RECs, RINs and other environmental attributes that may be available;
- Determining true capital and O&M costs for the specific technology options;
- Developing a financial model that includes these values and determines a net present value for comparison of technology options at the landfill;
- A pros and cons discussion of the spectrum of different ownership options between the City and Developer(s); and
- A recommendation for a technology option that provides the best value for the City and suggestions for next steps in procurement, negotiation and/or design.

Attachment 1
LandGEM Model Report

Summary Report

Landfill Name or Identifier: SIOUX FALLS REGIONAL SANITARY LANDFILL

Date: Thursday, March 09, 2017

Description/Comments:

Landfill disposal tonnages (in MG/yr) obtained from GHG Report for 2015 Reporting Year. Disposal tonnage for 2016 and NMOC Concentration are obtained from "Landgem 2016" excel file obtained from the Landfill Staff. Disposal tonnages from 2016 onwards assume 2.2% average annual increase in waste generation (assumption based on population growth data). Methane concentration is based on review of GHG Reports for RY 2013 through 2015.

About LandGEM:

First-Order Decomposition Rate Equation:

$$Q_{CH_4} = \sum_{i=1}^{n} \sum_{j=0.1}^{1} kL_o \left(\frac{M_i}{10} \right) e^{-kt_{ij}}$$

Where,

Q_{CH4} = annual methane generation in the year of the calculation *(m^3/year)*

i = 1-year time increment

n = (year of the calculation) - (initial year of waste acceptance)

j = 0.1-year time increment

k = methane generation rate *($year^{-1}$)*

L_o = potential methane generation capacity *(m^3/Mg)*

M_i = mass of waste accepted in the i^{th} year *(Mg)*

t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year *(decimal years*, e.g., 3.2 years)

LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at http://www.epa.gov/ttnatw01/landfill/landflpg.html.

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate. Defaults for estimating emissions for this type of operation are being developed to include in LandGEM along with defaults for convential landfills (no leachate or liquid additions) for developing emission inventories and determining CAA applicability. Refer to the Web site identified above for future updates.

Input Review

The 80-year waste acceptance limit of the model has been exceeded before the Waste Design Capacity was reached. The model will assume the 80th year of waste acceptance as the final year to estimate emissions. See Section 2.6 of the User's Manual.

LANDFILL CHARACTERISTICS

Landfill Open Year	**1979**	
Landfill Closure Year (with 80-year limit)	**2058**	
Actual Closure Year (without limit)	***2076***	
Have Model Calculate Closure Year?	**Yes**	
Waste Design Capacity	**24,707,573**	*short tons*

MODEL PARAMETERS

Methane Generation Rate, k	**0.040**	*$year^{-1}$*
Potential Methane Generation Capacity, L_o	**170**	*m^3/Mg*
NMOC Concentration	**273**	*ppmv as hexane*
Methane Content	**50**	*% by volume*

GASES / POLLUTANTS SELECTED

Gas / Pollutant #1:	**Total landfill gas**
Gas / Pollutant #2:	**Methane**
Gas / Pollutant #3:	**Carbon dioxide**
Gas / Pollutant #4:	**NMOC**

WASTE ACCEPTANCE RATES

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
1979	91,843	101,027	0	0
1980	96,974	106,671	91,843	101,027
1981	103,431	113,774	188,817	207,699
1982	109,267	120,194	292,248	321,473
1983	115,253	126,778	401,515	441,667
1984	124,445	136,890	516,768	568,445
1985	134,900	148,390	641,213	705,334
1986	119,864	131,850	776,113	853,724
1987	129,036	141,940	895,977	985,575
1988	129,445	142,390	1,025,013	1,127,514
1989	128,345	141,180	1,154,458	1,269,904
1990	120,017	132,019	1,282,803	1,411,083
1991	127,273	140,000	1,402,820	1,543,102
1992	127,273	140,000	1,530,093	1,683,102
1993	140,427	154,470	1,657,366	1,823,103
1994	132,963	146,259	1,797,793	1,977,572
1995	126,634	139,297	1,930,756	2,123,832
1996	114,095	125,505	2,057,390	2,263,129
1997	116,605	128,266	2,171,485	2,388,634
1998	120,624	132,686	2,288,090	2,516,899
1999	125,197	137,717	2,408,714	2,649,585
2000	127,802	140,582	2,533,911	2,787,302
2001	139,602	153,562	2,661,713	2,927,884
2002	141,445	155,590	2,801,315	3,081,447
2003	145,450	159,995	2,942,760	3,237,036
2004	155,931	171,524	3,088,210	3,397,031
2005	156,396	172,036	3,244,141	3,568,555
2006	160,163	176,179	3,400,537	3,740,591
2007	156,158	171,774	3,560,700	3,916,770
2008	163,966	180,363	3,716,858	4,088,544
2009	155,386	170,925	3,880,824	4,268,906
2010	154,579	170,037	4,036,210	4,439,831
2011	156,496	172,146	4,190,789	4,609,868
2012	152,237	167,461	4,347,285	4,782,014
2013	150,226	165,249	4,499,522	4,949,474
2014	155,929	171,522	4,649,748	5,114,723
2015	147,180	161,898	4,805,677	5,286,245
2016	158,281	174,109	4,952,857	5,448,143
2017	161,763	177,940	5,111,138	5,622,252
2018	165,322	181,854	5,272,901	5,800,191

WASTE ACCEPTANCE RATES (Continued)

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
2019	168,959	185,855	5,438,223	5,982,045
2020	172,676	189,944	5,607,182	6,167,900
2021	176,475	194,123	5,779,858	6,357,844
2022	180,357	198,393	5,956,333	6,551,967
2023	184,325	202,758	6,136,691	6,750,360
2024	188,381	207,219	6,321,016	6,953,118
2025	192,525	211,777	6,509,397	7,160,336
2026	196,760	216,436	6,701,922	7,372,114
2027	201,089	221,198	6,898,682	7,588,550
2028	205,513	226,064	7,099,771	7,809,748
2029	210,034	231,038	7,305,284	8,035,813
2030	214,655	236,121	7,515,319	8,266,851
2031	219,378	241,315	7,729,974	8,502,971
2032	224,204	246,624	7,949,351	8,744,287
2033	229,136	252,050	8,173,555	8,990,911
2034	234,177	257,595	8,402,692	9,242,961
2035	239,329	263,262	8,636,869	9,500,556
2036	244,595	269,054	8,876,198	9,763,818
2037	249,976	274,973	9,120,793	10,032,872
2038	255,475	281,023	9,370,768	10,307,845
2039	261,096	287,205	9,626,243	10,588,868
2040	266,840	293,524	9,887,339	10,876,073
2041	272,710	299,981	10,154,179	11,169,596
2042	278,710	306,581	10,426,889	11,469,577
2043	284,841	313,325	10,705,598	11,776,158
2044	291,108	320,219	10,990,440	12,089,484
2045	297,512	327,263	11,281,547	12,409,702
2046	304,057	334,463	11,579,060	12,736,966
2047	310,747	341,821	11,883,117	13,071,429
2048	317,583	349,341	12,193,864	13,413,250
2049	324,570	357,027	12,511,447	13,762,592
2050	331,711	364,882	12,836,017	14,119,619
2051	339,008	372,909	13,167,727	14,484,500
2052	346,466	381,113	13,506,736	14,857,409
2053	354,089	389,497	13,853,202	15,238,522
2054	361,879	398,066	14,207,290	15,628,020
2055	369,840	406,824	14,569,169	16,026,086
2056	377,976	415,774	14,939,009	16,432,910
2057	386,292	424,921	15,316,985	16,848,684
2058	394,790	434,269	15,703,277	17,273,605

Pollutant Parameters

		Gas / Pollutant Default Parameters:		User-specified Pollutant Parameters:	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Gases	Total landfill gas		0.00		
	Methane		16.04		
	Carbon dioxide		44.01		
	NMOC	4,000	86.18		
Pollutants	1,1,1-Trichloroethane (methyl chloroform) - HAP	0.48	133.41		
	1,1,2,2-Tetrachloroethane - HAP/VOC	1.1	167.85		
	1,1-Dichloroethane (ethylidene dichloride) - HAP/VOC	2.4	98.97		
	1,1-Dichloroethene (vinylidene chloride) - HAP/VOC	0.20	96.94		
	1,2-Dichloroethane (ethylene dichloride) - HAP/VOC	0.41	98.96		
	1,2-Dichloropropane (propylene dichloride) - HAP/VOC	0.18	112.99		
	2-Propanol (isopropyl alcohol) - VOC	50	60.11		
	Acetone	7.0	58.08		
	Acrylonitrile - HAP/VOC	6.3	53.06		
	Benzene - No or Unknown Co-disposal - HAP/VOC	1.9	78.11		
	Benzene - Co-disposal - HAP/VOC	11	78.11		
	Bromodichloromethane - VOC	3.1	163.83		
	Butane - VOC	5.0	58.12		
	Carbon disulfide - HAP/VOC	0.58	76.13		
	Carbon monoxide	140	28.01		
	Carbon tetrachloride - HAP/VOC	4.0E-03	153.84		
	Carbonyl sulfide - HAP/VOC	0.49	60.07		
	Chlorobenzene - HAP/VOC	0.25	112.56		
	Chlorodifluoromethane	1.3	86.47		
	Chloroethane (ethyl chloride) - HAP/VOC	1.3	64.52		
	Chloroform - HAP/VOC	0.03	119.39		
	Chloromethane - VOC	1.2	50.49		
	Dichlorobenzene - (HAP for para isomer/VOC)	0.21	147		
	Dichlorodifluoromethane	16	120.91		
	Dichlorofluoromethane - VOC	2.6	102.92		
	Dichloromethane (methylene chloride) - HAP	14	84.94		
	Dimethyl sulfide (methyl sulfide) - VOC	7.8	62.13		
	Ethane	890	30.07		
	Ethanol - VOC	27	46.08		

Pollutant Parameters (Continued)

	Gas / Pollutant Default Parameters:			User-specified Pollutant Parameters:	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Pollutants	Ethyl mercaptan (ethanethiol) - VOC	2.3	62.13		
	Ethylbenzene - HAP/VOC	4.6	106.16		
	Ethylene dibromide - HAP/VOC	1.0E-03	187.88		
	Fluorotrichloromethane - VOC	0.76	137.38		
	Hexane - HAP/VOC	6.6	86.18		
	Hydrogen sulfide	36	34.08		
	Mercury (total) - HAP	2.9E-04	200.61		
	Methyl ethyl ketone - HAP/VOC	7.1	72.11		
	Methyl isobutyl ketone - HAP/VOC	1.9	100.16		
	Methyl mercaptan - VOC	2.5	48.11		
	Pentane - VOC	3.3	72.15		
	Perchloroethylene (tetrachloroethylene) - HAP	3.7	165.83		
	Propane - VOC	11	44.09		
	t-1,2-Dichloroethene - VOC	2.8	96.94		
	Toluene - No or Unknown Co-disposal - HAP/VOC	39	92.13		
	Toluene - Co-disposal - HAP/VOC	170	92.13		
	Trichloroethylene (trichloroethene) - HAP/VOC	2.8	131.40		
	Vinyl chloride - HAP/VOC	7.3	62.50		
	Xylenes - HAP/VOC	12	106.16		

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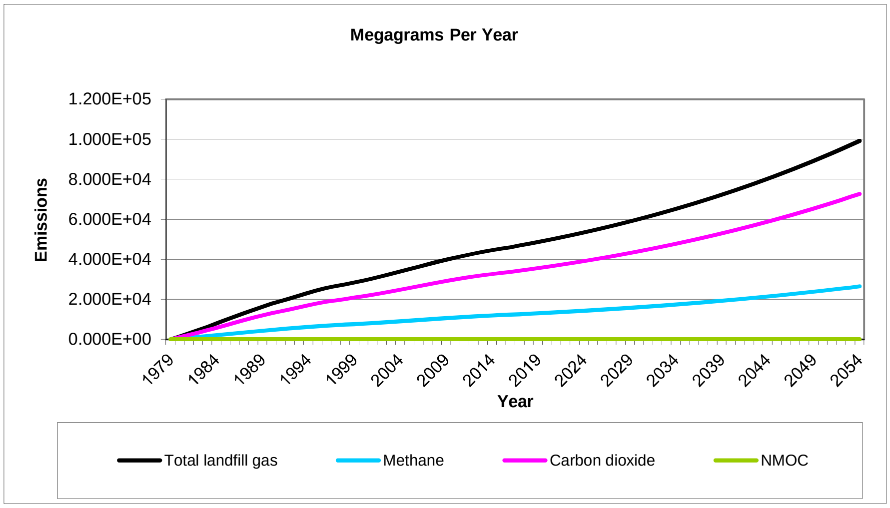
Graphs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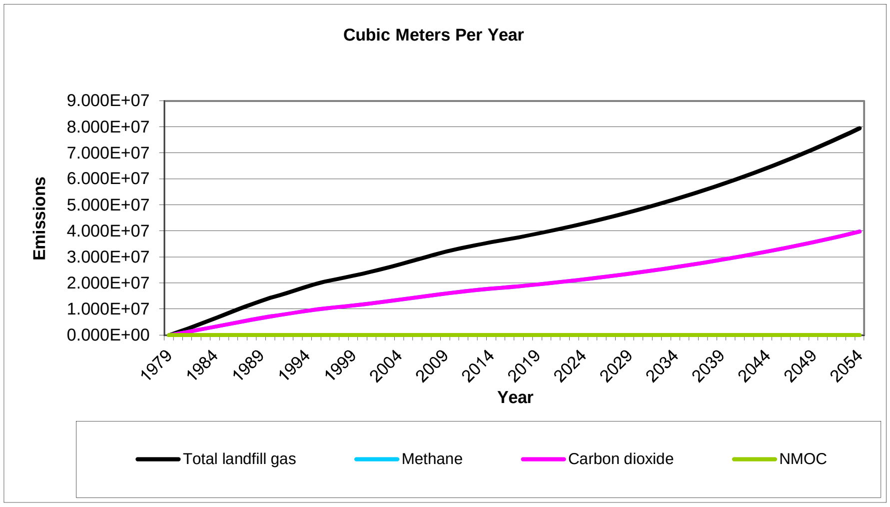
Year
Total landfill gas
Methane
Carbon dioxide
NMOC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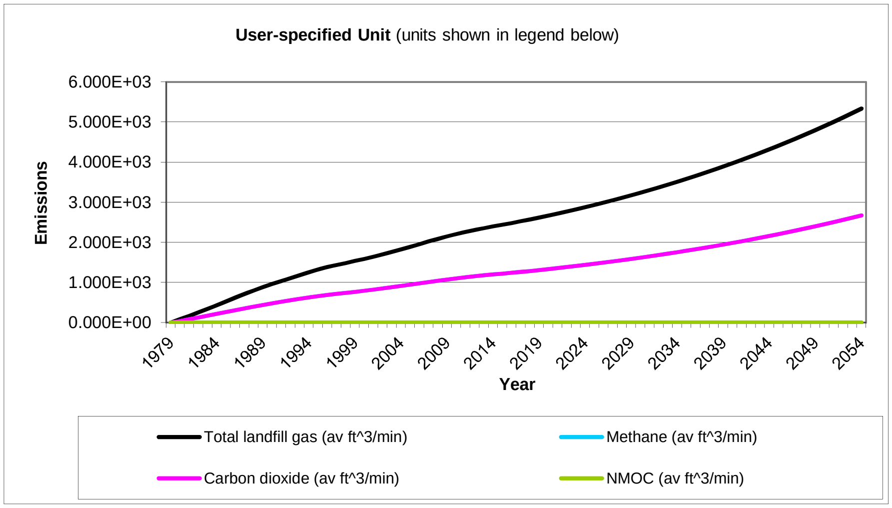
2.000E+07
1.000E+07
0.000E+00
Emissions
1979 1984 1989 1994 1999 2004 2009 2014 2019 2024 2029 2034 2039 2044 2049 2054
Year
Total landfill gas
Methane
Carbon dioxide
NMOC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3.000E+03
2.000E+03
1.000E+03
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Emissions
1979 1984 1989 1994 1999 2004 2009 2014 2019 2024 2029 2034 2039 2044 2049 2054
Year
Total landfill gas (av ft^3/min)
Methane (av ft^3/min)
Carbon dioxide (av ft^3/min)
NMOC (av ft^3/min)

Results

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
1979	0	0	0	0	0	0
1980	1.532E+03	1.227E+06	8.243E+01	4.093E+02	6.134E+05	4.122E+01
1981	3.090E+03	2.474E+06	1.662E+02	8.253E+02	1.237E+06	8.312E+01
1982	4.694E+03	3.759E+06	2.526E+02	1.254E+03	1.879E+06	1.263E+02
1983	6.333E+03	5.071E+06	3.407E+02	1.692E+03	2.536E+06	1.704E+02
1984	8.007E+03	6.412E+06	4.308E+02	2.139E+03	3.206E+06	2.154E+02
1985	9.769E+03	7.823E+06	5.256E+02	2.609E+03	3.911E+06	2.628E+02
1986	1.164E+04	9.318E+06	6.261E+02	3.108E+03	4.659E+06	3.130E+02
1987	1.318E+04	1.055E+07	7.091E+02	3.520E+03	5.277E+06	3.546E+02
1988	1.482E+04	1.186E+07	7.971E+02	3.957E+03	5.932E+06	3.986E+02
1989	1.639E+04	1.313E+07	8.820E+02	4.379E+03	6.564E+06	4.410E+02
1990	1.789E+04	1.433E+07	9.627E+02	4.779E+03	7.164E+06	4.813E+02
1991	1.919E+04	1.537E+07	1.033E+03	5.127E+03	7.684E+06	5.163E+02
1992	2.056E+04	1.647E+07	1.106E+03	5.493E+03	8.233E+06	5.532E+02
1993	2.188E+04	1.752E+07	1.177E+03	5.845E+03	8.760E+06	5.886E+02
1994	2.337E+04	1.871E+07	1.257E+03	6.241E+03	9.355E+06	6.286E+02
1995	2.467E+04	1.975E+07	1.327E+03	6.589E+03	9.876E+06	6.636E+02
1996	2.581E+04	2.067E+07	1.389E+03	6.895E+03	1.033E+07	6.944E+02
1997	2.670E+04	2.138E+07	1.437E+03	7.133E+03	1.069E+07	7.184E+02
1998	2.760E+04	2.210E+07	1.485E+03	7.373E+03	1.105E+07	7.425E+02
1999	2.853E+04	2.285E+07	1.535E+03	7.621E+03	1.142E+07	7.675E+02
2000	2.950E+04	2.362E+07	1.587E+03	7.880E+03	1.181E+07	7.936E+02
2001	3.048E+04	2.440E+07	1.640E+03	8.141E+03	1.220E+07	8.199E+02
2002	3.161E+04	2.531E+07	1.701E+03	8.444E+03	1.266E+07	8.504E+02
2003	3.273E+04	2.621E+07	1.761E+03	8.743E+03	1.310E+07	8.805E+02
2004	3.387E+04	2.712E+07	1.822E+03	9.048E+03	1.356E+07	9.112E+02
2005	3.515E+04	2.814E+07	1.891E+03	9.388E+03	1.407E+07	9.455E+02
2006	3.638E+04	2.913E+07	1.957E+03	9.717E+03	1.456E+07	9.786E+02
2007	3.762E+04	3.013E+07	2.024E+03	1.005E+04	1.506E+07	1.012E+03
2008	3.875E+04	3.103E+07	2.085E+03	1.035E+04	1.552E+07	1.043E+03
2009	3.997E+04	3.201E+07	2.150E+03	1.068E+04	1.600E+07	1.075E+03
2010	4.099E+04	3.283E+07	2.206E+03	1.095E+04	1.641E+07	1.103E+03
2011	4.197E+04	3.360E+07	2.258E+03	1.121E+04	1.680E+07	1.129E+03
2012	4.293E+04	3.438E+07	2.310E+03	1.147E+04	1.719E+07	1.155E+03
2013	4.379E+04	3.506E+07	2.356E+03	1.170E+04	1.753E+07	1.178E+03
2014	4.458E+04	3.569E+07	2.398E+03	1.191E+04	1.785E+07	1.199E+03
2015	4.543E+04	3.638E+07	2.444E+03	1.213E+04	1.819E+07	1.222E+03
2016	4.610E+04	3.692E+07	2.480E+03	1.231E+04	1.846E+07	1.240E+03
2017	4.694E+04	3.758E+07	2.525E+03	1.254E+04	1.879E+07	1.263E+03
2018	4.779E+04	3.827E+07	2.571E+03	1.277E+04	1.914E+07	1.286E+03
2019	4.868E+04	3.898E+07	2.619E+03	1.300E+04	1.949E+07	1.309E+03
2020	4.959E+04	3.971E+07	2.668E+03	1.325E+04	1.985E+07	1.334E+03
2021	5.052E+04	4.046E+07	2.718E+03	1.350E+04	2.023E+07	1.359E+03
2022	5.149E+04	4.123E+07	2.770E+03	1.375E+04	2.061E+07	1.385E+03
2023	5.248E+04	4.202E+07	2.823E+03	1.402E+04	2.101E+07	1.412E+03
2024	5.349E+04	4.284E+07	2.878E+03	1.429E+04	2.142E+07	1.439E+03
2025	5.454E+04	4.367E+07	2.934E+03	1.457E+04	2.184E+07	1.467E+03
2026	5.561E+04	4.453E+07	2.992E+03	1.485E+04	2.227E+07	1.496E+03
2027	5.671E+04	4.541E+07	3.051E+03	1.515E+04	2.271E+07	1.526E+03
2028	5.785E+04	4.632E+07	3.112E+03	1.545E+04	2.316E+07	1.556E+03

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
2029	5.901E+04	4.725E+07	3.175E+03	1.576E+04	2.362E+07	1.587E+03
2030	6.020E+04	4.820E+07	3.239E+03	1.608E+04	2.410E+07	1.619E+03
2031	6.142E+04	4.918E+07	3.304E+03	1.640E+04	2.459E+07	1.652E+03
2032	6.267E+04	5.018E+07	3.372E+03	1.674E+04	2.509E+07	1.686E+03
2033	6.395E+04	5.121E+07	3.441E+03	1.708E+04	2.560E+07	1.720E+03
2034	6.527E+04	5.226E+07	3.511E+03	1.743E+04	2.613E+07	1.756E+03
2035	6.661E+04	5.334E+07	3.584E+03	1.779E+04	2.667E+07	1.792E+03
2036	6.799E+04	5.445E+07	3.658E+03	1.816E+04	2.722E+07	1.829E+03
2037	6.941E+04	5.558E+07	3.734E+03	1.854E+04	2.779E+07	1.867E+03
2038	7.086E+04	5.674E+07	3.812E+03	1.893E+04	2.837E+07	1.906E+03
2039	7.234E+04	5.793E+07	3.892E+03	1.932E+04	2.896E+07	1.946E+03
2040	7.386E+04	5.914E+07	3.974E+03	1.973E+04	2.957E+07	1.987E+03
2041	7.541E+04	6.039E+07	4.057E+03	2.014E+04	3.019E+07	2.029E+03
2042	7.701E+04	6.166E+07	4.143E+03	2.057E+04	3.083E+07	2.072E+03
2043	7.864E+04	6.297E+07	4.231E+03	2.100E+04	3.148E+07	2.115E+03
2044	8.031E+04	6.430E+07	4.321E+03	2.145E+04	3.215E+07	2.160E+03
2045	8.201E+04	6.567E+07	4.412E+03	2.191E+04	3.284E+07	2.206E+03
2046	8.376E+04	6.707E+07	4.507E+03	2.237E+04	3.354E+07	2.253E+03
2047	8.555E+04	6.850E+07	4.603E+03	2.285E+04	3.425E+07	2.301E+03
2048	8.738E+04	6.997E+07	4.701E+03	2.334E+04	3.498E+07	2.351E+03
2049	8.925E+04	7.147E+07	4.802E+03	2.384E+04	3.573E+07	2.401E+03
2050	9.116E+04	7.300E+07	4.905E+03	2.435E+04	3.650E+07	2.452E+03
2051	9.312E+04	7.457E+07	5.010E+03	2.487E+04	3.728E+07	2.505E+03
2052	9.513E+04	7.617E+07	5.118E+03	2.541E+04	3.809E+07	2.559E+03
2053	9.718E+04	7.782E+07	5.228E+03	2.596E+04	3.891E+07	2.614E+03
2054	9.927E+04	7.949E+07	5.341E+03	2.652E+04	3.975E+07	2.671E+03
2055	1.014E+05	8.121E+07	5.457E+03	2.709E+04	4.061E+07	2.728E+03
2056	1.036E+05	8.297E+07	5.575E+03	2.768E+04	4.148E+07	2.787E+03
2057	1.059E+05	8.476E+07	5.695E+03	2.827E+04	4.238E+07	2.848E+03
2058	1.081E+05	8.660E+07	5.819E+03	2.889E+04	4.330E+07	2.909E+03
2059	1.105E+05	8.848E+07	5.945E+03	2.951E+04	4.424E+07	2.972E+03
2060	1.062E+05	8.501E+07	5.712E+03	2.836E+04	4.250E+07	2.856E+03
2061	1.020E+05	8.168E+07	5.488E+03	2.724E+04	4.084E+07	2.744E+03
2062	9.800E+04	7.847E+07	5.273E+03	2.618E+04	3.924E+07	2.636E+03
2063	9.416E+04	7.540E+07	5.066E+03	2.515E+04	3.770E+07	2.533E+03
2064	9.046E+04	7.244E+07	4.867E+03	2.416E+04	3.622E+07	2.434E+03
2065	8.692E+04	6.960E+07	4.676E+03	2.322E+04	3.480E+07	2.338E+03
2066	8.351E+04	6.687E+07	4.493E+03	2.231E+04	3.343E+07	2.246E+03
2067	8.023E+04	6.425E+07	4.317E+03	2.143E+04	3.212E+07	2.158E+03
2068	7.709E+04	6.173E+07	4.148E+03	2.059E+04	3.086E+07	2.074E+03
2069	7.407E+04	5.931E+07	3.985E+03	1.978E+04	2.965E+07	1.992E+03
2070	7.116E+04	5.698E+07	3.829E+03	1.901E+04	2.849E+07	1.914E+03
2071	6.837E+04	5.475E+07	3.679E+03	1.826E+04	2.737E+07	1.839E+03
2072	6.569E+04	5.260E+07	3.534E+03	1.755E+04	2.630E+07	1.767E+03
2073	6.311E+04	5.054E+07	3.396E+03	1.686E+04	2.527E+07	1.698E+03
2074	6.064E+04	4.856E+07	3.263E+03	1.620E+04	2.428E+07	1.631E+03
2075	5.826E+04	4.665E+07	3.135E+03	1.556E+04	2.333E+07	1.567E+03
2076	5.598E+04	4.482E+07	3.012E+03	1.495E+04	2.241E+07	1.506E+03
2077	5.378E+04	4.307E+07	2.894E+03	1.437E+04	2.153E+07	1.447E+03
2078	5.167E+04	4.138E+07	2.780E+03	1.380E+04	2.069E+07	1.390E+03
2079	4.965E+04	3.976E+07	2.671E+03	1.326E+04	1.988E+07	1.336E+03

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
2080	4.770E+04	3.820E+07	2.566E+03	1.274E+04	1.910E+07	1.283E+03
2081	4.583E+04	3.670E+07	2.466E+03	1.224E+04	1.835E+07	1.233E+03
2082	4.403E+04	3.526E+07	2.369E+03	1.176E+04	1.763E+07	1.185E+03
2083	4.231E+04	3.388E+07	2.276E+03	1.130E+04	1.694E+07	1.138E+03
2084	4.065E+04	3.255E+07	2.187E+03	1.086E+04	1.627E+07	1.093E+03
2085	3.905E+04	3.127E+07	2.101E+03	1.043E+04	1.564E+07	1.051E+03
2086	3.752E+04	3.005E+07	2.019E+03	1.002E+04	1.502E+07	1.009E+03
2087	3.605E+04	2.887E+07	1.940E+03	9.630E+03	1.443E+07	9.698E+02
2088	3.464E+04	2.774E+07	1.864E+03	9.252E+03	1.387E+07	9.318E+02
2089	3.328E+04	2.665E+07	1.791E+03	8.889E+03	1.332E+07	8.953E+02
2090	3.197E+04	2.560E+07	1.720E+03	8.541E+03	1.280E+07	8.602E+02
2091	3.072E+04	2.460E+07	1.653E+03	8.206E+03	1.230E+07	8.264E+02
2092	2.952E+04	2.364E+07	1.588E+03	7.884E+03	1.182E+07	7.940E+02
2093	2.836E+04	2.271E+07	1.526E+03	7.575E+03	1.135E+07	7.629E+02
2094	2.725E+04	2.182E+07	1.466E+03	7.278E+03	1.091E+07	7.330E+02
2095	2.618E+04	2.096E+07	1.408E+03	6.993E+03	1.048E+07	7.042E+02
2096	2.515E+04	2.014E+07	1.353E+03	6.718E+03	1.007E+07	6.766E+02
2097	2.417E+04	1.935E+07	1.300E+03	6.455E+03	9.676E+06	6.501E+02
2098	2.322E+04	1.859E+07	1.249E+03	6.202E+03	9.296E+06	6.246E+02
2099	2.231E+04	1.786E+07	1.200E+03	5.959E+03	8.932E+06	6.001E+02
2100	2.143E+04	1.716E+07	1.153E+03	5.725E+03	8.581E+06	5.766E+02
2101	2.059E+04	1.649E+07	1.108E+03	5.501E+03	8.245E+06	5.540E+02
2102	1.979E+04	1.584E+07	1.065E+03	5.285E+03	7.922E+06	5.323E+02
2103	1.901E+04	1.522E+07	1.023E+03	5.078E+03	7.611E+06	5.114E+02
2104	1.826E+04	1.463E+07	9.827E+02	4.879E+03	7.313E+06	4.913E+02
2105	1.755E+04	1.405E+07	9.441E+02	4.687E+03	7.026E+06	4.721E+02
2106	1.686E+04	1.350E+07	9.071E+02	4.504E+03	6.750E+06	4.536E+02
2107	1.620E+04	1.297E+07	8.715E+02	4.327E+03	6.486E+06	4.358E+02
2108	1.556E+04	1.246E+07	8.374E+02	4.157E+03	6.231E+06	4.187E+02
2109	1.495E+04	1.197E+07	8.045E+02	3.994E+03	5.987E+06	4.023E+02
2110	1.437E+04	1.150E+07	7.730E+02	3.838E+03	5.752E+06	3.865E+02
2111	1.380E+04	1.105E+07	7.427E+02	3.687E+03	5.527E+06	3.713E+02
2112	1.326E+04	1.062E+07	7.136E+02	3.543E+03	5.310E+06	3.568E+02
2113	1.274E+04	1.020E+07	6.856E+02	3.404E+03	5.102E+06	3.428E+02
2114	1.224E+04	9.804E+06	6.587E+02	3.270E+03	4.902E+06	3.294E+02
2115	1.176E+04	9.419E+06	6.329E+02	3.142E+03	4.710E+06	3.164E+02
2116	1.130E+04	9.050E+06	6.081E+02	3.019E+03	4.525E+06	3.040E+02
2117	1.086E+04	8.695E+06	5.842E+02	2.900E+03	4.348E+06	2.921E+02
2118	1.043E+04	8.354E+06	5.613E+02	2.787E+03	4.177E+06	2.807E+02
2119	1.002E+04	8.027E+06	5.393E+02	2.677E+03	4.013E+06	2.697E+02

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
1979	0	0	0	0	0	0
1980	1.123E+03	6.134E+05	4.122E+01	1.201E+00	3.349E+02	2.250E-02
1981	2.264E+03	1.237E+06	8.312E+01	2.421E+00	6.754E+02	4.538E-02
1982	3.440E+03	1.879E+06	1.263E+02	3.678E+00	1.026E+03	6.895E-02
1983	4.641E+03	2.536E+06	1.704E+02	4.962E+00	1.384E+03	9.302E-02
1984	5.868E+03	3.206E+06	2.154E+02	6.274E+00	1.750E+03	1.176E-01
1985	7.160E+03	3.911E+06	2.628E+02	7.655E+00	2.136E+03	1.435E-01
1986	8.528E+03	4.659E+06	3.130E+02	9.118E+00	2.544E+03	1.709E-01
1987	9.659E+03	5.277E+06	3.546E+02	1.033E+01	2.881E+03	1.936E-01
1988	1.086E+04	5.932E+06	3.986E+02	1.161E+01	3.239E+03	2.176E-01
1989	1.202E+04	6.564E+06	4.410E+02	1.285E+01	3.584E+03	2.408E-01
1990	1.311E+04	7.164E+06	4.813E+02	1.402E+01	3.911E+03	2.628E-01
1991	1.407E+04	7.684E+06	5.163E+02	1.504E+01	4.196E+03	2.819E-01
1992	1.507E+04	8.233E+06	5.532E+02	1.611E+01	4.495E+03	3.020E-01
1993	1.604E+04	8.760E+06	5.886E+02	1.715E+01	4.783E+03	3.214E-01
1994	1.712E+04	9.355E+06	6.286E+02	1.831E+01	5.108E+03	3.432E-01
1995	1.808E+04	9.876E+06	6.636E+02	1.933E+01	5.392E+03	3.623E-01
1996	1.892E+04	1.033E+07	6.944E+02	2.023E+01	5.643E+03	3.791E-01
1997	1.957E+04	1.069E+07	7.184E+02	2.092E+01	5.838E+03	3.922E-01
1998	2.023E+04	1.105E+07	7.425E+02	2.163E+01	6.034E+03	4.054E-01
1999	2.091E+04	1.142E+07	7.675E+02	2.236E+01	6.237E+03	4.191E-01
2000	2.162E+04	1.181E+07	7.936E+02	2.312E+01	6.449E+03	4.333E-01
2001	2.234E+04	1.220E+07	8.199E+02	2.388E+01	6.662E+03	4.476E-01
2002	2.317E+04	1.266E+07	8.504E+02	2.477E+01	6.910E+03	4.643E-01
2003	2.399E+04	1.310E+07	8.805E+02	2.565E+01	7.155E+03	4.808E-01
2004	2.483E+04	1.356E+07	9.112E+02	2.654E+01	7.405E+03	4.975E-01
2005	2.576E+04	1.407E+07	9.455E+02	2.754E+01	7.683E+03	5.162E-01
2006	2.666E+04	1.456E+07	9.786E+02	2.851E+01	7.952E+03	5.343E-01
2007	2.757E+04	1.506E+07	1.012E+03	2.948E+01	8.225E+03	5.526E-01
2008	2.840E+04	1.552E+07	1.043E+03	3.037E+01	8.472E+03	5.692E-01
2009	2.929E+04	1.600E+07	1.075E+03	3.132E+01	8.737E+03	5.871E-01
2010	3.004E+04	1.641E+07	1.103E+03	3.212E+01	8.961E+03	6.021E-01
2011	3.076E+04	1.680E+07	1.129E+03	3.288E+01	9.174E+03	6.164E-01
2012	3.146E+04	1.719E+07	1.155E+03	3.364E+01	9.385E+03	6.306E-01
2013	3.209E+04	1.753E+07	1.178E+03	3.431E+01	9.572E+03	6.431E-01
2014	3.267E+04	1.785E+07	1.199E+03	3.493E+01	9.745E+03	6.547E-01
2015	3.329E+04	1.819E+07	1.222E+03	3.560E+01	9.931E+03	6.673E-01
2016	3.379E+04	1.846E+07	1.240E+03	3.613E+01	1.008E+04	6.772E-01
2017	3.440E+04	1.879E+07	1.263E+03	3.678E+01	1.026E+04	6.894E-01
2018	3.503E+04	1.914E+07	1.286E+03	3.745E+01	1.045E+04	7.020E-01
2019	3.568E+04	1.949E+07	1.309E+03	3.814E+01	1.064E+04	7.150E-01
2020	3.634E+04	1.985E+07	1.334E+03	3.886E+01	1.084E+04	7.284E-01
2021	3.703E+04	2.023E+07	1.359E+03	3.959E+01	1.104E+04	7.421E-01
2022	3.773E+04	2.061E+07	1.385E+03	4.034E+01	1.126E+04	7.562E-01
2023	3.846E+04	2.101E+07	1.412E+03	4.112E+01	1.147E+04	7.708E-01
2024	3.921E+04	2.142E+07	1.439E+03	4.192E+01	1.169E+04	7.857E-01
2025	3.997E+04	2.184E+07	1.467E+03	4.274E+01	1.192E+04	8.011E-01
2026	4.076E+04	2.227E+07	1.496E+03	4.358E+01	1.216E+04	8.168E-01
2027	4.157E+04	2.271E+07	1.526E+03	4.444E+01	1.240E+04	8.330E-01
2028	4.239E+04	2.316E+07	1.556E+03	4.533E+01	1.265E+04	8.496E-01

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
2029	4.324E+04	2.362E+07	1.587E+03	4.624E+01	1.290E+04	8.667E-01
2030	4.412E+04	2.410E+07	1.619E+03	4.717E+01	1.316E+04	8.842E-01
2031	4.501E+04	2.459E+07	1.652E+03	4.812E+01	1.343E+04	9.021E-01
2032	4.593E+04	2.509E+07	1.686E+03	4.911E+01	1.370E+04	9.205E-01
2033	4.687E+04	2.560E+07	1.720E+03	5.011E+01	1.398E+04	9.393E-01
2034	4.783E+04	2.613E+07	1.756E+03	5.114E+01	1.427E+04	9.586E-01
2035	4.882E+04	2.667E+07	1.792E+03	5.220E+01	1.456E+04	9.784E-01
2036	4.983E+04	2.722E+07	1.829E+03	5.328E+01	1.486E+04	9.987E-01
2037	5.087E+04	2.779E+07	1.867E+03	5.439E+01	1.517E+04	1.019E+00
2038	5.193E+04	2.837E+07	1.906E+03	5.552E+01	1.549E+04	1.041E+00
2039	5.302E+04	2.896E+07	1.946E+03	5.668E+01	1.581E+04	1.063E+00
2040	5.413E+04	2.957E+07	1.987E+03	5.787E+01	1.615E+04	1.085E+00
2041	5.527E+04	3.019E+07	2.029E+03	5.909E+01	1.649E+04	1.108E+00
2042	5.644E+04	3.083E+07	2.072E+03	6.034E+01	1.683E+04	1.131E+00
2043	5.763E+04	3.148E+07	2.115E+03	6.162E+01	1.719E+04	1.155E+00
2044	5.885E+04	3.215E+07	2.160E+03	6.293E+01	1.756E+04	1.180E+00
2045	6.011E+04	3.284E+07	2.206E+03	6.426E+01	1.793E+04	1.205E+00
2046	6.139E+04	3.354E+07	2.253E+03	6.563E+01	1.831E+04	1.230E+00
2047	6.270E+04	3.425E+07	2.301E+03	6.703E+01	1.870E+04	1.257E+00
2048	6.404E+04	3.498E+07	2.351E+03	6.847E+01	1.910E+04	1.283E+00
2049	6.541E+04	3.573E+07	2.401E+03	6.993E+01	1.951E+04	1.311E+00
2050	6.681E+04	3.650E+07	2.452E+03	7.144E+01	1.993E+04	1.339E+00
2051	6.825E+04	3.728E+07	2.505E+03	7.297E+01	2.036E+04	1.368E+00
2052	6.972E+04	3.809E+07	2.559E+03	7.454E+01	2.080E+04	1.397E+00
2053	7.122E+04	3.891E+07	2.614E+03	7.615E+01	2.124E+04	1.427E+00
2054	7.276E+04	3.975E+07	2.671E+03	7.779E+01	2.170E+04	1.458E+00
2055	7.433E+04	4.061E+07	2.728E+03	7.947E+01	2.217E+04	1.490E+00
2056	7.594E+04	4.148E+07	2.787E+03	8.119E+01	2.265E+04	1.522E+00
2057	7.758E+04	4.238E+07	2.848E+03	8.295E+01	2.314E+04	1.555E+00
2058	7.926E+04	4.330E+07	2.909E+03	8.474E+01	2.364E+04	1.588E+00
2059	8.098E+04	4.424E+07	2.972E+03	8.658E+01	2.415E+04	1.623E+00
2060	7.780E+04	4.250E+07	2.856E+03	8.319E+01	2.321E+04	1.559E+00
2061	7.475E+04	4.084E+07	2.744E+03	7.992E+01	2.230E+04	1.498E+00
2062	7.182E+04	3.924E+07	2.636E+03	7.679E+01	2.142E+04	1.439E+00
2063	6.901E+04	3.770E+07	2.533E+03	7.378E+01	2.058E+04	1.383E+00
2064	6.630E+04	3.622E+07	2.434E+03	7.089E+01	1.978E+04	1.329E+00
2065	6.370E+04	3.480E+07	2.338E+03	6.811E+01	1.900E+04	1.277E+00
2066	6.120E+04	3.343E+07	2.246E+03	6.544E+01	1.826E+04	1.227E+00
2067	5.880E+04	3.212E+07	2.158E+03	6.287E+01	1.754E+04	1.178E+00
2068	5.650E+04	3.086E+07	2.074E+03	6.041E+01	1.685E+04	1.132E+00
2069	5.428E+04	2.965E+07	1.992E+03	5.804E+01	1.619E+04	1.088E+00
2070	5.215E+04	2.849E+07	1.914E+03	5.576E+01	1.556E+04	1.045E+00
2071	5.011E+04	2.737E+07	1.839E+03	5.357E+01	1.495E+04	1.004E+00
2072	4.814E+04	2.630E+07	1.767E+03	5.147E+01	1.436E+04	9.649E-01
2073	4.626E+04	2.527E+07	1.698E+03	4.946E+01	1.380E+04	9.270E-01
2074	4.444E+04	2.428E+07	1.631E+03	4.752E+01	1.326E+04	8.907E-01
2075	4.270E+04	2.333E+07	1.567E+03	4.565E+01	1.274E+04	8.558E-01
2076	4.103E+04	2.241E+07	1.506E+03	4.386E+01	1.224E+04	8.222E-01
2077	3.942E+04	2.153E+07	1.447E+03	4.214E+01	1.176E+04	7.900E-01
2078	3.787E+04	2.069E+07	1.390E+03	4.049E+01	1.130E+04	7.590E-01
2079	3.639E+04	1.988E+07	1.336E+03	3.890E+01	1.085E+04	7.292E-01

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
2080	3.496E+04	1.910E+07	1.283E+03	3.738E+01	1.043E+04	7.006E-01
2081	3.359E+04	1.835E+07	1.233E+03	3.591E+01	1.002E+04	6.732E-01
2082	3.227E+04	1.763E+07	1.185E+03	3.450E+01	9.626E+03	6.468E-01
2083	3.101E+04	1.694E+07	1.138E+03	3.315E+01	9.249E+03	6.214E-01
2084	2.979E+04	1.627E+07	1.093E+03	3.185E+01	8.886E+03	5.970E-01
2085	2.862E+04	1.564E+07	1.051E+03	3.060E+01	8.537E+03	5.736E-01
2086	2.750E+04	1.502E+07	1.009E+03	2.940E+01	8.203E+03	5.511E-01
2087	2.642E+04	1.443E+07	9.698E+02	2.825E+01	7.881E+03	5.295E-01
2088	2.539E+04	1.387E+07	9.318E+02	2.714E+01	7.572E+03	5.088E-01
2089	2.439E+04	1.332E+07	8.953E+02	2.608E+01	7.275E+03	4.888E-01
2090	2.343E+04	1.280E+07	8.602E+02	2.506E+01	6.990E+03	4.697E-01
2091	2.252E+04	1.230E+07	8.264E+02	2.407E+01	6.716E+03	4.512E-01
2092	2.163E+04	1.182E+07	7.940E+02	2.313E+01	6.452E+03	4.335E-01
2093	2.078E+04	1.135E+07	7.629E+02	2.222E+01	6.199E+03	4.165E-01
2094	1.997E+04	1.091E+07	7.330E+02	2.135E+01	5.956E+03	4.002E-01
2095	1.919E+04	1.048E+07	7.042E+02	2.051E+01	5.723E+03	3.845E-01
2096	1.843E+04	1.007E+07	6.766E+02	1.971E+01	5.498E+03	3.694E-01
2097	1.771E+04	9.676E+06	6.501E+02	1.894E+01	5.283E+03	3.550E-01
2098	1.702E+04	9.296E+06	6.246E+02	1.819E+01	5.076E+03	3.410E-01
2099	1.635E+04	8.932E+06	6.001E+02	1.748E+01	4.877E+03	3.277E-01
2100	1.571E+04	8.581E+06	5.766E+02	1.679E+01	4.685E+03	3.148E-01
2101	1.509E+04	8.245E+06	5.540E+02	1.614E+01	4.502E+03	3.025E-01
2102	1.450E+04	7.922E+06	5.323E+02	1.550E+01	4.325E+03	2.906E-01
2103	1.393E+04	7.611E+06	5.114E+02	1.490E+01	4.156E+03	2.792E-01
2104	1.339E+04	7.313E+06	4.913E+02	1.431E+01	3.993E+03	2.683E-01
2105	1.286E+04	7.026E+06	4.721E+02	1.375E+01	3.836E+03	2.577E-01
2106	1.236E+04	6.750E+06	4.536E+02	1.321E+01	3.686E+03	2.476E-01
2107	1.187E+04	6.486E+06	4.358E+02	1.269E+01	3.541E+03	2.379E-01
2108	1.141E+04	6.231E+06	4.187E+02	1.220E+01	3.402E+03	2.286E-01
2109	1.096E+04	5.987E+06	4.023E+02	1.172E+01	3.269E+03	2.196E-01
2110	1.053E+04	5.752E+06	3.865E+02	1.126E+01	3.141E+03	2.110E-01
2111	1.012E+04	5.527E+06	3.713E+02	1.082E+01	3.018E+03	2.028E-01
2112	9.720E+03	5.310E+06	3.568E+02	1.039E+01	2.899E+03	1.948E-01
2113	9.339E+03	5.102E+06	3.428E+02	9.985E+00	2.786E+03	1.872E-01
2114	8.973E+03	4.902E+06	3.294E+02	9.593E+00	2.676E+03	1.798E-01
2115	8.621E+03	4.710E+06	3.164E+02	9.217E+00	2.571E+03	1.728E-01
2116	8.283E+03	4.525E+06	3.040E+02	8.856E+00	2.471E+03	1.660E-01
2117	7.958E+03	4.348E+06	2.921E+02	8.509E+00	2.374E+03	1.595E-01
2118	7.646E+03	4.177E+06	2.807E+02	8.175E+00	2.281E+03	1.532E-01
2119	7.346E+03	4.013E+06	2.697E+02	7.854E+00	2.191E+03	1.472E-01

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City of Sioux Falls
SOUTH DAKOTA

City of Sioux Falls Solid Waste Management Master Plan

Appendix L: Task 13 – Stakeholder Outreach Materials

- Workshop 1 Presentation
- Workshop 1 Notes
- Hauler Survey Memo
- Workshop 2 Presentation
- Workshop 2 Notes
- Solid Waste Planning Board Workshop Presentation
- Solid Waste Planning Board Workshop Notes

HDR

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City of Sioux Falls

Solid Waste Management Master Plan

Stakeholder Workshop

November 17, 2016

A Comprehensive Solid Waste Management Master Plan will serve as Sioux Falls' roadmap for the next 30 years.

01 Project Overview

02 Goals for the Solid Waste Management Master Plan

03 Overview of the Current Solid Waste System

04 Group Discussion: General Thoughts

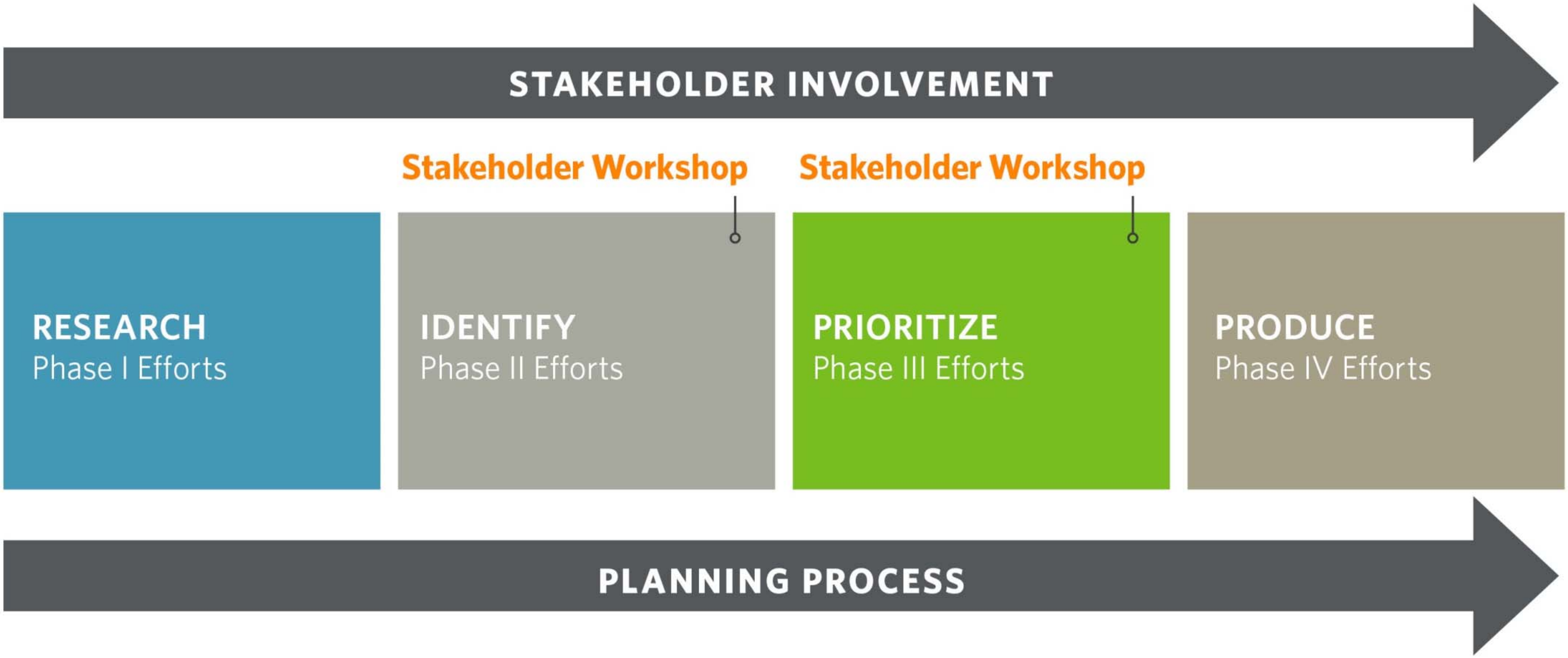
05 Group Discussion: Potential Strategies and Modifications

01 Project Overview

Project Drivers

- Develop a 30-year comprehensive Solid Waste Management Master Plan (SWMMP)
- SWMMP should build on the City's Sustainability Master Plan
- SWMMP should evaluate the City's existing solid waste system, and improvements to enhance the system

Project Overview



Project Overview

TASK NO.	TASK DESCRIPTION
1	Waste Characterization
2	Waste Collection Alternatives
3	C&D MRF and Integrated Facility Options
4	Key Landfill Operational Issues
5	Waste Generation and Disposal Projections
6	Pending Legislative and Regulatory Framework
7	Public Education Program
8	Emerging Technologies
9	Household Hazardous Waste and Problem Materials Management
10	Identify Innovative Green Projects
11	Transfer Station
12	Long-Term Landfill Gas Options
13	Stakeholder Input Process
14	Monitoring the Master Plan Implementation
15	Prepare Solid Waste Management Master Plan

SUSTAINABILITY PLAN GOAL	SOLID WASTE MANAGEMENT MASTER PLAN TASKS ASSOCIATED													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
WASTE MINIMIZATION	ALL WASTE MINIMIZATION GOALS GENERALLY INFLUENCE THE SWMMP													
1) Increase the existing waste diversion rate from an estimated 28% to 35% by 2016.	✓	✓	✓				✓	✓		✓			✓	
2) Reduce landfill disposal per capita by 15% by 2015 for the entire regional wasteshed.	✓	✓	✓	✓			✓	✓		✓			✓	
3) Determine the City of Sioux Falls existing recycling participation rate and establish a minimum participation rate of 75% by 2016.		✓												
4) Shorten LFG projected GHG impacts by at least 5 years by enhancing waste degradation and LFG recovery/capture.												✓		
5) Increase the City's hauler recycling goal from 12% in 2008 to 25% by 2017.	✓	✓												
WATER RESOURCES	COULD INFLUENCE THE EVALUATION CRITERIA FOR GREEN TECHNOLOGIES													
ENERGY														
1) Decrease GHG emissions from City government activities by 50% by 2017.			✓	✓										
2) Decrease GHG emissions for the non-governmental community activities by 10% by 2017.		✓												
3) Displace 3% to 5% of total energy consumption for city operations from the existing mix of energy fuel sources with renewable energy sources by 2017.								✓		✓		✓		
4) Foster growth of renewable energy through implementation of at least two public-private partnership projects and transactions by 2017.								✓		✓		✓		
TRANSPORTATION														
1) Reduce fuel consumption by the City's heavy duty diesel vehicles by 10% by 2015 and light duty vehicles by 20% by 2015.			✓	✓										
2) Reduce vehicle miles traveled by 10% per person by 2015.		✓									✓			
BUILT AND NATURAL ENVIRONMENT														
4) Plan and complete at least three sustainability demonstration projects (e.g. LEED, LID) by 2018.			✓					✓		✓				
COMMUNITY VITALITY														
2) Develop a community outreach and education program starting with K-12 schools by2015.							✓							
4) Modify the City's capital improvement program (CIP) evaluation to include environmental and social considerations in addition to economic criteria (beginning with the 2015 – 2018 CIP).			✓					✓		✓				

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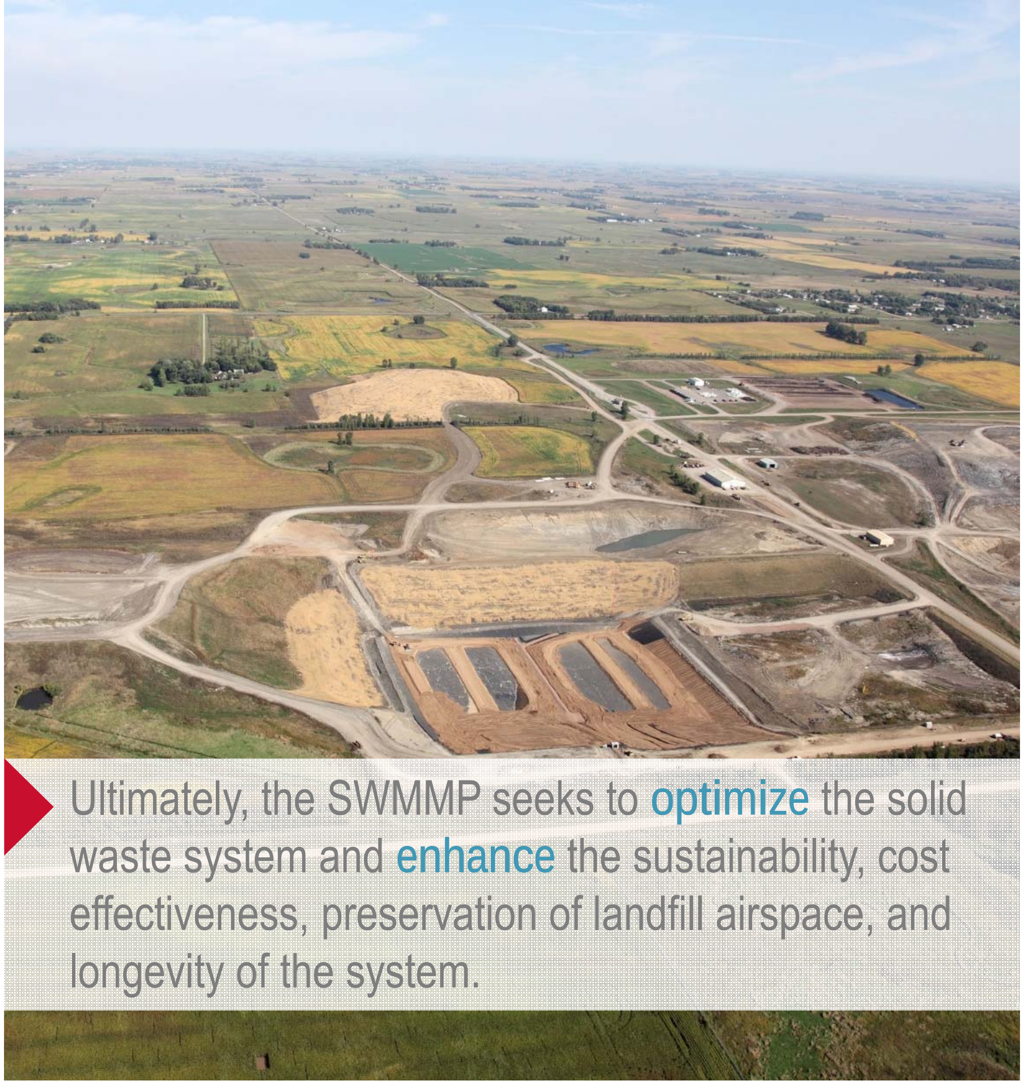
02 Goals for the Solid Waste Management Master Plan

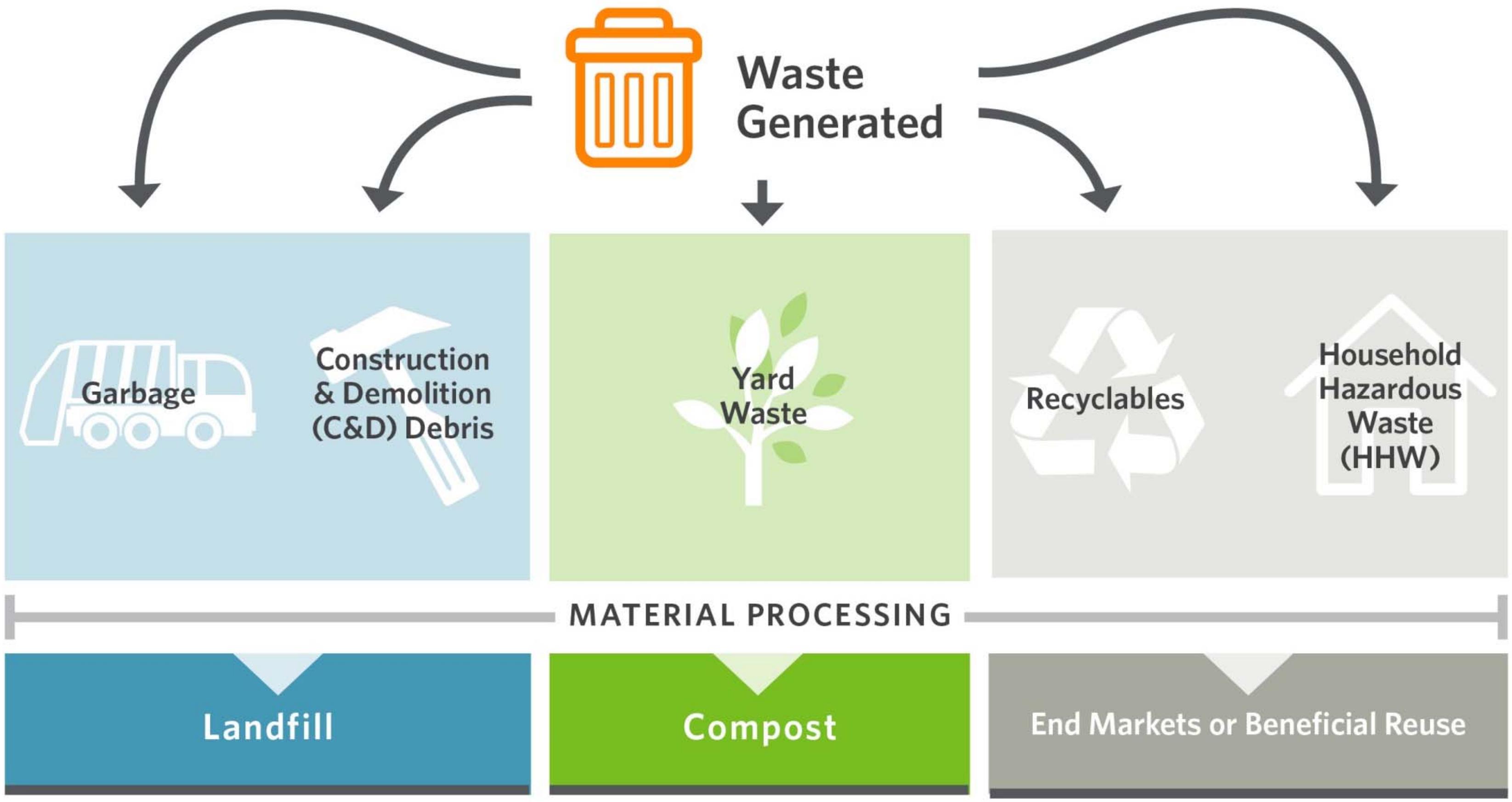
Goals of the Solid Waste Master Plan

- Build and maintain an integrated, sustainable solid waste management system
- Continue to increase recycling and reuse opportunities
- Streamline collection practices
- Maintain the cleanliness of our region
- Protect the public and environment
- Facilitate public input on the system, and develop public education of the master plan

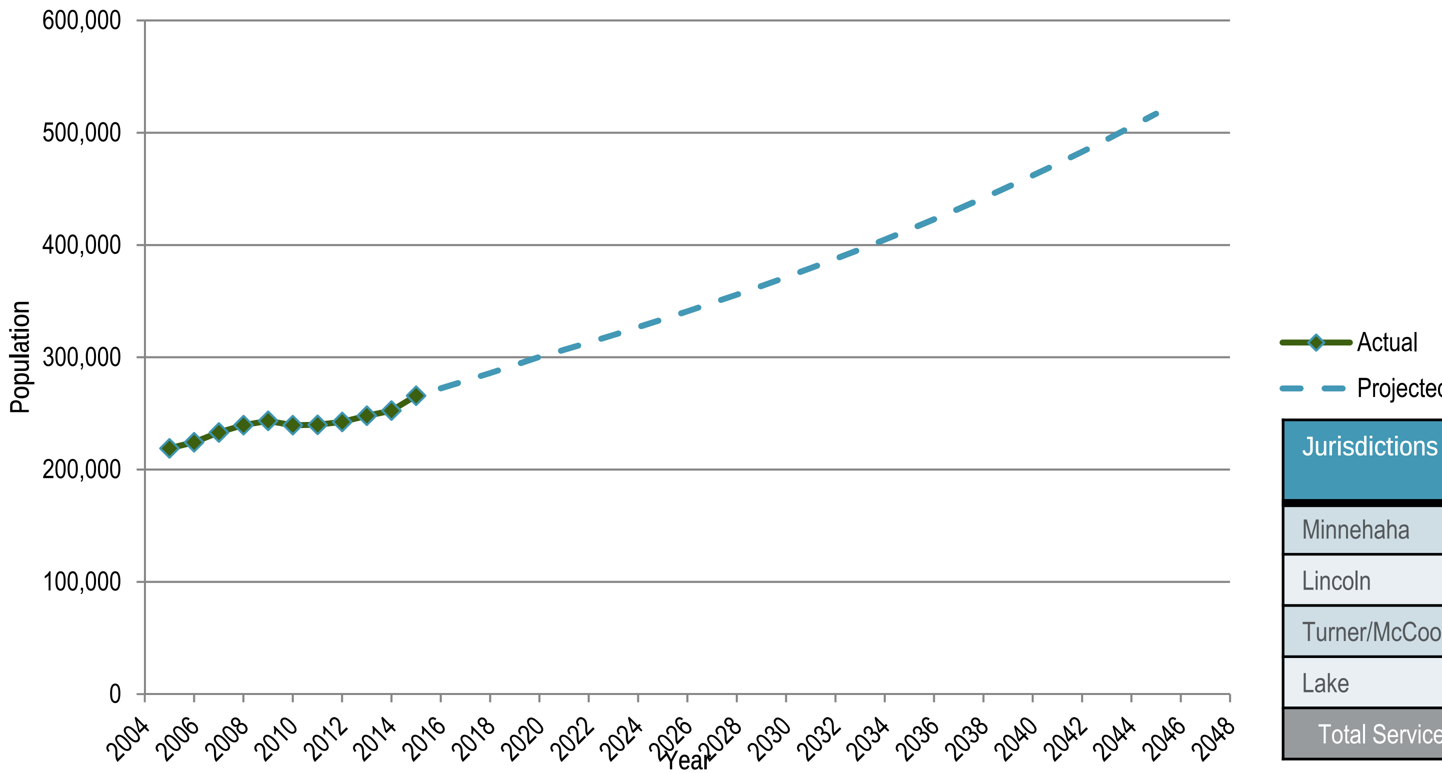


03 Overview of the Current System

Overview of City's Current System



Historical & Projected Service Area Population



Jurisdictions	2015 Population
Minnehaha	185,179
Lincoln	53,000
Turner/McCook	15,050
Lake	12,622
Total Service Area	265,851

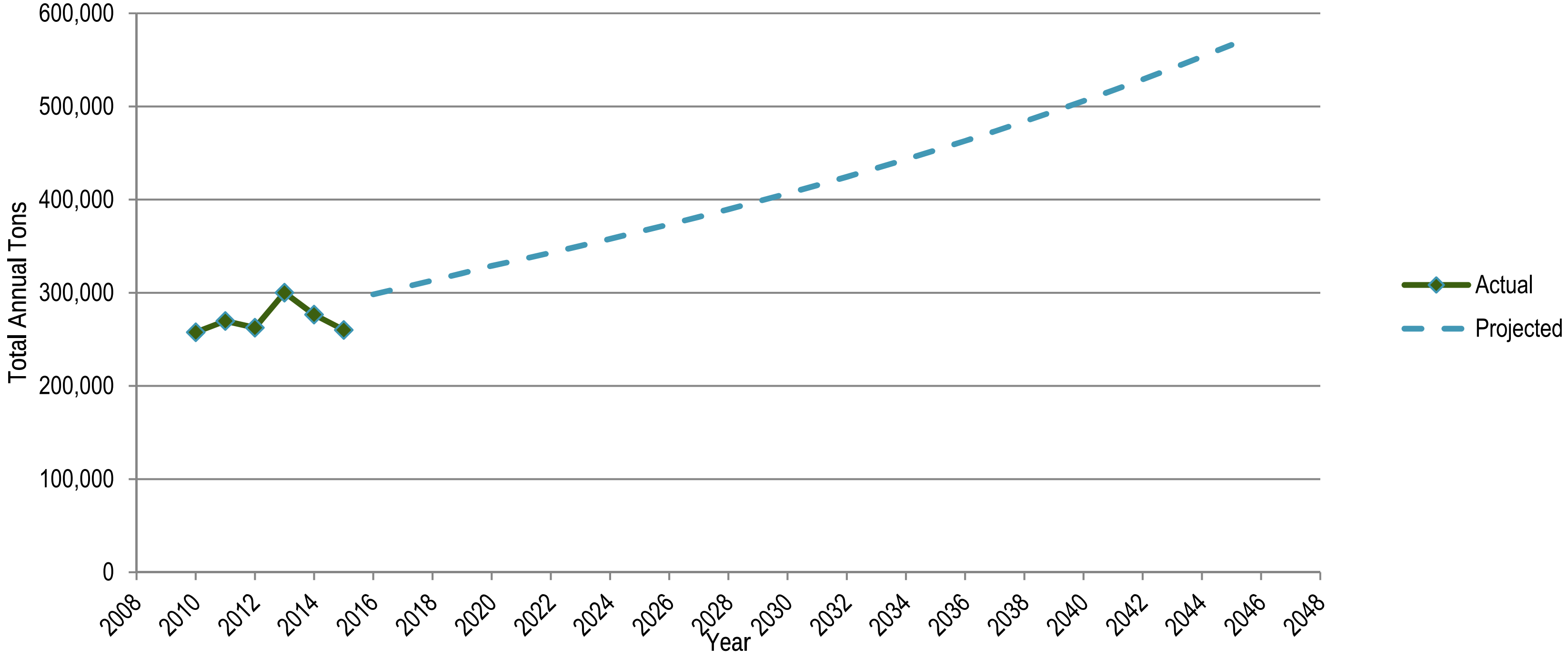
Source: U.S. Census (historical); U.S. Census and SHAPE Sioux Falls (projected)

Per Capita Generation Rates by Material Type

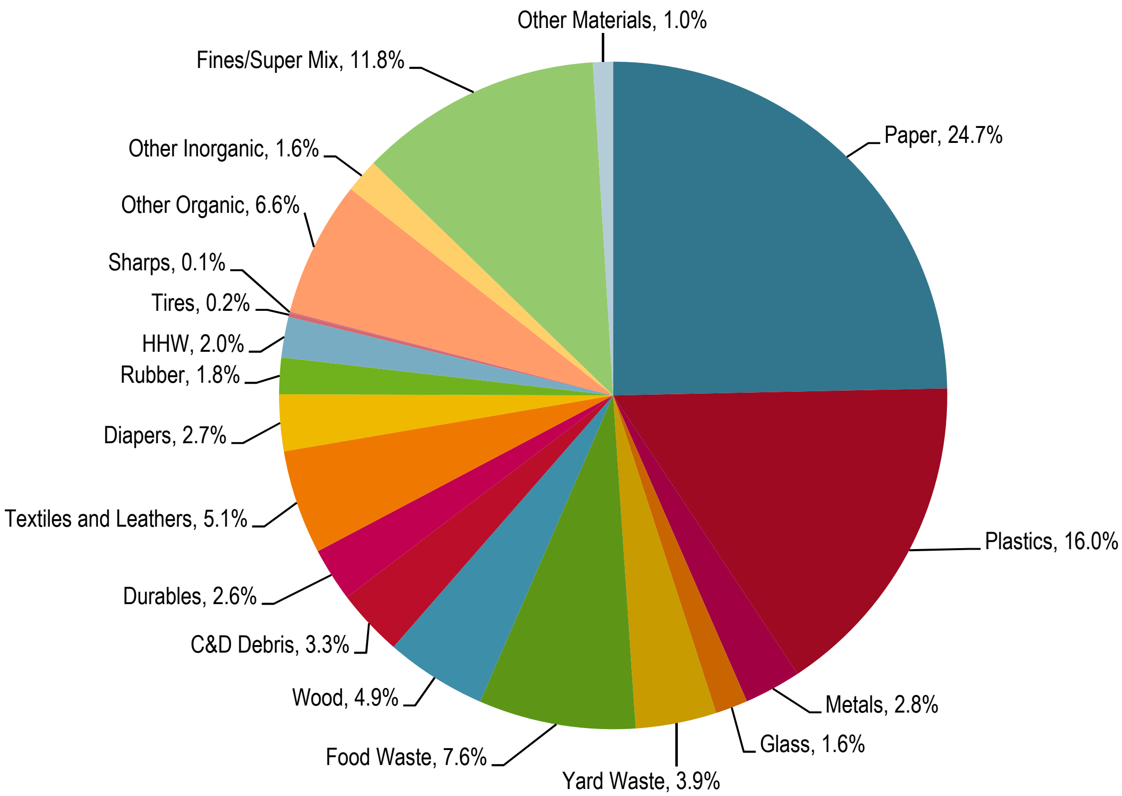
Based on Five Year Historical Average

Per Capita Generation Rates by Material	Tons per Year
MSW	0.68
Yard Waste	0.03
C&D	0.32
Wood Waste	0.03
Mattresses	0.0011
Asbestos	0.0009
Contaminated Soil	0.04
Tires	0.002
Total	1.09

Waste Generation Projections



Composition of Municipal Solid Waste Disposed at Landfill

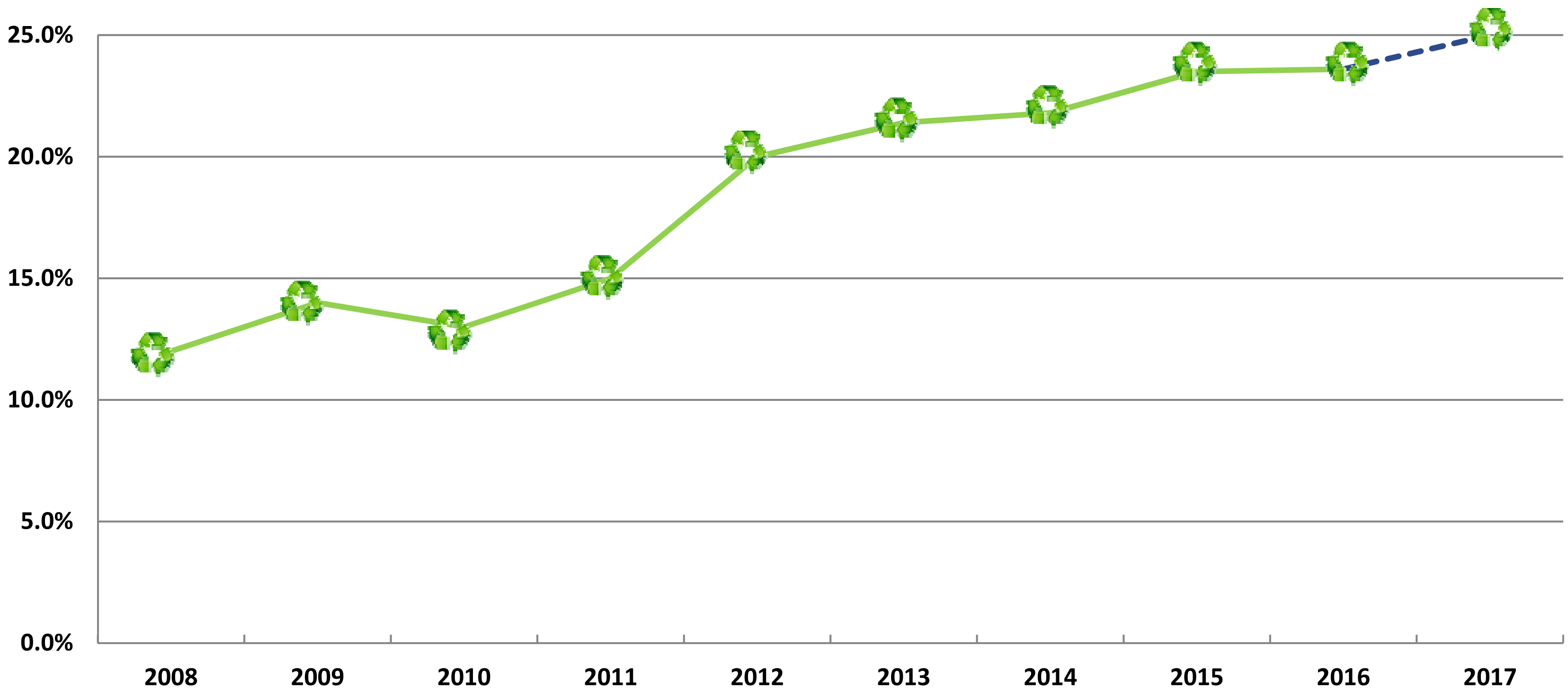


Source: HDR Waste Characterization Study, June 2016

Recycling in Sioux Falls

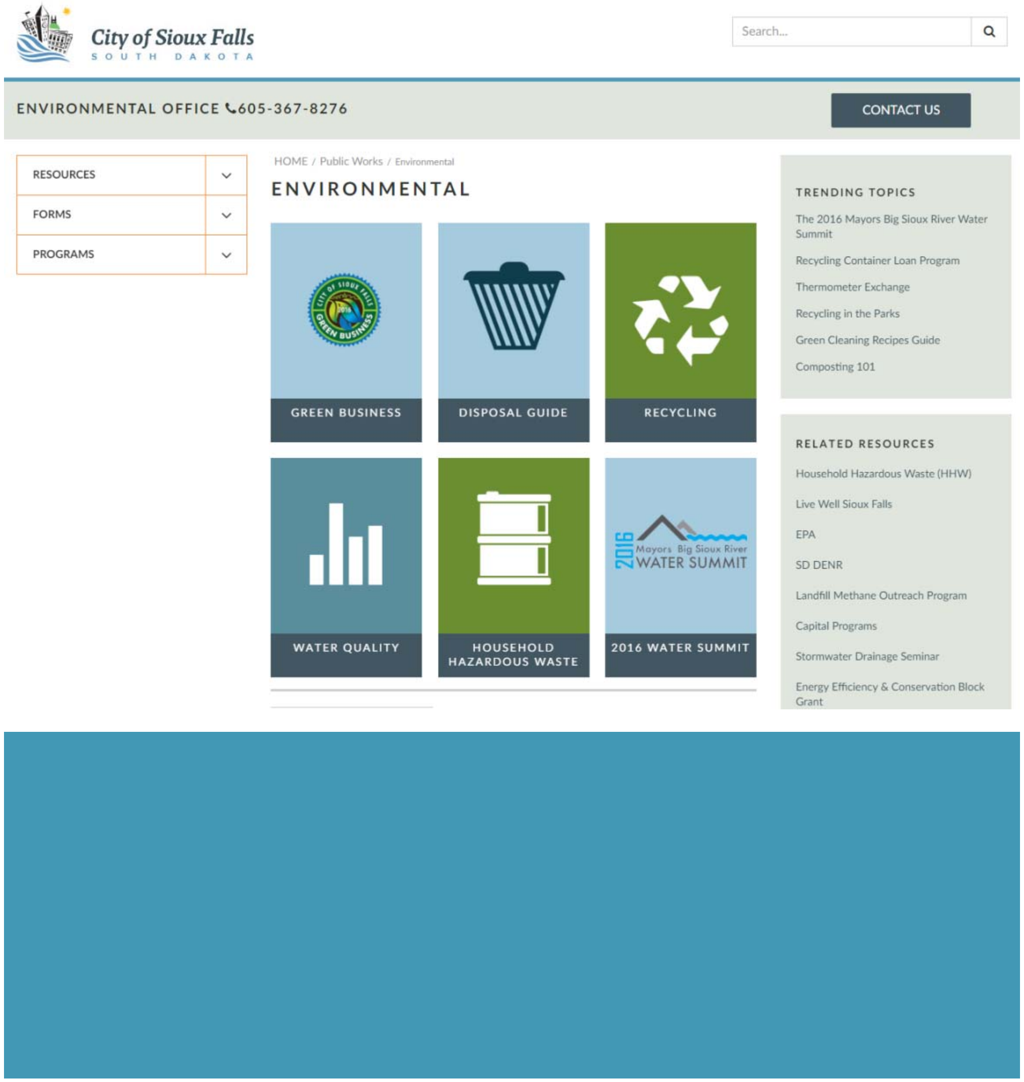
- Sioux Falls' goal: increase recycling from 12% to 25% by 2017
- Certain recyclable materials banned from the landfill, per ordinance
- Residents and businesses are required to recycle
- Recycling collection services are provided by private waste hauling companies
  - Each of these companies uses a single-stream system
  - Each hauler reports to City in order to measure recycling rate
  - 2016 Waste Hauler Recycling Rate: 23.5%

Waste Hauler Recycling Progress



Current Public Education Summary

- Solid Waste Planning Board
  - Members are selected by the mayor
  - Tasked with improving recycling and solid waste issue in Sioux Falls
- Classroom education program and a recycling education kit
- Program resources on the environmental page
  - The site offers links to program details, recycling guides, downloadable education
- Active presence on Facebook and Twitter
- YouTube channel with playlists dedicated to different city offices
- Recycling fliers to all households twice a year



Current Collection Services Summary

- The City's current collection system is commonly referred to as an "open" or "subscription" based collection service
- Licenses are issued by the Public Works Department
- Twenty-one haulers are licensed to collect garbage and recyclables in the City
- City requires haulers to offer recycling collection services, and residents are required to recycle
- Construction and demolition debris (C&D) haulers do not currently have to hold a City-issued license (but will in 2017)

Current Household Hazardous Waste and Problem Materials Handling Summary

Household Hazardous Waste Facility (HHWF)

- The HHWF takes hazardous waste that can’t be put into recycling or landfills
- No charge for residents of Lake, Lincoln, McCook, Minnehaha, or Turner Counties
- Materials must be in containers ≤ 5 gallons
- Leave materials in tightly sealed, original containers when possible
- NEVER mix household hazardous waste items
- Drive under the awning of the HHW Facility and the staff will unload your waste for you

Location:

1015 E. Chambers St.
Sioux Falls, SD 57104

Hours of Operation:

Tues.-Friday: 8am to 5 pm
Saturday: 8 am to 12 pm

Items accepted…

- Automotive Chemicals
- Lawn Care Chemicals
- Household Chemicals
- Home Improvement Chemicals
- Electronics
- Microwaves

Over 2 million pounds in 2015!

HHWF Reuse Room

- Items still in good, reusable condition are placed in the Reuse Room for redistribution to the public
- Must be a resident of the 5 county region in order to take items
- Limit of 3 items per week

Reuse Room is located on the front side of the Environmental Division Offices building.

Sioux Falls Regional Sanitary Landfill Current Operations

- Largest permitted landfill in the State of South Dakota
- Five county region contributes to disposal of MSW and C&D
- Simultaneous disposal of MSW and C&D as two separate waste streams in two discrete landfills
- Other waste management initiatives at the Landfill include:
  - The public drop off area includes the collection of MSW and recyclables such as white goods, yard waste, wood palettes, lawn mowers, scrap metal, tires
  - Yard waste is composted on a portion of the property, and there is a wood recycling area south and adjacent to the compost pad area
- Landfill gas from the MSW landfill is collected and processed before being directed to the POET ethanol plant to be used as a fuel source

Yard Waste and Compost Programs

- Yard waste can be composted at home or you can take your yard waste to the landfill which will then be composted there
- Finished compost is available to residents for FREE at the landfill.

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04 General Thoughts for the Solid Waste System

General Thoughts

Group Discussion

- What do you like about the current system?
- What don’t you like about current system?
- What priorities and goals do you feel the City should keep in mind?
- What should the future of Sioux Falls solid waste system look like?

05 Potential Modifications to the System

- Public Education and Outreach
- Collection and Transfer System
- HHW and Problem Materials
- Alternative Technologies
- Other Innovative Green Projects

Public Education Benchmarking Results

Communication Tactic	Sioux Falls, SD	Sioux City, IA	Saint Paul, MN	Fargo, ND	Lincoln, NE
Dedicated Recycling Webpage		●		●	●
Public Works/Environmental Webpage or Other	●		●		
Dedicated Social Media	●	●			●
City Social Media			●	●	●
Paid Advertising	●		●	●	●
Public Service Announcements	●		●		●
Meetings	●	●			●
Primary Education Curriculum	●			●	●
Video	●			●	
Recycling Guide	●	●	●	●	●
Stickers	●				
Television/Radio	●				
Tours/Classes	●	●		●	●
Special Events	●	●	●	●	●
Direct Mailings	●		●	●	●
Infographics			●		
Advisory Board	●	●			
Survey			●	●	
Branding				●	
Earned Media	●	●	●	●	●
Pop-up/Mobile Events			●		

Public Education and Outreach

Current Successes

- Relationship building with local haulers
- The support and encouragement by the Mayor’s office
- Private haulers throughout the community work well with the City recycling coordinator
- The haulers involvement in the Planning Board provides them a seat at the table and encourages open dialogue about the goals and implementation of the program
- The City sets recycling goals each year
- In 2014, Sioux Falls had a record setting year and surpassed their desired goal
- Enforcement of requirements helps to meet this goal
- Individual haulers are required to meet at least 80 percent of the city’s recycling goal or fines will be imposed. Haulers who exceed the goal can qualify for incentives provided by the city.

Public Education and Outreach

Current Challenges

- Since transitioning to single-stream recycling collection, contamination has remained a concern
- The City has worked to combat the issue with education and outreach regarding contamination
- The City attempts to explain the importance of properly sorting through earned media opportunities, social media, and public service announcements

Public Education and Outreach

Your Opinions on the Initial Recommendations

Adopt Core Values for Recycling Education

- Values should be a result of community based conversation
- Have varying stakeholders and users weigh-in on core values
- Solid Waste Planning Board might champion this initiative

Information Delivery

- Move away from primarily traditional forms of communication (flyers, mailers)
- In our digital world, communities are more reliant on mobile devices for alerts, notifications, and engagement opportunities that are accommodating to a flexible schedule

Public Education and Outreach

Your Opinions on the Initial Recommendations

Frequent Engagement

- Develop a consistent relationship with haulers and residents
- Key to behavioral change
- Coupled with a prominent brand identity

Access and Ease-of-Use

- The current website offers a variety of resources
- Strengthen the organization and accessibility of the website
- Minimize the number of “clicks” a user will have to go through to access their desired resource

Public Education and Outreach

Your Opinions on the Initial Recommendations

Visual Communications

- We are visual in nature and are more likely to relate and remember information when presented in visual mediums
- Continue use of videos and graphical materials
- Tools should use consistent and targeted messaging

Earned Media/Social Media vs. Paid Media

- Earned media: the opportunities for media coverage that is not paid for
- Cost effective way to communicate and promote programs
- Develop a social media framework for communication
- Actively engaging followers on social media
- Keep posts timely, relevant, and interesting

Collection System Options

- Open or Subscription
- Municipal
- Franchise or Contract

Collection System Types

Open/Subscription Collection	
Advantages	**Disadvantages**
• Customer choice in service providers	• Multiple large vehicles traveling on the same streets
• Multiple haulers, including local/independent haulers, can provide service	• Increased risk to public safety • More emissions • More wear and tear on roads

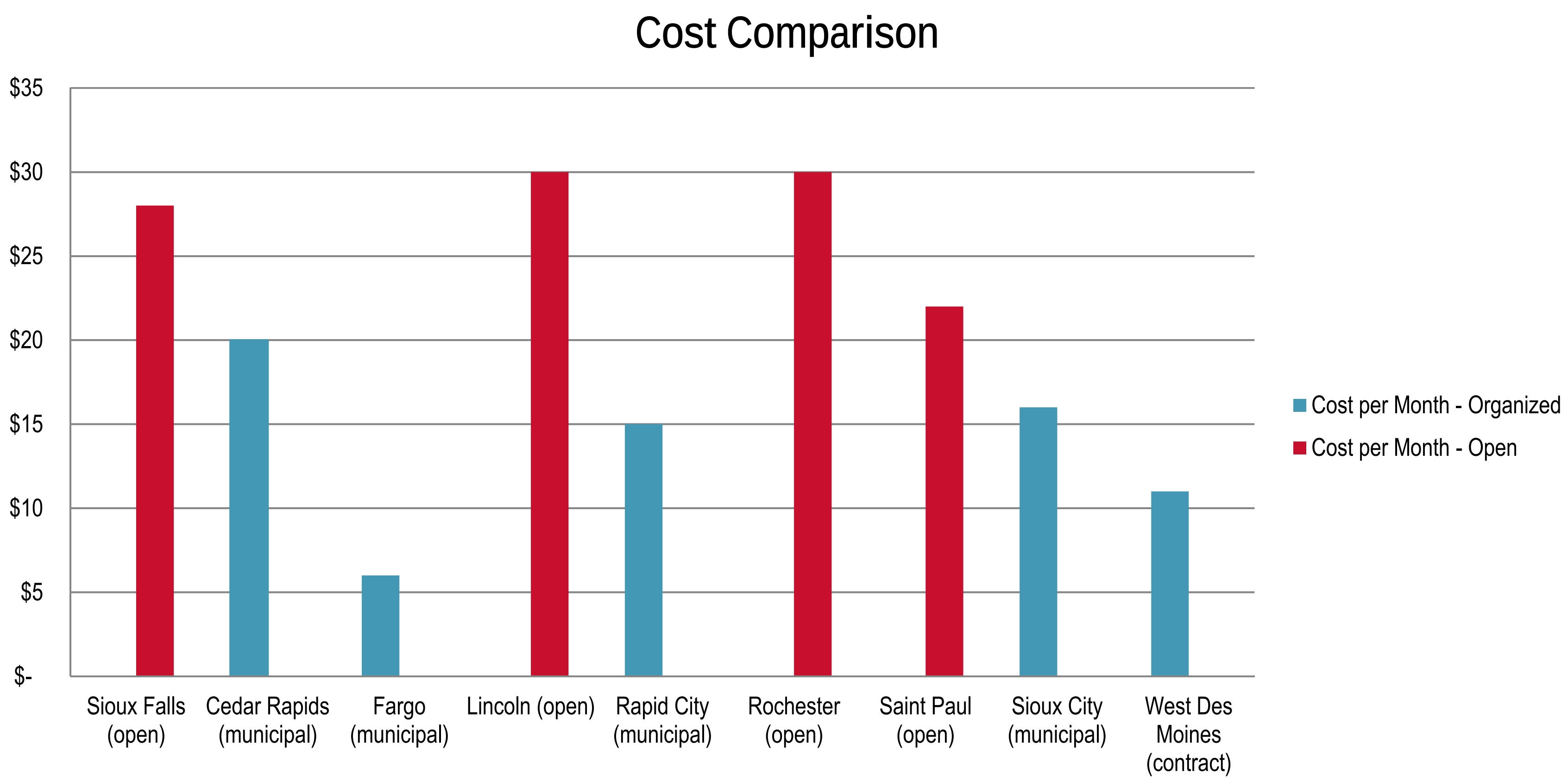
Municipal Collection	
Advantages	**Disadvantages**
• Less large vehicle traffic on streets (increased public safety, fewer emissions, less wear and tear on roads) • Economies of scale with one service provider could mean more efficient and therefore less expensive collection costs	• Customers do not get a choice in service provider • Implementation could displace some haulers

Franchised or Contracted Collection	
Advantages	**Disadvantages**
• One hauler/ agreement to administer • Guaranteed customer base and economies of scale • Recycling participation may increase if residents are required to pay for the service • Less large vehicle traffic on streets (increased public safety, fewer emissions, less wear and tear on roads)	• No choice of hauler for residents • Residents have to have and pay for service • Implementation could displace some haulers

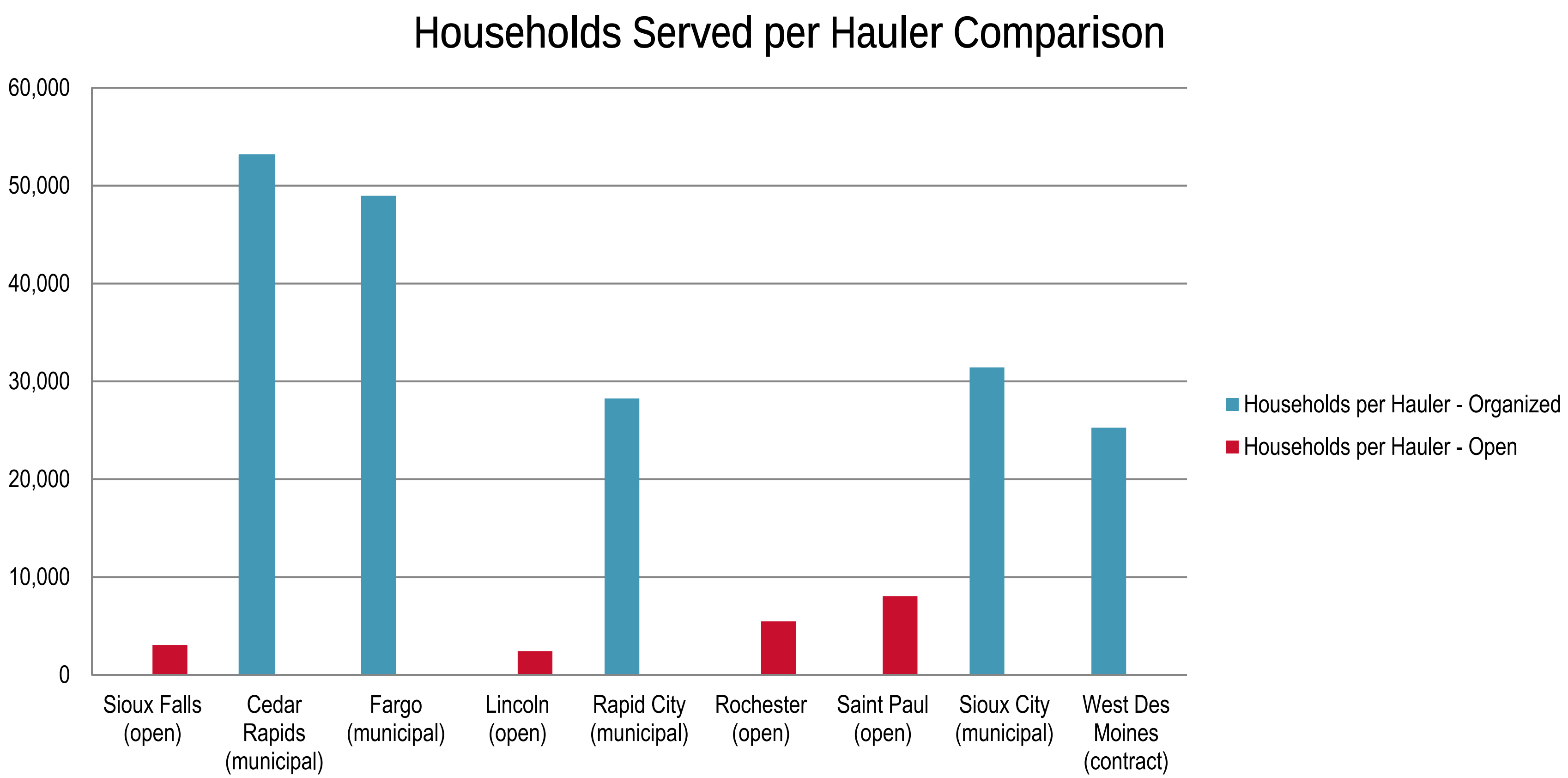
Collection Benchmarking Results

Community	Provider	Garbage Rate	Recycling Rate	Yard Waste Rate	Total
Sioux Falls, SD	O	Range: $15 to $35	Included with Garbage	Range: $13 to $18 (seasonal)	Range: $28 to $53
Cedar Rapids, IA	M	$16.02 35-Gal Cart; $1.50 for Additional Stickers	$4.30	Included with garbage	$20.32
Fargo, ND	M	42-gal $6 64-gal $9 96-gal $14	No additional charge (optional)	Not included	$6 to $14
Lincoln, NE	O	$20 avg.	$10 avg.	Included with garbage	$30
Rapid City, SD	M	35-gal $14.99/month 64-gal $16.83/month 96-gal $18.68/month	Included with garbage	Included with garbage	$14.99 to $18.68
Rochester/Olmstead County, MN	O	$30 avg.	Included with garbage	Not included	$30
Saint Paul, MN	O	30-38 gallons: avg. $22; 50 to 68 gallons: avg. $27.19; 90 to 96 gallons: avg. $27.23	Unknown	Unknown	$22 to $27.23
Sioux City, IA	M	$16.30 + $1 per extra bag	Included with garbage	Not included	$16.30
West Des Moines, IA	C	$7.96 48 gal. $8.66 96 gal.	$2.59	PAYT – stickers and bags	$10.55 to $11.25

Collection Benchmarking Results



Collection Benchmarking Results



Group Discussion:
Collection System Potential Modifications

- What should the priorities be for collection services?
- Should the City move toward organized collection?
- Is there more research needed? If so, what?
  - More City-specific data? More outreach?
  - We will be interviewing the licensed haulers in the City

Group Discussion: Build a Transfer Station

- Preliminary work in progress includes:
  - Analyzing the waste stream data to determine the material fractions that could be received at a transfer station
  - The sizing and orientation of the facility to safely and efficiently process the material
  - The development of an opinion of probable construction cost
  - Financial pro forma to determine the estimated annualized and per-ton operations and maintenance costs
  - Hauler interviews include questions relating to opinions on need for and location of a transfer station

- What should the priorities be in determining whether a transfer station should be built?

Group Discussion
HHW and Problem Materials

Residential Users:

- Are you aware that the City of Sioux Falls operates an HHW facility for residents to drop off HHW free of charge?
- Do you know what items can be dropped off at the HHW facility free of charge?
- Have you ever utilized this free service?
- What would make it more convenient for you? Additional hours? Community turn ins? Additional collection sites? Curbside collection?
- Would you be willing to pay for disposal of HHW? If so, what would be an acceptable fee?
- Other suggestions?

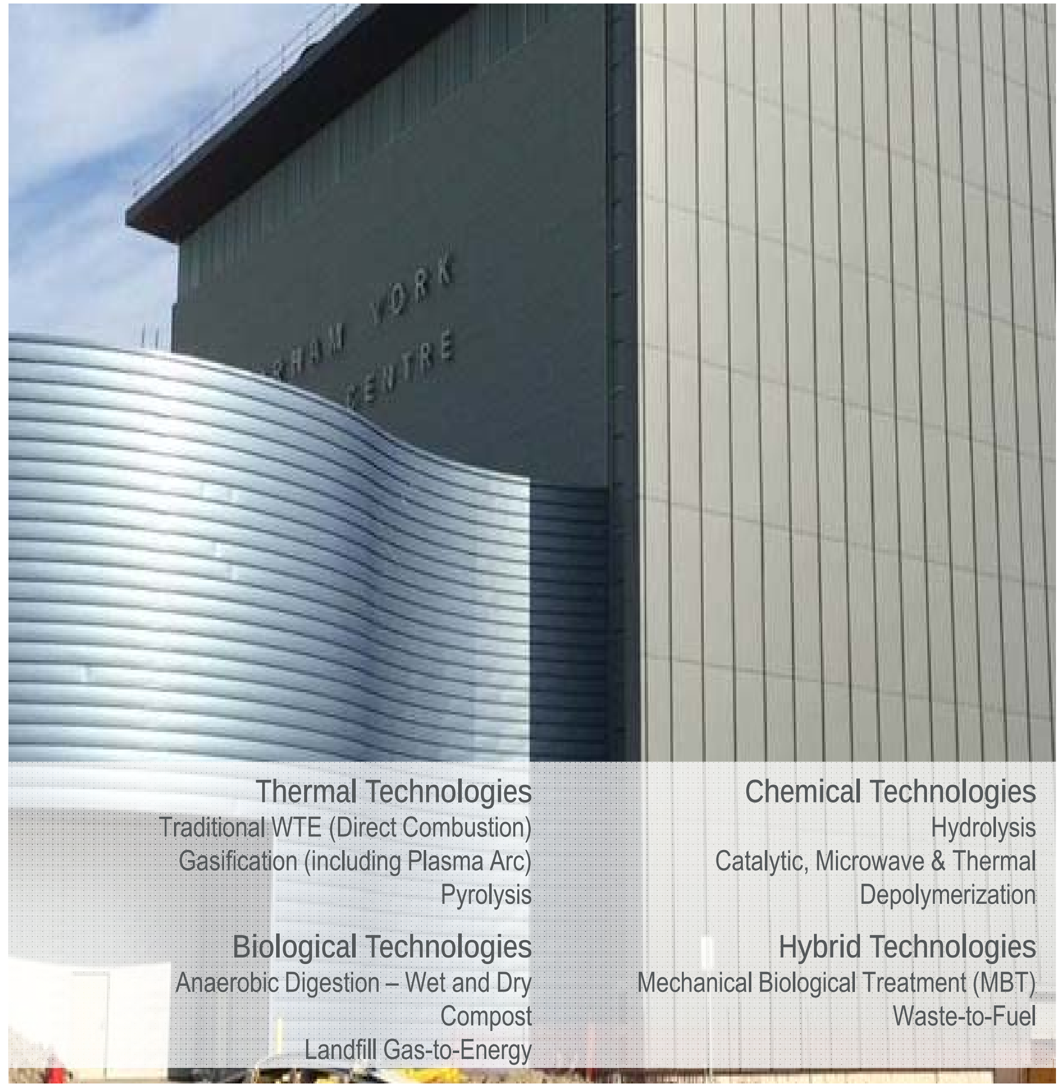
Group Discussion
HHW and Problem Materials

Commercial Users:

- As a business, do you generate HHW?
- How do you currently dispose of HHW? Landfill? Through the current City CESQG program? Other?
- Would you be willing to pay for disposal of HHW? If so, what is an acceptable fee?
- Do you have other suggestions for a successful program?

Group Discussion
Alternatives to Landfill

- Types of Technologies in Solid Waste Industry
  - Thermal
  - Biological
  - Chemical
  - Mechanical
- Priorities:
  - Proven Technology
  - Feasible / Commercially Viable
  - Environmentally Sound
- Mechanical Technology Opportunity with Existing Sioux Falls Partner



Group Discussion: Other Innovative Green Initiatives

Related to Sustainability Master Plan Goals

- Goal: Increase the existing waste diversion rate from an estimated 28% to 35% by 2016
  - **Industrial waste composting**, targeting food processing by-products, food waste, and other organic materials generated by regional food processing facilities, dairy operations and possibly food retailers.
    - Based on the Waste Characterization study, food waste and other organic materials represent approximately 5.6 and 11.6 percent of industrial/commercial institutions (ICI) municipal solid waste, respectively
  - **Zoo waste (manure) composting** where "Zoo Doo" is produced from herbivore manure and bedding at an on-site aerated static pile and used throughout the facility as plant bedding and mulch.
    - Successfully implemented at the Oregon Zoo since 1988
  - **Incentivize residential recycling** through programs such as Recyclebank, a private company that encourages participation in curbside recycling programs by offering discounts and rewards based on collected volume.

Group Discussion: Other Innovative Green Initiatives

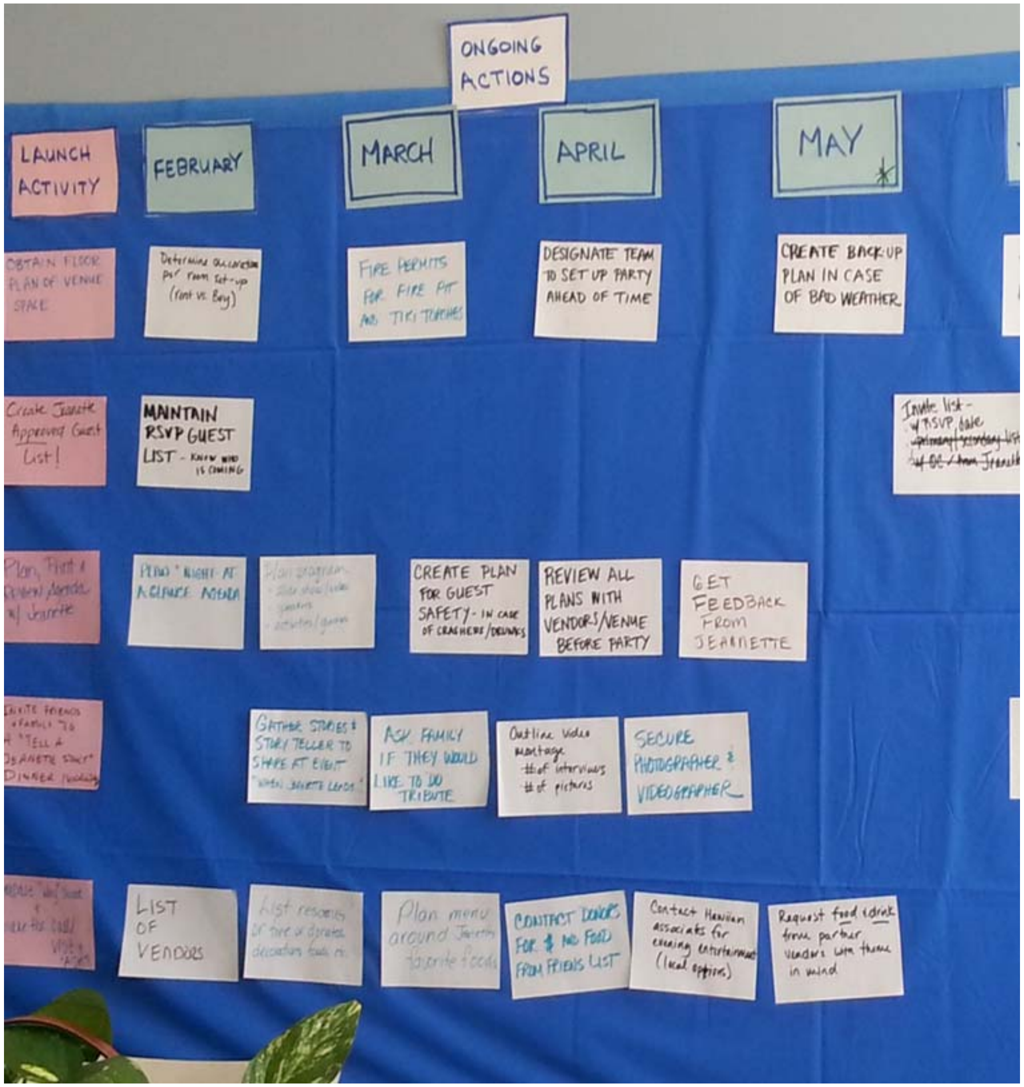
Related to Sustainability Master Plan Goals

- Goal: Reduce landfill disposal per capita by 15% for the entire regional wasteshed
  - Food waste rescue, by collaborating with local stakeholders to prevent food waste at the source
  - C&D material rescue and reuse to salvage building materials that can be reclaimed and repurposed
  - DOW Energy Bag program – currently piloted in Citrus Heights CA:
    - The program captures often non-recycled plastics such as chip bags, candy bar wraps and drink pouches.
    - Consumers are able to collect these plastics into the Hefty Energy Bags, which local haulers collect from regular recycling bins and carts. The Energy Bags are sorted at the local recycling facilities, and directed to regional waste-to-energy facilities.
    - Based on the Waste Characterization study, plastic film/wrap/bags represent approximately 5.3 percent of residential municipal solid waste

Any other thoughts for strategies or modifications?

Next Steps

- City staff and HDR continue research and strategy refinement with your feedback in mind
- Another workshop in mid to late January to review additional research and refinement before final decisions are made



Open Floor

Meeting Adjourned

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Solid Waste Master Plan Workshop, Meeting #1 | 1PM (Commercial/Business)

November 17, 2016
Meeting Notes

A general overview of the current system was presented to the group. Prior to discussions on specific topics and strategies, the group was asked for their **general thoughts** about the City's current solid waste system. The following are key points noted during this part of the discussion.

<u>General Thoughts</u>

- Inefficient collection is not very sustainability, too many trucks on the road.
- Like the open system – what would happen if the City only had one hauler and that hauler went on strike?
- Like the rule to keep garbage contained / up at the house (current side door service approach)
- Safety of haulers should also be considered with collection style (safer to perform automated service than manual service).
- In Harrisburg, there is an open system but only 8 haulers (compared to 21 haulers in Sioux Falls)
- Why do you choose one hauler over another?
    - Price
    - How recycling is handled
    - Equipment in good shape/ reliable
    - Good service
- There is a lot of waste to manage; we need to minimize waste, maximize recycling, also need to consider aesthetics, cost, and convenience (all should be priorities for the City to consider)
- With regard to diversion, businesses have to pay extra for recyclables collection, so small businesses are less likely to do it. Larger businesses often recycle as part of corporate commitment to sustainability, even though it increases costs.

An overview of current practices and initial recommendations regarding public education were presented to the group, and the group was asked for their opinions on **public education**. The following are key points noted during this part of the discussion.

<u>Public Education</u>

- With mailers, it only reaches the one who looks at it (may not be everyone in the home).
- Electronic means can reach a larger audiences.
- Businesses can stream content provided by the City in break rooms or common areas; businesses want to support the community.
- Electronic billboards on main streets seem to be effective - everyone sees them.

An overview of the current collection practices and initial research including benchmarking with other similar communities were presented to the group. Initial research into the need/benefit of a transfer station within the City was also presented to the group, and the group was asked for their opinions on collection and transfer. The following are key points noted during this part of the discussion.

Collection Services

- Can commercial and residential customers be treated the same? May not be able to due to difference in collection services and needs.
- Is there a way the City can do something to make the current system less chaotic without fully taking over collection with just one hauler?
- Can garbage trucks/staff double for snow plowing or other city functions?
- The disadvantage to having only one hauler is if they go on strike, no one is picking up the garbage (aesthetics, odors, public safety)
- Some people have relationships with their hauler
- Overall, folks want some better organization, but not really restricted to just one hauler
- Low unemployment, and drivers/collectors bouncing around between companies can make it difficult to staff collection services

Transfer Station

- A transfer station could be added customer service and convenience for the haulers, but not necessarily a direct benefit to the city (would add cost to City system)
- Could a transfer station help divert/recycle more?
- Overall, the group trusts city leaders to make the right financial decision.

An overview of the current household hazardous waste (HHW) and problem materials system was presented to the group, and the group was asked to provide their opinions on HHW and problem materials. The following are key points noted during this part of the discussion.

HHW and Problem Materials

- Some in the group did not know it was free to residents.
- One in the group once attempted to drop off as a resident, and it was closed.
- Cars want to come through on Mondays, but the HHW facility is closed on Mondays.
- Tuesday and Saturday are most popular days.
- For commercial generators of HHW, it is common to use Safety Kleen, depending on the type of HHW.
- For some commercial generators, Veolia, through an agreement, takes some HHW/Problem Materials and the company does not have to pay additional fees.
- Some companies have a lot of electronics, which are not a part of CESQG.
- Overall, HHW/Problem Materials are a minor costs for businesses
- The group generally loves the free landfill pass flyers. It has lots of good information. HHW is very efficient.

- No one in the group knew the re-use room existed.
- Keep price in tipping fee, would not pay direct costs.
- City will pay transfer fee for CESQGs (on millennium) through Veolia contract.
- Some companies take truckloads of electronics for recycling on their own, and it's a relatively minor cost.

An overview of initial ideas for other innovative green initiatives was presented to the group, and the group was asked for their opinions on the other innovative green initiatives. The following are key points noted during this part of the discussion.

<u>Other Innovative Green Initiatives</u>

- Any POTW that could be diverted as part of industrial waste composting?
- Are there organics currently going to landfill that could be added to industrial waste composting?
    - Flaxseed type material w/ several thousand pounds per week?
- Landfill is looking at adding more than yard waste to composting efforts.
- Processing techniques make a difference in what can be added to compost.
- There are currently 700 tons of "zoo doo" per year coming into the landfill, so "zoo doo" idea could be interesting.
- Regarding recycling incentive programs, one hauler currently offers this, but it doesn't have much reward. General consensus in the room that they would recycle regardless of an incentive program – doubt it would have much of an impact on residential recycling.
- How can city help incentivize commercial recycling?
- Can the City help find markets for "problem materials"?

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City of Sioux Falls
SOUTH DAKOTA

Solid Waste Master Plan Workshop, Meeting #2 | 5:30pm (Residential)

November 17, 2016
Meeting Notes

A general overview of the current system was presented to the group. Prior to discussions on specific topics and strategies, the group was asked for their **general thoughts** about the City's current solid waste system. The following are key points noted during this part of the discussion.

General Thoughts

- Residents generally love single stream recycling.
- Is there consistency with haulers, given how many different haulers there are in the City?
- Services seem different on the street. The haulers may not accept the same materials for recycling.
- How are hauling and recycling rules enforced?
- For haulers that use automated collection, they no longer pick up anything out of cart.
- What kinds of efforts are there for reuse and compost? Some residents unaware of what the City already does.
- It should be a priority to keep streets clean. That is difficult to do in the downtown area.
- What about restaurants? Food scraps would be good to compost.
- There is value in sustainability.
- It would be good to connect the Sioux Falls Schools Superintendent with the City Sustainability Manager to work with the schools in promoting recycling and other sustainability initiatives. Can we incentivize kids to recycling through their schools, perhaps through clubs on campus?
- Some overall concern with the amount of cardboard and plastics still in the waste stream (based on composition study results shared with the group).
- Can we make public recycling containers more available? And consistent with materials collected in residential program?

An overview of current practices and initial recommendations regarding public education were presented to the group, and the group was asked for their opinions on **public education**. The following are key points noted during this part of the discussion.

Public Education

- One HOA just completed a customer survey through Survey Monkey, and there was consensus that the residents of that HOA prefers email communications to hard copy/ paper communications. Facebook communications was a close second to emails.
- Some concern expressed about email since some people do not have smart phones.

- Fewer clicks on the City website to get to the information you are looking for would be better.
- If you use email, you will need the email address, and that can be a challenge.
- Can haulers put stickers on containers to inform residents of what materials can be recycled?
- Can we move toward more consistency on recycling? E.g. Gas stations do not have recycling containers.
- How much are we doing with schools? Can we incentivize school/students?

An overview of the current collection practices and initial research including benchmarking with other similar communities were presented to the group. Initial research into the need/benefit of a transfer station within the City was also presented to the group, and the group was asked for their opinions on collection and transfer. The following are key points noted during this part of the discussion.

<u>Collection Systems</u>

- Group was surprised to see that open rates are higher than organized collection rates.
- Could garbage collection crews be used to do something else? (Snow Plow?)
- Really do see multiple trucks on the same street, and it sometimes is a bottle neck for traffic, but not a big issue.
- Can the City organize collection without putting haulers out of business?
- Can the City organize collection and encourage current workforce to move into other areas?
- Keep it local if you franchise.
- Can we ask haulers for metrics like vehicle hours? Full trips? Efficient routes?
- Wear and tear on the roads: what do multiple collection vehicles really do to the roads?
- Can haulers have standards on trash containers (consistency)?
- Having multiple trucks on multiple days is a problem, in the opinion of some.
- If the City were to organize, the group generally thought municipal collection would be preferred.

<u>Transfer Station</u>

- NIMBY (not in my backyard).
- What is the cost versus the benefit? Is it worth it?
- Noise concerns.
- Can anyone get in? (Safety concerns)
- Would need to be placed in a strategic location, fenced off (perhaps an industrial park location).
- Is double-handling of materials inefficient?
- Some concern expressed about litter/blowing in the city.
- General Consensus: does not seem to be a good idea.

An overview of the current household hazardous waste (HHW) and problem materials system was presented to the group, and the group was asked to provide their opinions on HHW and problem materials. The following are key points noted during this part of the discussion.

HHW/ Problem Materials

- Everyone in the group was aware of the drop off facility, and using it.
- General consensus that it could be used more, and belief that some are throwing it in the garbage.
- Could electronics collected curbside be a part of the bid if city franchises?
- Can the city partner with Ace, Lowes, etc. for collection of HHW/Problem Materials to add to convenience for customers?
- General consensus that the current service is great.
- Used City website to know what can be taken there.
- General consensus: Everyone loves the free pass for the landfill.

An overview of initial ideas for other innovative green initiatives was presented to the group, and the group was asked for their opinions on the other innovative green initiatives. The following are key points noted during this part of the discussion.

Other Innovative Green

- “Zoo Doo” would be great (divert 700 tons/year from the landfill).
- What about hobby farmers, etc.? Agriculture Department regulates farmers, so composting may not be allowed.
- Permit modifications have to be considered for the landfill to take more materials to compost (beyond current yard waste composting).
- What can be done with pet waste? Road kill?
- Can we estimate how much is out there that could be composted?
- Food Scraps: general consensus in the group that they would pay more at a restaurant that composts.
- Incentive program does not play a key role in why we recycle, but there is a place for it. Would like to be able to forward “points” to Girl Scouts or similar (Civic Benefit).
- C & D mandate for recycling? Could specify that a certain percent of C&D waste generated be recycled.
- City should look into a bag ban or tax, and look into Styrofoam ban.

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Memo

Date:	Thursday, January 12, 2017
Project:	City of Sioux Falls Licensed Waste Hauler Survey
To:	Dustin Hansen, Landfill Superintendent
From:	Allison Trulock, HDR, Wendy Mifflin, HDR
Subject:	Licensed Waste Hauler Survey Summary

The purpose of this memorandum is to summarize the results of the waste hauler survey that was undertaken as part of the City of Sioux Falls (City) Solid Waste Management Master Plan process to solicit hauler recommendations for solid waste system efficiencies and convenience improvements. The hauler interviews were conducted as part of Task 13, Stakeholder Input Process, in addition to stakeholder meetings.

Approach and Response Rate:

HDR developed a draft questionnaire for review and input by City staff, and finalized the questionnaire based on City comments received. The City provided contact information for each of the 25 currently licensed haulers and two additional haulers currently seeking a license to haul in the City. HDR emailed the questionnaire along with introductory language to describe the effort to all 27 haulers on December 13, 2016. HDR followed up with each hauler via telephone to discuss the survey effort and solicit responses. Each hauler was made aware that individual hauler responses would be kept confidential, and only summary data would be provided to the City. Of the 27 licensed haulers, 13 haulers completed the survey, 3 haulers chose not to participate, and 11 haulers did not respond to our contact attempts. A copy of the questionnaire that was used to guide the telephone interviews is included as an attachment to this memo. (Individual survey responses are not included, as it was agreed with the City that responses would be kept confidential.)

The remainder of this memo provides a summary of the key responses to the survey effort. This is not an exhaustive analysis of each question and response, but a broader report on the survey as a whole, and the key takeaways from the haulers that completed the confidential survey. The following are the key response summaries, organized by topic area.

Curbside Collection Efficiency and Convenience Improvement Suggestions:

Respondents were asked to provide suggestions to improve collection efficiency and convenience. The following are key responses from the haulers that participated in the survey.

- Each of the respondents that collect from dumpsters expressed some concern over illegal dumping. Feedback included the following: the City needs to address illegal dumping in dumpsters; it is a huge problem in commercial dumpsters; need enforcement with a community awareness advertising campaign.

- A few of the respondents suggested that the City should move away from walk up service, and allow cans to be on the curb. Related feedback included: this change would allow haulers to upgrade to automated collection vehicles; there is a high rate of injuries to hauler employees under the current system, liability for accessing private property is an issue and inefficiency in providing the service under the current system drives up the rates to customers.
- A few of the respondents suggested that allowing earlier routes would help hauling time and efficiency, and allow truck traffic to be off the City streets when traffic, citizens and children are there.
- One respondent suggested that the City could require that all residents and commercial businesses have both trash and recycling collection. Traditionally, there has been a significant decrease in illegal dumping, particularly on the commercial side, when this type of service is required by the local government.
- Each of the haulers interviewed expressed a need for the City to listen to the suggestions from the licensed haulers. It was indicated that the last time haulers were surveyed by the City, the feedback was ignored.
- One hauler expressed concern that there are currently haulers that have no identification on their trucks and are operating trucks without safety equipment. It was suggested that the City should require a DOT level inspection on haul trucks with enforcement in order for a hauler to maintain a City license.
- One hauler suggested that solid waste is a health and human services issue, and should be recognized and enforced as such.

Problem Materials/Recycling:

Respondents were asked what materials should be included in the base services to customers, and what materials are creating a problem for collection services. There was consensus among the respondents that the current recycling ordinance and requirements are negatively affecting their businesses. The following are key responses from the haulers that participated in the survey.

- All of the respondents indicated that the current City of Sioux Falls recycling ordinance is unfavorable and discriminatory. It was suggested that it needs to be reviewed for usability and be equitable for all licensed haulers whether they are curbside haulers, or commercial/C&D haulers.
- All of the respondents indicated that the City needs to expand recycling commodities. It was reported that there are many recyclable commodities, in addition to the EPA recyclable commodities, that could be counted towards the recycling rate.
- All of the respondents indicated that competition needs to be established for end destination of recyclables. It was reported that there is currently only one facility accepting recyclables. The current MRF is charging additional fees on top of the single stream fee. Haulers to the MRF are getting surcharges, in addition to the recycling fee, for moisture, glass and contamination. Fees are up to $100.00 per ton at the MRF in addition to the regular per ton fee. There is no basis for the surcharges from the MRF.
- All of the respondents indicated that there is limited-to-no enforcement of the current recycling ordinance by the City.
- One respondent suggested that the MRF should contract directly with haulers for recycling pickup.
- All of the respondents indicated that there is a need for more education and outreach to citizens. The average citizen does not understand what can and cannot go in the recycling can.

- All of the respondents indicated that the landfill is no longer accepting glass, and the MRF is charging a surcharge to accept glass. It was suggested that the City needs to review its recycling policies.

Landfill Efficiency and Convenience Improvement Suggestions:

Respondents were asked for suggestions to improve efficiency and convenience for them at the landfill. There were a variety of responses, including the following:

- One respondent indicated that the landfill operates efficiently.
- All of the respondents reported being 90% to 100% full when tipping loads at the landfill.
- All of the respondents reported typically spending between 15 and 45 minutes at the face, depending on landfill conditions, though one hauler reported as much as a two hour wait due to conditions at the landfill.
- Several respondents brought up concerns over safety issues at the landfill. Feedback included: the landfill needs to establish a safety plan; trucks are not properly spaced when tipping waste at the face, which puts haulers trucks at risk for damage and puts employees at risk for injury; safety equipment, including orange safety vests and hardhats, should be required in the tipping area.
- Most of the respondents indicated that the roads on site need improvement.
- A majority of respondents indicated that the active face area needs maintenance and improvement, including pushing waste more often, removing mud during the rainy season, dust abatement in the summer, and an all-weather asphalt pad.
- A majority of respondents expressed a need and desire for the City to work cooperatively with the licensed haulers at the landfill face. It was suggested that there should be more equitable treatment for all haulers.
- A few respondents indicated that the landfill needs better qualified, full time staff running equipment.
- One respondent suggested that the City should consider staggering breaks for the landfill employees at the face, so the piles of waste are continually moved, giving better accessibility to the tipping area.
- A few respondents suggested that the City should operate the landfill like a business, including better hours of operation.
- One respondent suggested that the City shouldn’t charge the citizens if they bring in waste from roadside ditches and illegal dumping.
- A few respondents requested that the City enforce the covered load ordinance.

Organized Collection/Franchise:

Respondents were asked, if the City decided to organize collection, potentially with a franchise system, what would be suggested to include in the process. There was consensus among the respondents that they were opposed to the idea of franchising. The following are responses:

- All of the respondents indicated that the City should not limit free enterprise. It was stated that the current system gives the City residents the ability to select their own haulers based on their needs.
- A few respondents pointed out that a franchise system would eliminate the small haulers, as they could not compete with the large companies.
- One respondent suggested that the City should leave the system competitive but limit the amount of licenses issued, possibly on a per-capita basis; adding that all current haulers could be grandfathered in with the ability to sell licenses.

- All of the respondents indicated that the current haulers should be protected because they have a lot of money invested.
- One respondent suggested that the City should stop additional license issuance, and allow haulers to sell their licenses or establish a bid process for sale of licenses.
- One respondent suggested that the City needs to proceed with caution on franchising, adding that the last time this issue was brought up there was a firestorm of public outcry.

Transfer Station:

Respondents were asked if they felt that a transfer station located somewhere in the City would be helpful to collection services. Four (4) respondents felt that a transfer station might be helpful while nine (9) felt a transfer station would not help their operations. The majority felt that a transfer station would cause significant rate increases to the citizens due to additional handling and transport of waste, would put additional heavy truck traffic on City streets, and would not be a significant benefit due to the current proximity of the landfill to haul routes.

Conclusions:

As indicated at the beginning of this report, the goal of this summary is to focus on key survey responses. Primary takeaways from the survey effort include the following.

- The City and haulers could work cooperatively to come up with a strategy to move away from the current walk up service for garbage collection, allowing for the improved efficiency and safety of curbside collection and possibility of automated collection.
- The current City recycling ordinance should be reviewed, and potentially revised, for more equitable regulation and enforcement, as well as the potential to increase diversion with more materials.
- Competition appears to be needed for the processing/ end use of recyclables. The City should review the current recycling system including costs, commodities and surcharges.
- Opportunities for cooperation between the haulers and landfill staff should be explored.
- There was consensus that the respondents were opposed to the idea of franchising. It was felt that the current free-enterprise system is working well and that the City should proceed cautiously on this issue.
- There appears to be a need to address safety and operational issues at the landfill.
- Construction of a transfer station does not currently appear to be of significant benefit to the haulers.
- The respondents were cooperative and open in their responses to the survey, and were supportive of working together with the City to make improvements to solid waste management.

HDR would like to thank all of the haulers that took the time to speak with us on this effort. We appreciate their candor and willingness to share ideas to improve the overall solid waste system.

ATTACHMENT:

CITY OF SIOUX FALLS
HAULER QUESTIONNAIRE

1. What ideas would you suggest, as a hauler, to meet the following needs of the City of Sioux Falls:
   a. Reducing garbage truck traffic on City streets and alleys.
   b. Reducing littering and illegal dumping.
   c. Ensuring a consistent level of service to the customers.
   d. Ensuring consistent rates to the customers.
   e. Increasing recycling opportunities/commodities.
   f. Other Ideas.
2. What do you feel should be included in base services to the customers in addition to solid waste curbside collection?
   a. Recycling.
   b. Yard Waste (seasonal).
   c. Bulky Items.
   d. Difficult to manage items such as tires or used oil.
   e. Senior Discount.
   f. Other (i.e. Christmas tree collection, food waste, residential sharps, back door/side door/ carry out service).
3. How efficient are the routes you currently run:
   a. How full are vehicles when you go to the landfill?
   b. How many miles per day, on average, do you travel?
   c. How many homes (or businesses) per day, on average, do you service?
   d. How many hours per day, on average, do you spend on collection routes?
   e. How much time do you spend at the landfill?
4. What, if any, materials do you feel are creating a problem for providing your collection services? (Please describe the material and the problems it causes.)
5. As the City of Sioux Falls moves forward with the Solid Waste Management Planning Process, what suggestions would you make to improve efficiency and convenience for you at the landfill?
6. As the City of Sioux Falls moves forward with the Solid Waste Management Planning Process, do you feel that a transfer station located somewhere in the City would be helpful to your collection service?
7. If the City of Sioux Falls decided to organize collection, potentially with a franchise system, what would you suggest be included in the process?
   a. Issuance of multiple franchises (non-exclusive) which allows for competition within the same area, though the number of franchise holders may be limited?
   b. Issuance of an RFP by the City of Sioux Falls with designated multiple exclusive franchise areas?
   c. Issuance of a single exclusive franchise for residential services only, leaving commercial open/subscription?
   d. Issuance of a single exclusive franchise for residential and commercial services?
   e. Issuance of separate exclusive franchises, one for commercial and one for residential services?
   f. Assigning a specific collection day in designated areas.
   g. Limiting the number of haulers in the City and letting the resident select.
   h. Other suggestions for changes to the current system.
8. What other ideas or suggestions would you like to share with the City as part of this process to improve the current system?

City of Sioux Falls

Solid Waste Management Master Plan

Stakeholder Workshop

February 16, 2017

A Comprehensive Solid Waste Management Master Plan will serve as Sioux Falls' roadmap for the next 30 years.

01 Project Overview

02 Goals for the Solid Waste Management Master Plan

03 Overview of the Current Solid Waste System

04 Group Discussion: General Thoughts and Priorities

05 Group Discussion: Recap Potential Strategies and Modifications, Additional Research, Additional Strategies

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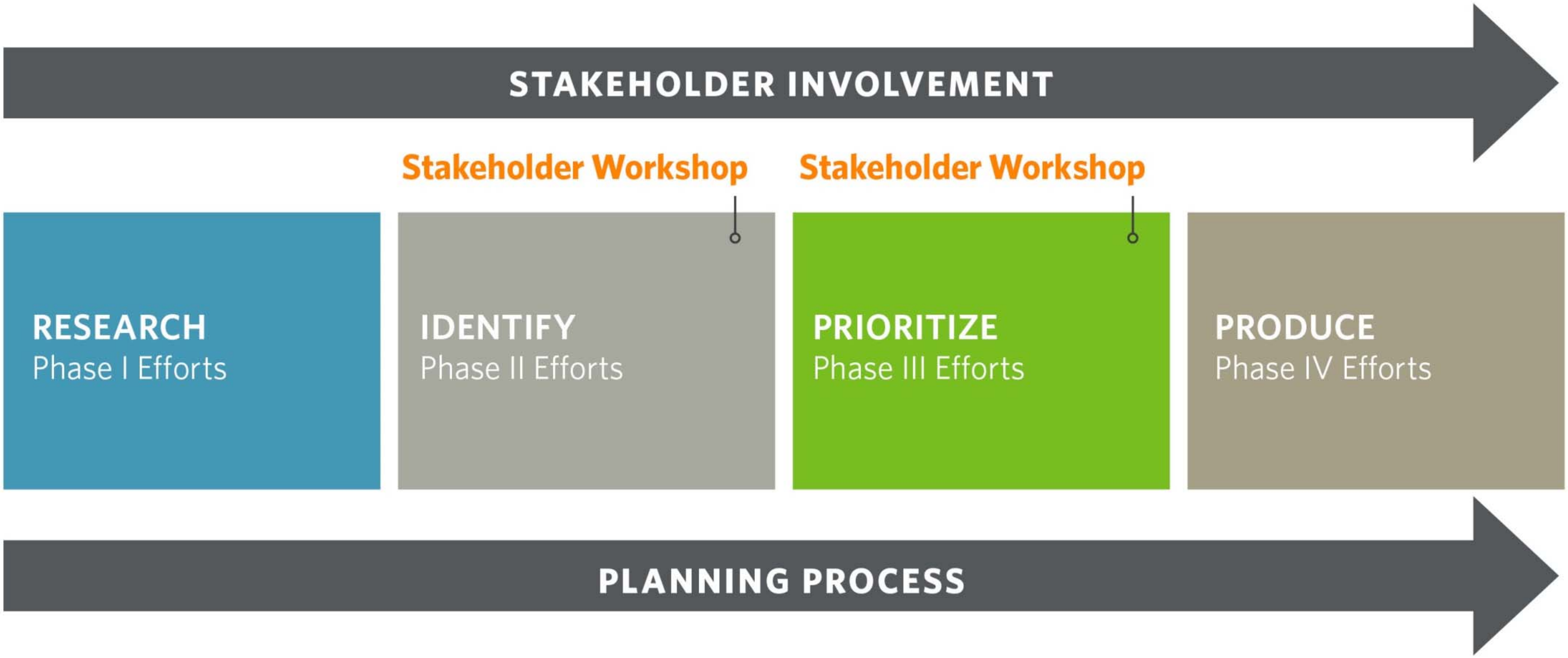
01 Project Overview

Project Drivers

- Develop a 30-year comprehensive Solid Waste Management Master Plan (SWMMP)
- SWMMP should build on the City's Sustainability Master Plan
- SWMMP should evaluate the City's existing solid waste system, and improvements to enhance the system

Project Overview



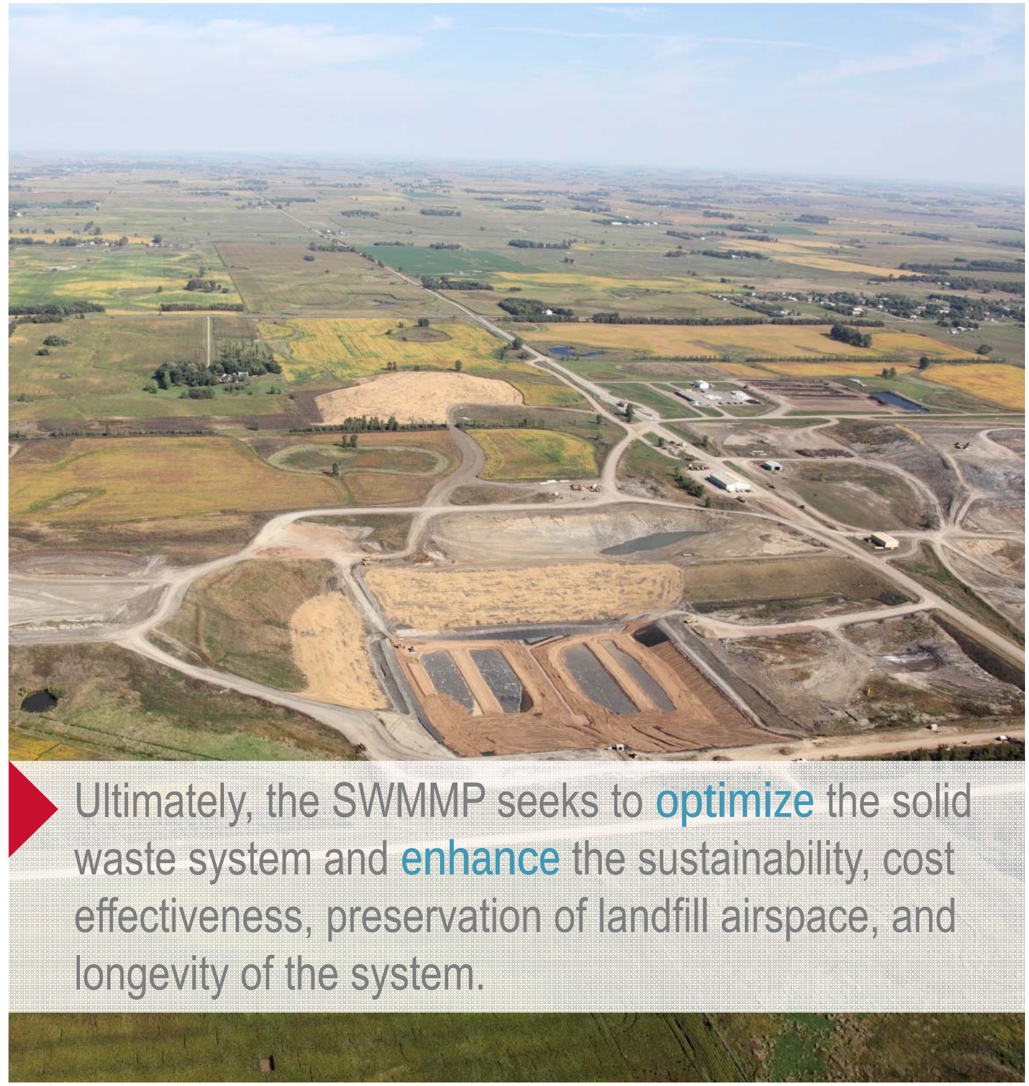
Project Overview

TASK NO.	TASK DESCRIPTION
1	Waste Characterization
2	Waste Collection Alternatives
3	C&D MRF and Integrated Facility Options
4	Key Landfill Operational Issues
5	Waste Generation and Disposal Projections
6	Pending Legislative and Regulatory Framework
7	Public Education Program
8	Emerging Technologies
9	Household Hazardous Waste and Problem Materials Management
10	Identify Innovative Green Projects
11	Transfer Station
12	Long-Term Landfill Gas Options
13	Stakeholder Input Process
14	Monitoring the Master Plan Implementation
15	Prepare Solid Waste Management Master Plan

02 Goals for the Solid Waste Management Master Plan

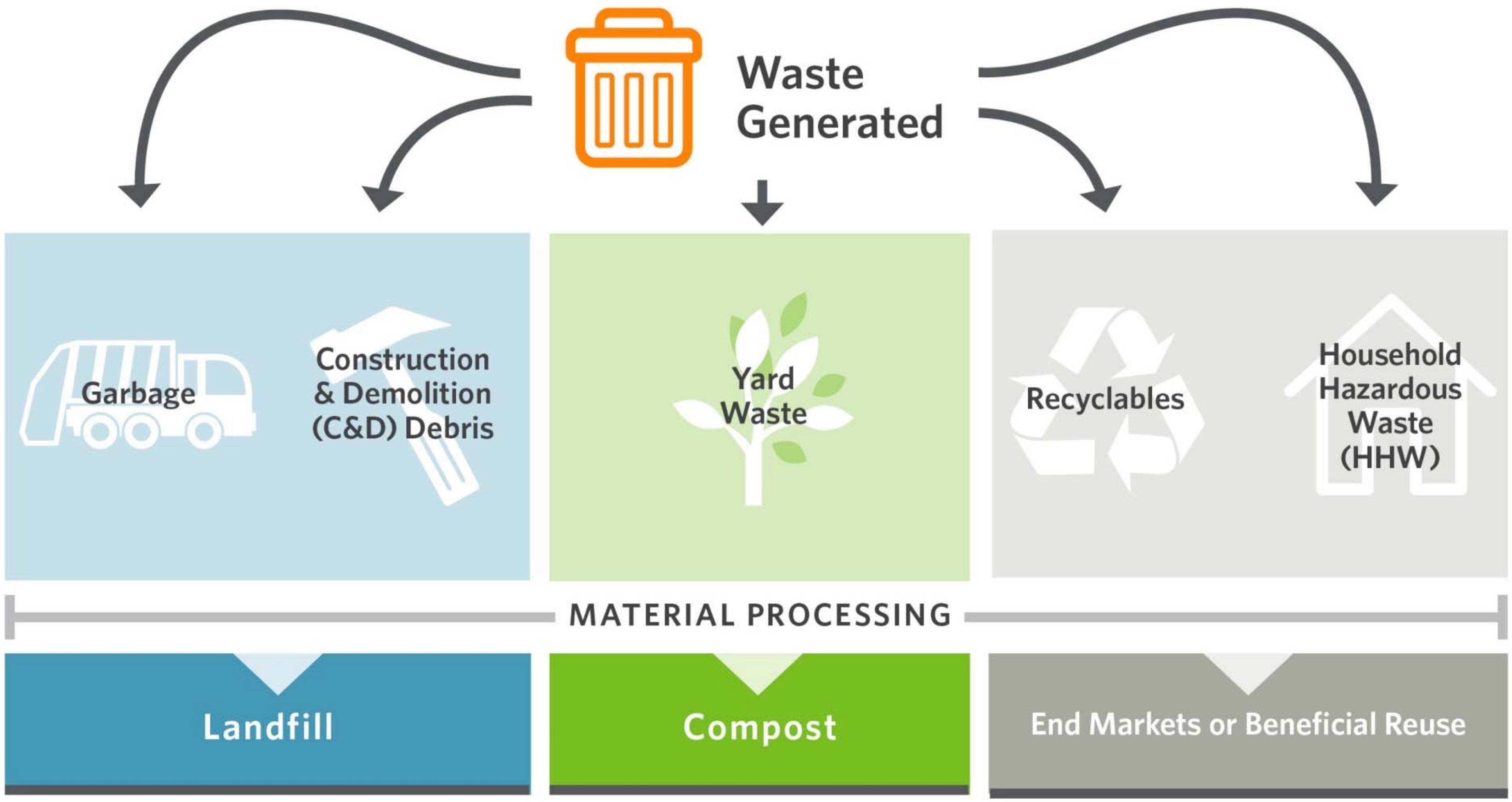
Goals of the Solid Waste Master Plan

- Build and maintain an integrated, sustainable solid waste management system
- Continue to increase recycling and reuse opportunities
- Streamline collection practices
- Maintain the cleanliness of our region
- Protect the public and environment
- Facilitate public input on the system, and develop public education of the master plan

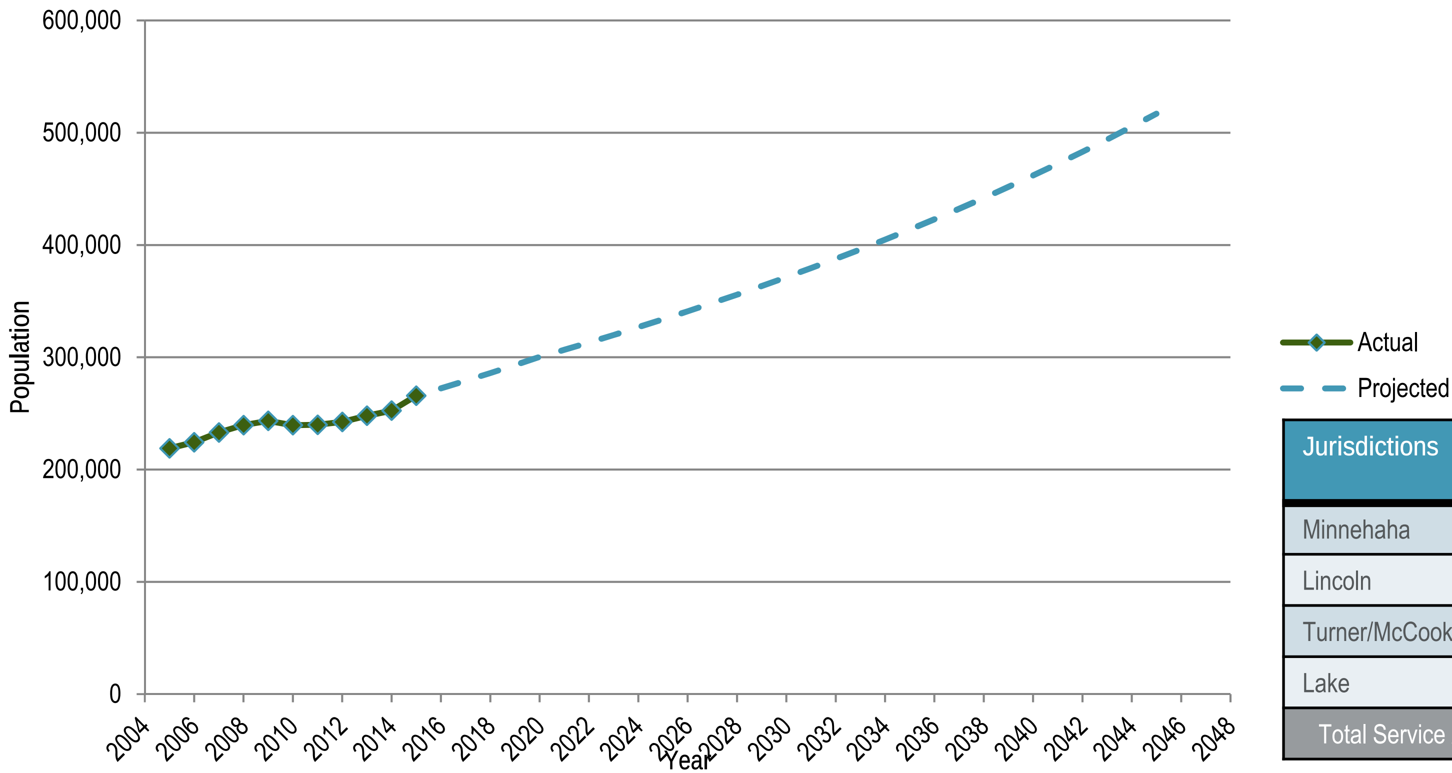


03 Overview of the Current System

Overview of City’s Current System



Historical & Projected Service Area Population



Jurisdictions	2015 Population
Minnehaha	185,179
Lincoln	53,000
Turner/McCook	15,050
Lake	12,622
Total Service Area	265,851

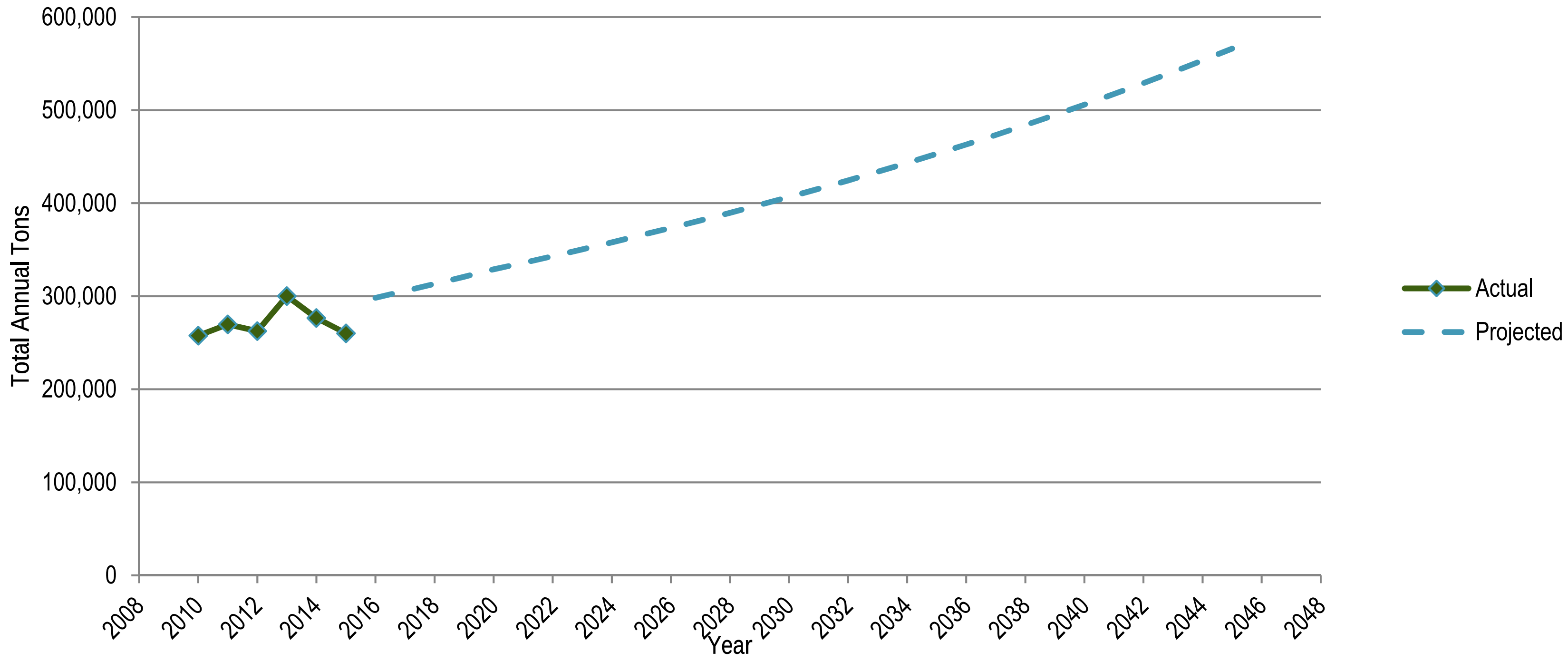
Source: U.S. Census (historical); U.S. Census and SHAPE Sioux Falls (projected)

Per Capita Generation Rates by Material Type

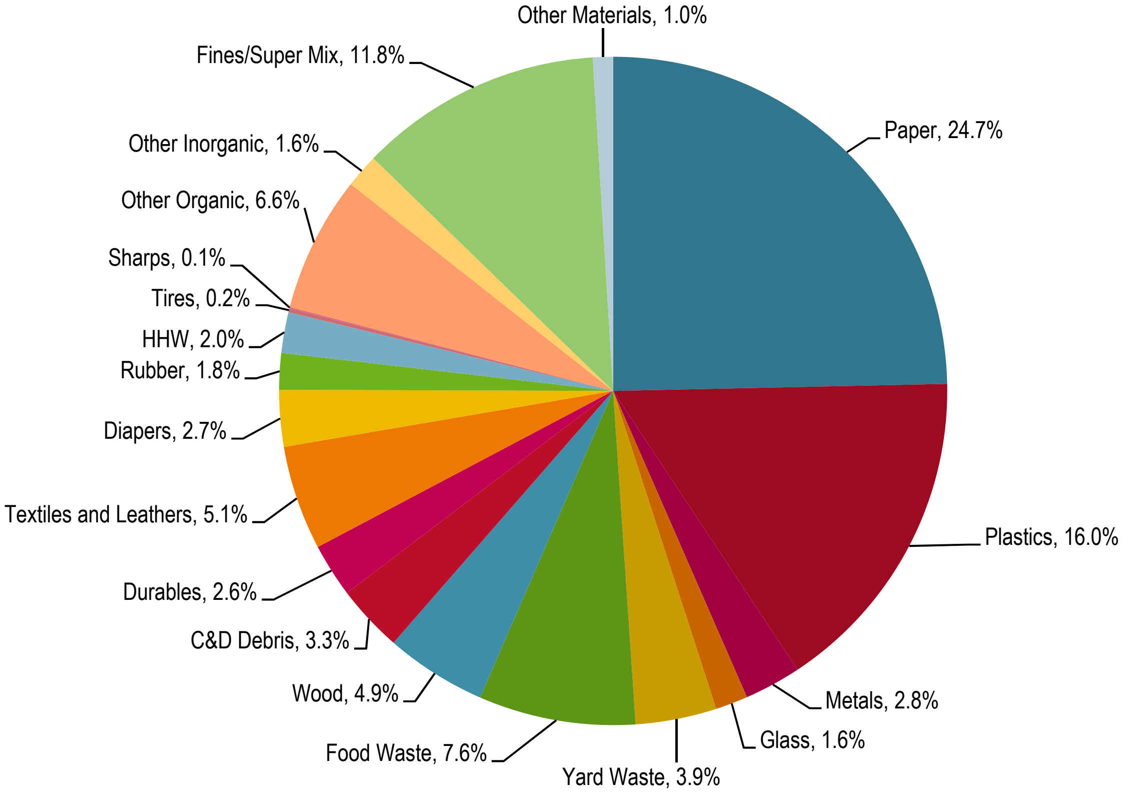
Based on Five Year Historical Average

Per Capita Generation Rates by Material	Tons per Year
MSW	0.67
Yard Waste	0.03
C&D	0.32
Wood Waste	0.03
Mattresses	0.0011
Asbestos	0.0009
Contaminated Soil	0.04
Tires	0.002
Total	1.09

Waste Generation Projections



Composition of Municipal Solid Waste Disposed at Landfill

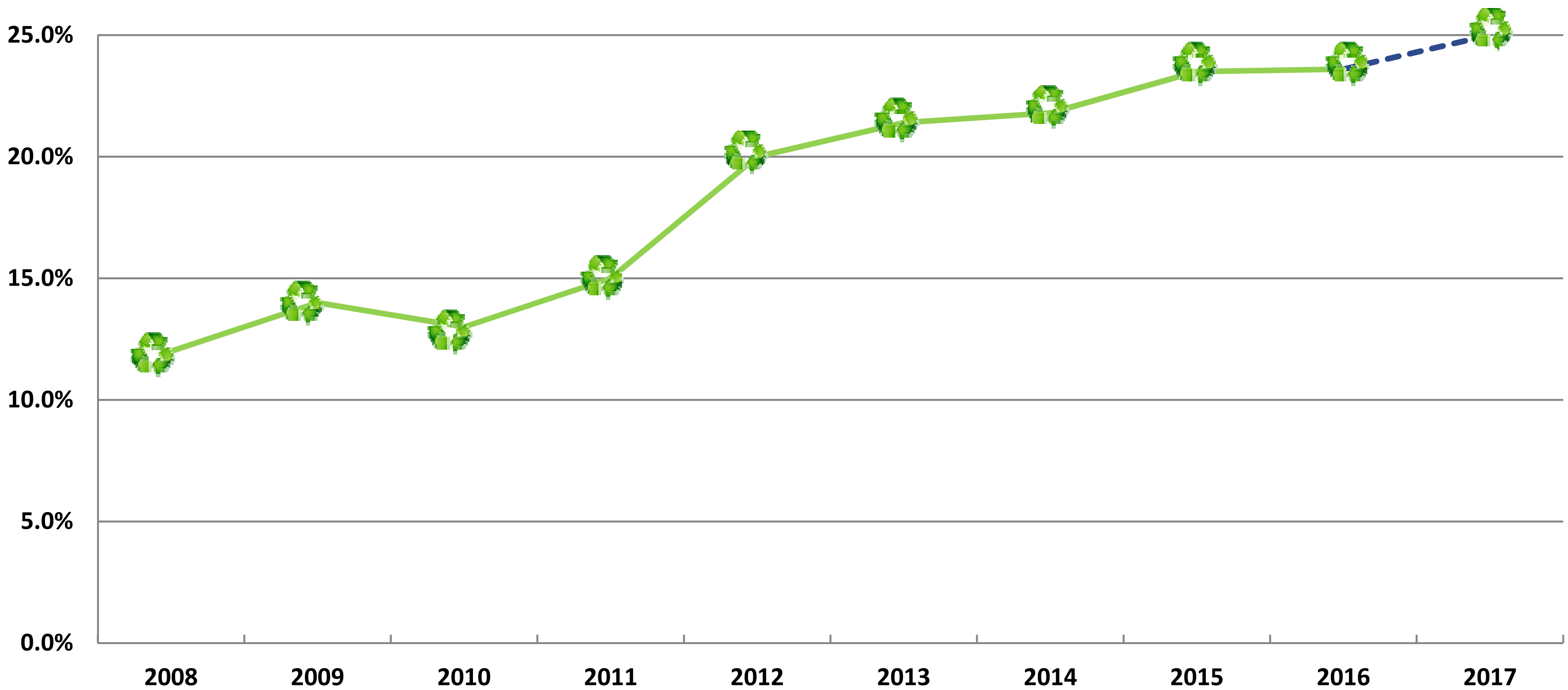


Source: HDR Waste Characterization Study, June 2016

Recycling in Sioux Falls

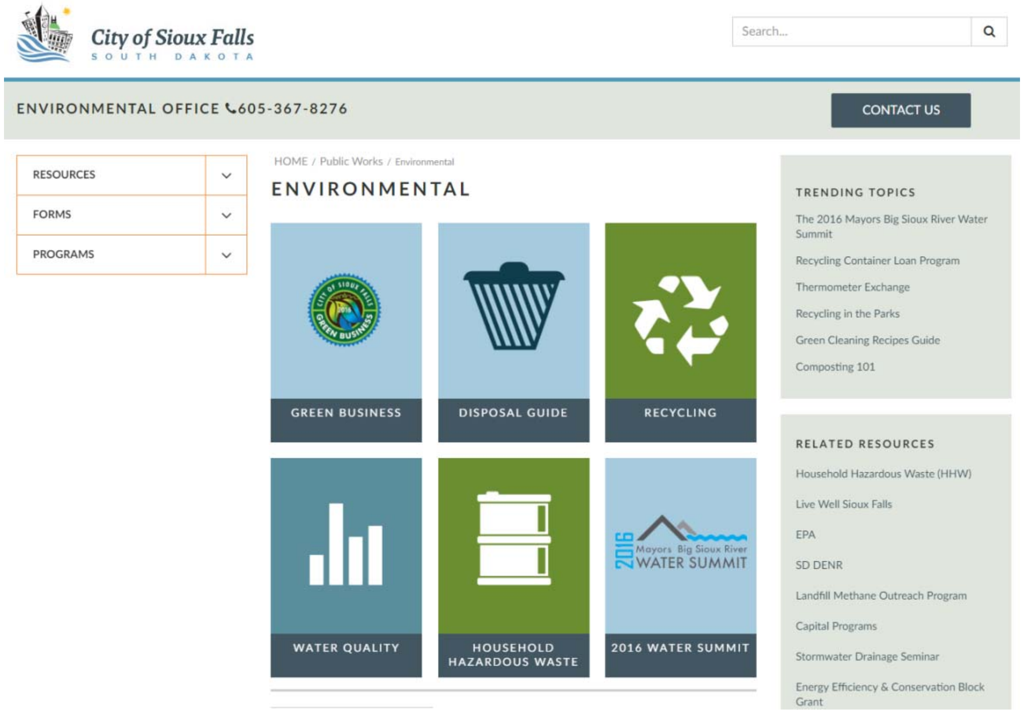
- Sioux Falls' goal: increase recycling from 12% to 25% by 2017
- Certain recyclable materials banned from the landfill, per ordinance
- Residents and businesses are required to recycle
- Recycling collection services are provided by private waste hauling companies
  - Each of these companies uses a single-stream system
  - Each hauler reports to City in order to measure recycling rate
  - 2016 Waste Hauler Recycling Rate: 23.5%

Waste Hauler Recycling Progress



Current Public Education Summary

- Solid Waste Planning Board
  - Members are selected by the mayor
  - Tasked with improving recycling and solid waste issue in Sioux Falls
- Classroom education program and a recycling education kit
- Program resources on the environmental page
  - The site offers links to program details, recycling guides, downloadable education
- Active presence on Facebook and Twitter
- YouTube channel with playlists dedicated to different city offices
- Recycling fliers to all households twice a year



Current Collection Services Summary

- The City's current collection system is commonly referred to as an "open" or "subscription" based collection service
- Licenses are issued by the Public Works Department
- Twenty-five haulers are licensed to collect garbage and recyclables in the City
- City requires haulers to offer recycling collection services, and residents are required to recycle
- Construction and demolition debris (C&D) haulers used to not have to hold a City-issued license (but do now, starting in 2017)

Current Household Hazardous Waste and Problem Materials Handling Summary

Household Hazardous Waste Facility (HHWF)

- The HHWF takes hazardous waste that can't be put into recycling or landfills
- No charge for residents of Lake, Lincoln, McCook, Minnehaha, or Turner Counties
- Materials must be in containers ≤ 5 gallons
- Leave materials in tightly sealed, original containers when possible
- NEVER mix household hazardous waste items
- Drive under the awning of the HHW Facility and the staff will unload your waste for you

Location:

1015 E. Chambers St.
Sioux Falls, SD 57104

Hours of Operation:

Tues.-Friday: 8am to 5 pm
Saturday: 8 am to 12 pm

Items accepted…

- Automotive Chemicals
- Lawn Care Chemicals
- Household Chemicals
- Home Improvement Chemicals
- Electronics
- Microwaves

Over 2 million pounds in 2015!

HHWF Reuse Room

- Items still in good, reusable condition are placed in the Reuse Room for redistribution to the public
- Must be a resident of the 5 county region in order to take items
- Limit of 3 items per week

Reuse Room is located on the front side of the Environmental Division Offices building.

Sioux Falls Regional Sanitary Landfill Current Operations

- Largest permitted landfill in the State of South Dakota
- Five county region contributes to disposal of MSW and C&D
- Simultaneous disposal of MSW and C&D as two separate waste streams in two discrete landfills
- Other waste management initiatives at the Landfill include:
  - The public drop off area includes the collection of MSW and recyclables such as white goods, yard waste, wood palettes, lawn mowers, scrap metal, tires
  - Yard waste is composted on a portion of the property, and there is a wood recycling area south and adjacent to the compost pad area
- Landfill gas from the MSW landfill is collected and processed before being directed to the POET ethanol plant to be used as a fuel source

Yard Waste and Compost Programs

- Yard waste can be composted at home or you can take your yard waste to the landfill which will then be composted there
- Finished compost is available to residents for FREE at the landfill.

04 General Thoughts for the Solid Waste System

General Thoughts

Group Discussion

- What do you like about the current system?
- What don't you like about current system?
- What priorities and goals do you feel the City should keep in mind?
    - Aesthetics
    - Convenience
    - Cost
    - Environmental Stewardship

05 Potential Modifications to the System

- Public Education and Outreach
- Collection and Transfer System
- HHW and Problem Materials
- Alternative Technologies
- Other Innovative Green Projects

Public Education Benchmarking Results

Communication Tactic	Sioux Falls, SD	Sioux City, IA	Saint Paul, MN	Fargo, ND	Lincoln, NE
Dedicated Recycling Webpage		●		●	●
Public Works/Environmental Webpage or Other	●		●		
Dedicated Social Media	●	●			●
City Social Media			●	●	●
Paid Advertising	●		●	●	●
Public Service Announcements	●		●		●
Meetings	●	●			●
Primary Education Curriculum	●			●	●
Video	●			●	
Recycling Guide	●	●	●	●	●
Stickers	●				
Television/Radio	●				
Tours/Classes	●	●		●	●
Special Events	●	●	●	●	●
Direct Mailings	●		●	●	●
Infographics			●		
Advisory Board	●	●			
Survey			●	●	
Branding				●	
Earned Media	●	●	●	●	●
Pop-up/Mobile Events			●		

Public Education and Outreach

Current Successes

- Relationship building with local haulers
- The support and encouragement by the Mayor’s office
- Private haulers throughout the community work well with the City recycling coordinator
- The haulers involvement in the Planning Board provides them a seat at the table and encourages open dialogue about the goals and implementation of the program
- The City sets recycling goals each year
- In 2014, Sioux Falls had a record setting year and surpassed their desired goal
- Enforcement of requirements helps to meet this goal
- Individual haulers are required to meet at least 80 percent of the city’s recycling goal or fines will be imposed. Haulers who exceed the goal can qualify for incentives provided by the city.

Public Education and Outreach

Current Challenges

- Since transitioning to single-stream recycling collection, contamination has remained a concern
- The City has worked to combat the issue with education and outreach regarding contamination
- The City attempts to explain the importance of properly sorting through earned media opportunities, social media, and public service announcements

Public Education and Outreach

Your Opinions on the Initial Recommendations

Adopt Core Values for Recycling Education

- Values should be a result of community based conversation
- Have varying stakeholders and users weigh-in on core values
- Solid Waste Planning Board might champion this initiative

Information Delivery

- Move away from primarily traditional forms of communication (flyers, mailers)
- In our digital world, communities are more reliant on mobile devices for alerts, notifications, and engagement opportunities that are accommodating to a flexible schedule

Public Education and Outreach

Your Opinions on the Initial Recommendations

Frequent Engagement

- Develop a consistent relationship with haulers and residents
- Key to behavioral change
- Coupled with a prominent brand identity

Access and Ease-of-Use

- The current website offers a variety of resources
- Strengthen the organization and accessibility of the website
- Minimize the number of “clicks” a user will have to go through to access their desired resource

Public Education and Outreach

Your Opinions on the Initial Recommendations

Visual Communications

- We are visual in nature and are more likely to relate and remember information when presented in visual mediums
- Continue use of videos and graphical materials
- Tools should use consistent and targeted messaging

Earned Media/Social Media vs. Paid Media

- Earned media: the opportunities for media coverage that is not paid for
- Cost effective way to communicate and promote programs
- Develop a social media framework for communication
- Actively engaging followers on social media
- Keep posts timely, relevant, and interesting

Public Education and Outreach

Feedback from the last workshop

- With mailers, it only reaches the one who looks at it (may not be everyone in the home).
- Electronic means can reach a larger audiences.
- Businesses can stream content provided by the City in break rooms or common areas; businesses want to support the community.
- Electronic billboards on main streets seem to be effective - everyone sees them.
- One HOA just completed a customer survey through Survey Monkey, and there was consensus that the residents of that HOA prefers email communications to hard copy/ paper communications. Facebook communications was a close second to emails.
- Some concern expressed about email since some people do not have smart phones.
- Fewer clicks on the City website to get to the information you are looking for would be better.
- If you use email, you will need the email address, and that can be a challenge.
- Can haulers put stickers on containers to inform residents of what materials can be recycled?
- Can we move toward more consistency on recycling? E.g. Gas stations do not have recycling containers.
- How much are we doing with schools? Can we incentivize school/students?

Collection System Options

- Open or Subscription
- Municipal
- Franchise or Contract

Collection System Types

Open/Subscription Collection	
Advantages	**Disadvantages**
• Customer choice in service providers	• Multiple large vehicles traveling on the same streets
• Multiple haulers, including local/independent haulers, can provide service	• Increased risk to public safety • More emissions • More wear and tear on roads

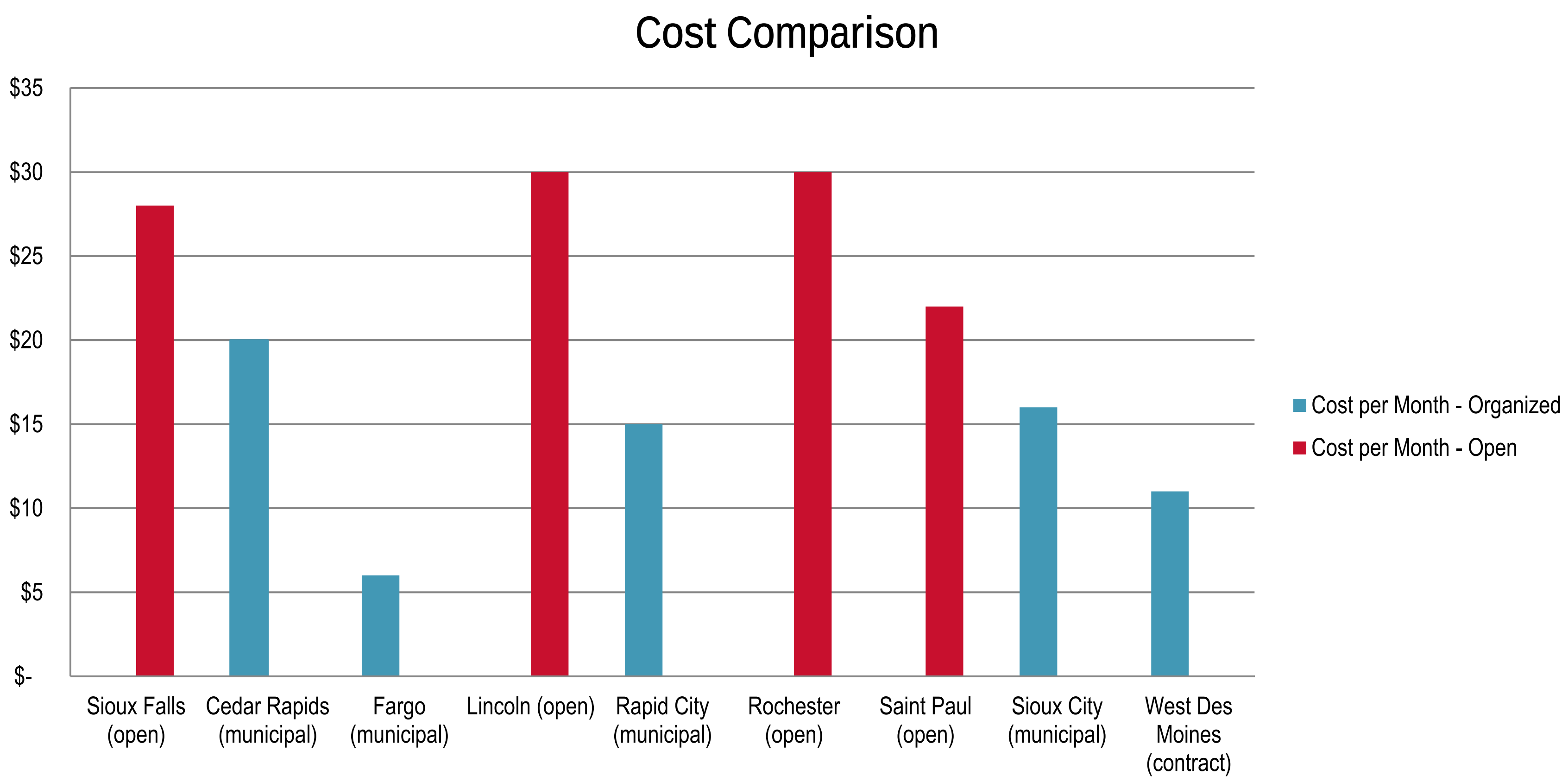
Municipal Collection	
Advantages	**Disadvantages**
• Less large vehicle traffic on streets (increased public safety, fewer emissions, less wear and tear on roads) • Economies of scale with one service provider could mean more efficient and therefore less expensive collection costs	• Customers do not get a choice in service provider • Implementation could displace some haulers

Franchised or Contracted Collection	
Advantages	**Disadvantages**
• One hauler/ agreement to administer • Guaranteed customer base and economies of scale • Recycling participation may increase if residents are required to pay for the service • Less large vehicle traffic on streets (increased public safety, fewer emissions, less wear and tear on roads)	• Customers do not get a choice in service provider • Implementation could displace some haulers

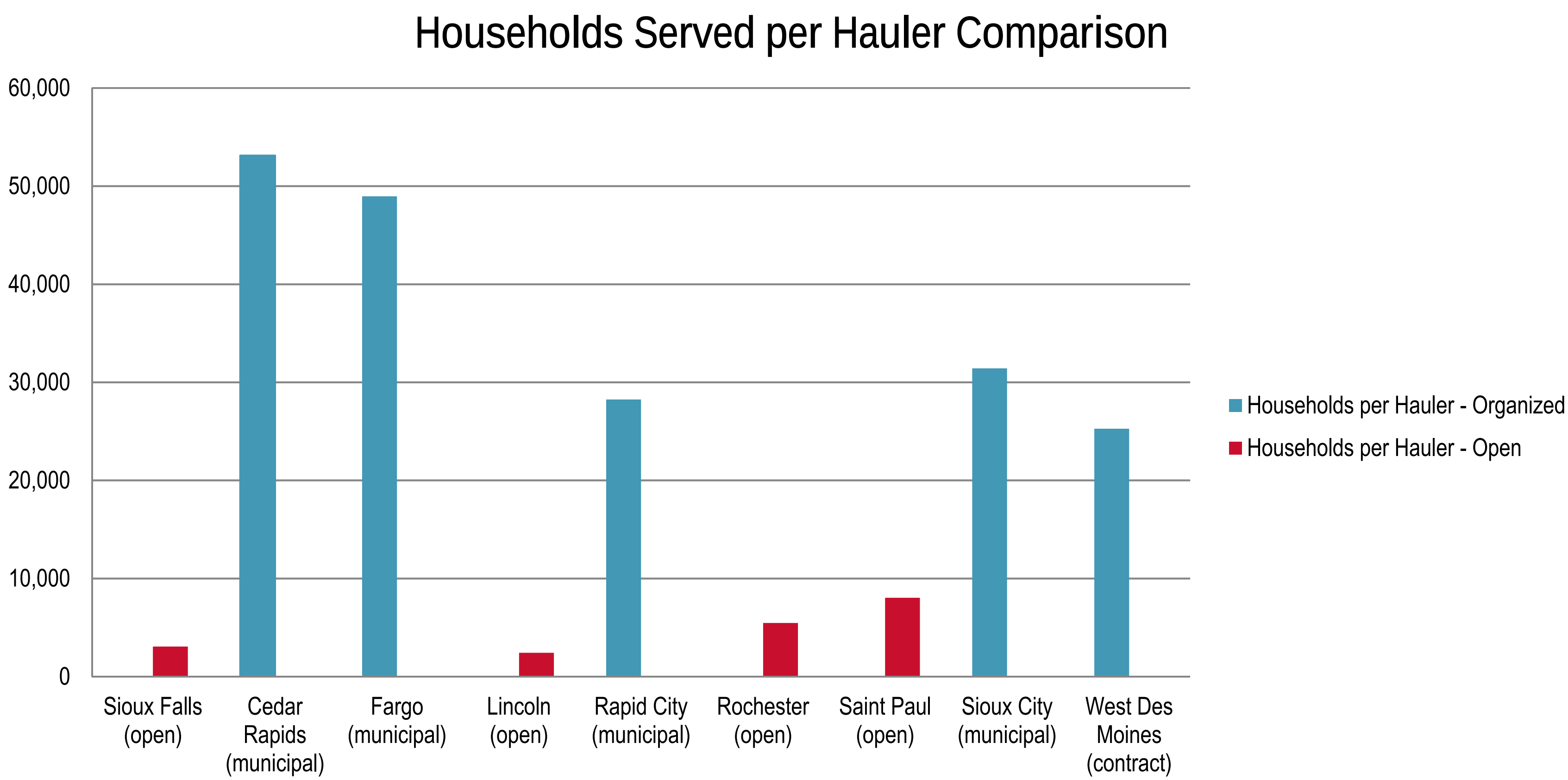
Collection Benchmarking Results

Community	Provider	Garbage Rate	Recycling Rate	Yard Waste Rate	Total
Sioux Falls, SD	O	Range: $15 to $35	Included with Garbage	Range: $13 to $18 (seasonal)	Range: $28 to $53
Cedar Rapids, IA	M	$16.02 35-Gal Cart; $1.50 for Additional Stickers	$4.30	Included with garbage	$20.32
Fargo, ND	M	42-gal $6 64-gal $9 96-gal $14	No additional charge (optional)	Not included	$6 to $14
Lincoln, NE	O	$20 avg.	$10 avg.	Included with garbage	$30
Rapid City, SD	M	35-gal $14.99/month 64-gal $16.83/month 96-gal $18.68/month	Included with garbage	Included with garbage	$14.99 to $18.68
Rochester/Olmstead County, MN	O	$30 avg.	Included with garbage	Not included	$30
Saint Paul, MN	O	30-38 gallons: avg. $22; 50 to 68 gallons: avg. $27.19; 90 to 96 gallons: avg. $27.23	Unknown	Unknown	$22 to $27.23
Sioux City, IA	M	$16.30 + $1 per extra bag	Included with garbage	Not included	$16.30
West Des Moines, IA	C	$7.96 48 gal. $8.66 96 gal.	$2.59	PAYT – stickers and bags	$10.55 to $11.25

Collection Benchmarking Results



Collection Benchmarking Results



Collection System Potential Modifications

Feedback from the last workshop

- Can commercial and residential customers be treated the same? May not be able to due to difference in collection services and needs.
- Is there a way the City can do something to make the current system less chaotic without fully taking over collection with just one hauler?
- Can garbage trucks/staff double for snow plowing or other city functions?
- The disadvantage to having only one hauler is if they go on strike, no one is picking up the garbage (aesthetics, odors, public safety)
- Some people have relationships with their hauler
- Overall, folks want some better organization, but not really restricted to just one hauler
- Low unemployment, and drivers/collectors bouncing around between companies can make it difficult to staff collection services
- Group was surprised to see that open rates are higher than organized collection rates.
- Could garbage collection crews be used to do something else? (Snow Plow?)
- Really do see multiple trucks on the same street, and it sometimes is a bottle neck for traffic, but not a big issue.
- Can the City organize collection without putting haulers out of business?
- Can the City organize collection and encourage current workforce to move into other areas?
- Keep it local if you franchise.
- Can we ask haulers for metrics like vehicle hours? Full trips? Efficient routes?
- Wear and tear on the roads: what do multiple collection vehicles really do to the roads?
- Can haulers have standards on trash containers (consistency)?
- Having multiple trucks on multiple days is a problem, in the opinion of some.
- If the City were to organize, the group generally thought municipal collection would be preferred.

Collection System Potential Modifications

Feedback from the haulers

Curbside Collection Efficiency and Convenience Improvement Suggestions:

- Each of the respondents that collect from dumpsters expressed some concern over illegal dumping. Feedback included the following: the City needs to address illegal dumping in dumpsters; it is a huge problem in commercial dumpsters; need enforcement with a community awareness advertising campaign.
- A few of the respondents suggested that the City should move away from walk up service, and allow cans to be on the curb. Related feedback included: this change would allow haulers to upgrade to automated collection vehicles; there is a high rate of injuries to hauler employees under the current system, liability for accessing private property is an issue and inefficiency in providing the service under the current system drives up the rates to customers.
- A few of the respondents suggested that allowing earlier routes would help hauling time and efficiency, and allow truck traffic to be off the City streets when traffic, citizens and children are there.
- One respondent suggested that the City could require that all residents and commercial businesses have both trash and recycling collection. Traditionally, there has been a significant decrease in illegal dumping, particularly on the commercial side, when this type of service is required by the local government.
- Each of the haulers interviewed expressed a need for the City to listen to the suggestions from the licensed haulers. It was indicated that the last time haulers were surveyed by the City, the feedback was ignored.
- One hauler expressed concern that there are currently haulers that have no identification on their trucks and are operating trucks without safety equipment. It was suggested that the City should require a DOT level inspection on haul trucks with enforcement in order for a hauler to maintain a City license.
- One hauler suggested that solid waste is a health and human services issue, and should be recognized and enforced as such.

Collection System Potential Modifications

Feedback from the haulers

Organized Collection/Franchise:

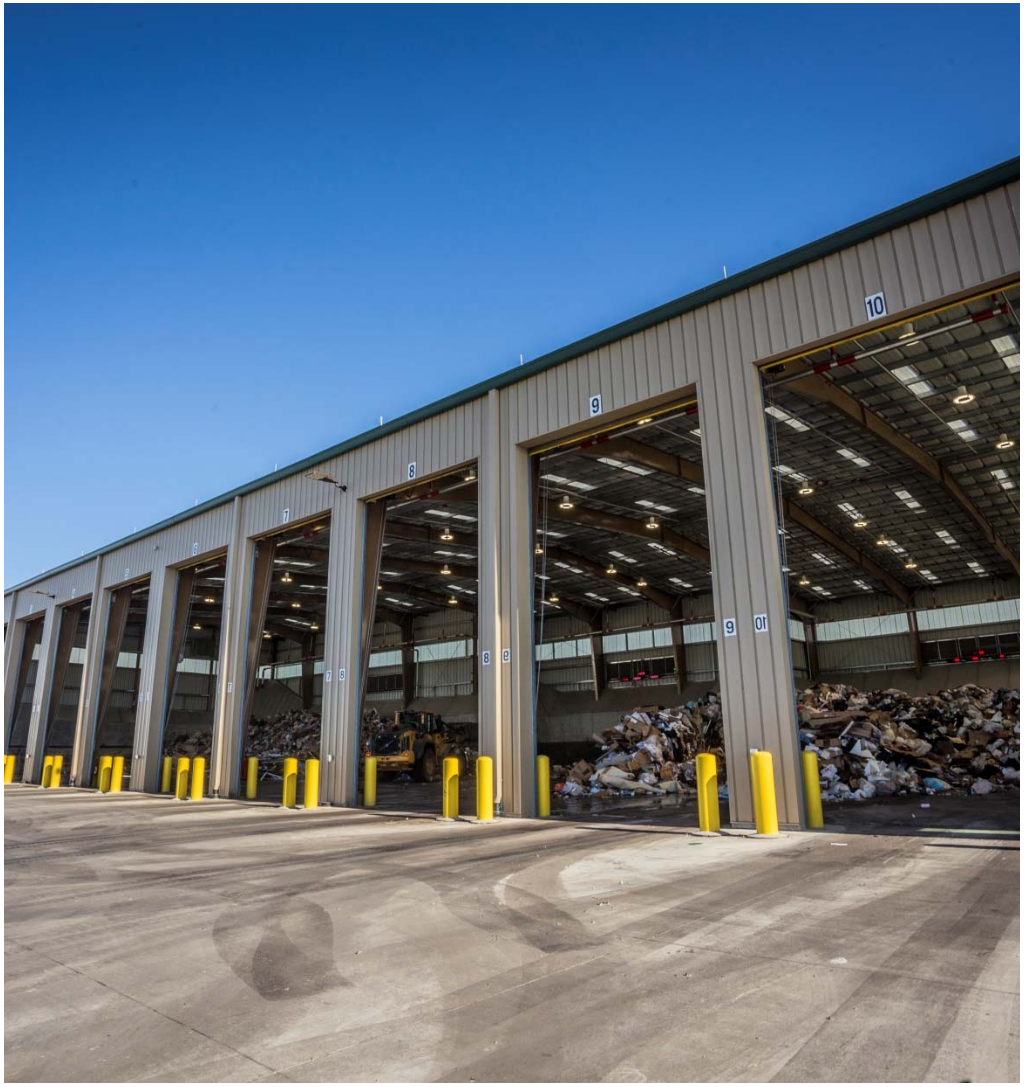
- All of the respondents indicated that the City should not limit free enterprise. It was stated that the current system gives the City residents the ability to select their own haulers based on their needs.
- A few respondents pointed out that a franchise system would eliminate the small haulers, as they could not compete with the large companies.
- One respondent suggested that the City should leave the system competitive but limit the amount of licenses issued, possibly on a per-capita basis; adding that all current haulers could be grandfathered in with the ability to sell licenses.
- All of the respondents indicated that the current haulers should be protected because they have a lot of money invested.
- One respondent suggested that the City should stop additional license issuance, and allow haulers to sell their licenses or establish a bid process for sale of licenses.
- One respondent suggested that the City needs to proceed with caution on franchising, adding that the last time this issue was brought up there was a firestorm of public outcry.

Group Discussion: Additional Thoughts for Collection?

Group Discussion:
Build a Transfer Station

Preliminary work completed:

- The sizing and orientation of the facility to safely and efficiently process the material
  - East-southeast location to balance the travel distance for a majority of the collection routes
- Probable construction cost: Over $18 million with contingencies
- Financial pro forma to determine the estimated annualized and per-ton operations and maintenance costs
  - Estimated cost of $15.94 per ton - includes the transfer and haul operations and the equipment required; all other collection, haul and disposal costs (e.g. tipping fees) are not included
- Hauler interviews included questions relating to opinions on need for and location of a transfer station



Group Discussion: Build a Transfer Station

Feedback from last workshop:

- NIMBY (not in my backyard).
- What is the cost versus the benefit? Is it worth it?
- Noise concerns.
- Can anyone get in? (Safety concerns)
- Would need to be placed in a strategic location, fenced off (perhaps an industrial park location).
- Is double-handling of materials inefficient?
- Some concern expressed about litter/blowing in the city.
- A transfer station could be added customer service and convenience for the haulers, but not necessarily a direct benefit to the city (would add cost to City system)
- Could a transfer station help divert/recycle more?
- General Consensus: does not seem to be a good idea.
- Overall, the group trusts city leaders to make the right financial decision.

Feedback from hauler interviews:

Respondents were asked if they felt that a transfer station located somewhere in the City would be helpful to collection services.

- Four (4) respondents felt that a transfer station might be helpful
- Nine (9) felt a transfer station would not help their operations.
- The majority felt that a transfer station would:
    - cause significant rate increases to the citizens due to additional handling and transport of waste
    - put additional heavy truck traffic on City streets
    - would not be a significant benefit due to the current proximity of the landfill to haul routes.

Group Discussion: Additional Thoughts for Transfer Station?

Group Discussion

HHW and Problem Materials

Feedback from the last workshop:

- Some in the afternoon group did not know it was free to residents.
- One in the group once attempted to drop off as a resident, and it was closed.
- Cars want to come through on Mondays, but the HHW facility is closed on Mondays.
- Tuesday and Saturday are most popular days.
- For commercial generators of HHW, it is common to use Safety Kleen, depending on the type of HHW.
- For some commercial generators, Veolia, through an agreement, takes some HHW/Problem Materials and the company does not have to pay additional fees.
- Some companies have a lot of electronics, which are not a part of CESQG.
- Overall, HHW/Problem Materials are a minor costs for businesses
- The group generally loves the free landfill pass flyers. It has lots of good information. HHW is very efficient.

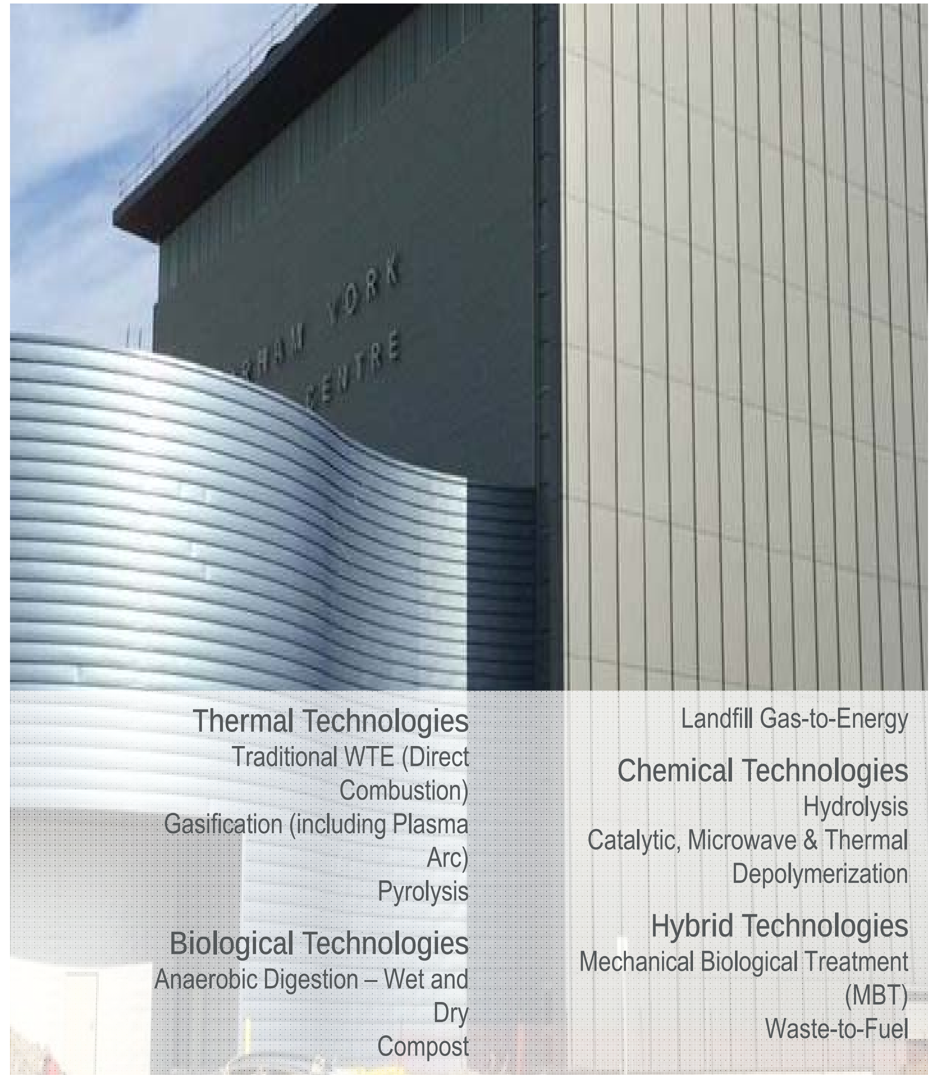
- Everyone in the evening group was aware of the drop off facility, and using it.
- General consensus that it could be used more, and belief that some are throwing it in the garbage.
- Could electronics collected curbside be a part of the bid if city franchises?
- Can the city partner with Ace, Lowes, etc. for collection of HHW/Problem Materials to add to convenience for customers?
- General consensus that the current service is great.
- Used City website to know what can be taken there.
- General consensus: Everyone loves the free pass for the landfill.

Group Discussion: Additional Thoughts on HHW?

Group Discussion:

Alternatives to Landfill

- Many Types of Technologies
- Priorities:
  - Proven Technology
  - Feasible / Commercially Viable
  - Environmentally Sound
- Mechanical Technology Opportunity with Existing Sioux Falls Partner
  - Solid Refuse Fuel (SRF) - Non-Hazardous Secondary Material meeting EPA Requirements
  - SRF Produced From Waste That Would be Diverted From the Landfill
  - Need to Obtain EPA Determination For Process and Fuel
  - Developing Alternatives for a Pilot System to Demonstrate SRF Properties and Process for a Determination



Other Innovative Green Initiatives Previously Discussed

Related to Sustainability Master Plan Goals

- Industrial waste composting, targeting food processing by-products, food waste, and other organic materials generated by regional food processing facilities, dairy operations and possibly food retailers. (Based on the Waste Characterization study, food waste and other organic materials represent approximately 5.6 and 11.6 percent of industrial/commercial institutions (ICI) municipal solid waste, respectively)

- Feedback from last workshop:
  - What about hobby farmers? Agriculture Department regulates farmers, so composting may not be allowed
  - Permit modifications have to be considered for the landfill to take more than yard waste to compost
  - Any POTW that could be diverted as part of industrial waste composting?
  - Are there organics currently going to landfill that could be added to industrial waste composting?
    - Flaxseed type material w/ several thousand pounds per week?
  - Landfill is looking at adding more than yard waste to composting efforts.
  - Processing techniques make a difference in what can be added to compost.

Other Innovative Green Initiatives Previously Discussed

Related to Sustainability Master Plan Goals

- Zoo waste (manure) composting where “Zoo Doo” is produced from herbivore manure and bedding at an on-site aerated static pile and used throughout the facility as plant bedding and mulch.
  - Successfully implemented at the Oregon Zoo since 1988

- Feedback from last workshop:
  - “Zoo Doo” would be great (divert 700 tons/year from the landfill).
  - What can be done with pet waste? Road kill?

Other Innovative Green Initiatives Previously Discussed

Related to Sustainability Master Plan Goals

- **Incentivize residential recycling** through programs such as Recyclebank, a private company that encourages participation in curbside recycling programs by offering discounts and rewards based on collected volume.

- **Feedback from last workshop**:
  - Incentive program does not play a key role in why we recycle, but there is a place for it. Would like to be able to forward “points” to Girl Scouts or similar (Civic Benefit).
  - One hauler currently offers this, but it doesn’t have much reward. General consensus in the room that they would recycle regardless of an incentive program – doubt it would have much of an impact on residential recycling.
  - How can city help incentivize commercial recycling?

Other Innovative Green Initiatives Previously Discussed

Related to Sustainability Master Plan Goals

- **Food waste rescue**, by collaborating with local stakeholders to prevent food waste at the source
- **Feedback from last workshop**: Food Scraps: general consensus in the group that they would pay more at a restaurant that composts.

- **C&D material rescue** and reuse to salvage building materials that can be reclaimed and repurposed
- **Feedback from last workshop**: Could the City consider a C & D mandate for recycling? Could specify that a certain percent of C&D waste generated be recycled.

Other Innovative Green Initiatives Previously Discussed

Related to Sustainability Master Plan Goals

- DOW Energy Bag program – currently piloted in Citrus Heights CA:
  - The program captures often non-recycled plastics such as chip bags, candy bar wraps and drink pouches.
  - Consumers are able to collect these plastics into the Hefty Energy Bags, which local haulers collect from regular recycling bins and carts. The Energy Bags are sorted at the local recycling facilities, and directed to regional waste-to-energy facilities.
  - Based on the Waste Characterization study, plastic film/wrap/bags represent approximately 5.3 percent of residential municipal solid waste.
- Feedback from last workshop:
  - City should look into a bag ban or tax, and look into Styrofoam ban.

Group Discussion
Additional Green Initiatives

Anaerobic digestion (AD) of food waste and select organic materials from ICI waste

Sources may include food processing, dairy operations, restaurants and food retailers

- Co-anaerobic digestion with the wastewater treatment plant
  - May include compression extraction process for enhanced recovery of organics
- Modular dry anaerobic digestion
  - May locate at landfill
  - Removal of contaminants after gas recovery

Group Discussion
Additional Green Initiatives

- Biogas to compressed natural gas
  - Cleaned, dried and compressed for vehicle fuel or natural gas pipeline distribution
  - May remove moisture, CO2 and trace gases
  - Potentially increase value of gas that might otherwise be flared
- Modified landfill gas direct use
  - Utilize microturbines or engines to produce electricity
  - Serve as a backup if landfill gas usage by existing Sioux Falls partner is no longer viable
  - May required some gas cleanup

Group Discussion
Additional Green Initiatives

- Onsite solar energy generation through the installation of conventional photovoltaics or thin-film solar panels
  - Thin-film panels would mount on liner
  - Utilize existing landfill surfaces to generate about 1 MW electricity for every 10 acres
  - ROI is dropping but currently is usually about 15 to 20 years
- Onsite wind energy generation through the installation of conventional turbines, arrays of small vertical-axis wind turbines
  - Previously reviewed and determined to not be feasible due to payback period

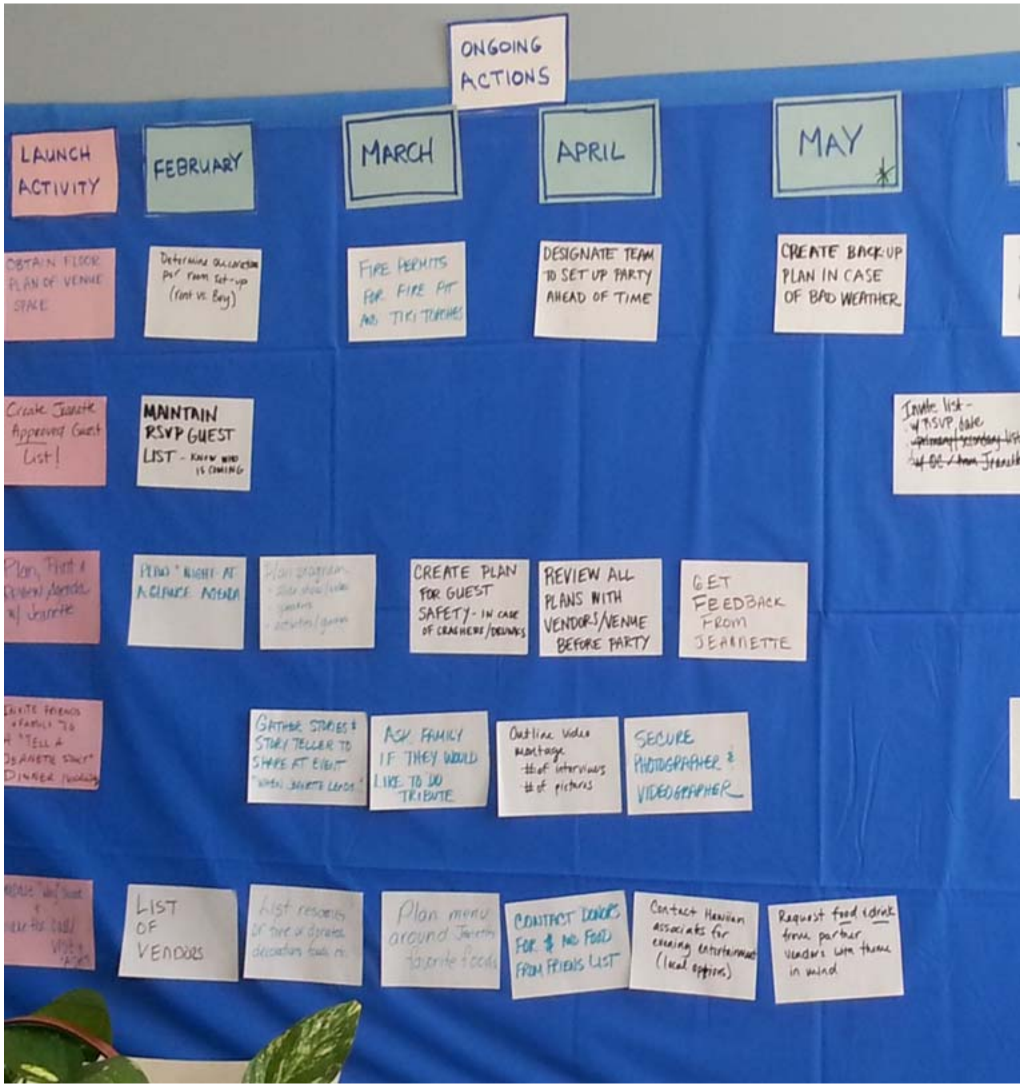
Group Discussion
Additional Green Initiatives

- Educational facility at the landfill
  - Could be open to primary and secondary education institutions
  - Possibly a training and/or educational building with the primary focus of the program to help educate our community about waste management, recycling, sustainability
  - Could be facilities owned by the city, but operated by outside institutions such as local universities
  - On site projects might include:
    - Green house, which utilizes LFG to fuel a small boiler or heat recovered from the gas conditioning plant
    - Food waste composting and marketing of the finished product
    - Improving water quality with the use of Aqua Biofilter

Any other thoughts for strategies or modifications?

Next Steps

- City staff and HDR continue research and strategy refinement with your feedback in mind
- Material will be presented to the Solid Waste Planning Board
- Final Master Plan will be developed



Open Floor

Meeting Adjourned

HDR

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City of Sioux Falls
SOUTH DAKOTA

Solid Waste Master Plan Workshop, Meeting #2

February 16, 2017
Meeting Notes

A general overview of the current system was presented to the group. Prior to discussions on specific topics and strategies, the group was asked for their **general thoughts** about the City's current solid waste system. The following was noted during this part of the discussion.

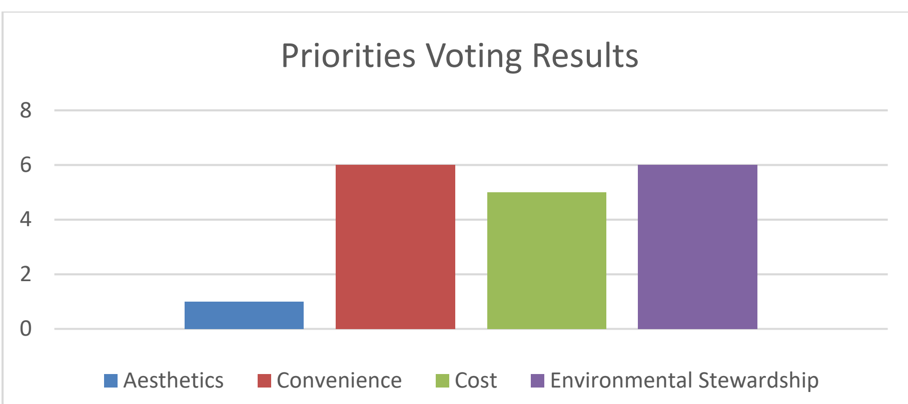
General Thoughts

- One attendee requested drop off boxes for recyclables to be located at grocery stores, churches and other public locations – would allow people to recycle away from home.

Priorities

Attendees were asked to "vote" on priorities for the City to keep in mind while deciding on strategies for the SWMMP. Each attendee was provided with three sticker dots, and were presented with four items to prioritize. Each attendee was allowed to allocate the three dot votes in any manner they preferred (e.g. all three dots for one item, two dots for one item and one for another item, or one dot for each of three items). The results of the dot voting showed:

- Aesthetics: 1 dot vote
- Convenience: 6 dot votes
- Cost: 5 dot votes
- Environmental Stewardship: 6 dot votes



An overview of the current collection practices and initial research including benchmarking with other similar communities were presented to the group. Results of hauler interviews relating to collection were also presented to the group. Initial research into the need/benefit of a transfer station within the City was also presented to the group, and the group was asked for their opinions on collection and transfer. The following are key points noted during this part of the discussion.

Collection Services

- Commercial entities prefer an open system
- HOA's decide on residential hauler to be used in some neighborhoods
- In other neighborhoods, there are only a couple of haulers that are typically collecting
- There did not appear to be concern in the group regarding multiple haulers on the same residential streets
- The haulers' request for taking cans/carts to the curb to improve efficiency and reduce liability was met with some concern by attendees about:
    - Windy conditions blowing garbage and garbage containers around
    - Elderly or disabled residents having to take garbage containers to the curb
- Will the natural progression of the industry reduce the number of haulers, if the City caps the number of haulers at the current level (if no new collection licenses were allowed)?

An overview of the current household hazardous waste (HHW) and problem materials system was presented to the group, and the group was asked to provide their opinions on HHW and problem materials. The following are key points noted during this part of the discussion.

HHW and Problem Materials

- One attendee attempted to drop off on a Saturday after the facility closed.
- General consensus that expanding Saturday hours to 4pm or 5pm in the afternoon would be beneficial to customers.

An overview of initial ideas for other innovative green initiatives was presented to the group, and the group was asked for their opinions on the other innovative green initiatives. The following are key points noted during this part of the discussion.

Other Innovative Green Initiatives

- Food scraps composting: Hy-Vee stores participate in Feeding South Dakota currently, for food rescue. Some food scraps (e.g. meat trimmings, produce trimmings) currently go to the landfill.
- C&D recycling: it would be preferable to recognize companies that voluntarily recycle, rather than mandate recycling certain percentage of C&D projects ("carrots" better than "sticks").
    - Could the City's green initiatives take on development and execution of a recognition program?
- Styrofoam ban: City should not ban Styrofoam until there is an affordable alternative
    - Is it possible for the City to provide tax incentives for environmental efforts (e.g. using alternatives to Styrofoam)?
    - Could the City or some other form of co-op in the City to buy alternatives to Styrofoam containers in bulk, to make alternatives more affordable for smaller businesses?

- Education facility at the landfill: would be good to open up the programs to more than primary and secondary schools. Interested residents and businesses could organize tours so people can better understand the full waste management process.
- Ordinances: City current building ordinance requires several things to be validated for certificate of occupancy or business license, such as how and where waste is handled, how many parking spaces are available, etc. but does not currently include any requirements for recycling.

City of Sioux Falls

Solid Waste Management Master Plan

Solid Waste Planning Board Workshop

April 13, 2017


A Comprehensive Solid Waste Management
Master Plan will serve as
Sioux Falls' roadmap for the next 30 years.

01 Project Overview

02 Goals for the Solid Waste Management Master Plan

03 Overview of the Current Solid Waste System

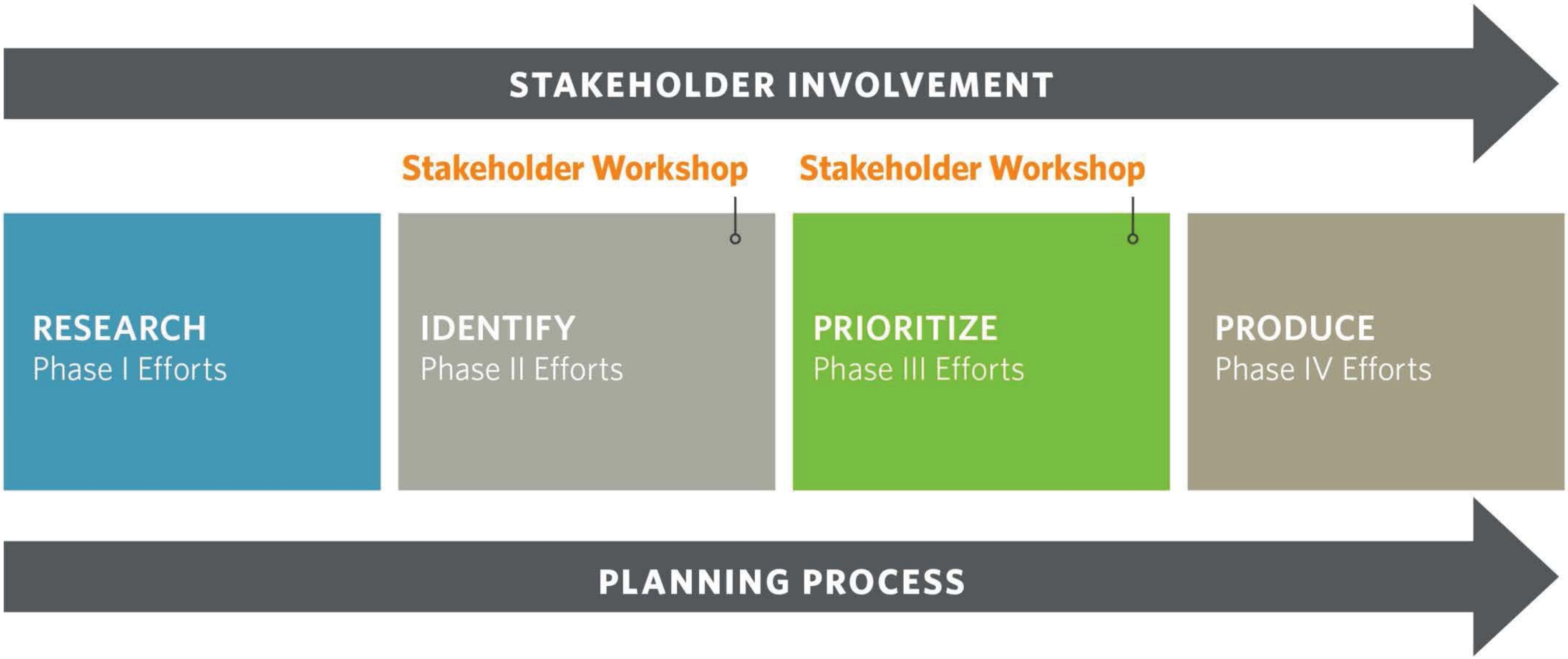
04 Review Results by Task Including Potential Strategies and Modifications

01 Project Overview

Project Drivers

- Develop a 30-year comprehensive Solid Waste Management Master Plan (SWMMP)
- SWMMP should build on the City's Sustainability Master Plan
- SWMMP should evaluate the City's existing solid waste system, and improvements to enhance the system

Project Planning Process Overview



Project Overview

TASK NO.	TASK DESCRIPTION
1	Waste Characterization
2	Waste Collection Alternatives
3	C&D MRF and Integrated Facility Options
4	Key Landfill Operational Issues
5	Waste Generation and Disposal Projections
6	Pending Legislative and Regulatory Framework
7	Public Education Program
8	Emerging Technologies
9	Household Hazardous Waste and Problem Materials Management
10	Identify Innovative Green Projects
11	Transfer Station
12	Long-Term Landfill Gas Options
13	Stakeholder Input Process
14	Monitoring the Master Plan Implementation
15	Prepare Solid Waste Management Master Plan

02 Goals for the Solid Waste Management Master Plan

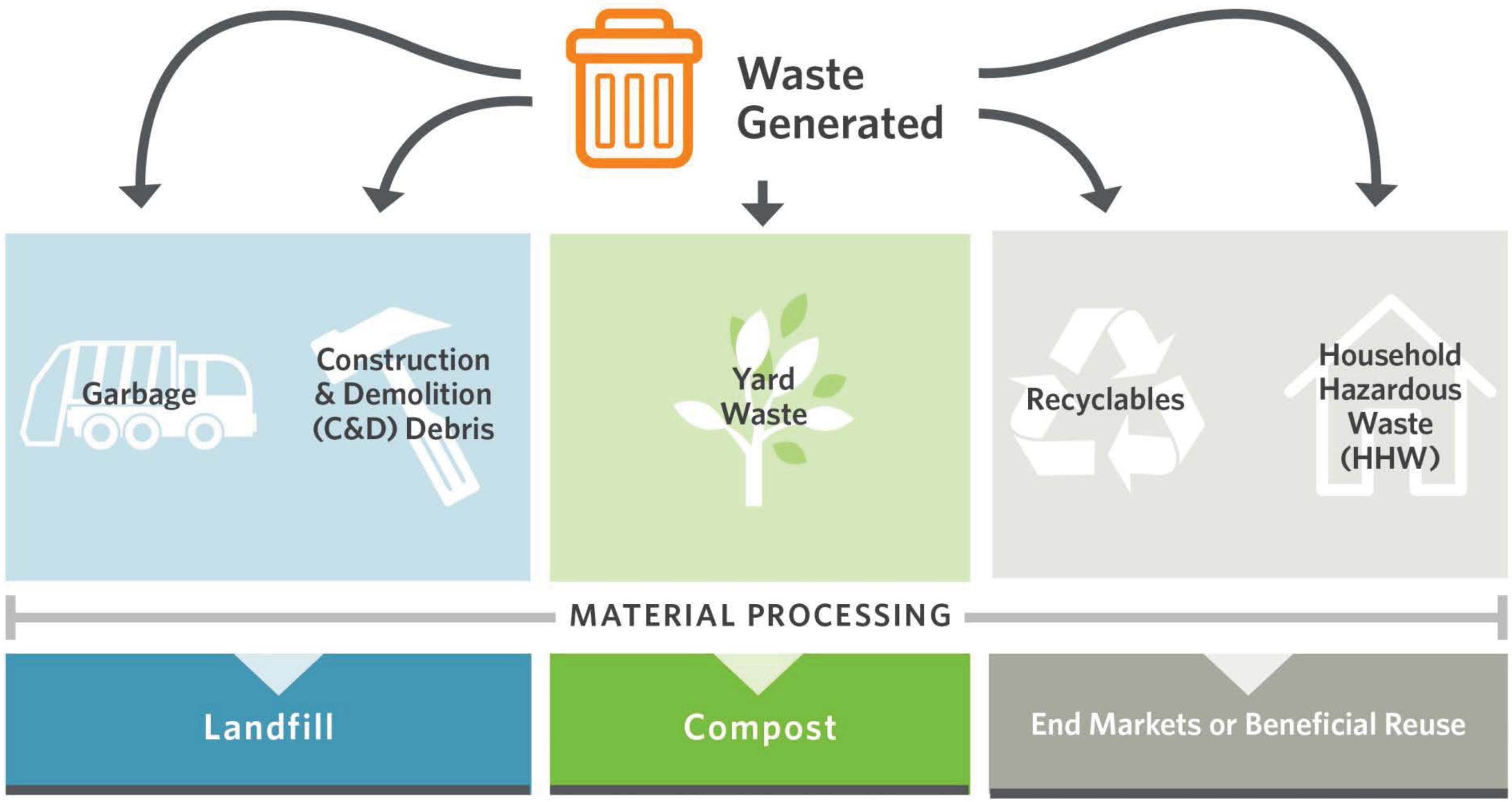
Goals of the Solid Waste Master Plan

- Build and maintain an integrated, sustainable solid waste management system
- Continue to increase recycling and reuse opportunities
- Streamline collection practices
- Maintain the cleanliness of our region
- Protect the public and environment
- Facilitate public input on the system, and develop public education of the master plan

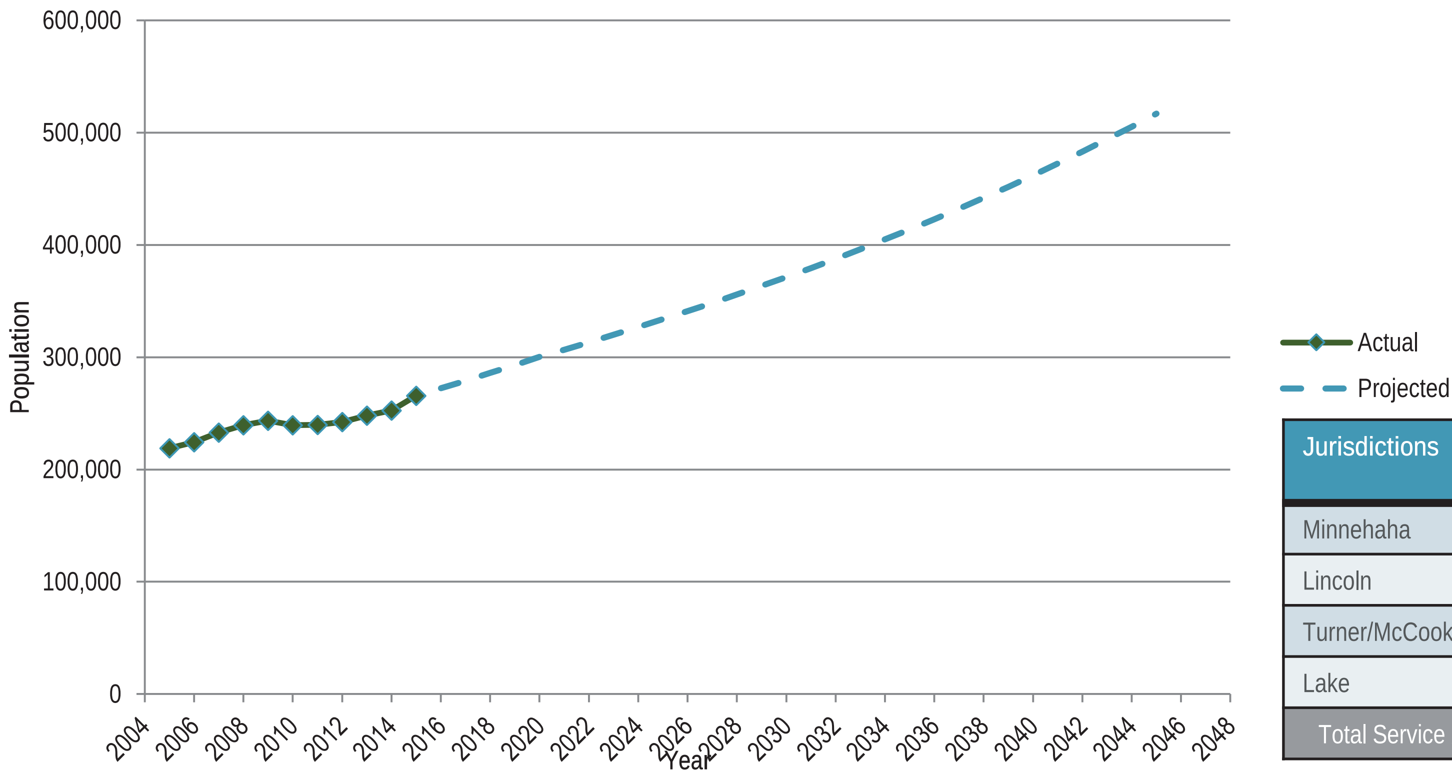
Ultimately, the SWMMP seeks to optimize the solid waste system and enhance the sustainability, cost effectiveness, preservation of landfill airspace, and longevity of the system.

03 Overview of the Current System

Overview of City's Current System



Historical & Projected Service Area Population (Task 5)



Jurisdictions	2015 Population
Minnehaha	185,179
Lincoln	53,000
Turner/McCook	15,050
Lake	12,622
Total Service Area	265,851

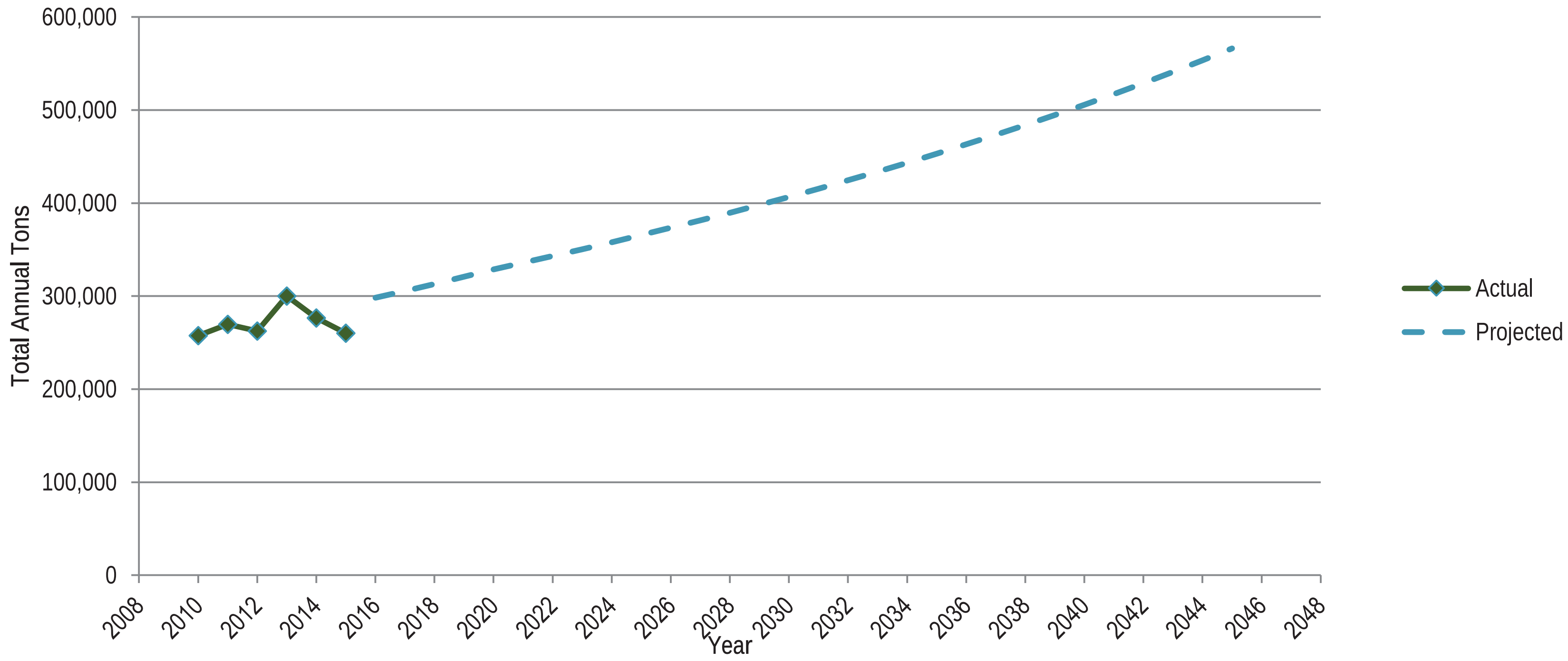
Source: U.S. Census (historical); U.S. Census and SHAPE Sioux Falls (projected)

Per Capita Generation Rates by Material Type (Task 5)

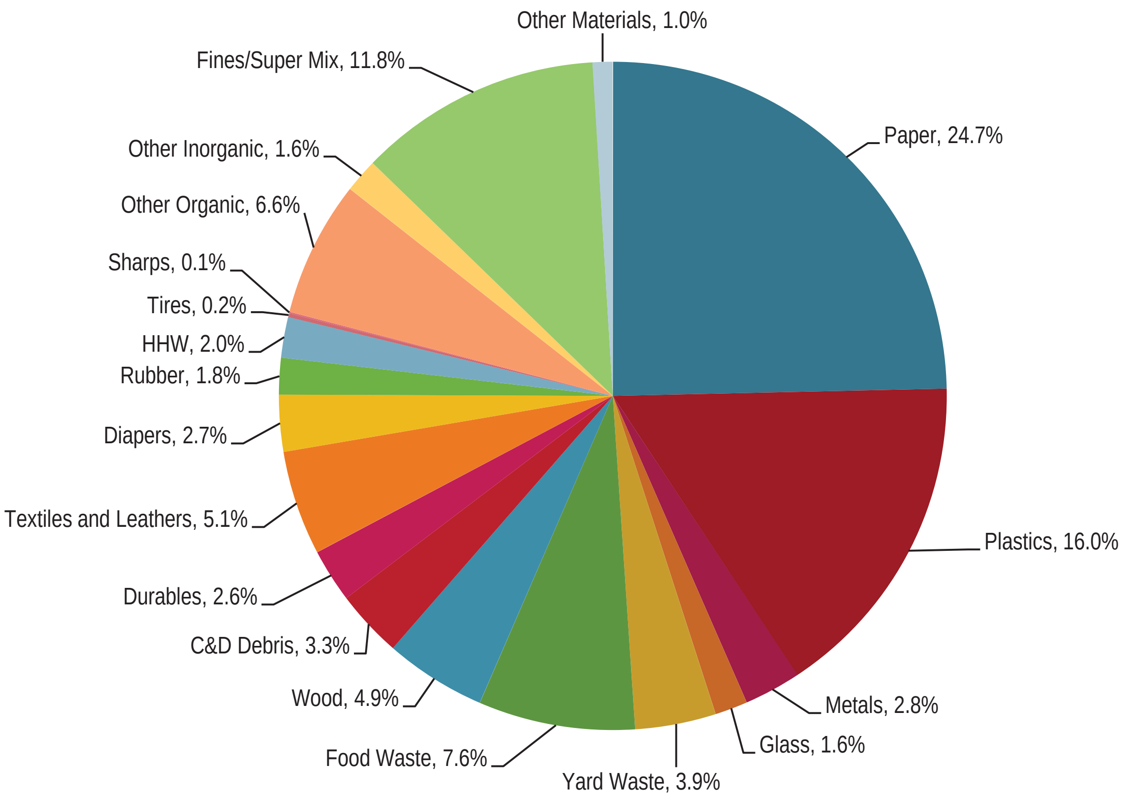
Based on Five Year Historical Average

Per Capita Generation Rates by Material	Tons per Year
MSW	0.67
Yard Waste	0.03
C&D	0.32
Wood Waste	0.03
Mattresses	0.0011
Asbestos	0.0009
Contaminated Soil	0.04
Tires	0.002
Total	1.09

Waste Generation Projections (Task 5)



Composition of Municipal Solid Waste Disposed at Landfill (Task 1)

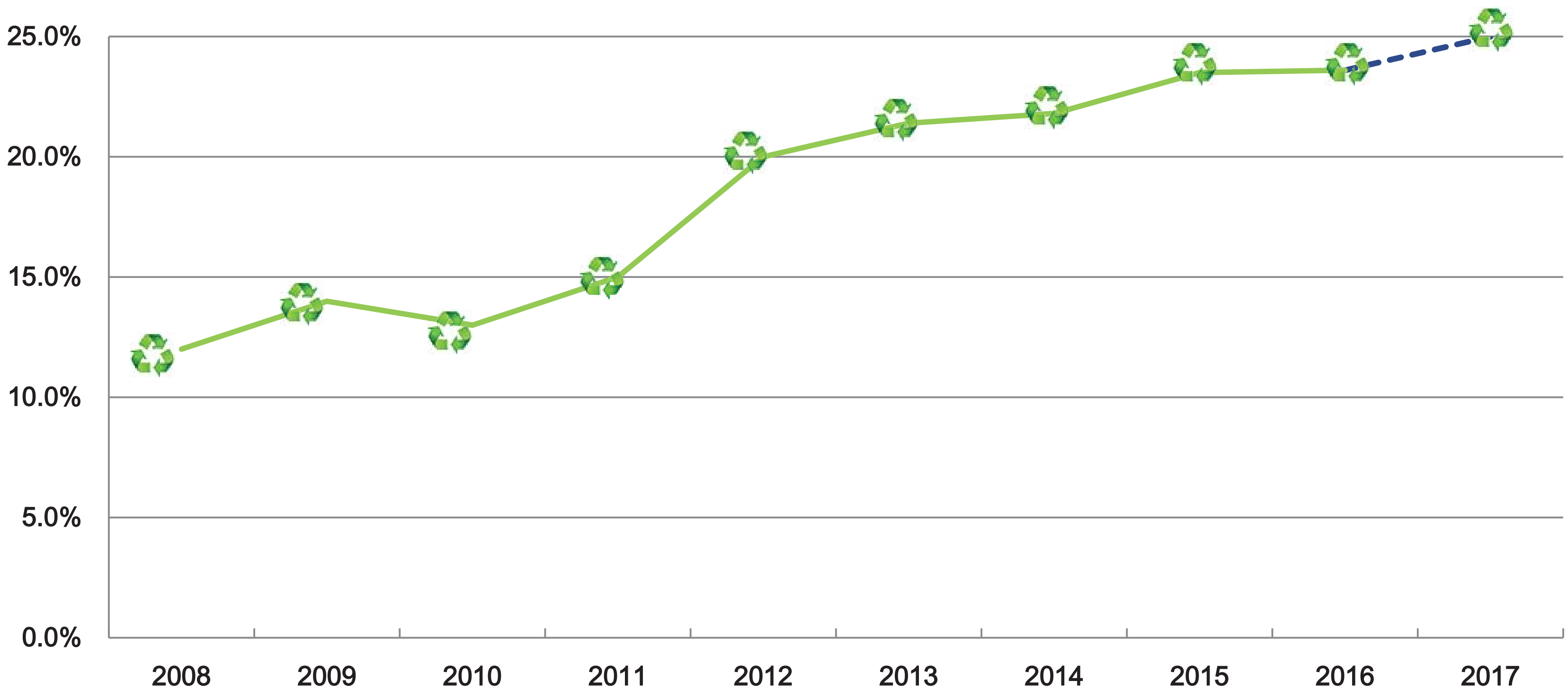


Source: HDR Waste Characterization Study, June 2016

Recycling in Sioux Falls

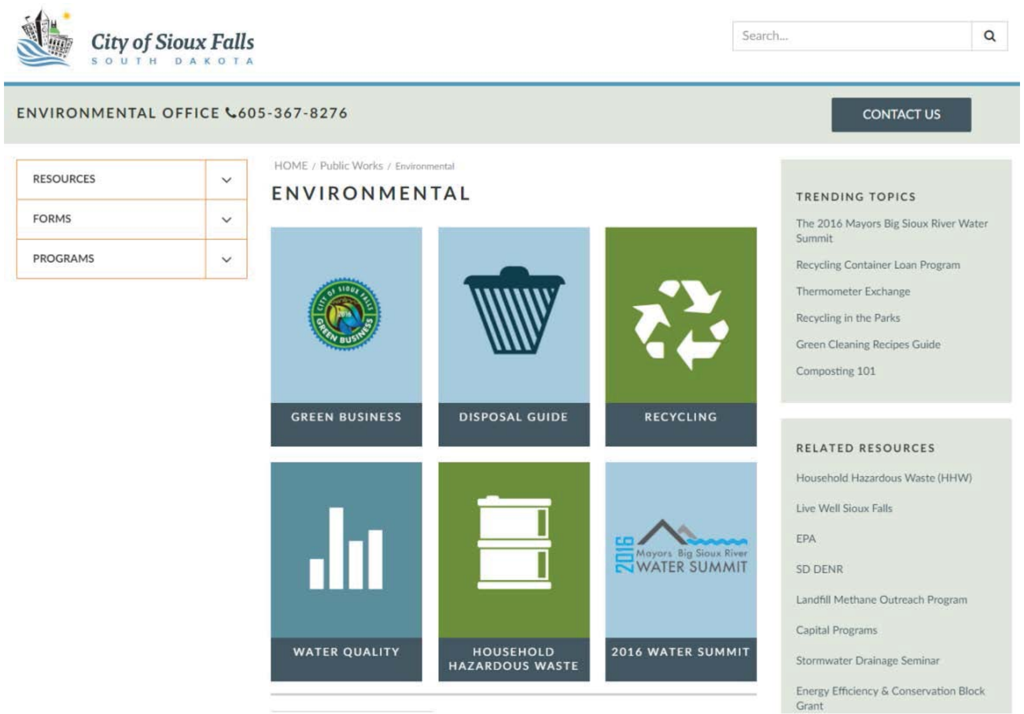
- Sioux Falls' goal: increase recycling from 12% to 25% by 2017
- Certain recyclable materials banned from the landfill, per ordinance
- Residents and businesses are required to recycle
- Recycling collection services are provided by private waste hauling companies
  - Each of these companies uses a single-stream system
  - Each hauler reports to City in order to measure recycling rate
  - 2016 Waste Hauler Recycling Rate: 23.5%

Waste Hauler Recycling Progress



Current Public Education Summary (Task 7)

- Solid Waste Planning Board
  - Members are selected by the mayor
  - Tasked with improving recycling and solid waste issue in Sioux Falls
- Classroom education program and a recycling education kit
- Program resources on the environmental page
  - The site offers links to program details, recycling guides, downloadable education
- Active presence on Facebook and Twitter
- YouTube channel with playlists dedicated to different city offices
- Recycling fliers to all households twice a year



Current Collection Services Summary (Task 2)

- The City's current collection system is commonly referred to as an "open" or "subscription" based collection service
- Licenses are issued by the Public Works Department
- Twenty-five haulers are licensed to collect garbage and recyclables in the City
- City requires haulers to offer recycling collection services, and residents are required to recycle
- Construction and demolition debris (C&D) haulers used to not have to hold a City-issued license (but do now, starting in 2017)

Current Household Hazardous Waste and Problem Materials Handling Summary

(Task 9) Household Hazardous Waste Facility (HHWF)

- The HHWF takes hazardous waste that can't be put into recycling or landfills
- No charge for residents of Lake, Lincoln, McCook, Minnehaha, or Turner Counties
- Materials must be in containers ≤ 5 gallons
- Leave materials in tightly sealed, original containers when possible
- NEVER mix household hazardous waste items
- Drive under the awning of the HHW Facility and the staff will unload your waste for you

Location:

1015 E. Chambers St.
Sioux Falls, SD 57104

Hours of Operation:

Tues.-Friday: 8am to 5 pm
Saturday: 8 am to 12 pm

Items accepted…

- Automotive Chemicals
- Lawn Care Chemicals
- Household Chemicals
- Home Improvement Chemicals
- Electronics
- Microwaves

Over 2 million pounds in 2015!

HHWF Reuse Room

- Items still in good, reusable condition are placed in the Reuse Room for redistribution to the public
- Must be a resident of the 5 county region in order to take items
- Limit of 3 items per week

Reuse Room is located on the front side of the Environmental Division Offices building.

Sioux Falls Regional Sanitary Landfill Current Operations (Task 4)

- Largest permitted landfill in the State of South Dakota
- Five county region contributes to disposal of MSW and C&D
- Simultaneous disposal of MSW and C&D as two separate waste streams in two discrete landfills
- Other waste management initiatives at the Landfill include:
  - The public drop off area includes the collection of MSW and recyclables such as white goods, yard waste, wood palettes, lawn mowers, scrap metal, tires
  - Yard waste is composted on a portion of the property, and there is a wood recycling area south and adjacent to the compost pad area
- Landfill gas from the MSW landfill is collected and processed before being directed to the POET ethanol plant to be used as a fuel source

Yard Waste and Compost Programs

- Yard waste can be composted at home or you can take your yard waste to the landfill which will then be composted there
- Finished compost is available to residents for FREE at the landfill.

04 Review Results by Task Including Potential Strategies and Modifications

Public Education Benchmarking Results (Task 7)

Communication Tactic	Sioux Falls, SD	Sioux City, IA	Saint Paul, MN	Fargo, ND	Lincoln, NE
Dedicated Recycling Webpage		●		●	●
Public Works/Environmental Webpage or Other	●		●		
Dedicated Social Media	●	●			●
City Social Media			●	●	●
Paid Advertising	●		●	●	●
Public Service Announcements	●		●		●
Meetings	●	●			●
Primary Education Curriculum	●			●	●
Video	●			●	
Recycling Guide	●	●	●	●	●
Stickers	●				
Television/Radio	●				
Tours/Classes	●	●		●	●
Special Events	●	●	●	●	●
Direct Mailings	●		●	●	●
Infographics			●		
Advisory Board	●	●			
Survey			●	●	
Branding				●	
Earned Media	●	●	●	●	●
Pop-up/Mobile Events			●		

Public Education and Outreach (Task 7)

Feedback from Stakeholder Workshops

- With mailers, it only reaches the one who looks at it (may not be everyone in the home).
- Electronic means can reach a larger audiences.
- Businesses can stream content provided by the City in break rooms or common areas; businesses want to support the community.
- Electronic billboards on main streets seem to be effective - everyone sees them.
- One HOA just completed a customer survey through Survey Monkey, and there was consensus that the residents of that HOA prefers email communications to hard copy/ paper communications. Facebook communications was a close second to emails.
- Some concern expressed about email since some people do not have smart phones.
- Fewer clicks on the City website to get to the information you are looking for would be better.
- If you use email, you will need the email address, and that can be a challenge.
- Can haulers put stickers on containers to inform residents of what materials can be recycled?
- Can we move toward more consistency on recycling? E.g. Gas stations do not have recycling containers.
- How much are we doing with schools? Can we incentivize school/students?

Public Education and Outreach (Task 7)

Recommendations

Adopt Core Values for Recycling Education

- Values should be a result of community based conversation
- Have varying stakeholders and users weigh-in on core values
- Solid Waste Planning Board might champion this initiative

Information Delivery

- Keep traditional forms of communication (flyers, mailers)
- In our digital world, communities are more reliant on mobile devices for alerts, notifications, and engagement opportunities that are accommodating to a flexible schedule
- “All of the above” approach to delivery to reach all audiences

Frequent Engagement

- Develop a consistent relationship with haulers and residents
- Key to behavioral change
- Coupled with a prominent brand identity

Public Education and Outreach (Task 7)

Recommendations

Visual Communications

- We are visual in nature and are more likely to relate and remember information when presented in visual mediums
- Continue use of videos and graphical materials
- Tools should use consistent and targeted messaging

Earned Media/Social Media vs. Paid Media

- Earned media: the opportunities for media coverage that is not paid for
- Cost effective way to communicate and promote programs
- Develop a social media framework for communication
- Actively engaging followers on social media
- Keep posts timely, relevant, and interesting

Access and Ease-of-Use

- The current website offers a variety of resources
- Strengthen the organization and accessibility of the website
- Minimize the number of “clicks” a user will have to go through to access their desired resource

Collection System Types (Task 2)

Open/Subscription Collection	
Advantages	**Disadvantages**
• Customer choice in service providers	• Multiple large vehicles traveling on the same streets
• Multiple haulers, including local/independent haulers, can provide service	• Increased risk to public safety • More emissions • More wear and tear on roads

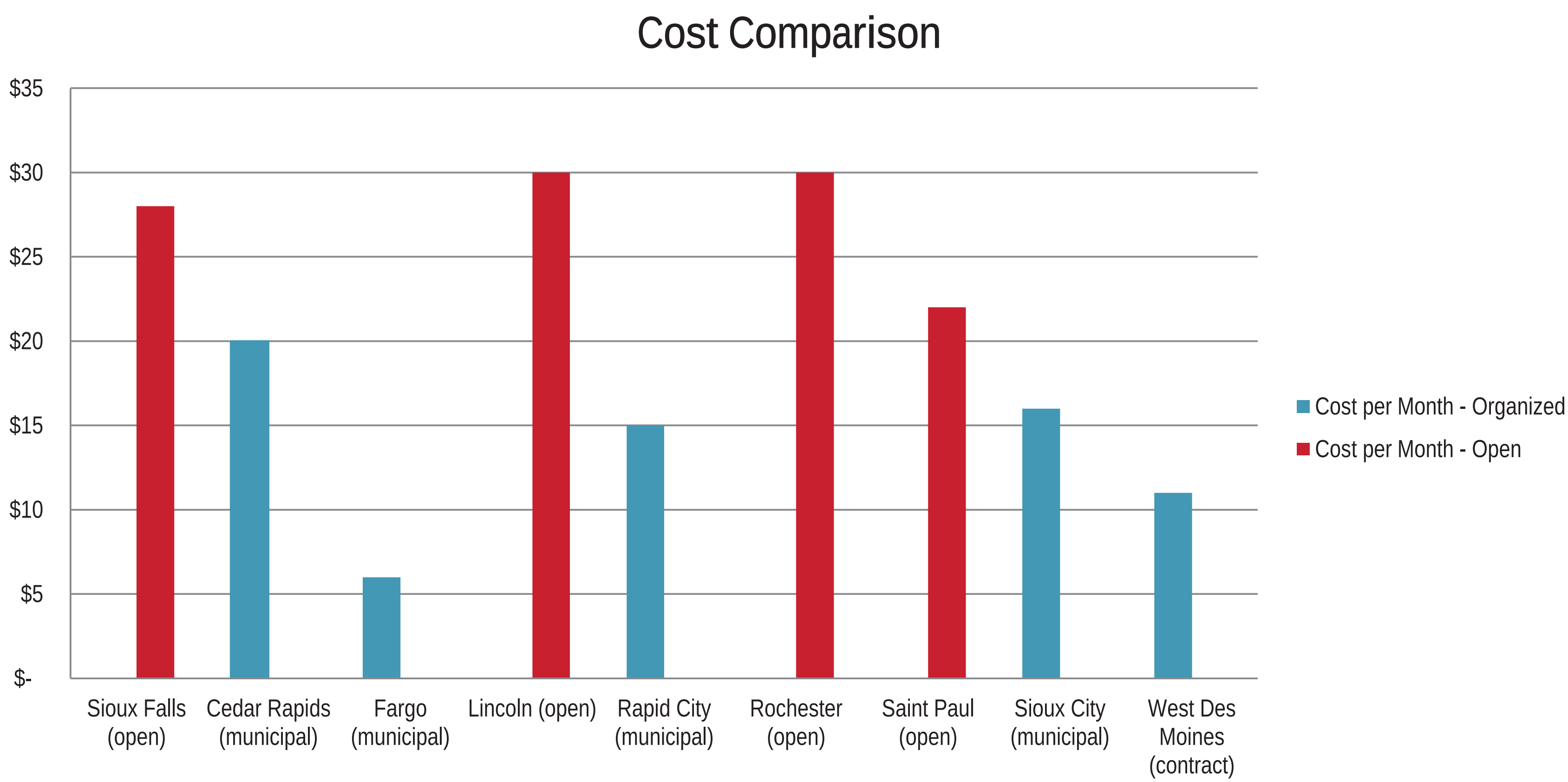
Municipal Collection	
Advantages	**Disadvantages**
• Less large vehicle traffic on streets (increased public safety, fewer emissions, less wear and tear on roads) • Economies of scale with one service provider could mean more efficient and therefore less expensive collection costs	• Customers do not get a choice in service provider • Implementation could displace some haulers

Franchised or Contracted Collection	
Advantages	**Disadvantages**
• One hauler/ agreement to administer • Guaranteed customer base and economies of scale • Recycling participation may increase if residents are required to pay for the service • Less large vehicle traffic on streets (increased public safety, fewer emissions, less wear and tear on roads)	• Customers do not get a choice in service provider • Implementation could displace some haulers

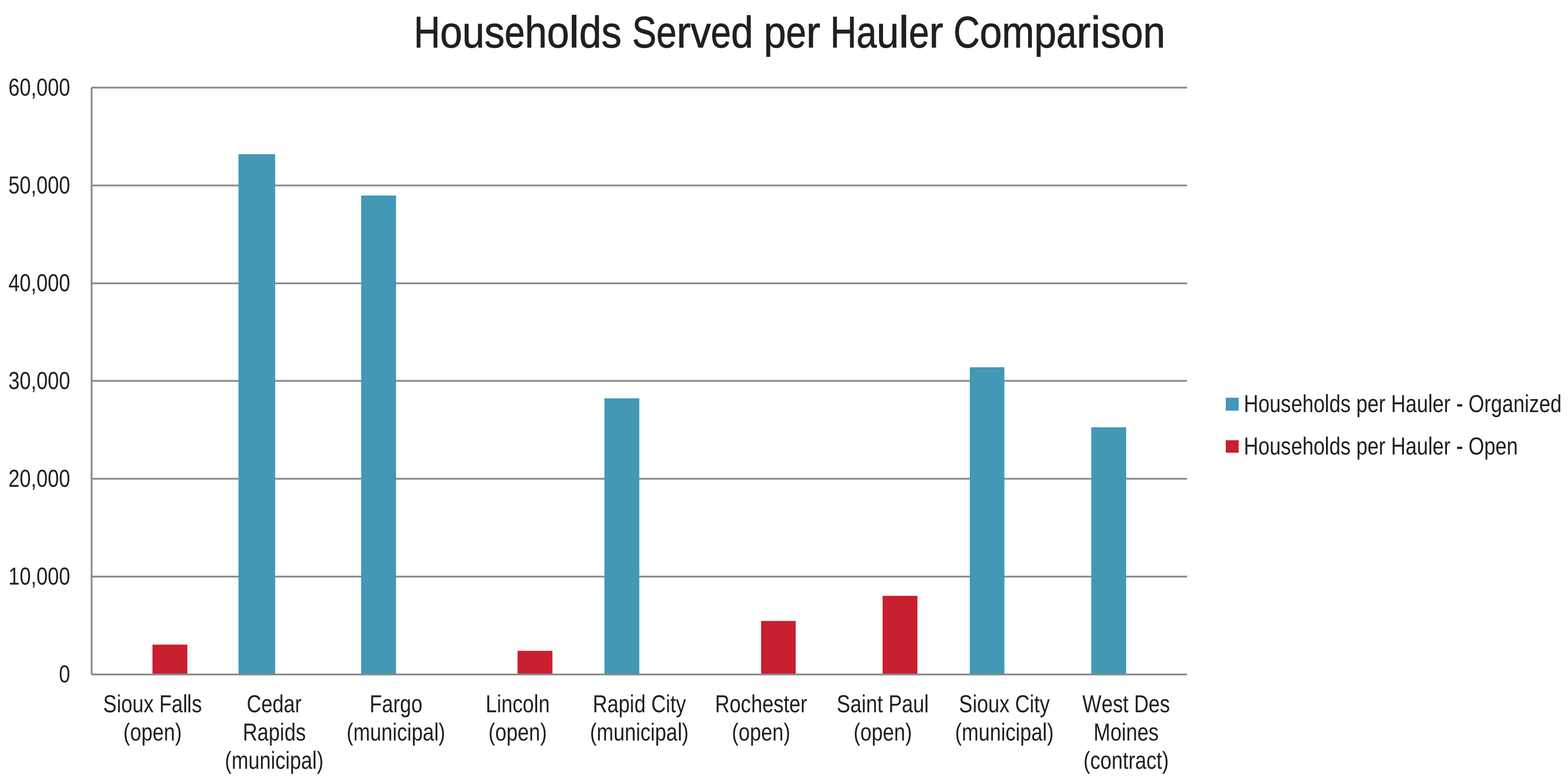
Collection Benchmarking Results (Task 2)

Community	Provider	Garbage Rate	Recycling Rate	Yard Waste Rate	Total
Sioux Falls, SD	O	Range: $15 to $35	Included with Garbage	Range: $13 to $18 (seasonal)	Range: $28 to $53
Cedar Rapids, IA	M	$16.02 35-Gal Cart; $1.50 for Additional Stickers	$4.30	Included with garbage	$20.32
Fargo, ND	M	42-gal $6 64-gal $9 96-gal $14	No additional charge (optional)	Not included	$6 to $14
Lincoln, NE	O	$20 avg.	$10 avg.	Included with garbage	$30
Rapid City, SD	M	35-gal $14.99/month 64-gal $16.83/month 96-gal $18.68/month	Included with garbage	Included with garbage	$14.99 to $18.68
Rochester/Olmstead County, MN	O	$30 avg.	Included with garbage	Not included	$30
Saint Paul, MN	O	30-38 gallons: avg. $22; 50 to 68 gallons: avg. $27.19; 90 to 96 gallons: avg. $27.23	Unknown	Unknown	$22 to $27.23
Sioux City, IA	M	$16.30 + $1 per extra bag	Included with garbage	Not included	$16.30
West Des Moines, IA	C	$7.96 48 gal. $8.66 96 gal.	$2.59	PAYT – stickers and bags	$10.55 to $11.25

Collection Benchmarking Results (Task 2)



Collection Benchmarking Results (Task 2)



Collection System Potential Modifications (Task 2)

Feedback from Public Workshops

- Can commercial and residential customers be treated the same? May not be able to due to difference in collection services and needs.
- Is there a way the City can do something to make the current system less chaotic without fully taking over collection with just one hauler?
- Can garbage trucks/staff double for snow plowing or other city functions?
- The disadvantage to having only one hauler is if they go on strike, no one is picking up the garbage (aesthetics, odors, public safety)
- Some people have relationships with their hauler
- Overall, folks want some better organization, but not really restricted to just one hauler
- Low unemployment, and drivers/collectors bouncing around between companies can make it difficult to staff collection services
- Group was surprised to see that open rates are higher than organized collection rates.
- Could garbage collection crews be used to do something else? (Snow Plow?)
- Really do see multiple trucks on the same street, and it sometimes is a bottle neck for traffic, but not a big issue.
- Can the City organize collection without putting haulers out of business?
- Can the City organize collection and encourage current workforce to move into other areas?
- Keep it local if you franchise.
- Can we ask haulers for metrics like vehicle hours? Full trips? Efficient routes?
- Wear and tear on the roads: what do multiple collection vehicles really do to the roads?
- Can haulers have standards on trash containers (consistency)?
- Having multiple trucks on multiple days is a problem, in the opinion of some.
- If the City were to organize, the group generally thought municipal collection would be preferred.

Collection System Potential Modifications (Task 2)

Feedback from Haulers Interviewed

Curbside Collection Efficiency and Convenience Improvement Suggestions:

- Each of the respondents that collect from dumpsters expressed some concern over illegal dumping. Feedback included the following: the City needs to address illegal dumping in dumpsters; it is a huge problem in commercial dumpsters; need enforcement with a community awareness advertising campaign.
- A few of the respondents suggested that the City should move away from walk up service, and allow cans to be on the curb. Related feedback included: this change would allow haulers to upgrade to automated collection vehicles; there is a high rate of injuries to hauler employees under the current system, liability for accessing private property is an issue and inefficiency in providing the service under the current system drives up the rates to customers.
- A few of the respondents suggested that allowing earlier routes would help hauling time and efficiency, and allow truck traffic to be off the City streets when traffic, citizens and children are there.
- One respondent suggested that the City could require that all residents and commercial businesses have both trash and recycling collection. Traditionally, there has been a significant decrease in illegal dumping, particularly on the commercial side, when this type of service is required by the local government.
- Each of the haulers interviewed expressed a need for the City to listen to the suggestions from the licensed haulers. It was indicated that the last time haulers were surveyed by the City, the feedback was ignored.
- One hauler expressed concern that there are currently haulers that have no identification on their trucks and are operating trucks without safety equipment. It was suggested that the City should require a DOT level inspection on haul trucks with enforcement in order for a hauler to maintain a City license.
- One hauler suggested that solid waste is a health and human services issue, and should be recognized and enforced as such.

Collection System Potential Modifications (Task 2)

Feedback from Haulers Interviewed

Organized Collection/Franchise:

- All of the respondents indicated that the City should not limit free enterprise. It was stated that the current system gives the City residents the ability to select their own haulers based on their needs.
- A few respondents pointed out that a franchise system would eliminate the small haulers, as they could not compete with the large companies.
- One respondent suggested that the City should leave the system competitive but limit the amount of licenses issued, possibly on a per-capita basis; adding that all current haulers could be grandfathered in with the ability to sell licenses.
- All of the respondents indicated that the current haulers should be protected because they have a lot of money invested.
- One respondent suggested that the City should stop additional license issuance, and allow haulers to sell their licenses or establish a bid process for sale of licenses.
- One respondent suggested that the City needs to proceed with caution on franchising, adding that the last time this issue was brought up there was a firestorm of public outcry.

Collection System Potential Modifications (Task 2)

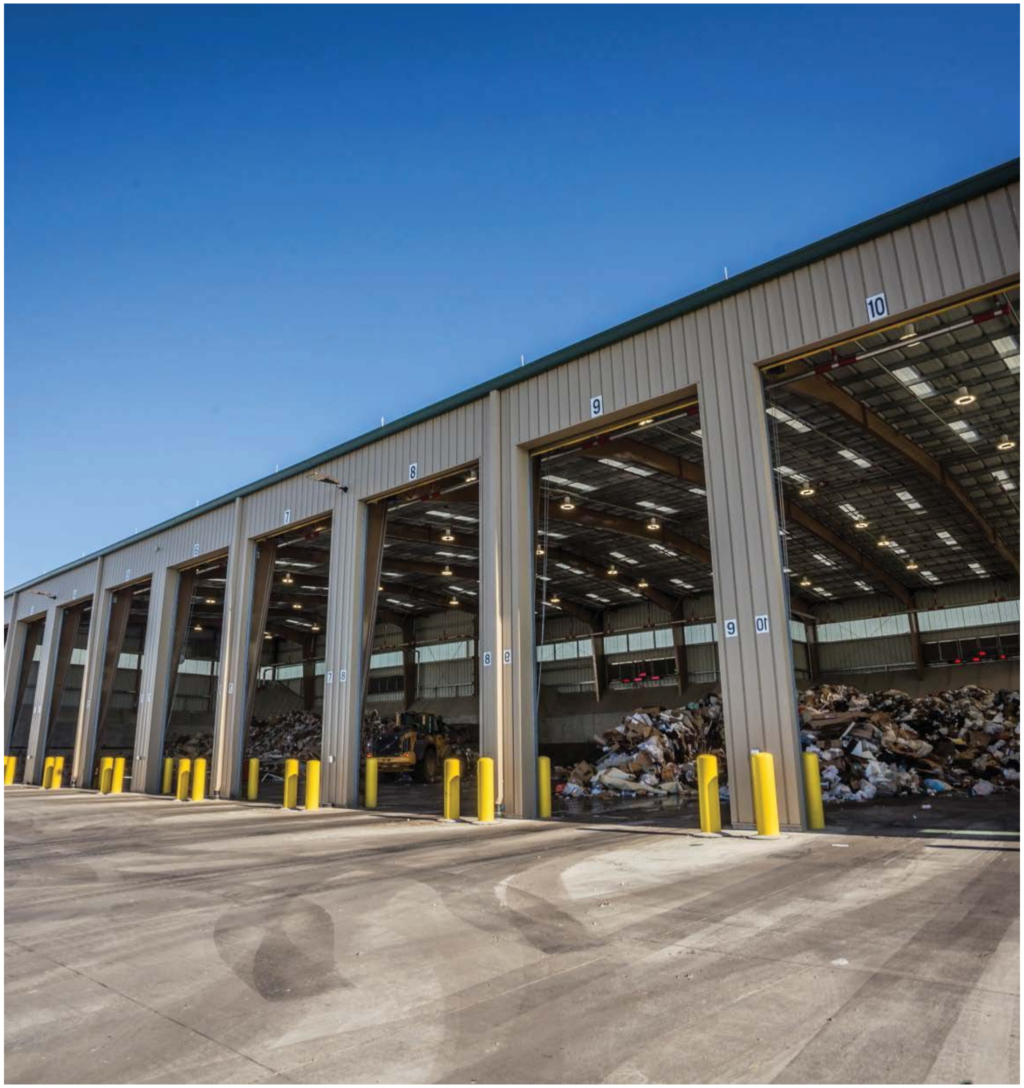
Recommendations for Consideration

- Leave commercial service open
- Phased approach toward organized (franchised) collection for residential service
  - Short term: Limit number of licenses to those already issued (no new licenses)
  - Mid term: Engage haulers and residents in discussions of advantages and disadvantages of organized collection, seek feedback from haulers for ways to streamline collection
  - Long term:
    - Consider curbside rather than side-door service for efficiency
    - Exclusive franchise for residential collection, potentially using multiple zones within the City to allow more than one hauler to provide residential collection services in the City; OR
    - Non-exclusive franchises with a limited number of haulers providing residential service, potentially by zone

Build a Transfer Station (Task 11)

Preliminary work completed:

- The sizing and orientation of the facility to safely and efficiently process the material
  - East-southeast location to balance the travel distance for a majority of the collection routes
- Probable construction cost: Over $18 million with contingencies
- Financial pro forma to determine the estimated annualized and per-ton operations and maintenance costs
  - Estimated cost of $15.94 per ton - includes the transfer and haul operations and the equipment required; all other collection, haul and disposal costs (e.g. tipping fees) are not included
- Hauler interviews included questions relating to opinions on need for and location of a transfer station



Build a Transfer Station (Task 11)

Feedback from Stakeholder Workshops:

- NIMBY (not in my backyard).
- What is the cost versus the benefit? Is it worth it?
- Noise concerns.
- Can anyone get in? (Safety concerns)
- Would need to be placed in a strategic location, fenced off (perhaps an industrial park location).
- Is double-handling of materials inefficient?
- Some concern expressed about litter/blowing in the city.
- A transfer station could be added customer service and convenience for the haulers, but not necessarily a direct benefit to the city (would add cost to City system)
- Could a transfer station help divert/recycle more?
- General Consensus: does not seem to be a good idea.
- Overall, the group trusts city leaders to make the right financial decision.

Feedback from Hauler Interviews:

Respondents were asked if they felt that a transfer station located somewhere in the City would be helpful to collection services.

- Four (4) respondents felt that a transfer station might be helpful
- Nine (9) felt a transfer station would not help their operations.
- The majority felt that a transfer station would:
    - cause significant rate increases to the citizens due to additional handling and transport of waste
    - put additional heavy truck traffic on City streets
    - would not be a significant benefit due to the current proximity of the landfill to haul routes.

Recommendation: Do not build a transfer station

HHW and Problem Materials (Task 9)

Feedback from Stakeholder Workshops:

- Some in the afternoon group did not know it was free to residents.
- One in the group once attempted to drop off as a resident, and it was closed.
- Cars want to come through on Mondays, but the HHW facility is closed on Mondays.
- Tuesday and Saturday are most popular days.
- For commercial generators of HHW, it is common to use Safety Kleen, depending on the type of HHW.
- For some commercial generators, Veolia, through an agreement, takes some HHW/Problem Materials and the company does not have to pay additional fees.
- Some companies have a lot of electronics, which are not a part of CESQG.
- Overall, HHW/Problem Materials are a minor costs for businesses
- The group generally loves the free landfill pass flyers. It has lots of good information. HHW is very efficient.

- Everyone in the evening group was aware of the drop off facility, and using it.
- General consensus that it could be used more, and belief that some are throwing it in the garbage.
- Could electronics collected curbside be a part of the bid if city franchises?
- Can the city partner with Ace, Lowes, etc. for collection of HHW/Problem Materials to add to convenience for customers?
- General consensus that the current service is great.
- Used City website to know what can be taken there.
- General consensus: Everyone loves the free pass for the landfill.

HHW and Problem Materials (Task 9)

Key Recommendations: (Additional recommendations for specific material types also provided in the Technical Memorandum for Task 9.)

- Update operations plan for the City facility
- Develop and Implement Standard Operating Procedures (SOP) for each waste stream entering the HHW facility, the waste handling processes and procedures, re-use program and equipment operational processes and procedures
- Implement a volume reduction program for latex paints, oil base paints and aerosols with the purchase, installation and operation of a latex can crusher, oil base paint can crusher and aerosol can crusher for bulking these waste streams
- Research the feasibility of implementing a volume reduction program for small propane cylinders with the purchase and operations of a Red Dragon Propane flare system
- Evaluate the purchase and installation of a computer tracking system for the HHW Facility with the ability to track customers (scanning capabilities), waste streams and quantities
- Implement a weigh in/weigh out protocol to track waste entering and leaving the HHW Facility, in order to be able to verify and audit materials coming in and out of the facility.
- Revise the current operational hours of the facility for acceptance of HHW to Wednesday through Saturday, 9:00 a.m. to 5:00 p.m. to increase Saturday hours for households and allow contractor staff the ability to ship waste and schedule acceptance of CESQG waste by appointment only on Tuesdays.
- Consider relocating the Re-use Room back to the HHW Facility so it is staffed full time, or staff it full time in its current location. Implement a weigh out system to track waste, by customer and weight, leaving the Re-use Room.
- Review the current contract for operations of the HHW Facility for potential cost savings to the City, as well as to ensure liability to the City is as limited as is reasonably possible

Landfill Operational Issues (Task 4)

Key Recommendations:

- Immediate Steps for Safety, Environmental Compliance, and to Set Stage for Future
  - Improve surface of existing customer access road
  - Move all dry weather fill operations to the northwest corner of the cell
  - Begin use of the existing west access road leading to the soil borrow area as the exclusive route for soil hauling equipment
  - Place soil cover over exposed or flagging trash
  - Install a soil diversion berm on the existing south sideslope and seed the existing south and north sideslopes
- Develop Operations Plans to Increase Landfill Efficiency
  - Implement an Operational Fill Plan
  - Implement a Soil Borrow Area Development Plan
  - Implement Pancake Fill Method
- Implement Design Enhancements for Cost Savings & Operational Efficiencies

Long Term Landfill Gas Options (Task 12)

Key Recommendations:

- Current gas utilization is the most revenue-positive of all evaluated options, and continuation of this arrangement with POET is highly preferred.
- If POET contract were to terminate or no longer become financially advantageous, other revenue-positive options exist, specifically electricity generation and RNG, which should be further evaluated.
- Numerous future regulatory and market drivers are anticipated in the coming years which need to be monitored closely and may impact overall revenues (EPA NSPS regulations, new POET contract, MRF, EPA 2030 food waste goal, etc).
- Recent data shows gas generation rates in the closed MSW landfill are lower than previously expected. While there is a pretty good understanding as to why, this situation is not fully understood and should be further evaluated to inform decisions on future capital expenditures and revenue planning efforts.

Alternatives to Landfill (Task 8)

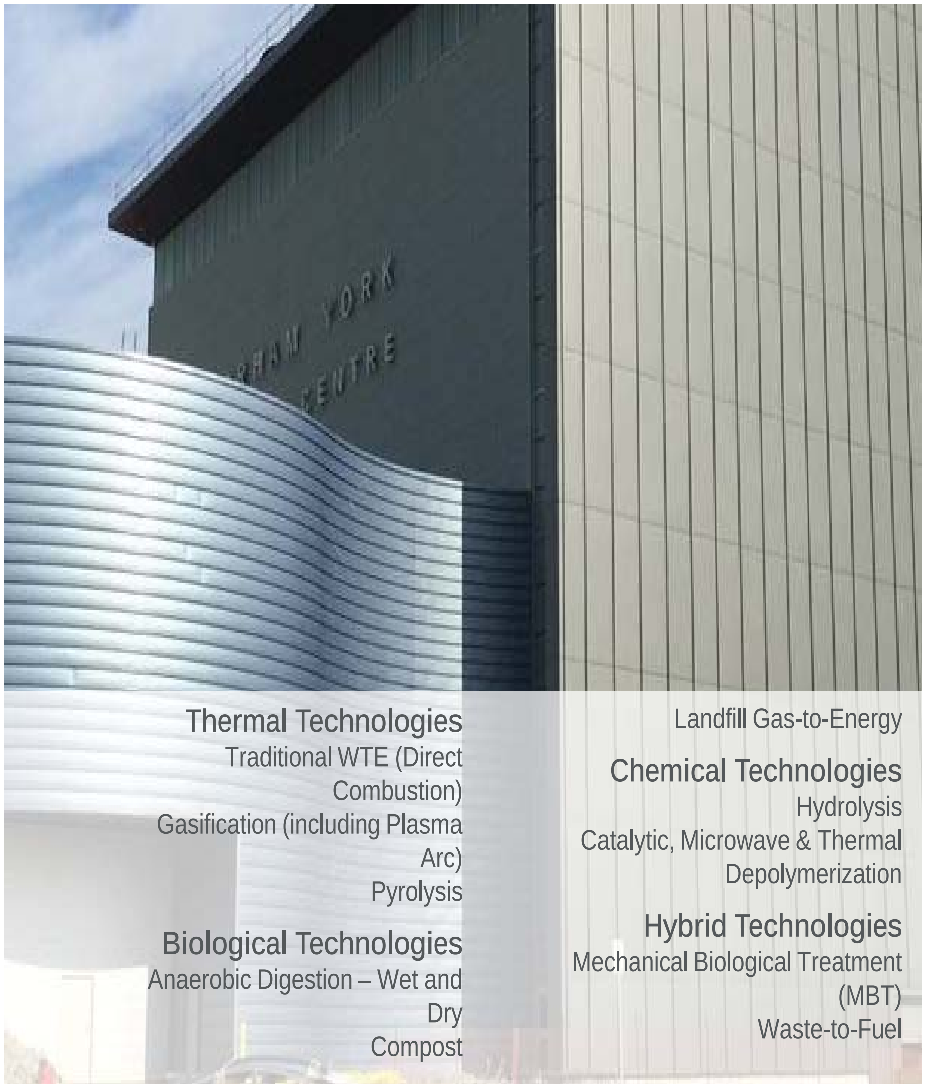
Task 8: Emerging Technologies Review

- Priorities:
  - Proven Technology
  - Feasible / Commercially Viable
  - Environmentally Sound

- **Recommendation:** Continue to Pursue

Mechanical Technology Opportunity with Existing Sioux Falls Partner

- Solid Refuse Fuel (SRF) - Non-Hazardous Secondary Material meeting EPA Requirements
- SRF Produced From Waste That Would be Diverted From the Landfill
- Need to Obtain EPA Determination For Process and Fuel
- Developing Alternatives for a Pilot System to Demonstrate SRF Properties and Process for a Determination



Other Innovative Green Projects (Task 10)

Innovative Green Project	Timing of Project	Feasibility Rating	Goals Addressed	Recommendations for Follow-up
Anaerobic Digestion at Wastewater Treatment Plant	Intermediate term	Potentially feasible	• Renewable energy • Public-Private Partnership • Landfill Diversion • Landfill Reduction per Capita	Complete additional discussions with wastewater and engineering analysis to further evaluate economics
Landfill Wet or Modular Dry Anaerobic Digestion	Intermediate term	Potentially feasible	• Renewable energy • Public-Private Partnership • Landfill Diversion • Landfill Reduction per Capita • Reduced Transportation	Complete additional engineering analysis to further evaluate economics
Biogas and Landfill Gas to Biogas Applications (AD End Use)	Intermediate term	Potentially feasible but a more complicated AD project and presumes a vehicle fleet to use biogas	• Renewable energy • Public-Private Partnership • Landfill Diversion • Landfill Reduction per Capita • Reduced Transportation	Complete additional engineering analysis to further evaluate economics as needed, if current markets close
Modified Landfill Gas Direct Use (AD End Use)	Intermediate term	Potentially feasible but a more complicated AD projects	• Renewable energy • Public-Private Partnership • Landfill Diversion • Landfill Reduction per Capita • Reduced Transportation	Complete additional engineering analysis to further evaluate economics as needed, if current markets close

Other Innovative Green Projects (Task 10)

Innovative Green Project	Timing of Project	Feasibility Rating	Goals Addressed	Recommendations for Follow-up
Onsite Solar Energy Generation	Intermediate to Long term	Potentially feasible; could be completed in phases	• Renewable energy • Public-Private Partnership	Complete additional engineering analysis to further evaluate economics
Onsite Wind Energy Generation	Long Term	Infeasible at this time	• Renewable energy • Public-Private Partnership	Re-evaluate in future
Industrial Waste Composting	Short Term	Potentially feasible; needs industry buy-in	• Landfill Diversion • Landfill Reduction per Capita	Complete additional marketing analysis to further evaluate economics
Zoo Waste (Manure) Composting	Short Term	Potentially feasible; small number of potential tons	• Landfill Diversion • Landfill Reduction per Capita • Potentially transportation reduction	Complete additional discussions with zoo and engineering analysis to further evaluate economics
Incentivize Recycling	Intermediate term	Potentially feasible; needs well publicized and managed program	• Landfill Diversion • Landfill Reduction per Capita	Complete additional marketing and engineering analysis to further evaluate economics

Other Innovative Green Projects (Task 10)

Innovative Green Project	Timing of Project	Feasibility Rating	Goals Addressed	Recommendations for Follow-up
Food Waste Rescue	Intermediate term	Potentially feasible; needs industry buy-in	• Landfill Diversion • Landfill Reduction per Capita • Potentially transportation reduction	Complete additional marketing analysis to further evaluate economics
C&D Material Rescue and Reuse	Intermediate term	Potentially feasible; needs industry buy-in	• Landfill Diversion • Landfill Reduction per Capita • Potential for transportation reduction	Complete additional marketing analysis to further evaluate economics
DOW Energy Bag Program	Long Term	Only feasible if pilot in other communities are successful and program gains acceptance	• Landfill Diversion • Landfill Reduction per Capita • Renewable energy	Re-evaluate in future when more data is available from pilot program
Plastic Bag and Styrofoam Ban or Tax	Short Term	Low feasibility; requires ordinance revisions; may have low acceptance	• Landfill Diversion Landfill Reduction per Capita	Complete additional marketing analysis to further evaluate economics and implementation issues

Additional Initiative for Consideration

- Educational facility at the landfill
  - Could be open to primary and secondary education institutions
  - Possibly a training and/or educational building with the primary focus of the program to help educate our community about waste management, recycling, sustainability
  - Could be facilities owned by the city, but operated by outside institutions such as local universities
  - On site projects might include:
    - Green house, which utilizes LFG to fuel a small boiler or heat recovered from the gas conditioning plant
    - Food waste composting and marketing of the finished product
    - Improving water quality with the use of Aqua Biofilter

Open Floor

Meeting Adjourned

HDR

City of Sioux Falls
SOUTH DAKOTA

Solid Waste Management Master Plan Workshops
Solid Waste Planning Board and City Staff Meetings

April 13, 2017
Solid Waste Planning Board Meeting Notes

A presentation was delivered to the group, including review of the project, goals for the master plan, a general overview of the current system, and a review of results by task along with key findings and potential recommendations. Participants were encouraged to interrupt with questions and comments throughout the presentation. The key points made by the solid waste planning board members in attendance include the following.

- Is there real money to put toward the programs and technologies?
- Are grants possible to assist with implementing strategies? (Could the City provide grants?)
- Public Education:
  - Is it possible to have a dedicated website for recycling and waste? (Less clicks to get to the information)
  - We should not only promote recycling programs; we should promote the benefits of recycling.
- Recycling, generally:
  - A lengthy discussion on enforcement of recycling requirements occurred for both haulers and residents. Bottom line is that <u>enforcement is a challenge</u> – do not want to be punitive, privacy concerns, cost of enforcement concerns.
  - Can the hauler recycling goal and corresponding reduced tipping fees be changed to further encourage recycling? It was stated that the recycling goals for haulers are not achievable.
- Collection:
  - Elected officials like free enterprise.
  - In the past the City limited the number of licenses granted for collection, but that changed several years ago to promote free enterprise.
  - Could the licensing be based on population, the way liquor licenses are granted?
- Innovation:
  - POET may have another potential partner already working with cellulose ethanol; it may be worth reaching out to additional partners for additional innovation and mutual benefit.

April 14, 2013
City Staff Meeting Notes

A presentation was delivered to the group, including review of the project, goals for the master plan, a general overview of the current system, and a review of results by task along with key findings and potential recommendations. Participants were encouraged to interrupt with questions and comments throughout the presentation. The key points made by City Staff in attendance include the following.

- Public Education:
    - There are certain rules for the City regarding dedicated websites.
    - Any City-specific website must be “SiouxFalls.org/…”
    - A public/private partnership for the website might be possible.
    - LiveWellSiouxFalls is an example of a dedicated website, but it may have to be 3rd party site.
- Recycling:
    - The City could conduct a random survey to identify violators of the recycling requirements, which could save time and money on enforcement.
- Collection:
    - Small haulers get together and organize where/how they collect.
    - Some HOA’s contract with a hauler to alleviate multiple trucks on the roads; other neighborhoods do not currently do that.
    - The City could encourage further organizing collection by the haulers.
    - The City could limit licenses, but there will be push back on the part of elected officials.
    - Changing to curbside collection (instead of side door service) could not likely happen until collection is organized.
    - Could we put minimum standards on the haulers to require safety equipment and standards be met, which could push attrition? (Small haulers may claim hardship)
    - Could we look at more cities within South Dakota in the collection benchmark, like Brookings, Watertown, to show more local?
    - In the short term, best to survey residents and reach out to haulers first, then limit licenses.
    - There are inconsistencies on rates being charged by the same hauler.
    - A statistically valid surveying effort could allow City to gain insights on rates being paid by homeowners, gaging opinions on system and potential changes, and allow staff to keep Council apprised of what is being learned about current collection system.
    - Important to work with the haulers to move toward solutions for better organized collection.
    - The master plan should describe best practices for moving forward, such as the MN state law guidelines. St Paul, MN is a good example of outreach before organizing.
    - An alcohol license costs the business $250,000. A hauler license costs the hauler $100.
    - Impacts on surrounding cities should also be considered. Neighboring cities should be a part of the outreach effort for organizing collection.
- Processing:
    - Anaerobic Digestion:
        - WWTP has already ruled out AD for FOG’s.
        - It is very capital intensive for what you get out of it.
        - AD is probably ten to fifteen years out.
    - Was leachate management addressed? It was addressed in the landfill operations TM, and will be included in the master plan.
    - Has DENR been involved in discussions for alternative technologies? Yes.