February 11, 2020

Mr. John Foley
Community Eco Springfield, LLC
188 M Street
Springfield, MA 01001

RE: 2019 Waste Characterization Study Report – Community Eco Springfield, LLC

Dear Mr. Foley:

At your request, SAK Environmental, LLC (SAK) is submitting a triennial Waste Characterization Study (WCS) Report for Community Eco Springfield, a waste-to-energy facility located at 188 M Street in Springfield, MA. This submittal is in accordance with the facility's operating permit for its Class II Recycling Program. The WCS was performed by MSW Consultants, a subcontractor to SAK. This submittal includes the following attachments:

Attachment 1 – Waste Characterization Study Report for 2019
Attachment 2 – Raw Composition Data (see CD)
Attachment 3 – Waste Characterization Study Protocol & MassDEP Approval (see CD)

The WCS was performed in accordance with the approved Protocol.

Do not hesitate to contact us at 978-688-7804 x 115 with any questions.

Sincerely,

SAK Environmental, LLC

Prepared by:

Chhavan Nuon, Engineer
Project Manager

Reviewed by:

Stephen A. Sakakeeny, LSP, CHMM, CPG
Principal

COMMUNITY ECO SPRINGFIELD

2019 WASTE CHARACTERIZATION STUDY
IN SUPPORT OF CLASS II RECYCLING PROGRAM

FINAL REPORT

FEBRUARY 11, 2020

MSW CONSULTANTS

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TABLE OF CONTENTS

LIST OF APPENDICES

TABLE OF CONTENTS

List of Figures

List of Tables

1. INTRODUCTION

1.1 INTRODUCTION

In Massachusetts, combustion facilities with Class II Recycling Programs are required to conduct a waste characterization study (WCS) within 18 months of receiving their Class II Recycling Program certification from the Massachusetts Department of Environmental Protection (MassDEP) and every three years thereafter. Inaugural WCSs were conducted in calendar year 2010.

In 2018, MassDEP released the "2019 Class II Recycling Program Waste Characterization Scope and Methodology Guidance" document (WCS Guidance) which includes guidance on the scope, methodology and protocols to be used in conducting the waste characterization studies that are required by 310 CMR 19.300. The 2019 WCS Guidance document relies in turn on the methodologies and protocols described in ASTM Test Method for Determination of the Composition of Unprocessed Municipal Solid Waste, Designation D 5231 – 92 (2016).

Per the Class II Recycling Program regulations, Community Eco Springfield, formerly Covanta Springfield (Springfield), engaged a Project Team that included MSW Consultants to conduct a WCS of the waste arriving at the Springfield facility located in Agawam, Massachusetts.

Pursuant to the WCS Guidance document, the objectives of the WCS were to:

1. Characterize, in a statistically defensible manner, the waste stream at the Springfield facility according to MassDEP protocols; and
2. Provide representative waste characterization raw data and statistics that can subsequently be aggregated with other WCS study data and used by MassDEP in subsequent data analysis to be performed by MassDEP, to
    a. Estimate statewide waste characterization information;
    b. Measure the success of future waste reduction efforts;
    c. Identify specific materials for increased diversion; and
    d. Help guide MassDEP policy and program initiatives in solid waste management.

This report contains the results of the Community Eco Springfield 2019 WCS.

1.2 SPRINGFIELD SITE OVERVIEW

Community Eco Springfield, also known as the Pioneer Valley Resource Recovery Facility, is a mass burn Energy-from-Waste (EfW) facility located on a 5.3-acre site in Agawam, Massachusetts. The facility began operations in 1988 and is permitted to combust 408 tons per day, or 131,400 tons per year of solid waste generated from residential and commercial operations throughout Western Massachusetts. Pioneer Valley produces 9.4 megawatts (MW) of energy, of which 7.5 MW is sold to Eversource.

Community Eco Springfield acquired the facility from Covanta Springfield LLC on May 16, 2019 at which time the incoming waste stream changed significantly. The quantity of solid waste received reduced and contracts with some generators also changed, or were terminated. These changes conflicted with assumptions upon which the Waste Characterization Study Protocol was prepared and approved by MassDEP back in 2018. Deviations to the Study Protocol were encountered and approved by MassDEP as detailed in Section 2.8 of this report.

This facility has one scale used to weigh both in-bound and out-bound trucks. The incoming trucks follow the traffic pattern across the scale around the facility to the staging area just outside the entrance to the four-tip floor receiving doors. Facility personnel direct the in-coming trucks to the correct door to empty

their loads. Springfield scale house and operations staff were able to support representative sampling and interviewing of incoming loads for the WCS.

1.3 REPORT ORGANIZATION

The remainder of this report presents the methodology and results of the Springfield waste composition study. The report is divided into the following sections:

- **Methodology**: This section provides an overview of waste disposal data available from Springfield reports and supplemented with direct surveys to establish reasonable estimates by generator sector, and provides the detailed sampling plan that was developed to govern the study process and to provide statistically defensible data. This section also summarizes the field data collection methods and analytical methods applied in the study.
- **Results**: Detailed results about the composition of the combusted waste are presented in this section. Results are presented primarily in tabular format with some summary graphics to highlight findings of interest.
- **Appendices**: Detailed waste category definitions and the tabular 2019 study results are contained in the appendices.

It should also be noted that the raw data captured for this study has been delivered electronically in spreadsheet format for use by Springfield and for subsequent transmittal to MassDEP.

2. METHODOLOGY

2.1 WASTE DISPOSAL QUANTITIES

Community Eco Springfield provided MSW Consultants with annual waste total for 2019. Table 2-1 shows the total annual waste received at the facility by waste type.

Table 2-1 2019 Waste Disposal Quantities

Waste Type	Total Tons	Percent
MSW-10	111,079	99.4%
Brokered MSW	535	0.5%
TSMSW	162	0.1%
Grand Total Inbound	111,776	100.0%

As shown in Table 2-1, the majority of wastes received are coded as type MSW-10. All MSW-10, TSMSW, and Brokered MSW waste types were targeted during the WCS (although in practice only MSW-10 was sampled).

For purposes of the WCS analysis, we have applied the results of the study to all inbound loads of MSW. The remainder of this section therefore considers all 96,408 inbound tons as the universe of material to which WCS results apply.

2.2 TRUCK TYPES

Community EcoSpringfield has modified their scalehouse software to record the truck type for all incoming deliveries in a manner that is consistent with MassDEP guidance. The following truck types were defined and segregated during the WCS. Scale data differentiates:

- Rear Load and Side Load compacting vehicles,
- Frontload compacting vehicles,
- Roll-off compactors,
- Roll-off open top containers, and
- Roll-off closed top containers.

The Springfield facility also receives waste on transfer trailers. Because it is not possible to determine the generating sector of origin for wastes contained on transfer trailers, these loads were excluded from sampling during the WCS. Table 2-2 shows the total tons and percent of waste by vehicle type in 2019, separating the transfer trailer waste from direct haul loads.

Table 2-2 2019 Waste Deliveries by Vehicle Type

Vehicle Type	Total Vehicles	Percent of Vehicles	Total Tons	Percent of Tons
Rear/Side Loader	5,884	46.3%	47,650	42.6%
Front Loader	3,844	30.2%	35,665	31.9%
Roll-off Compactor	2,299	18.1%	17,036	15.2%
Roll-off Open Top	224	1.8%	1,131	1.0%
Roll-off Closed Top	0	0.0%	0	0.0%
Acceptable Vehicle Total	12,251	96.3%	101,482	90.8%
Tractor/Transfer Trailer	471	3.7%	10,294	9.2%
Other/Not Applicable	0	0.0%	0	0.0%
Unacceptable Vehicle Total	471	3.7%	10,294	9.2%
Grand Total	12,722	100.0%	111,776	100.0%

2.3 GENERATOR SECTORS

Consistent with MassDEP's WCS Guidance, samples obtained in this study were classified into one of three generator types:

- **Residential**: Residential waste was defined in this study as waste from vehicles in which 80 percent or more of the waste originated from single family or multi-family residential sources. These vehicles included residential drop-off containers (i.e. roll-offs, dedicated transfer trailers from municipal drop-off programs) and both side load and rear load compacting vehicles.
- **ICI - Industrial/Commercial/Institutional**: This category included wastes generated by non-residential sources including commercial businesses, institutions, and industrial facilities (excepting any special industrial wastes or industrial wastes elsewhere classified). ICI waste was defined in this study as waste from vehicles in which 80 percent or more of the waste was generated by ICI sources. Typically waste from ICI vehicles included compactor boxes, open top boxes and front-load compacting vehicles.
- **Unacceptable Loads**: Unacceptable loads were defined as loads that contained less than 80 percent of either residential or ICI waste; loads that were more than 50 percent construction and demolition (C&D) material; and loads that originated from out of state. Unacceptable loads were not sampled or sorted during the WCS.

The proportion of waste delivered to the facility by each of these generator types was not tracked or known by the facility operators prior to this study. Random sampling of incoming loads was therefore used to assure appropriate allocation of samples to each generator sector. It was agreed upon that MassDEP did not intend for Unacceptable Loads to undergo sampling and sorting as part of the study. Unacceptable Loads were defined as:

- Front Load and Rear Load compacting trucks that mix Residential (including multi-family) and ICI accounts on the same route such neither the Residential nor the ICI fraction exceeds 80 percent of the load;

- All Transfer/Tractor Trailers. These usually originate at commercial transfer stations that accept a mix of Residential and ICI wastes; or originate at transfer stations that may accept waste from out-of-state.

If encountered during the random sampling, Unacceptable Loads were excluded from the composition analysis. However, consistent with MassDEP's reporting requirements, the overall fraction of wastes arriving in Unacceptable Loads from Front and Rear Load vehicles were documented for the facility by randomly selecting vehicles and surveying the drivers regarding load origination.

Table 2-3 shows the results of the random sampling conducted at the Springfield facility. Results are shown both in terms of the percentage of loads (top half) and the percentage of waste by weight (bottom half).

Table 2-3 Incoming Vehicle Random Sample Results

	Vehicle Type	Residential	ICI	Mixed	Total
Percent by Number of Loads	Rear & Side Loader	100.0%	0.0%	0.0%	100.0%
	Front Loader	9.1%	90.9%	0.0%	100.0%
	Roll-off Compactor	16.7%	83.3%	0.0%	100.0%
	Roll-off Open Top	0.0%	0.0%	0.0%	0.0%
	Roll-off Closed Top	0.0%	0.0%	0.0%	0.0%
	Transfer Trailers	0.0%	0.0%	100.0%	100.0%
Percent by Weight of Loads	Rear & Side Loader	100.0%	0.0%	0.0%	100.0%
	Front Loader	5.4%	94.6%	0.0%	100.0%
	Roll-off Compactor	25.9%	74.1%	0.0%	100.0%
	Roll-off Open Top	0.0%	0.0%	0.0%	0.0%
	Roll-off Closed Top	0.0%	0.0%	0.0%	0.0%
	Transfer Trailers	0.0%	0.0%	100.0%	100.0%

These survey results in Table 2-3 were subsequently applied to the total waste deliveries by truck type to estimate the proportion of wastes delivered by generator sector. Quantities of waste were summed by generator sector. The results of this exercise are shown in Table 2-4. As shown, the survey data collected during this study suggest that the Springfield facility receives roughly 45.8 percent ICI waste and 54.2 percent Residential waste. This assumes that the Mixed Waste entering the facility is the same split as the direct haul waste.

Further study would be required to improve on the estimate below.

Table 2-4 Residential/ICI Split

Allocation Method	Residential	ICI	Mixed	Total
By Load Count	52.8%	41.8%	5.5%	100.0%
By Weight of Load	49.2%	40.6%	10.2%	100.0%
Excluding Mixed	54.8%	45.2%	N/A	100.0%

It should also be noted that MassDEP's WCS Guidance document calls for a 55 percent to 45 percent split between ICI and residential waste as the state-wide average. MSW Consultants understands that this split was intended only as a guideline in the absence of actual data. For this WCS, the weighting factors derived from the random samples and the truck type stratification were used to calculate results (although it is noted that Community Eco Springfield's ratio is nearly identical to the 2016 WCS).

2.4 SAMPLE ALLOCATION

Table 2-5 below shows the targeted allocation of samples by truck type and by season, based on actual 2017 scale house data. This table shows how the 52 total samples were stratified, with random sampling performed for each stratum. This table also shows the actual samples obtained in the study. As shown, the study obtained the targeted sampling stratification, but fell short of the targeted number of samples.

Table 2-5 Proposed Samples vs. Actual Samples Collected (Excluding Transfer Trailers)

Vehicle Type	Actual 2017 Percent Tons	Proposed Sampled	Proposed Percent	Actual Sample	Actual Percent
Rear & Side Load Packers	49.1%	30	57.7%	24	51.1%
Front Loader	35.7%	12	23.1%	11	23.4%
Roll-off Compactor	11.3%	9	17.3%	12	25.5%
Roll-off Open Top	3.0%	0	0.0%	0	0.0%
Roll-off Closed Top	0.9%	1	1.9%	0	0.0%
Other	0.0%	0	0.0%	0	0.0%
Grand Total	**100.0%**	**52**	**100.0%**	**47**	**100.0%**

The sampling shortfall arose as a result of the change in ownership of the Springfield plant and subsequent modifications to inbound waste receipts. In the process of the Q3 sampling event, it slowly became evident that the inbound delivery patterns had changed. The stratified sampling plan, which was based on 2017 scale data while the plant was under prior ownership, identified several residential haulers that were expected to deliver each day, with some front loaders arriving on Saturday. During the Q3 sampling event, it first became evident that multiple residential haulers were not arriving, and the only residential waste supplier was the City of Springfield. Second, the expected front loaders on Saturday simply did not arrive. The significance of changes to the inbound delivery patters was not evident to the new facility owners, and consequently it was not realized that only Springfield trucks were using the plant and that 3-4 more samples should have been taken from City of Springfield trucks. The same dynamic was true for the Saturday frontload deliveries, which evidently no longer occurred with the ownership change. Upon realizing that inbound delivery patterns had changed, and in an attempt to make up for the shortfalls in packer trucks, additional samples were taken of roll-off trucks. At the conclusion of the Q3 sorting period, 21 of the 26 targeted samples had been obtained.

Subsequent to the Q3 field data collection event, the data was analyzed and it was confirmed that, although rear-load/sideload trucks were slightly under-sampled and roll-off compactor trucks were slightly oversampled relative to the Study Protocol, the sample distribution appears to be in line with new delivery patterns. Other than acknowledging that the shortfall of samples (47 instead of 52) slightly increased the width of the confidence intervals (meaning that the results of the 2019 WCS will be slightly less precise than the prior iterations), the results of this WCS are still representative of the waste stream entering the Springfield plant.

Further, a sample size of 47 samples is still above minimum sampling targets for a waste characterization study based on current waste composition best practices. Of particular note, California's official state

waste characterization guidance document specifies a 30-sample minimum for residential waste and a 40 sample minimum for commercial (or mixed residential and commercial) waste. Both of these targets were exceeded. Sampling at Springfield still covered all days of the week on which loads were received, and achieve geographic representation as a result. Further, the 47 samples from this facility will still be reasonably representative when aggregated with the results from the other five Massachusetts WTEs that perform waste composition studies and could still be used to develop statewide composition estimates.

Based on this information, the Massachusetts Department of Environmental Protection (MassDEP) approved the sampling completed as described, and did not require additional load sampling.

2.5 WASTE CATEGORIES

This study sorted wastes into the nine (9) primary categories and 62 secondary categories identified by MassDEP in the WCS Guidance document. Table 2-6 on the following page summarizes these waste categories. More detailed definitions of each of the 62 waste categories are provided in Appendix A.

Table 2-6 Waste Categories

PAPER	
Uncoated Corrugated Cardboard/Kraft Paper	Newsprint
Waxed Cardboard	Other Recyclable Paper
High Grade Office Paper	Compostable Paper
Magazines/Catalogs	Remainder/Composite Paper
PLASTICS	
PET Beverage Containers (non-MA deposit containers)	Expanded Polystyrene Non-Food Grade
PET Containers other than Beverage Containers	Bulk Rigid Plastic Items
Plastic MA Deposit Beverage Containers	Film (non-bag clean commercial and industrial packaging film)
HDPE Bottles, colored and natural	Grocery and Other Merchandise Bags
Plastic Tubs and lids (HDPE, PP, etc.)	Other Film means plastic film
Plastic Containers #3-#7	Remainder/Composite Plastic
Expanded Polystyrene Food Grade	
METALS	
Aluminum Beverage Containers (non-MA deposit containers)	Other Ferrous and Non-Ferrous
Aluminum MA Deposit Beverage Containers	White Goods
Tin/Steel Containers	Remainder/Composite Metal
Other Aluminum	
GLASS	
Glass Beverage Containers (non-MA deposit containers)	Glass MA Deposit Beverage Containers
Other Glass Packaging Containers (non-MA deposit containers)	Remainder/Composite Glass
ORGANICS	
Food Waste	Manures
Branches and Stumps	Remainder/Composite Organic
Pruning, Trimmings, Leaves and Grass	
C&D MATERIALS	
Asphalt Pavement, Brick, and Concrete	Asphalt Roofing
Aggregates, Stone, Rock	Drywall/Gypsum Board
Wood – Treated	Carpet and Carpet Padding
Wood – Untreated	Remainder/Composite Construction and Demolition
HOUSEHOLD HAZARDOUS WASTE	
Ballasts, CFLs, and Other Fluorescents	Bio-Hazardous

Batteries – Lead Acid	Vehicle and Equipment Fluids
Batteries – Other	Empty Metal, Glass, and Plastic Containers (that originally contained toxic materials)
Paints	Other Hazardous or Household Hazardous Waste
ELECTRONICS	
Computer-related Electronics	Televisions & Computer Monitors
Other "Brown Goods"	
OTHER MATERIALS	
Tires and Other Rubber	Mattresses
Textiles	Restaurant Fats, Oils and Grease
Bulky Materials	Other Miscellaneous

2.6 SEASONALITY

To ensure that the final results captured seasonal fluctuations in the composition of the waste stream, the study was performed over two seasons. Consistent with MassDEP guidance, the first season field sort occurred between April 15 and June 15, 2019, and the second season field sort occurred between July 15 and September 15, 2019. Field sorting was scheduled to avoid the days immediately preceding and following major holidays.

The Study Design proposed 26 samples to be collected equally between each of the two seasons for a total of 52 samples. The sampling targets were achieved for Season 1, however there was a 5-sample shortfall in Season 2. Table 2-7 shows the field data collection schedule.

Table 2-7 Sampling and Sorting Schedule

Day of Week	Spring Season	Fall Season
Monday	May 6, 2019	N/A
Tuesday	May 7, 2019	N/A
Wednesday	May 8, 2019	N/A
Thursday	N/A	August 15, 2019
Friday	N/A	August 16, 2019
Saturday	N/A	August 17, 2019

2.7 FIELD DATA COLLECTION

2.7.1 LOAD SELECTION

For each of the truck types identified above, MSW Consultants used a systematic selection of incoming vehicles. Sufficient incoming scale data was provided by the Springfield facility prior to the study to estimate the expected number of loads delivered by each truck type. An "Nth Vehicle" approach was used each season for each truck type. Systematic sampling is intended to remove any sampling bias that may arise from an individual selecting specific incoming vehicles. MSW Consultants divided the number of incoming loads (by vehicle type) by the number of samples needed that day from the facility. The resulting number was the sampling frequency and determined whether every third vehicle, every sixth vehicle, or every 20th vehicle will be selected for sampling. This strategy is known as the "Nth Vehicle" approach.

The Field Supervisor, working in coordination with facility personnel, kept a tally of vehicles from each truck type as they entered the facility. When the designated nth truck arrived, the vehicle was directed to the sampling area.

The Field Supervisor interviewed the drivers of selected loads to obtain information about origin of the load, validation of waste generating sector, hauler, vehicle type and number, and other data. This

information was noted on the Field Supervisor's vehicle selection form, along with a unique identifying number associated with that vehicle on that day.

2.7.2 TAKING RANDOM SAMPLES FOR MANUAL SORTING

Once the incoming load was identified and discharged on the tipping floor, a sample was taken using the method described in ASTM standards. A front-end loader removed material longitudinally along one entire side of the discharged load in order to obtain a representative cross-section of the material. The Field Supervisor and loader operator attempted to remove approximately 1,000 pounds of material, based on a visual assessment. This equates to four times the targeted sample weight of 250 pounds. The loader operator then mixed, coned, and quartered the sample material.

Figure 2-2 Tipped Load Awaiting Sample Collection

The Field Supervisor then systematically selected roughly one quarter of the material to be taken via a grab sample. For samples that contained heavy or bulky materials, the Field Supervisor estimated the fraction of the sample occupied by the bulky item, and applied that percentage to the overall weight of the bulky item. For example, if a sofa bed was part of the grab sample that has been dumped for sampling, Field Supervisor estimated what fraction of the sofa bed was contained within the regular municipal solid waste sample and recorded the fractional weight of the bulky item as part of the overall sample.

The Field Supervisor then placed the material for sorting in 35-gallon barrels and pre-weighed each barrel to ensure the sample used for sorting was at least 225 pounds. A white board with the sample number was placed in the barrel and staged for the sorting by the field sorting crew. Figure 2-2 shows samples staged for sorting.

Figure 2-1 Sort Crew

2.7.3 MANUAL SORTING

Once the sample was acquired and placed in barrels, the material was manually sorted into the prescribed component categories. Plastic 20-gallon bins with sealed bottoms were used to contain the separated components. A picture of the sorting crew working the sort table and bins is shown in Figure 2-1.

2.7.4 DATA RECORDING

The weigh-out and data recording process is the most critical process of the sort. The Crew Chief was singularly responsible for overseeing all weighing and data recording of each sample. Once each sample was sorted the weigh-out was performed. Each bin containing sorted materials from the just-completed

samples was physically carried over to a digital scale. Sorting laborers assisted with carrying and weighing the bins of sorted material, and the Crew Chief recorded all data.

The Crew Chief used a rugged tablet computer to record the composition weights. The tablet allowed samples to be tallied in real time so that field data collection could immediately identify and rectify errors associated with light sample weights. The tablet periodically synchronized with the cloud via cellular signal, providing excellent data security. Each sample was cross-referenced against the Field Supervisor's sample sheet to assure accurate tracking of the samples each day.

This real-time data entry system offers several important advantages:

- The template contains built-in logic and error checking to prevent erroneous entries.
- The template sums sample weights in real time so the Crew Chief can confirm achievement of weight targets for each and every sample.
- Except where host facilities are outside of cell phone range, the data file syncs routinely and can be accessed and checked by MSW Consultants QA/QC staff back at the office. For remote facilities that cannot synchronize during the work day, it is usually possible to sync in the evening upon returning to the hotel.

The Crew Chief also carried paper field forms as a back-up in case the tablet computer encountered unforeseen technical difficulties.

2.7.5 STATISTICAL METHODS

The following statistical measures were calculated to determine the overall composition of each waste generator sector.

- **Sample Mean**: The sample mean, or average, composition is considered the "most likely" fraction for each material category in the waste stream. The sample mean is determined by (i) summing the weight of each material in each sample; (ii) summing the total weight of all samples, and (iii) dividing the first value by the second value to determine the percent-by-weight composition. Note that the sample mean, while a good estimate, is unlikely to be identical to the population mean value. The meaningfulness of the sample mean is enhanced by the following statistical measures.
- **Standard Deviation**: The standard deviation measures how widely values within the data set are dispersed from the sample mean. A higher standard deviation denotes higher variation in the underlying samples for each material, while a lower standard deviation reflects lower variation among the individual samples. The standard deviation is stated in the same unit as the sample mean, which in this case is percent by weight.
- **Confidence Intervals**: When a sample of data is obtained, it is analyzed in an attempt to determine certain values that describe the entire population of data under analysis. For example, in a poll of likely voters, the intent of the poll is to determine the percentage of all voters who support a given candidate, not simply the percentage of voters in the poll who support that candidate. The percentage of voters who support a given candidate in the poll can easily vary from sample to sample; but the percentage of all voters who support that candidate is a fixed value. In our sample of incoming loads of waste, we are not primarily interested in the percentage composition of the sampled loads, but rather in trying to determine what the composition of the sampled loads tells us about the composition of all waste generated. A confidence interval is a statistical concept that attempts to indicate the likely range within which the true value lies. The confidence intervals reflect the upper and lower range within which the population mean can be expected to fall. Confidence intervals require the following "inputs":
  - The "level of confidence", or how sure one wants to be that the interval being constructed will actually encompass the population mean;

- The sample mean, around which the confidence interval will be constructed;
- The sample standard deviation, which is used as a measure of the variability of the population from which the sample was obtained; and
- The number of sampling units that comprised the sample (a.k.a. sample size).

Consistent with MassDEP guidance, confidence intervals were calculated at a 90 percent level of confidence, meaning that we can be 90 percent sure that the mean falls within the upper and lower confidence intervals shown. (The converse is also true: that there is a 10 percent chance that the mean falls outside of the sample mean.) In general, as the number of samples increases, the width of the confidence intervals decreases, although the more variable the underlying waste stream composition, the less noticeable the improvement for adding incremental samples.

2.8 DEVIATIONS FROM WASTE CHARACTERIZATION STUDY PROTOCOL

A deviation from the Waste Characterization Study Protocol was required, and approved by MassDEP, due to a significant change in the nature of solid waste entering the facility. Community Eco Springfield acquired the facility from Covanta Springfield LLC on May 16, 2019 at which time the incoming waste stream changed significantly. The quantity of solid waste received was reduced and contracts with some generators were also changed, or were terminated. These changes conflicted with assumptions upon which the Waste Characterization Study Protocol was prepared and approved by MassDEP back in 2018. Specifically, 47 samples were collected/analyzed, out of the 52 samples targeted at this facility over two seasons (a five (5) sample shortfall). Twenty-six (26) samples were collected during Season 01 which took place on Monday-Wednesday, and 21 samples were collected/analyzed out of 26 planned samples during Season 02 which took place on Thursday-Saturday. The reason for the Season 02 sampling shortfall was an unexpected drop in incoming waste tonnage as a result of the facility's ownership change from Covanta Springfield Inc. to Community Eco Springfield LLC on May 16, 2019. The facility scale house report reflects this change. Although the quantity of "planned samples" (the number of which was based on historic Covanta data) were short, we believe the number of "actual samples" collected accurately represents the lower tonnage observed in the Season 02 sampling event.

The rearload/sideload trucks appear to have been under-sampled, and that the roll-off compactor trucks appear to have been oversampled relative to the Study Protocol. However, what appears to be a sampling shortfall may in fact be commensurate with Community Eco Springfield's lower waste quantities. The shortfall of samples (47 instead of 52) may slightly impact the width of confidence intervals that will be calculated to estimate the facility's waste composition (meaning that the results of the 2019 WCS will be slightly less precise than the prior iterations) and that the Season 02 will be slightly underrepresented in the results compared to Season 01, but not of numerical significance in policy planning.

A sample size of 47 samples is still above minimum sampling targets for a waste characterization study based on current waste composition best practices. Of particular note, California's official state waste characterization guidance document specifies a 30-sample minimum for residential waste and a 40-sample minimum for commercial (or mixed residential and commercial) waste. Both of these targets were exceeded. Sampling at Springfield still covered all days of the week on which loads are received, and should achieve geographic representation as a result. Further, the 47 samples from this facility would still be reasonably representative when aggregated with the results from the other five Massachusetts WTEs that perform waste composition studies and could still be used to develop statewide composition estimates for policy planning.

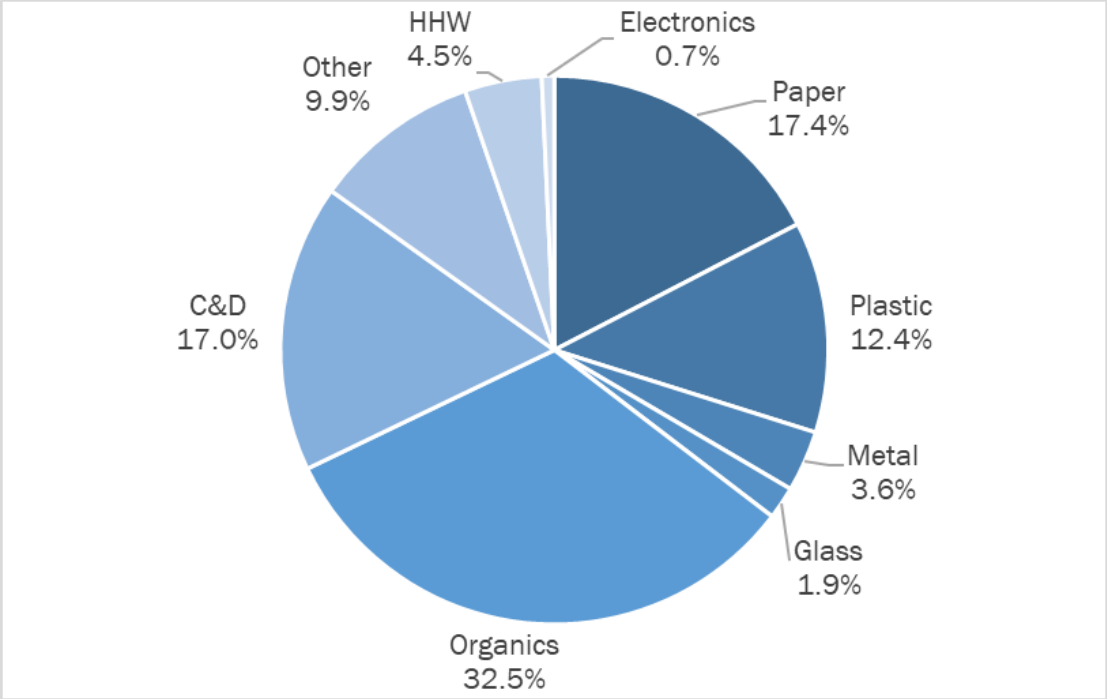
See **Appendix B** for MassDEP's approval of this deviation.

3. RESULTS

3.1 AGGREGATE WASTE COMPOSITION

Figure 3-1 shows the breakdown of major material groups for the aggregate overall municipal solid waste stream entering the facility. Results are shown in percentage terms. As shown, Organics and Paper are the most prevalent materials in the aggregate disposal stream.

Figure 3-1 Overall Waste Composition by Material Group



3. RESULTS

Table 3-1 shows the top 10 most prevalent material categories in the overall MSW stream, as well as for the Residential and ICI streams. Not surprisingly, Food Waste is the single most prevalent category. However, compostable paper was also found to be prevalent.

Table 3-1 Top 10 Most Prevalent Material Categories

	Aggregate	Residential	ICI
1	Food Waste (21.7%)	Food Waste (20.9%)	Food Waste (22.8%)
2	Compostable Paper (7.7%)	Textiles (10.2%)	Compostable Paper (9.8%)
3	Textiles (7.0%)	Compostable Paper (6.2%)	Remainder/Composite Organic (6.4%)
4	Remainder/Composite Organic (5.4%)	Prunings, Trimmings, Leaves and Grass (5.3%)	Wood - Treated (6.3%)
5	Wood - Treated (5.1%)	Remainder/Composite C&D (5.1%)	Other Plastic Film (4.3%)
6	Prunings, Trimmings, Leaves and Grass (4.7%)	Bio-Hazards (4.8%)	Prunings, Trimmings, Leaves and Grass (3.8%)
7	Bio-Hazards (4.2%)	Remainder/Composite Organic (4.7%)	Uncoated Corrugated Cardboard/Kraft Paper (3.7%)
8	Remainder/Composite C&D (3.9%)	Wood - Treated (4.2%)	Carpet and Carpet Padding (3.5%)
9	Other Plastic Film (3.9 %)	Other Recyclable Paper (4.0%)	Bio-Hazards (3.4%)
10	Other Recyclable Paper (3.5%)	Other Plastic Film (3.6%)	Film (non-bag clean commercial and industrial packaging film) (3.3%)
	Subtotal = 67.1%	**Subtotal = 69.0%**	**Subtotal = 67.0%**

Table 3-1 on the following page provides a detailed statistical profile of the overall disposed MSW stream. For each material category, the estimated disposed tons, mean percent, and lower and upper confidence intervals are shown. Confidence intervals are calculated at a 90 percent level of confidence.

Table 3-2 Detailed Aggregate MSW Composition

Material	Percent	Std. Dev	Conf Int (+/-)
Paper	**17.4%**	**9.1%**	**2.2%**
Uncoated Corrugated Cardboard/Kraft Paper	2.6%	3.3%	0.8%
Waxed Cardboard	0.4%	1.4%	0.3%
High Grade Office Paper	0.4%	0.9%	0.2%
Magazines/Catalogs	0.8%	1.7%	0.4%
Newsprint	0.7%	1.5%	0.4%
Other Recyclable Paper	3.5%	2.6%	0.6%
Compostable Paper	7.7%	5.5%	1.3%
Remainder/Composite Paper	1.3%	1.9%	0.5%
Plastic	**12.4%**	**8.5%**	**2.0%**
#1 PET Beverage Containers (non-deposit)	0.7%	0.5%	0.1%
PET Containers other than Beverage	0.2%	0.2%	0.0%
Plastic MA Deposit Beverage Containers	0.1%	0.1%	0.0%
#2 HDPE Natural/Colored Bottles	0.5%	0.4%	0.1%
Injection Molded Plastic Tubs/Lids	0.3%	0.5%	0.1%
#3 - #7 Plastic Containers	0.9%	0.7%	0.2%
Food Grade Expanded Polystyrene	0.5%	0.5%	0.1%
Non-food Grade Expanded Polystyrene	0.2%	0.8%	0.2%
Bulk Rigid Plastic Items	0.9%	2.0%	0.5%
Clean Com'l/Ind'l Packaging Film (non-bag)	1.5%	7.3%	1.8%
Grocery and other Merchandise Bags	0.7%	0.6%	0.1%
Other Plastic Film	3.9%	1.9%	0.5%
Remainder/Composite Plastic	2.0%	2.2%	0.5%
Metal	**3.6%**	**3.9%**	**0.9%**
Non-MA Deposit Alum. Bev. Containers	0.0%	0.1%	0.0%
MA Deposit Alum. Bev. Containers	0.2%	0.4%	0.1%
Tin/Steel Containers	0.8%	0.7%	0.2%
Other Aluminum	0.4%	1.0%	0.2%
Other Ferrous and Non-Ferrous Scrap	1.2%	3.3%	0.8%
White Goods	0.3%	1.3%	0.3%
Remainder/Composite Metal	0.7%	1.9%	0.5%
Glass	**1.9%**	**2.6%**	**0.6%**
Non-MA Deposit Glass Beverage Containers	0.7%	1.9%	0.5%
Non-MA Deposit Other Glass Containers	0.3%	0.4%	0.1%
MA Deposit Glass Beverage Containers	0.4%	0.9%	0.2%
Remainder/Composite Glass	0.5%	0.5%	0.1%

Material	Percent	Std. Dev	Conf Int (+/-)
Organics	**32.5%**	**14.6%**	**3.5%**
Food Waste	21.7%	12.3%	2.9%
Branches and Stumps	0.5%	2.2%	0.5%
Prunings, Trimmings, Leaves, Grass	4.7%	7.6%	1.8%
Manures	0.2%	0.9%	0.2%
Remainder/Composite Organic	5.4%	8.5%	2.0%
C&D	**17.0%**	**16.1%**	**3.9%**
Asphalt Pavement, Brick, Concrete	0.3%	2.0%	0.5%
Aggregates, Stones, Rock	0.1%	0.5%	0.1%
Wood – Treated	5.1%	7.0%	1.7%
Wood – Untreated	2.6%	5.0%	1.2%
Asphalt Roofing	0.7%	3.3%	0.8%
Drywall/Gypsum Board	0.9%	3.2%	0.8%
Carpet and Carpet Padding	3.5%	6.6%	1.6%
Remainder/Composite C&D	3.9%	8.0%	1.9%
Household Hazardous Waste	**4.5%**	**6.4%**	**1.5%**
Ballasts, CFLs, Other Fluorescents	0.0%	0.0%	0.0%
Batteries – Lead Acid	0.0%	0.0%	0.0%
Other Batteries	0.0%	0.1%	0.0%
Paint	0.0%	0.3%	0.1%
Bio-Hazards	4.2%	6.3%	1.5%
Vehicle and Equipment Fluids	0.0%	0.1%	0.0%
Empty Metal, Glass, Plastic Containers	0.1%	0.1%	0.0%
Other HHW	0.2%	0.7%	0.2%
Electronics	**0.7%**	**4.0%**	**1.0%**
Computer-related Electronics	0.2%	0.8%	0.2%
Other "brown goods"	0.5%	2.3%	0.6%
Televisions and Computer Monitors	0.0%	0.0%	0.0%
Other	**9.9%**	**6.6%**	**1.6%**
Tires and Other Rubber	1.4%	3.2%	0.8%
Textiles	7.0%	6.0%	1.4%
Bulky Materials	0.3%	2.1%	0.5%
Mattresses	0.0%	0.0%	0.0%
Restaurant Fats, Oils and Greases	0.0%	0.1%	0.0%
Other Miscellaneous	1.1%	2.8%	0.7%
Totals	**100.0%**		
Sample Count	**47**		

Confidence intervals calculated at the 90% confidence level. Percentages for material types may not total 100% due to rounding.

3.2 WASTE COMPOSITION BY GENERATOR SECTOR

Table 3-3 compares the detailed composition of the aggregate disposed waste stream with the Residential and ICI generator sectors individually. This table illustrates the differences in Residential and ICI wastes, and the need for programs to target specific material streams by generator sector.

Table 3-3 Composition of Waste Composition by Generator Sector

Material	Aggregate	Resi-dential	ICI	Material	Aggregate	Resi-dential	ICI
Paper	**17.4%**	**15.8%**	**19.6%**	**Organics**	**32.5%**	**31.6%**	**33.7%**
Uncoated Corrugated Cardboard/Kraft Paper	2.6%	1.8%	3.7%	Food Waste	21.7%	20.9%	22.8%
Waxed Cardboard	0.4%	0.0%	0.9%	Branches and Stumps	0.5%	0.4%	0.6%
High Grade Office Paper	0.4%	0.5%	0.3%	Prunings, Trimmings, Leaves, Grass	4.7%	5.3%	3.8%
Magazines/Catalogs	0.8%	1.1%	0.2%	Manures	0.2%	0.3%	0.2%
Newsprint	0.7%	0.9%	0.4%	Remainder/Composite Organic	5.4%	4.7%	6.4%
Other Recyclable Paper	3.5%	4.0%	2.9%				
Compostable Paper	7.7%	6.2%	9.8%	**C&D**	**17.0%**	**16.8%**	**17.2%**
Remainder/Composite Paper	1.3%	1.3%	1.3%	Asphalt Pavement, Brick, Concrete	0.3%	0.0%	0.7%
				Aggregates, Stones, Rock	0.1%	0.0%	0.2%
Plastic	**12.4%**	**11.5%**	**13.7%**	Wood – Treated	5.1%	4.2%	6.3%
#1 PET Beverage Containers (non-deposit)	0.7%	0.8%	0.7%	Wood – Untreated	2.6%	2.0%	3.3%
PET Containers other than Beverage	0.2%	0.2%	0.2%	Asphalt Roofing	0.7%	1.2%	0.0%
Plastic MA Deposit Beverage Containers	0.1%	0.1%	0.1%	Drywall/Gypsum Board	0.9%	0.9%	1.0%
#2 HDPE Natural/Colored Bottles	0.5%	0.6%	0.3%	Carpet and Carpet Padding	3.5%	3.5%	3.5%
Injection Molded Plastic Tubs/Lids	0.3%	0.2%	0.4%	Remainder/Composite C&D	3.9%	5.1%	2.3%
#3 - #7 Plastic Containers	0.9%	0.9%	1.0%				
Food Grade Expanded Polystyrene	0.5%	0.6%	0.4%	**Household Hazardous Waste**	**4.5%**	**5.3%**	**3.5%**
Non-food Grade Expanded Polystyrene	0.2%	0.1%	0.5%	Ballasts, CFLs, Other Fluorescents	0.0%	0.0%	0.0%
Bulk Rigid Plastic Items	0.9%	0.8%	1.1%	Batteries – Lead Acid	0.0%	0.0%	0.0%
Clean Com'l/Ind'l Packaging Film (non-bag)	1.5%	0.1%	3.3%	Other Batteries	0.0%	0.1%	0.0%
Grocery and other Merchandise Bags	0.7%	0.9%	0.4%	Paint	0.0%	0.1%	0.0%
Other Plastic Film	3.9%	3.6%	4.3%	Bio-Hazards	4.2%	4.8%	3.4%
Remainder/Composite Plastic	2.0%	2.6%	1.2%	Vehicle and Equipment Fluids	0.0%	0.0%	0.0%
				Empty Metal, Glass, Plastic Containers	0.1%	0.1%	0.1%
Metal	**3.6%**	**3.7%**	**3.5%**	Other HHW	0.2%	0.2%	0.1%
Non-MA Deposit Alum. Bev. Containers	0.0%	0.0%	0.0%				
MA Deposit Alum. Bev. Containers	0.2%	0.2%	0.3%	**Electronics**	**0.7%**	**1.2%**	**0.2%**
Tin/Steel Containers	0.8%	0.7%	0.8%	Computer-related Electronics	0.2%	0.3%	0.1%
Other Aluminum	0.4%	0.3%	0.5%	Other "brown goods"	0.5%	0.9%	0.0%
Other Ferrous and Non-Ferrous Scrap	1.2%	1.3%	1.1%	Televisions and Computer Monitors	0.0%	0.0%	0.0%
White Goods	0.3%	0.4%	0.0%				
Remainder/Composite Metal	0.7%	0.7%	0.8%	**Other**	**9.9%**	**12.5%**	**6.3%**
				Tires and Other Rubber	1.4%	1.3%	1.5%
Glass	**1.9%**	**1.7%**	**2.3%**	Textiles	7.0%	10.2%	2.7%
Non-MA Deposit Glass Beverage Containers	0.7%	0.5%	1.0%	Bulky Materials	0.3%	0.0%	0.7%
Non-MA Deposit Other Glass Containers	0.3%	0.3%	0.3%	Mattresses	0.0%	0.0%	0.0%
MA Deposit Glass Beverage Containers	0.4%	0.3%	0.5%	Restaurant Fats, Oils and Greases	0.0%	0.0%	0.0%
Remainder/Composite Glass	0.5%	0.5%	0.5%	Other Miscellaneous	1.1%	1.0%	1.2%
				Totals	**100.0%**	**100.0%**	**100.0%**
				Sample Count	**47**	**27**	**20**

Confidence intervals calculated at the 90% confidence level. Percentages for material types may not total 100% due to rounding.

3.3 WASTE COMPOSITION BY VEHICLE TYPE

This study also sought to capture and report on waste composition by truck type, shown in Table 3-4. It should be noted that these results are based on an increasingly small number of samples, which in turn increases the width of the confidence intervals. Further, outlier samples will have a much greater potential to skew results given the progressively smaller sample counts. For this reason, the reader is cautioned that the data below are limited in their ability to convey details about waste composition.

Table 3-4 Comparison of Waste Composition by Truck Type

Material	Aggregate	Rearload Sideload	Frontload	Roll-off Compactor	Roll-off Open Top
Paper	**17.4%**	**15.9%**	**16.2%**	**21.7%**	**N/A**
Uncoated Corrugated Cardboard/Kraft Paper	2.6%	1.6%	3.7%	3.6%	N/A
Waxed Cardboard	0.4%	0.0%	0.9%	0.8%	N/A
High Grade Office Paper	0.4%	0.5%	0.3%	0.3%	N/A
Magazines/Catalogs	0.8%	1.2%	0.4%	0.2%	N/A
Newsprint	0.7%	1.0%	0.3%	0.5%	N/A
Other Recyclable Paper	3.5%	4.0%	3.4%	2.8%	N/A
Compostable Paper	7.7%	6.2%	6.6%	11.7%	N/A
Remainder/Composite Paper	1.3%	1.4%	0.7%	1.7%	N/A
Plastic	**12.4%**	**10.7%**	**10.2%**	**18.0%**	**N/A**
#1 PET Beverage Containers (non-deposit)	0.7%	0.8%	0.6%	0.7%	N/A
PET Containers other than Beverage	0.2%	0.2%	0.2%	0.1%	N/A
Plastic MA Deposit Beverage Containers	0.1%	0.1%	0.1%	0.0%	N/A
#2 HDPE Natural/Colored Bottles	0.5%	0.6%	0.4%	0.3%	N/A
Injection Molded Plastic Tubs/Lids	0.3%	0.3%	0.2%	0.5%	N/A
#3 - #7 Plastic Containers	0.9%	0.9%	0.7%	1.2%	N/A
Food Grade Expanded Polystyrene	0.5%	0.7%	0.2%	0.5%	N/A
Non-food Grade Expanded Polystyrene	0.2%	0.1%	0.0%	0.8%	N/A
Bulk Rigid Plastic Items	0.9%	0.3%	0.4%	2.5%	N/A
Clean Com'l/Ind'l Packaging Film (non-bag)	1.5%	0.1%	0.6%	5.0%	N/A
Grocery and other Merchandise Bags	0.7%	0.9%	0.3%	0.5%	N/A
Other Plastic Film	3.9%	3.5%	3.7%	4.8%	N/A
Remainder/Composite Plastic	2.0%	2.2%	2.6%	1.2%	N/A
Metal	**3.6%**	**4.0%**	**3.9%**	**2.6%**	**N/A**
Non-MA Deposit Alum. Bev. Containers	0.0%	0.0%	0.0%	0.0%	N/A
MA Deposit Alum. Bev. Containers	0.2%	0.2%	0.2%	0.4%	N/A
Tin/Steel Containers	0.8%	0.8%	0.9%	0.5%	N/A
Other Aluminum	0.4%	0.3%	0.2%	0.7%	N/A
Other Ferrous and Non-Ferrous Scrap	1.2%	1.4%	1.1%	0.9%	N/A
White Goods	0.3%	0.5%	0.0%	0.0%	N/A
Remainder/Composite Metal	0.7%	0.7%	1.5%	0.1%	N/A
Glass	**1.9%**	**1.7%**	**1.7%**	**2.5%**	**N/A**
Non-MA Deposit Glass Beverage Containers	0.7%	0.6%	0.5%	1.2%	N/A
Non-MA Deposit Other Glass Containers	0.3%	0.3%	0.4%	0.2%	N/A
MA Deposit Glass Beverage Containers	0.4%	0.3%	0.1%	0.8%	N/A
Remainder/Composite Glass	0.5%	0.5%	0.7%	0.3%	N/A
Organics	**32.5%**	**32.3%**	**29.1%**	**36.1%**	**N/A**
Food Waste	21.7%	21.2%	16.7%	27.2%	N/A
Branches and Stumps	0.5%	0.5%	1.1%	0.0%	N/A
Prunings, Trimmings, Leaves, Grass	4.7%	5.9%	3.6%	3.1%	N/A
Manures	0.2%	0.1%	0.3%	0.4%	N/A
Remainder/Composite Organic	5.4%	4.5%	7.4%	5.4%	N/A
C&D	**17.0%**	**16.9%**	**27.2%**	**7.6%**	**N/A**
Asphalt Pavement, Brick, Concrete	0.3%	0.0%	1.2%	0.0%	N/A
Aggregates, Stones, Rock	0.1%	0.0%	0.3%	0.0%	N/A
Wood – Treated	5.1%	3.6%	10.2%	3.3%	N/A
Wood – Untreated	2.6%	1.7%	6.2%	0.9%	N/A
Asphalt Roofing	0.7%	1.3%	0.0%	0.0%	N/A
Drywall/Gypsum Board	0.9%	1.0%	0.5%	1.2%	N/A
Carpet and Carpet Padding	3.5%	3.9%	6.3%	0.0%	N/A
Remainder/Composite C&D	3.9%	5.4%	2.4%	2.2%	N/A

Table 3-4 Comparison of Waste Composition by Truck Type (continued)

Material	Aggregate	Rearload Sideload	Frontload	Roll-off Compactor	Roll-off Open Top
Household Hazardous Waste	**4.5%**	**5.1%**	**2.6%**	**5.2%**	**N/A**
Ballasts, CFLs, Other Fluorescents	0.0%	0.0%	0.0%	0.0%	N/A
Batteries – Lead Acid	0.0%	0.0%	0.0%	0.0%	N/A
Other Batteries	0.0%	0.1%	0.0%	0.0%	N/A
Paint	0.0%	0.1%	0.0%	0.0%	N/A
Bio-Hazards	4.2%	4.6%	2.4%	5.0%	N/A
Vehicle and Equipment Fluids	0.0%	0.0%	0.0%	0.1%	N/A
Empty Metal, Glass, Plastic Containers	0.1%	0.1%	0.1%	0.0%	N/A
Other HHW	0.2%	0.2%	0.1%	0.0%	N/A
Electronics	**0.7%**	**0.9%**	**1.0%**	**0.1%**	**N/A**
Computer-related Electronics	0.2%	0.1%	0.7%	0.0%	N/A
Other "brown goods"	0.5%	0.9%	0.3%	0.1%	N/A
Televisions and Computer Monitors	0.0%	0.0%	0.0%	0.0%	N/A
Other	**9.9%**	**12.5%**	**8.1%**	**6.2%**	**N/A**
Tires and Other Rubber	1.4%	1.4%	1.9%	0.9%	N/A
Textiles	7.0%	9.9%	4.0%	3.9%	N/A
Bulky Materials	0.3%	0.0%	1.3%	0.0%	N/A
Mattresses	0.0%	0.0%	0.0%	0.0%	N/A
Restaurant Fats, Oils and Greases	0.0%	0.0%	0.0%	0.0%	N/A
Other Miscellaneous	1.1%	1.1%	0.8%	1.4%	N/A
Totals	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**N/A**
Sample Count	**47**	**24**	**11**	**12**	**0**

Confidence intervals calculated at the 90% confidence level. Percentages for material types may not total 100% due to rounding.

3.4 COMPARISON WITH PRIOR WASTE COMPOSITION

As a final note, this study updates comparable studies performed in 2010, 2013, and 2016 and contains the same results sets as in these prior studies. For the convenience of the reader, Table 3-5 compares the aggregate waste composition from this 2019 update with the previous studies. Similar comparisons can be made for all of the results contained in this 2019 Study update.

Table 3-5 Comparison of 2019 Results with Prior Studies

Material	2019 Aggregate	2016 Aggregate	2013 Aggregate	2010 Aggregate
Paper	**17.4%**	**22.1%**	**21.2%**	**20.1%**
Uncoated Corrugated Cardboard/Kraft Pape	2.6%	7.4%	3.5%	5.5%
Waxed Cardboard	0.4%	0.2%	1.4%	0.1%
High Grade Office Paper	0.4%	1.2%	0.8%	0.9%
Magazines/Catalogs	0.8%	0.8%	1.0%	1.1%
Newsprint	0.7%	0.9%	0.9%	2.0%
Other Recyclable Paper	3.5%	3.2%	5.1%	4.4%
Compostable Paper	7.7%	6.8%	7.4%	4.6%
Remainder/Composite Paper	1.3%	1.5%	1.1%	1.5%
Plastic	**12.4%**	**12.4%**	**14.0%**	**13.5%**
#1 PET Beverage Containers (non-deposit)	0.7%	0.5%	0.4%	0.4%
PET Containers other than Beverage	0.2%	0.3%	0.3%	0.1%
Plastic MA Deposit Beverage Containers	0.1%	0.1%	0.1%	0.1%
#2 HDPE Natural/Colored Bottles	0.5%	0.7%	0.4%	0.9%
Injection Molded Plastic Tubs/Lids	0.3%	0.4%	1.7%	0.2%
#3 - #7 Plastic Containers	0.9%	0.4%	0.8%	0.4%
Food Grade Expanded Polystyrene	0.5%	0.5%	0.4%	0.7%
Non-food Grade Expanded Polystyrene	0.2%	0.1%	0.1%	0.1%
Bulk Rigid Plastic Items	0.9%	2.4%	1.2%	3.9%
Clean Com'l/Ind'l Packaging Film (non-bag)	1.5%	0.5%	0.6%	0.5%
Grocery and other Merchandise Bags	0.7%	0.5%	0.6%	0.4%
Other Plastic Film	3.9%	3.6%	4.8%	2.9%
Remainder/Composite Plastic	2.0%	2.4%	2.6%	2.8%
Metal	**3.6%**	**4.1%**	**4.6%**	**4.6%**
Non-MA Deposit Alum. Bev. Containers	0.0%	0.1%	0.0%	0.0%
MA Deposit Alum. Bev. Containers	0.2%	0.2%	0.2%	0.2%
Tin/Steel Containers	0.8%	0.7%	0.7%	0.7%
Other Aluminum	0.4%	0.5%	0.3%	0.3%
Other Ferrous and Non-Ferrous Scrap	1.2%	0.8%	0.8%	1.1%
White Goods	0.3%	0.4%	0.9%	0.3%
Remainder/Composite Metal	0.7%	1.4%	1.6%	1.9%
Glass	**1.9%**	**1.5%**	**1.5%**	**1.4%**
Non-MA Deposit Glass Beverage Containers	0.7%	0.5%	0.6%	0.4%
Non-MA Deposit Other Glass Containers	0.3%	0.4%	0.5%	0.3%
MA Deposit Glass Beverage Containers	0.4%	0.3%	0.1%	0.3%
Remainder/Composite Glass	0.5%	0.3%	0.3%	0.4%
Organics	**32.5%**	**33.2%**	**31.0%**	**21.5%**
Food Waste	21.7%	26.0%	19.9%	15.6%
Branches and Stumps	0.5%	0.1%	0.2%	0.6%
Prunings, Trimmings, Leaves, Grass	4.7%	3.0%	7.2%	3.8%
Manures	0.2%	0.5%	0.1%	0.1%
Remainder/Composite Organic	5.4%	3.6%	3.5%	1.4%

Table 3-6 Comparison of 2019 Results with Prior Studies (continued)

Material	2019 Aggregate	2016 Aggregate	2013 Aggregate	2010 Aggregate
C&D	**17.0%**	**12.1%**	**13.0%**	**13.2%**
Asphalt Pavement, Brick, Concrete	0.3%	0.0%	0.1%	0.0%
Aggregates, Stones, Rock	0.1%	0.1%	0.5%	0.1%
Wood – Treated	5.1%	3.6%	2.4%	2.4%
Wood – Untreated	2.6%	1.4%	1.7%	2.2%
Asphalt Roofing	0.7%	0.6%	0.4%	0.2%
Drywall/Gypsum Board	0.9%	1.2%	1.5%	1.4%
Carpet and Carpet Padding	3.5%	2.8%	2.0%	5.4%
Remainder/Composite C&D	3.9%	2.5%	4.4%	1.4%
Household Hazardous Waste	**4.5%**	**4.0%**	**3.1%**	**2.9%**
Ballasts, CFLs, Other Fluorescents	0.0%	0.0%	0.0%	0.0%
Batteries – Lead Acid	0.0%	0.0%	0.0%	0.4%
Other Batteries	0.0%	0.2%	0.1%	0.0%
Paint	0.0%	0.1%	0.1%	0.2%
Bio-Hazards	4.2%	3.6%	2.6%	2.2%
Vehicle and Equipment Fluids	0.0%	0.0%	0.0%	0.1%
Empty Metal, Glass, Plastic Containers	0.1%	0.1%	0.2%	0.0%
Pesticides and Fertilizers	N/A	N/A	0.0%	0.0%
Other HHW	0.2%	0.0%	0.1%	0.0%
Electronics	**0.7%**	**1.7%**	**1.2%**	**6.3%**
Computer-related Electronics	0.2%	0.6%	0.3%	1.0%
Other “brown goods”	0.5%	1.1%	0.8%	2.9%
Televisions and Computer Monitors	0.0%	0.0%	0.0%	2.4%
Other	**9.9%**	**8.9%**	**10.5%**	**16.5%**
Tires and Other Rubber	1.4%	0.5%	1.5%	1.3%
Textiles	7.0%	5.7%	5.9%	8.4%
Bulky Materials	0.3%	1.0%	2.4%	3.8%
Matresses	0.0%	0.0%	N/A	N/A
Restaurant Fats, Oils and Greases	0.0%	0.0%	0.0%	0.1%
Other Miscellaneous	1.1%	1.7%	0.8%	3.0%
Totals	**100.0%**	**100.0%**	**100.0%**	**100.0%**
Sample Count	**47**	**52**	**52**	**52**

Confidence intervals calculated at the 90% confidence level. Percentages for material types may not total 100% due to rounding.

APPENDIX A

WASTE CATEGORIES

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APPENDIX A – MATERIAL DEFINITIONS

A 1. PRIMARY CATEGORIES

1. Paper
2. Plastics
3. Metals
4. Glass
5. Organic Materials
6. Construction and Demolition (in the MSW stream)
7. Household Hazardous Materials
8. Electronics
9. Other Waste

A 2. SECONDARY CATEGORIES (62)

Paper

1. Uncoated Corrugated Cardboard/Kraft Paper means corrugated boxes or paper bags made from Kraft paper. Uncoated Corrugated Cardboard has a wavy center layer and is sandwiched between the two outer layers and does not have any wax coating on the inside or outside. Examples include entire cardboard containers, such as shipping and moving boxes, computer packaging cartons, and sheets and pieces of boxes and cartons. This type does not include chipboard. Examples of Kraft paper include paper grocery bags, un-soiled fast food bags, department store bags, and heavyweight sheets of Kraft packing paper.

2. Waxed Cardboard means cardboard with wax coating on the inside or outside.

3. High Grade Office Paper means the type of paper that is free of ground wood fibers; usually sulfite or sulphate paper; includes office printing and writing papers such as white ledger, color ledger, envelopes, and computer printout paper, bond, rag, or stationary grade paper. This subtype does not include fluorescent dyed paper or deep-tone dyed paper such a goldenrod colored paper.

4. Magazines/Catalogs means items made of glossy coated paper. This paper is usually slick, smooth to the touch, and reflects light. Examples include glossy magazines, catalogs, brochures, and pamphlets.

5. Newsprint means the class or kind of paper chiefly used for printing newspapers – i.e. uncoated groundwood paper.

6. Other Recyclable Paper means paper, other than the paper mentioned above, which can be recycled. Examples include manila folders, manila envelopes, index cards, white envelopes, notebook paper, carbonless forms, junk mail, chipboard and uncoated paperboard, phone directories, non glossy catalogs, offshore cardboard and deep-toned or fluorescent dyed paper.

7. Compostable Paper means low grade paper that is not capable of being recycled, as well as food contaminated paper. Examples include paper towels, paper plates, waxed papers, egg cartons, pizza boxes, and tissues.

8. Remainder/Composite Paper means items made mostly of paper but combined with large amounts of other materials such as plastic, metal, glues, foil, and moisture. Examples include plastic coated corrugated cardboard, cellulose insulation, aseptic packages, polycoated (gable top) cartons, blueprints,

sepia, onionskin, foiled lined fast food wrappers, frozen juice containers, carbon paper, self-adhesive notes, softcover and hardcover books, and photographs.

Plastics

9. PET Beverage Containers (non-MA deposit containers) means clear or colored PET beverage bottles other than MA deposit containers (water, flavored water, juice, sports drinks, etc.). When marked for identification, it bears the number —1 in the center of the triangular recycling symbol and may also bear the letters —PETE or—PET. A PET container usually has a small dot left from the manufacturing process, not a seam.

10. PET Containers other than Beverage Containers (which originally contained non-hazardous material) means types of containers such as PET jars, rectangular PET containers used for produce; egg cartons, etc.

11. Plastic MA Deposit Beverage Containers means plastic beverage containers subject to MA's bottle bill and marked as deposit containers in Massachusetts.

12. HDPE Bottles, colored and natural, (which originally contained non-hazardous material) means natural and colored HDPE containers. This plastic is usually either cloudy white, allowing light to pass through it (natural) or a solid color, preventing light from passing through it (colored). When marked for identification, it bears the number —2 in the triangular recycling symbol and may also bear the letters—HDPE.

13. Plastic Tubs and lids (HDPE, PP, etc) Includes yogurt, margarine, sour cream, deli containers, etc. (i.e. injection molded).

14. Plastic Containers #3-#7 (which originally contained non-hazardous material) means plastic containers made of types of plastic other than HDPE or PET. Items may be made of PVC, PP, or PS. When marked for identification, these items may bear the number 3, 4, 5, 6, or 7 in the triangular recycling symbol. This subtype also includes unmarked plastic containers.

15. Expanded Polystyrene Food Grade means "Styrofoam" products includes food packaging and finished products made of expanded polystyrene including cups, plates, trays, clamshells, etc.

16. Expanded Polystyrene Non-food Grade includes non-food packaging and finished products made of expanded polystyrene including packing peanuts and other packaging materials.

17. Bulk Rigid Plastic Items means plastic objects other than disposable package items. These items are usually made to last for a few months up to many years. These include the plastics used in children toys, furniture, plastic landscape ties, buckets, crates, pallets, sporting goods, etc.

18. Film (non-bag clean commercial and industrial packaging film) means film plastic used for large-scale packaging or transport packaging. Examples include shrink-wrap, mattress bags, furniture wrap, and film bubble wrap.

19. Grocery and other Merchandise Bags means plastic shopping bags, used to contain merchandise to transport from the place of purchase, given out by the store with the purchase. Includes dry-cleaning plastic bags intended for one-time use and other plastic film commonly recycled with grocery bags.

20. Other Film means plastic film Examples include garbage bags and other types of plastic bags (sandwich bags, zipper-recloseable bags, produce bags, frozen vegetable bags, newspaper bags), painting tarps, food wrappers such as candy-bar wrappers, mailing pouches, bank bags, X-ray film, metallized film (wine containers and balloons), and plastic food wrap.

21. Remainder/Composite Plastic means plastic that cannot be put in any other type or subtype. This type includes items made mostly of plastic but combined with other materials. Examples include auto

parts made of plastic attached to metal, plastic drinking straws, foam packing blocks (not including expanded polystyrene blocks), plastic strapping, new plastic laminate (e.g., Formica), vinyl, linoleum, plastic lumber, imitation ceramics, handles and knobs, some kitchen ware, plastic string (as used for hay bales), and plastic rigid bubble/foil packaging (as for medications); CD's, and rigid plastic housewares, such as mop buckets, dishes, cups, and cutlery.

Metals

22. Aluminum Beverage Containers (non-MA deposit containers) means beverage containers made from aluminum other than MA deposit containers.

23. Aluminum MA Deposit Beverage Containers means metal beverage containers subject to MA's bottle bill and marked as deposit containers in Massachusetts.

24. Tin/Steel Containers means rigid containers made mainly of steel, such as food and beverage containers. These items will stick to a magnet and may be tin-coated.

25. Other Aluminum – includes foil, food containers, aerosols (empty), etc.

26. Other Ferrous and Non-Ferrous means any iron or steel that is magnetic and metal items that are not magnetic (copper, brass, lead, zinc, etc). This subtype does not include "tin/steel containers". Examples include empty or dry paint cans, structural steel beams, boilers, clothes hangers, pipes, some cookware, security bars, scrap ferrous/nonferrous items, and galvanized items such as nails and flashing.

27. White Goods means appliances that employ electricity, oil, natural gas, or liquefied propane and to preserve or cook food; wash or dry clothing, kitchen utensils, or related items; or to cool or heat air or water. These are primarily encased in metal, and include items such as refrigerators, freezers, stoves, water heaters, propane/compressed tanks, water coolers, dishwashers, clothes dryers, air conditioners, gas or electric ovens and ranges. White goods does not include microwaves.

28. Remainder/Composite Metal means metal that cannot be put in any other type. This type includes items made mostly of metal but combined with other materials and items made of both ferrous metal and nonferrous metal combined. Examples include microwaves, bikes, motors, insulated wire, and finished products that contain a mixture of metals, or metals and other materials, whose weight is derived significantly from the metal portion of its construction.

Glass

29. Glass Beverage Containers (non-MA deposit containers) includes wine bottles, nonalcoholic beverage containers, liquor bottles, etc.

30. Other Glass Packaging Containers (non-MA deposit containers) includes glass food and non-food containers such as sauces, jars, perfume containers, etc.

31. Glass MA Deposit Beverage Containers means glass beverage containers subject to MA's bottle bill and marked as deposit containers in Massachusetts.

32. Remainder/Composite Glass means glass that cannot be put in any other type. It may include items made mostly of glass but combined with other materials. Examples include Pyrex, Corningware, crystal, plate glass, window and door glass, ceramics, porcelain, and other glass tableware, mirrors, non-fluorescent light bulbs, auto windshields, laminated glass, or any curved glass.

Organic Materials

33. Food Waste means food material resulting from the processing, storage, preparation, cooking, handling, or consumption of food. This type includes material from industrial, commercial, or residential sources. Examples include discarded meat scraps, dairy products, eggshells, fruit or vegetable peels, and

other food items from homes, stores and restaurants. This type includes apple pomace and other processed residues or material from canneries, wineries or other industrial sources.

34. Branches and Stumps means trees, stumps, branches, or other wood greater than 1 inch in diameter generated from landscapes, clearing land for commercial or residential development, road construction, agricultural land clearing, storms, or natural disaster.

35. Prunings, Trimmings, Leaves and Grass means plant material, except woody material 1inch or less in diameter from any public or private landscapes. Examples include branches, prunings, shrubs, leaves, grass clippings, and plants. This subtype does not include woody material greater than 4 inches in diameter.

36. Manures means manure and soiled bedding materials from domestic, farm, wild, or ranch animals. Examples include manure and soiled bedding from animal production operations, racetracks, riding stables, animal hospitals, laboratories, zoos, nature centers, and other sources.

37. Remainder/Composite Organic means organic material that cannot be put in any other type or subtype. This type includes items made mostly of organic materials but combined with other materials. Examples include cork, hemp rope, hair, cigarette butts, full vacuum bags, sawdust, and animal feces.

Construction and Demolition (in the MSW stream)

38. Asphalt Pavement, Brick, and Concrete includes asphalt pavement, brick, and concrete from construction activities and demolition of buildings, roads, and bridges and similar sources. Asphalt pavement also includes other black or brown, tar-like material mixed with aggregate and used as a paving material. Brick also includes masonry brick, landscaping or walkway brick. Concrete also includes pieces of building foundations, concrete paving, and cinder blocks.

39. Aggregates, Stone, Rock, Soil, Fines includes non-organic material from construction and landscaping activities. May also include products made predominately from these materials (i.e. granite counters).

40. Wood - Treated means wood that contains an adhesive, paint, stain, fire retardant, pesticide or preservative.

41. Wood - Untreated refers to any wood which does not contain an adhesive, paint, stain, fire retardant, pesticide or preservative; includes such items as pallets, skids, spools, packaging materials, bulky wood waste or scraps from newly built wood products. Does not including land clearing debris or yard waste prunings and trimmings

42. Asphalt Roofing means composite shingles and other roofing material made with asphalt. Examples include asphalt shingles and attached roofing tar and tar paper.

43. Drywall/Gypsum Board means interior wall covering made of a sheet of gypsum sandwiched between paper layers. Examples include used or unused, broken or whole sheets of sheetrock, drywall, gypsum board, plasterboard, gypsum board, gyproc, and wallboard.

44. Carpet and Carpet Padding means flooring applications consisting of various natural or synthetic fibers which maybe bonded to some type of backing material and plastic, foam, felt, or other material used under carpet to provide insulation and padding.

45. Remainder/Composite Construction and Demolition means construction and demolition material that cannot be put in any other type or subtype. This type may include items from different types combined, which would be very hard to separate.

Household Hazardous Waste

46. Ballasts, CFLs, and Other Fluorescents include ballasts, which are devices that electrically control fluorescent light fixtures and that include a capacitor, CFLs, which are compact fluorescent bulbs, and other fluorescent lighting, which includes tubular fluorescent lamps, neon lamps, black lights, and other lamps used for sanitation or cosmetic purposes.

47. Batteries – Lead Acid means lead acid storage batteries most commonly used in vehicles such as cars, trucks, boats, etc.

48. Batteries – Other means alkaline (including alkaline rechargeable) or household batteries such as AA, AAA, C, D, 4.5 volt, button cell, rechargeable and 9 volt used for flashlights, small appliances, and electronic devices.

49. Paint means containers with paint in them. Examples include latex paint, oil based paint, and tubes of pigment or fine art paint. This type does not include dried paint, empty paint cans, or empty aerosol containers.

50. Bio-Hazardous - means discarded animal or human medical/treatment wastes including needles, first aid wastes, diapers and other products which are used in relation to animal or human care. This category does not include cat litter or animal feces.

51. Vehicle and Equipment Fluids in containers and oil filters means containers with fluids used in vehicles or engines. Examples include antifreeze, oil, and brake fluid. This type does not include empty vehicle and equipment fluid containers. Oil filters include vehicle engine oil filters.

52. Empty Metal, Glass, and Plastic Containers (that originally contained toxic materials) means all containers that are empty but that at one time contained toxic or hazardous fluids or other materials. Examples include empty antifreeze, oil, or lye containers.

53. Pesticides and Fertilizers means households and commercial products used to destroy or control organisms, pests or enhance plant growth.

54. Other Hazardous or Household Hazardous Waste means all household or commercial products characterized as toxic, corrosive, flammable, ignitable, radioactive, poisonous, or reactive.

Electronics

55. Computer-related Electronics includes computer CPUs, laptop computers, notebook computers, processors, printers, scanners, keyboards, etc. This category does not include automated typewriters or typesetters, portable handheld calculators, portable digital assistants or other similar devices.

56. Other "Brown Goods" includes cell phones, iPODs, PDAs, small electronic appliances such as toasters, telephones, stereos, radios, clocks, hair dryers etc.

57. Televisions and Computer Monitors means a stand-alone display system containing a CRT or any other type of display primarily intended to receive video programming via broadcast. Examples also include non-CRT units such as plasma and LCD monitors.

Other Materials

58. Tires and other rubber means a continuous solid or pneumatic rubber covering intended for use on any type of vehicle (including bicycles), or trailer to be used in tandem with any type vehicle and other rubber products.

59. Textiles means natural or man-made textile materials such as cottons, wools, silk, nylon, polyester. Includes clothing, curtains, towels and other fabric materials.

60. Bulky Materials means products made from multiple materials and large in size, which are meant for extended use. Includes mattresses, furniture (non-plastic), sinks, toilets, and other non-metal items

61. Restaurant Fats, Oils and Grease means any fats, oils and grease generated from the food preparation process.

62. Other Miscellaneous means any other type of waste not listed in any other sort category.

APPENDIX B

MASSDEP DEVIATION APPROVAL

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Stephen Sakakeeny

From: Stephen Sakakeeny
Sent: Monday, September 16, 2019 9:28 AM
To: Fischer, John (DEP)
Cc: John Foley; John Culbertson; Joe Vetrano; Chhavan Nuon
Subject: RE: Community Eco Springfield Waste - Characterization Exception Request

Thank you John.

Best Regards,

Stephen Sakakeeny
978-688-7804 x112

From: Fischer, John (DEP) <john.fischer@state.ma.us>
Sent: Friday, September 13, 2019 2:18 PM
To: Stephen Sakakeeny <ssakakeeny@sakenvironmental.com>
Cc: John Foley <jfoley@cecopower.com>; John Culbertson <jculbertson@mswconsultants.com>; Joe Vetrano <jvetrano@mswconsultants.com>; Chhavan Nuon <cnuon@sakenvironmental.com>
Subject: RE: Community Eco Springfield Waste - Characterization Exception Request

Stephen, John, and John,

Thank you for this additional documentation and explanation. Based on this information, the Massachusetts Department of Environmental Protection (MassDEP) will approve the sampling completed as is and not require additional load sampling. Please include the explanation you described below to clarify this reduced number of samples for readers of the report. Please let me know if you have any further questions or need additional information from me on this matter. Thank you.

John

John Fischer
Branch Chief, Commercial Waste Reduction and Waste Planning
MassDEP
617-292-5632
john.fischer@ state.ma.us
www.mass.gov/dep
https://twitter.com/massdep

From: Stephen Sakakeeny [mailto:ssakakeeny@sakenvironmental.com]
Sent: Tuesday, September 03, 2019 12:08 PM
To: Fischer, John (DEP)
Cc: John Foley; John Culbertson; Joe Vetrano; Chhavan Nuon
Subject: Community Eco Springfield Waste - Characterization Exception Request

John Fisher,

The purpose of this email is to recap the Waste Composition Study sample outcome and request an exception to the Waste Composition sampling targets at the Community Eco Springfield Waste to Energy facility in Springfield, MA. We were able to capture 47 out of the 52 samples that were targeted at this facility over two seasons. We captured all 26 samples

during the Q2 sort which took place on a Mon-Wed, and 21 samples out of 26 planned samples during the Q3 sort which took place on a Thu-Sat. The reason for the Q3 sampling shortfall is an unexpected drop in incoming waste tonnage as a result of the facility's ownership change from Covanta Springfield to Community Eco Springfield on May 15, 2019 **(See attached Scale House Report)**. Although the quantity of "planned samples" (the number of which was based on historic Covanta data) were short, we believe number of "actual samples" collected accurately represents the lower tonnage observed in the Q3 sampling event. For this reason, we request that this exception to the Study Protocol for this facility be considered by your office.

First some background. As you know, the study protocol was developed in Q3 of last year when the facility was owned by Covanta. We went back and confirmed that the protocol was based on 2017 annual tonnage, which was appropriate and supported by Covanta's qualitative input that their inbound customers and waste quantities when we did the protocol were reasonably similar to the 2017 annual data.

The Q2 sampling event went according to plan and reflected expected waste streams while under Covanta ownership. However, in the process of the Q3 sampling event, it slowly became evident that the inbound delivery patterns had changed. Our stratified sampling plan identified several residential RL/SL haulers that were expected to deliver each day, with some frontloaders arriving on Saturday. First it became evident that multiple residential haulers were not arriving, and the only residential waste supplier was the City of Springfield. Second, the expected frontloaders on Saturday simply did not arrive. We did not realize that only Springfield trucks were using the plant and did not realize that we should have taken 3-4 more samples from City of Springfield trucks. Further, to keep consistent with load distribution in the study protocol, we wanted to collect another sample of frontload on Saturday but no frontloaders arrived. In an attempt to make up for the shortfalls in packer trucks, we took additional samples of roll-off trucks. We ended the Q3 sorting period having characterized 21 of the 26 targeted samples. At this stage we are seeking guidance from DEP on the appropriate resolution to this situation.

We respectfully request that DEP allow the waste composition study to proceed with the 5-sample shortfall. We acknowledge that the rearload/sideload trucks appear to have been undersampled, and that the roll-off compactor trucks appear to have been oversampled relative to the Study Protocol. However, what appears to be a sampling shortfall may in fact be commensurate with Community Eco Springfield's lower waste quantities. We will be reviewing recent data export from the facility scale and re-evaluate the sample distribution in light of the new delivery patterns to be sure. We also acknowledge that the shortfall of samples (47 instead of 52) may slightly impact the width of the confidence intervals that will be calculated to estimate the facility's waste composition (meaning that the results of the 2019 WCS will be slightly less precise than the prior iterations) and that the 3rd quarter will be slightly underrepresented in the results compared to the 2nd quarter.

However, a sample size of 47 samples is still above minimum sampling targets for a waste characterization study based on current waste composition best practices. Of particular note, California's official state waste characterization guidance document specifies a 30-sample minimum for residential waste and a 40 sample minimum for commercial (or mixed residential and commercial) waste. We exceeded both of these targets. Sampling at Springfield still covered all days of the week on which loads are received, and should achieve geographic representation as a result. Further, the 47 samples from this facility would still be reasonably representative when aggregated with the results from the other five Massachusetts WTEs that perform waste composition studies and could still be used to develop statewide composition estimates.

If an exception is authorized, we will include the preceding two paragraphs in the report to alert readers to the slightly diminished rigor of the 2019 Springfield waste composition study.

If DEP deems that a make-up is necessary, it is recommended that the inbound scale transaction data 2019 YTD be analyzed to confirm the best way to "true up" the sampling targets to the current waste deliveries. It is further requested that DEP extend the Q3 sampling window until October 15 for scheduling the make-up day in order to make arrangements within currently scheduled field work.

We look forward to your response.

Best Regards,
Stephen A. Sakakeeny, LSP, PG, CHMM

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Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

Department of Environmental Protection

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Charles D. Baker
Governor

Karyn E. Polito
Lieutenant Governor

Matthew A. Beaton
Secretary

Martin Suuberg
Commissioner

John Foley
Covanta Springfield, L.P.
188 M Street
Agawam, MA 01001

Re: Covanta SEMASS, L.P. Waste Characterization Study Protocol
Facility ID # 50005

Dear Mr. Foley,

The Massachusetts Department of Environmental Protection (the "MassDEP") has completed the technical review of the Covanta Springfield's Waste Characterization Study Protocol dated September 12, 2018 as a condition of the Facility's Class II Recycling Permit (Condition #12). Based on the MSW Consultants submittal, MassDEP approves and authorizes Covanta Springfield to proceed with implementation of the Waste Characterization Study.

If you have any further questions or comments regarding this matter, please contact me at (617) 292 – 5988.

Sincerely,

Date: 10/1/2018

Greg Cooper
Division Director
BAW- Business Compliance & Recycling

cc: Daniel Hall, Charlie Clines, MassDEP WERO
George Drew, Covanta
John Culbertson, MSW Consultants
Stephen Sakakeeny, SAK Environmental

COVANTA SPRINGFIELD, LLC.

WASTE CHARACTERIZATION STUDY PROTOCOL

SEPTEMBER 12, 2018

MSW CONSULTANTS

MSW CONSULTANTS

11875 High Tech Avenue, Suite 150, Orlando, FL (800) 679-9220

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TABLE OF CONTENTS

LIST OF APPENDICES

TABLE OF CONTENTS

List of Tables

List of Figures

COVANTA SPRINGFIELD, LLC.
WASTE COMPOSITION STUDY DESIGN

1. INTRODUCTION

In Massachusetts, combustion facilities with Class II Recycling Programs are required to conduct a waste characterization study (WCS) within 18 months of receiving their Class II Recycling Program certification from the Massachusetts Department of Environmental Protection (MassDEP) and every three years thereafter. Covanta Springfield, LLC. (Springfield) performed an inaugural study in 2010 and subsequent studies in 2013 and 2016. The next study must be conducted in 2019. Combustion facilities are responsible for submitting a proposed waste characterization study methodology design to MassDEP six months prior to conducting the study. MassDEP will review these proposed study designs and approve a final WCS design for each facility

On August 20, 2018, MassDEP released the 2019 WCS guidance document for the conduct of waste characterization studies at qualifying Class II Recycling Program facilities. The document, titled "2019 Class II Recycling Program Waste Characterization Scope and Methodology Guidance," (WCS Guidance) includes guidance on the scope, methodology and protocols to be used in conducting the waste characterization studies that are required by state regulation. This WCS Guidance document relies in turn on the methodologies and protocols described in ASTM Test Method for Determination of the Composition of Unprocessed Municipal Solid Waste, Designation D 5231 – 92 (2016).

Per the Class II Recycling Program regulations, Springfield has engaged MSW Consultants, LLC, working as a subcontractor to SAK Environmental, LLC, to conduct a WCS of the waste arriving at the Covanta Springfield facility located in Agawam, Massachusetts.

The objectives of the WCS as described in this Study Design document are to:

1. Characterize, in a statistically defensible manner, the waste stream at the Springfield facility according to MassDEP protocols; and
2. Provide representative waste characterization raw data and statistics that can subsequently be aggregated with other WCS study data and used by MassDEP in subsequent data analysis to be performed by MassDEP, to
    a. Estimate statewide waste characterization information;
    b. Measure the success of future waste reduction efforts;
    c. Identify specific materials for increased diversion; and
    d. Help guide MassDEP policy and program initiatives in solid waste management.

The 2019 WCS at the Springfield facility, including all analysis and the final report, is required to be completed by February 15, 2020. This Study Design document describes the methods to be used to achieve the above schedule and objectives.

2. SITE DESCRIPTION

Covanta Springfield LLC, also known as the Pioneer Valley Resource Recovery Facility (facility), is a mass-burn Energy-from-Waste facility located on a 5.3-acre site in Agawam, Massachusetts. The facility began operations in 1988 and is permitted to combust 408 tons per day, or 131,400 tons per year of solid waste generated from residential and commercial operations throughout Western Massachusetts. The facility serves the needs of several long-term contract communities in Massachusetts and Connecticut. In addition to the three units, the facility also has an attached 500 ton-per-day transfer station. Pioneer Valley produces 9.4 megawatts (MW) of energy, of which 7.5 MW is sold to Northeast Utilities.

The Springfield facility has one scale used to weigh both in-bound and out-bound trucks. The incoming trucks follow the traffic pattern across the scale around the facility to the staging area just outside the entrance to the 6 tip floor receiving doors. Facility personnel direct the in-coming trucks to the correct door to empty their loads. MSW Consultants field staff will select and interview drivers while they wait in the staging line. The selected trucks will dump their loads on the tip floor and the loader operator will take the grab sample as directed by the Field Supervisor. The empty trucks exit the tip area and follow the traffic pattern back to the scale to weigh-out before leaving the facility.

The sort crew will be located inside door #1 where there is a protected, 20 x 20 square foot area just to the left of the door. This area will provide a safe work environment for the crew while maintaining an efficient work flow for the waste material. The loader operator will dump the grab sample on the floor inside door #1 and the sort crew will load, weigh, sort, and discard the samples without leaving the secured work area. Sorted materials will be discarded adjacently, and can easily be removed for processing by facility personnel.

3. STUDY DESIGN AND SAMPLING PLAN

The purpose of the WCS is to determine the composition of the wastes received for processing and disposal at the host facility. This section summarizes the critical elements of the overall study design, culminating in a sampling plan for obtaining and sorting samples at the host facility.

3.1 MATERIAL CATEGORIES

The waste received will be separated into the nine (9) material groups and 62 material categories identified by MassDEP in the 2019 WCS Guidance document. Table 3-1 summarizes these material categories. More detailed definitions of each of the 62 material categories are provided in Appendix A.

Table 3-1 Material Categories

Paper	
Uncoated Corrugated Cardboard/Kraft Paper	Newsprint
Waxed Cardboard	Other Recyclable Paper
High Grade Office Paper	Compostable Paper
Magazines/Catalogs	Remainder/Composite Paper
Plastics	
#1 PET Beverage Containers (non-MA deposit)	Non-food Grade Expanded Polystyrene
PET Containers other than Beverage	Bulk Rigid Plastic Items
Plastic MA Deposit Beverage Containers	Film (non-bag clean commercial and industrial packaging film)
#2 HDPE Natural/Colored Bottles	Grocery and other Merchandise Bags
Plastic Tubs and lids (HDPE, PP, etc.)	Other Plastic Film
Plastic Containers #3-#7	Remainder/Composite Plastic
Food Grade Expanded Polystyrene	
Metal	
Aluminum Beverage Containers (non-MA deposit containers)	Other Ferrous and Non-Ferrous
Aluminum MA Deposit Beverage Containers	White Goods
Tin/Steel Containers	Remainder/Composite Metal
Other Aluminum	
Glass	
Glass Beverage Containers (non-MA deposit containers)	Glass MA Deposit Beverage Containers
Other Glass Packaging Containers (non-MA deposit containers)	Remainder/Composite Glass
Organic	
Food Waste	Manures
Branches and Stumps	Remainder/Composite Organic
Prunings, Trimmings, Leaves and Grass	
C&D Materials	
Asphalt Pavement, Brick, and Concrete	Asphalt Roofing
Aggregates, Stones, Rock	Drywall/Gypsum Board
Wood – Treated	Carpet and Carpet Padding
Wood – Untreated	Remainder/Composite C&D
Household Hazardous Waste	
Ballasts, CFLs, and Other Fluorescents	Bio-Hazards
Batteries – Lead Acid	Vehicle and Equipment Fluids
Other Batteries	Empty Metal, Glass, and Plastic Containers (that originally contained toxic materials)
Paint	Other Household Hazardous Waste
Electronics	
Computer-related Electronics	Televisions and Computer Monitors
Other “brown goods”	
Other Wastes	
Tires and Other Rubber	Mattresses
Textiles	Restaurant Fats, Oils and Greases
Bulky Materials	Other Miscellaneous

The 2019 material category list is identical to the 2016 list, and also substantially identical to the 2010 and 2013 material categories. The 2019 material list retains a protocol to capture the disposal of mattresses and box springs which was introduced in the 2016 WCS.

3.2 NUMBER OF SAMPLES

The total number of samples to be obtained and analyzed is determined by ASTM Test Method D-5231-92 (2016). Specifically, the number of samples (*n*) needed to determine the composition of waste is governed by the equation:

$$\boldsymbol{n} = \left(\frac{\boldsymbol{t} \times \boldsymbol{s}}{\boldsymbol{e} \times \bar{\boldsymbol{x}}}\right)^2$$

Where:

t = the *t*-statistic corresponding to the desired level of confidence. For the purpose of this study, we have assumed a 90 percent level of confidence is sufficient and the *t* value is selected for $(n = \infty)$

s = estimated standard deviation

e = desired level of precision

$\bar{\boldsymbol{x}}$ = estimated mean

While this equation is straightforward, the selection of appropriate variables drives the ultimate sample size. The ASTM Test Method suggests values for both the *s* and $\bar{x}$ variables to be used in this formula. The ASTM Test Method also provides a table of t statistics. Based on the ASTM Test Method and on extensive prior experience conducting waste characterization studies, MSW Consultants recommends the following values be used in this formula:

t = 1.645 $(n = \infty)$

s = 0.06

e = 0.10 (10%)

$\bar{\boldsymbol{x}}$ = 0.14

It is important to note that the s and $\bar{x}$ values selected above are based on corrugated cardboard as the guiding waste component. Corrugated cardboard is commonly occurring in the residential and commercial wastes that are processed at this host facility. For this reason, corrugated cardboard can be considered to be normally distributed in the overall waste stream. Basing the sampling plan on corrugated cardboard is reasonable to defensibly differentiate among the commonly occurring components of the waste stream.[1]

However, selection of corrugated cardboard as the guiding components may not inform on uncommonly-occurring or trace components for this host facility. However, assuming MassDEP obtains comparable raw data from multiple facilities, it is expected that MassDEP will have the ability to fully assess the composition and incidence of virtually the entire waste stream when all data are considered in the aggregate.

[1] Had plastic, food waste, or aluminum been selected as the guiding waste component, the calculated number of samples would have been smaller than shown in this section. Had newsprint, ferrous, or glass been selected as the guiding component, the calculated number of samples would have been somewhat larger. Yet all of these materials are commonly occurring. Corrugated cardboard was selected as the guiding waste component as a reasonable midpoint of commonly occurring materials.

The selected values are inserted into the formula and solved below. As shown, these values suggest a total of 50 samples to be targeted.

$$\left(\frac{1.645 \times 0.06}{0.1 \times 0.14}\right)^2 = 50$$

As a final step, the ASTM Test Method requires that the resulting number of samples be re-tested with the correct t-statistic for n = 50 samples, which is 1.677 (instead of the 1.645 for n = ∞). Recalculating the equation, we find:

$$\left(\frac{1.677 \times 0.06}{0.1 \times 0.14}\right)^2 = 52$$

Because the estimate of 52 samples is within 10 percent of the original estimate of 50 samples, it is recommended that a total of 52 samples be targeted to determine facility-wide waste characterization.

3.3 SAMPLE WEIGHTS

Consistent with MassDEP guidance, ASTM Test Methods, and other industry literature, sample weights will be targeted between 225 and 250 pounds.

3.4 SEASONALITY AND SAMPLE ALLOCATION

To ensure that the final results will capture seasonal fluctuations in the composition of the waste stream, this study will be performed over two seasons. Consistent with MassDEP guidance, the first season field sort will occur between April 15, 2019 and June 15, 2019, and the second season field sort will take place between July 15, 2019 and September 15, 2019. Field sorting will be scheduled to avoid the days immediately preceding and following major holidays.

Samples will be allocated equally to each of the two seasons. This means that 26 samples will be obtained during each of the sampling and sorting periods.

3.5 GENERATOR SECTORS AND SAMPLE ALLOCATION

Consistent with MassDEP's WCS Guidance, each of the samples obtained in this study will be classified into one of three generator types:

- **Residential:** Residential waste will be defined in this study as waste from vehicles in which 80 percent or more of the waste originates from single family or multifamily residential sources. These vehicles will typically include residential drop-off containers (i.e. roll-offs, dedicated transfer trailers from municipal drop-off programs) and both sideload and rearload compacting vehicles. Some residential wastes may be delivered by self-haulers.
- **ICI - Industrial/Commercial/Institutional:** This category includes wastes generated by non-residential sources including commercial businesses, institutions, and industrial facilities (excepting any special industrial wastes or industrial wastes elsewhere classified). ICI waste will be defined in this study as waste from vehicles in which 80 percent or more of the waste is generated by ICI sources. Typically waste from ICI vehicles will include compactor boxes, open top boxes and front-load compacting vehicles. ICI wastes are also delivered by self-haulers.
- **Unacceptable Loads:** Unacceptable loads are defined as loads that contain less than 80 percent of either residential or ICI waste; loads that are more than 50 percent construction and demolition (C&D) material; and loads originating from out of state.

The proportion of waste delivered to the facility by each of these generator types is not currently tracked or known by the facility operators. Random sampling of incoming loads will therefore be used to assure appropriate allocation of samples to each generator sector. It is assumed that MassDEP does not intend

for Unacceptable Loads to undergo sampling and sorting as part of the study. Unacceptable Loads will include:

- Frontload and Rearload compacting trucks that mix Residential (including multi-family) and ICI accounts on the same route;
- Transfer Trailers originating at commercial transfer stations that accept a mix of Residential and ICI wastes; and
- Transfer Trailers originating at transfer stations that may accept waste from out-of-state.

At the Springfield facility, roughly five percent of incoming loads (by weight) arrive on transfer trailers, and will be Unacceptable Loads by definition. It is assumed that MassDEP prefers to focus data collection only on loads that can definitively be classified as Residential or ICI (which is also consistent with the prior WCS). For this reason, Unacceptable Loads will be excluded from the *composition* analysis. However, consistent with MassDEP's reporting requirements, the overall fraction of wastes arriving in Unacceptable Loads will be documented for the facility, for use in applying the results of the WCS.

It should be noted that the precise weighting factors for residential and ICI wastes at the Springfield facility are not known at this time. MassDEP's WCS Guidance document calls for a 55 percent to 45 percent split between ICI and residential waste as the state-wide average. It is MSW Consultants' professional opinion that these weighting factors should not be used for the Springfield facility unless random sampling supports this breakdown. Rather, the weighting factors to be used will fall out of the driver interviews above and the truck type stratification (Section 3.6). So, if Springfield obtains 70 percent ICI and 30 percent residential, these weighting factors will be used to develop Springfield's results.[2]

However, if MassDEP requires the 55-to-45 percent weighting factors to be used, the statistics can be calculated accordingly. It is not necessary to determine the final recommended weighting factors at this time.

3.6 TRUCK TYPES AND SAMPLE ALLOCATION

Sampling wastes is statistically equivalent to any other type of statistically-based survey. For example, where a telephone survey of political views is randomly selected from a universe of people, a waste characterization study is randomly selecting 225 to 250 pounds from the universe of waste.

A complicating factor in the sampling of loads of waste is that the incoming trucks of various types have different payloads. For example, compacting vehicles may typically be expected to deliver 10 or more tons of waste, whereas open top roll-off boxes (uncompacted) may only contain 2 or 3 tons. For this reason, it may not be appropriate to treat each incoming truck equally; doing so will result in smaller (lighter) and uncompacting loads being over-represented.

Rather, to align waste samples with the contribution of wastes by truck type, MSW Consultants recommends a stratified random sample, with the following truck types (defined by MassDEP) to be segregated:

- Roll-off open top containers,
- Roll-off closed top containers,
- Roll-off compactors,
- Rearload and sideload compacting vehicles,
- Frontload compacting vehicles,
- Transfer trailers, and

[2] In the 2016 WCS, there was a 67% Residential and 33% ICI breakdown derived from the incoming vehicle survey

- Other (self-haul).

Samples will be stratified so that each truck type is sampled in proportion to the total weight delivered by that truck type to the facility.

3.7 SAMPLE ALLOCATION BASED ON 2017 DATA

Table 3-2 below provides an allocation of samples by truck type and by season, based on actual 2017 scalehouse data. This table shows how the 52 total samples will be stratified, with random sampling performed for each stratum.

Table 3-2 Sample Allocation Based on 2017 Data

Vehicle Type [1]	Number of Deliveries	Annual Tonnage of Direct Haul	Percent of Direct Haul Loads [1]	Q1 Samples	Q4 Samples	Total Samples
Roll-Off (Open Top)	434	1,250	0.9%	0	0	0
Roll-Off (Closed Top)	103	105	1.7%	1	0	1
Roll-Off (Compactor)	2,699	14,780	16.4%	4	5	9
Rear & Side -Load Packers	9,665	86,442	58.6%	15	15	30
Front-Load Packer	2,921	37,975	22.4%	6	6	12
Totals	**15,822**	**122,158**	**100%**	**26**	**26**	**52**

[1] Transfer trailers have been excluded from the sample allocation calculations because it is proposed that transfer trailers not be sampled. Rather, the results of the WCS analysis of direct haul loads will be applied to transfer trailer tonnages.

It is important to note that the generator sector (residential or ICI) will be recorded for each incoming load. Although the objective of this study is to estimate the composition of wastes entering the Springfield facility, the underlying data can be aggregated in other ways by MassDEP for use in developing state-wide estimates of residential and ICI wastes.

3.8 SAMPLE SELECTION

For each of the truck types identified above, MSW Consultants will use systematic selection of incoming vehicles. If sufficient data can be provided by the Springfield facility prior to the study to estimate the expected number of loads delivered by each truck type, then an "Nth Vehicle" approach will be used. Systematic sampling is intended to remove any sampling bias that may arise from an individual selecting specific incoming vehicles. MSW Consultants will divide the number of incoming loads (by vehicle type) by the number of samples needed that day from the facility. The resulting number is the sampling frequency and determines whether every third vehicle, every sixth vehicle, or every 20th vehicle is selected for sampling. This strategy is known as the "Nth Vehicle" approach and is further explained in Section 4.

4. STAFFING AND SAFETY PLAN

4.1 STAFFING

MSW Consultants has developed a staffing plan that we believe will assure high consistency, operational efficiency, and accuracy of all field data. MSW Consultants will use a two-person professional staff supported by sorting laborers (supplied either by Covanta or via a light industrial temporary agency) to manage and conduct all refuse sampling and sorting required throughout the study.

Specifically, the field data collection team will include the following individuals:

- **Field Supervisor:** The Field Supervisor will have lead responsibility for planning each sampling and sorting event, and for interacting with the facility personnel whose cooperation will be needed throughout the field data collection. The Field Supervisor will generally lead the sampling selection process and will oversee the physical taking of the 250-pound samples. The Field Supervisor is

ultimately responsible for the successful completion of the grab sampling and manual sorting component of the project.

- **Crew Chief:** The Crew Chief will be the second professional staff person. The Crew Chief is responsible for managing the sorting area, including crew management, sorting productivity and accuracy, data recording, worksite health and safety, and cleaning up at the end of the day. MSW Consultants will supply a dedicated crew chief for the duration of the project.
- **Sorting Labor:** If Covanta employees are not available, MSW Consultants will utilize locally-based light industrial temporary workers to serve as sort labor. Training and oversight will be provided by the MSW Consultants field operations management staff mentioned above. MSW Consultants has proven experience in training and retaining temporary labor in the conduct of waste composition analysis.

4.2 SAFETY

MSW Consultants has a commitment to and methods for maintaining the health and safety of field personnel, host facility personnel and property, and third-party personnel and property throughout the course of the field study. In addition to maintaining itself as an ISNetWorld-certified contractor for Covanta, MSW Consultants has developed a full Safety and Health Plan (SAHP) for waste characterization studies that address the particular challenges associated with these projects. The SAHP includes concepts and methods spanning:

- Program Management
- Sanitation
- Medical and First Aid Requirements
- Personal Protective Equipment
- Hazardous Substances and Environments
- Material Handling
- Site Control
- Plan Approval and Sign-off

MSW Consultants has discussed safety issues during the site visit to this facility and will comply with all Covanta Energy's health and safety requirements. A copy of MSW Consultants' full SAHP has been provided to Covanta management through ISNetWorld.

5. FIELD DATA COLLECTION

This section describes the field procedures for obtaining samples, sorting and weighing.

5.1 SITE VISITS

MSW Consultants conducted the 2010, 2013 and 2016 WCS's and is familiar with the work site. It has been reported by facility management that the work site will be the same as in the prior study.

5.2 LOAD SELECTION

When MSW Consultants arrives at each facility, the targeted number of each vehicle type to sample will be known. However, it will be necessary to obtain these samples systematically to assure that no individual judgment is introduced into the selection of loads for sampling.

The Field Supervisor will divide the total number of expected incoming loads of each truck type by the number of samples needed that day from the facility. The resulting number is the sampling frequency and determines whether every third vehicle, every sixth vehicle, or every 20th vehicle is selected for sampling. This strategy is the known as the "Nth Truck" approach. If incoming targeted loads become too

infrequent for the "Nth Truck", the Field Supervisor may be required to sample an incoming load based upon load traffic, i.e., taking the next available truck.

During each day that waste is sampled, the Field Supervisor will note the samples targeted for that day, and actual samples obtained on the Field Supervisor Daily Targeted Samples worksheet (Appendix B).

The Field Supervisor, working in coordination with facility personnel, will keep a tally of vehicles from each truck type as they enter the facility. When the designated Nth truck arrives, the Field Supervisor (with assistance from facility personnel) will have the vehicle directed to the sampling area.

The Field Supervisor will interview the drivers of selected loads to obtain information about origin of the load, validation of waste generating sector, hauler, vehicle type and number, and other data.

This information will be noted on the Field Supervisor's vehicle selection form, along with a unique identifying number associated with that vehicle on that day. The daily field form is relatively simple design to allow the Field Supervisor to track incoming waste by vehicle type.

5.3 TAKING SAMPLES FROM SELECTED LOADS

Selected loads of refuse will be tipped in the designated area. As directed in the WCS guidance Incoming document, samples will be taken using the method described in ASTM standards. However, prior to taking the actual sample, the Field Supervisor will have the tipped load spread out by the loader, and will visually survey the entire tipped load to count and photograph mattresses and box springs contained in the load. The Springfield facility removes mattresses and box springs from the waste stream prior to processing, so these items will be inventoried during this process for selected loads. The inventory will be used to estimate the weight of mattresses and box springs as a percentage of the entire tipped load. Manual sorting will be used for the remainder of the characterization analysis (i.e., no mattresses will be manually sorted).

After the mattresses and box springs have been inventoried, a front-end loader will remove material longitudinally along one entire side of the discharged load in order to obtain a representative cross-section of the remaining material. The Field Supervisor and loader operator will attempt to remove approximately 1,000 pounds of material, based on a visual assessment. This equates to four times the targeted sample weight of 250 pounds. The loader operator will be directed to mix, cone, and quarter the sample material.

The Field Supervisor will then systematically select roughly one quarter of the material to be taken via a grab sample. For samples that contain heavy or bulky materials, the Field Supervisor will estimate the fraction of the sample occupied by the bulky item, and apply that percentage to the overall weight of the bulky item. For example, if a sofa bed is part of the grab sample that has been dumped for sampling, Field Supervisor will estimate what fraction of the sofa bed is contained within the regular municipal solid waste sample and record the fractional weight of the bulky item only as part of the overall sample.

The Field Supervisor will then place the material for sorting in 35-gallon barrels and pre-weigh each barrel to ensure the sample used for sorting is at least 225 pounds. A white board with the sample number will be placed in the barrel and staged for the sorting by the field sorting crew.

5.4 MANUAL SORTING

Once the sample has been acquired and placed in barrels, the material will be manually sorted into the prescribed component categories. Plastic 20-gallon bins with sealed bottoms will be used to contain the separated components. A picture of the sorting table and bins is shown in Figure 5-1.

Figure 5-1 Sort Table and Bins

Sorters are asked to specialize in certain material groups, with someone handling the paper categories, someone else the plastics, someone else the glass and metals, and so on. In this way, sorters become highly knowledgeable in a short period of time as to the definitions of individual material categories.

Additional details on the staffing plan are provided in the next section. The Crew Chief will monitor the bins as each sample is sorted, rejecting materials that may be improperly classified. Open bins allow the Crew Chief to see the material at all times.

The Crew Chief will also verify the purity of each component during the weigh-out (discussed below). The materials will be sorted to particle size of 2-inches or less by hand, until no more than a small amount of homogeneous fine material ("mixed residue") remains. The sort table is covered by a screen that allows half-inch-minus particles to fall through. The layer of materials larger than ½ inch and smaller than two inches will be manually sorted to the appropriate categories based on the best judgment of the Crew Chief—most often a combination of Other Paper, Other Organics, or Food Waste. Particles falling through the screen will be allocated to the "Dirt/Fines" category unless the majority of the fines can be identified, in which case they will be placed in the appropriate bin.

5.5 DATA RECORDING

The weigh-out and data recording process is the most critical process of the sort. The Crew Chief will be singularly responsible for overseeing all weighing and data recording of each sample (including the initial tare weights). Once each sample has been sorted the weigh-out will be performed. Each bin containing sorted materials from the just-completed samples will be carried over to a digital scale. Sorting laborers will assist with carrying and weighing the bins of sorted material, and the Crew Chief will record all data.

The Crew Chief will use a tablet computer to record the composition weights. The tablet allows for samples to be tallied in real time so that field data collection can immediately identify and rectify errors associated with light sample weights. The tablet can be synchronized with the cloud via cellular signal, providing excellent data security. Each sample will be cross-referenced against the Field Supervisor's sample sheet to assure accurate tracking of the samples each day.

The real-time data entry allows several important advantages:

- The template contains built-in logic and error checking to prevent erroneous entries.
- The template sums sample weights in real time so the Crew Chief can confirm achievement of weight targets for each and every sample.
- Except where host facilities are outside of cell phone range, the data file syncs routinely and can be accessed and checked by MSW Consultants QA/QC staff back at the office.

The electronic field data sheet used by the Crew Chief is included in Appendix C.

6. ANALYSIS AND REPORTING

6.1 ANALYSIS

At the conclusion of the seasonal waste composition sort at the Springfield facility, the data that has been entered into the composition database will be statistically analyzed to determine the estimated weight and estimated mean percent associated with each material in the samples. The analysis will produce estimates of the pounds and percent with each material in the samples. Relevant concepts to the data analysis are provided below.

6.1.1 STATISTICAL MEASURES

The following statistical measures will be calculated to determine the overall composition of each waste generator sector.

- **Sample Mean**: The sample mean, or average, composition is considered the "most likely" fraction for each material category in the waste stream. The sample mean is determined by (i) summing the weight of each material in each sample; (ii) summing the total weight of all samples, and (iii) dividing the first value by the second value to determine the percent-by-weight composition. Note that the sample mean, while a good estimate, is unlikely to be identical to the population mean value. The meaningfulness of the sample mean is enhanced by the following statistical measures.
- **Standard Deviation**: The standard deviation measures how widely values within the data set are dispersed from the sample mean. A higher standard deviation denotes higher variation in the underlying samples for each material, while a lower standard deviation reflects lower variation among the individual samples. The standard deviation is stated in the same unit as the sample mean, which in this case is percent by weight.
- **Confidence Intervals**: When a sample of data is obtained, it is analyzed in an attempt to determine certain values that describe the entire population of data under analysis. For example, in a poll of likely voters, the intent of the poll is to determine the percentage of all voters who support a given candidate, not simply the percentage of voters in the poll who support that candidate. The percentage of voters who support a given candidate in the poll can easily vary from sample to sample; but the percentage of all voters who support that candidate is a fixed value. In our sample of incoming loads of waste, we are not primarily interested in the percentage composition of the sampled loads, but rather in trying to determine what the composition of the sampled loads tells us about the composition of all waste generated. A confidence interval is a statistical concept that attempts to indicate the likely range within which the true value lies. The confidence intervals reflect the upper and lower range within which the population mean can be expected to fall. Confidence intervals require the following "inputs":
  - The "level of confidence", or how sure one wants to be that the interval being constructed will actually encompass the population mean;
  - The sample mean, around which the confidence interval will be constructed;
  - The sample standard deviation, which is used as a measure of the variability of the population from which the sample was obtained; and
  - The number of sampling units that comprised the sample (a.k.a. sample size).

Consistent with industry standard, confidence intervals will be calculated at a 90 percent level of confidence, meaning that we can be 90 percent sure that the mean falls within the upper and lower confidence intervals shown. (The converse is also true: that there is a 10 percent chance that the mean falls outside of the sample mean.) In general, as the number of samples increases, the width of the confidence intervals decreases, although the more variable the underlying waste stream composition, the less noticeable the improvement for adding incremental samples.

6.1.2 MATERIAL SUBSTREAM RESULTS

Consistent with MassDEP requirements, MSW Consultants will independently calculate the mean composition, standard deviation, and confidence intervals for the following subsets of sample data:

- **Overall**;
- **By generator sector**: Residential and ICI (but not Unacceptable); and
- **By truck type**: roll-off open top, roll-off closed top, roll-off compactor, side/rearload, frontload, self-haul.

6.2 REPORTING

6.2.1 INTERIM REPORT

MSW Consultants does not anticipate preparing an interim report. Rather, we will issue a memorandum summarizing the targeted and actual samples obtained, as well as a breakdown by generator sector and vehicle type. This memorandum will comment on any problems encountered and proposed solutions for the second seasonal field data collection event. At the request of the facility, individual sample data will be provided in electronic format.

6.2.2 FINAL REPORT

After both seasonal sorts are completed, MSW Consultants will prepare a report to document the outcome of the study. A waste characterization study report will be provided to MassDEP on or before February 15, 2020 and will include at a minimum the following:

- **Final Design**: An account of the variations included in the sampling period, the number and allocation of samples categorized, the overall vehicles sampled, loads sampled, and final sort design.
- **Overall Composition of Waste**: A summary account of the overall composition of the waste stream entering this facility as measured by the WCS.
- **Composition by Substream**: A summary account of the overall composition of the waste stream measured by the WCS grouped into the following sectors:
  - Residential; and
  - ICI.
- **Composition by Haul Type**: A summary account of the overall composition of the waste stream measured by the WCS grouped by the following:
  - Roll-off - open top
  - Roll-off - closed top
  - Roll-off – compactor
  - Rear and side loading packer
  - Front loading packer
- Observations and Analysis
- Summary data in Microsoft Excel Format broken out by Secondary Waste Categories for:
  - Overall Composition of Waste
  - Composition by Substream
  - Composition by Haul Type
- Raw data for each load sampled; and
- If requested by the facility, photographs of samples will be delivered electronically.

The final report will integrate comments received from Covanta Springfield and MassDEP, as required.

APPENDIX A

MATERIAL CATEGORIES AND DEFINITIONS

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APPENDIX A – MATERIAL DEFINITIONS

A 1. PRIMARY CATEGORIES

1. Paper
2. Plastics
3. Metals
4. Glass
5. Organic Materials
6. Construction and Demolition (in the MSW stream)
7. Household Hazardous Materials
8. Electronics
9. Other Waste

A 2. SECONDARY CATEGORIES (62)

Paper

1. Uncoated Corrugated Cardboard/Kraft Paper means corrugated boxes or paper bags made from Kraft paper. Uncoated Corrugated Cardboard has a wavy center layer and is sandwiched between the two outer layers and does not have any wax coating on the inside or outside. Examples include entire cardboard containers, such as shipping and moving boxes, computer packaging cartons, and sheets and pieces of boxes and cartons. This type does not include chipboard. Examples of Kraft paper include paper grocery bags, un-soiled fast food bags, department store bags, and heavyweight sheets of Kraft packing paper.

2. Waxed Cardboard means cardboard with wax coating on the inside or outside.

3. High Grade Office Paper means the type of paper that is free of ground wood fibers; usually sulfite or sulphate paper; includes office printing and writing papers such as white ledger, color ledger, envelopes, and computer printout paper, bond, rag, or stationary grade paper. This subtype does not include fluorescent dyed paper or deep-tone dyed paper such a goldenrod colored paper.

4. Magazines/Catalogs means items made of glossy coated paper. This paper is usually slick, smooth to the touch, and reflects light. Examples include glossy magazines, catalogs, brochures, and pamphlets.

5. Newsprint means the class or kind of paper chiefly used for printing newspapers – i.e. uncoated groundwood paper.

6. Other Recyclable Paper means paper, other than the paper mentioned above, which can be recycled. Examples include manila folders, manila envelopes, index cards, white envelopes, notebook paper, carbonless forms, junk mail, chipboard and uncoated paperboard, phone directories, non glossy catalogs, offshore cardboard and deep-toned or fluorescent dyed paper.

7. Compostable Paper means low grade paper that is not capable of being recycled, as well as food contaminated paper. Examples include paper towels, paper plates, waxed papers, egg cartons, pizza boxes, and tissues.

8. Remainder/Composite Paper means items made mostly of paper but combined with large amounts of other materials such as plastic, metal, glues, foil, and moisture. Examples include plastic coated corrugated cardboard, cellulose insulation, aseptic packages, polycoated (gable top) cartons, blueprints,

sepia, onionskin, foiled lined fast food wrappers, frozen juice containers, carbon paper, self-adhesive notes, softcover and hardcover books, and photographs.

Plastics

9. PET Beverage Containers (non-MA deposit containers) means clear or colored PET beverage bottles other than MA deposit containers (water, flavored water, juice, sports drinks, etc.). When marked for identification, it bears the number —1 in the center of the triangular recycling symbol and may also bear the letters —PETE or—PET. A PET container usually has a small dot left from the manufacturing process, not a seam.

10. PET Containers other than Beverage Containers (which originally contained non-hazardous material) means types of containers such as PET jars, rectangular PET containers used for produce; egg cartons, etc.

11. Plastic MA Deposit Beverage Containers means plastic beverage containers subject to MA's bottle bill and marked as deposit containers in Massachusetts.

12. HDPE Bottles, colored and natural, (which originally contained non-hazardous material) means natural and colored HDPE containers. This plastic is usually either cloudy white, allowing light to pass through it (natural) or a solid color, preventing light from passing through it (colored). When marked for identification, it bears the number —2 in the triangular recycling symbol and may also bear the letters—HDPE.

13. Plastic Tubs and lids (HDPE, PP, etc) Includes yogurt, margarine, sour cream, deli containers, etc. (i.e. injection molded).

14. Plastic Containers #3-#7 (which originally contained non-hazardous material) means plastic containers made of types of plastic other than HDPE or PET. Items may be made of PVC, PP, or PS. When marked for identification, these items may bear the number 3, 4, 5, 6, or 7 in the triangular recycling symbol. This subtype also includes unmarked plastic containers.

15. Expanded Polystyrene Food Grade means "Styrofoam" products includes food packaging and finished products made of expanded polystyrene including cups, plates, trays, clamshells, etc.

16. Expanded Polystyrene Non-food Grade includes non-food packaging and finished products made of expanded polystyrene including packing peanuts and other packaging materials.

17. Bulk Rigid Plastic Items means plastic objects other than disposable package items. These items are usually made to last for a few months up to many years. These include the plastics used in children toys, furniture, plastic landscape ties, buckets, crates, pallets, sporting goods, etc.

18. Film (non-bag clean commercial and industrial packaging film) means film plastic used for large-scale packaging or transport packaging. Examples include shrink-wrap, mattress bags, furniture wrap, and film bubble wrap.

19. Grocery and other Merchandise Bags means plastic shopping bags, used to contain merchandise to transport from the place of purchase, given out by the store with the purchase. Includes dry-cleaning plastic bags intended for one-time use and other plastic film commonly recycled with grocery bags.

20. Other Film means plastic film Examples include garbage bags and other types of plastic bags (sandwich bags, zipper-recloseable bags, produce bags, frozen vegetable bags, newspaper bags), painting tarps, food wrappers such as candy-bar wrappers, mailing pouches, bank bags, X-ray film, metallized film (wine containers and balloons), and plastic food wrap.

21. Remainder/Composite Plastic means plastic that cannot be put in any other type or subtype. This type includes items made mostly of plastic but combined with other materials. Examples include auto

parts made of plastic attached to metal, plastic drinking straws, foam packing blocks (not including expanded polystyrene blocks), plastic strapping, new plastic laminate (e.g., Formica), vinyl, linoleum, plastic lumber, imitation ceramics, handles and knobs, some kitchen ware, plastic string (as used for hay bales), and plastic rigid bubble/foil packaging (as for medications); CD's, and rigid plastic housewares, such as mop buckets, dishes, cups, and cutlery.

Metals

22. Aluminum Beverage Containers (non-MA deposit containers) means beverage containers made from aluminum other than MA deposit containers.

23. Aluminum MA Deposit Beverage Containers means metal beverage containers subject to MA's bottle bill and marked as deposit containers in Massachusetts.

24. Tin/Steel Containers means rigid containers made mainly of steel, such as food and beverage containers. These items will stick to a magnet and may be tin-coated.

25. Other Aluminum – includes foil, food containers, aerosols (empty), etc.

26. Other Ferrous and Non-Ferrous means any iron or steel that is magnetic and metal items that are not magnetic (copper, brass, lead, zinc, etc). This subtype does not include "tin/steel containers". Examples include empty or dry paint cans, structural steel beams, boilers, clothes hangers, pipes, some cookware, security bars, scrap ferrous/nonferrous items, and galvanized items such as nails and flashing.

27. White Goods means appliances that employ electricity, oil, natural gas, or liquefied propane and to preserve or cook food; wash or dry clothing, kitchen utensils, or related items; or to cool or heat air or water. These are primarily encased in metal, and include items such as refrigerators, freezers, stoves, water heaters, propane/compressed tanks, water coolers, dishwashers, clothes dryers, air conditioners, gas or electric ovens and ranges. White goods does not include microwaves.

28. Remainder/Composite Metal means metal that cannot be put in any other type. This type includes items made mostly of metal but combined with other materials and items made of both ferrous metal and nonferrous metal combined. Examples include microwaves, bikes, motors, insulated wire, and finished products that contain a mixture of metals, or metals and other materials, whose weight is derived significantly from the metal portion of its construction.

Glass

29. Glass Beverage Containers (non-MA deposit containers) includes wine bottles, nonalcoholic beverage containers, liquor bottles, etc.

30. Other Glass Packaging Containers (non-MA deposit containers) includes glass food and non-food containers such as sauces, jars, perfume containers, etc.

31. Glass MA Deposit Beverage Containers means glass beverage containers subject to MA's bottle bill and marked as deposit containers in Massachusetts.

32. Remainder/Composite Glass means glass that cannot be put in any other type. It may include items made mostly of glass but combined with other materials. Examples include Pyrex, Corningware, crystal, plate glass, window and door glass, ceramics, porcelain, and other glass tableware, mirrors, non-fluorescent light bulbs, auto windshields, laminated glass, or any curved glass.

Organic Materials

33. Food Waste means food material resulting from the processing, storage, preparation, cooking, handling, or consumption of food. This type includes material from industrial, commercial, or residential sources. Examples include discarded meat scraps, dairy products, eggshells, fruit or vegetable peels, and

other food items from homes, stores and restaurants. This type includes apple pomace and other processed residues or material from canneries, wineries or other industrial sources.

34. Branches and Stumps means trees, stumps, branches, or other wood greater than 1 inch in diameter generated from landscapes, clearing land for commercial or residential development, road construction, agricultural land clearing, storms, or natural disaster.

35. Prunings, Trimmings, Leaves and Grass means plant material, except woody material 1inch or less in diameter from any public or private landscapes. Examples include branches, prunings, shrubs, leaves, grass clippings, and plants. This subtype does not include woody material greater than 4 inches in diameter.

36. Manures means manure and soiled bedding materials from domestic, farm, wild, or ranch animals. Examples include manure and soiled bedding from animal production operations, racetracks, riding stables, animal hospitals, laboratories, zoos, nature centers, and other sources.

37. Remainder/Composite Organic means organic material that cannot be put in any other type or subtype. This type includes items made mostly of organic materials but combined with other materials. Examples include cork, hemp rope, hair, cigarette butts, full vacuum bags, sawdust, and animal feces.

Construction and Demolition (in the MSW stream)

38. Asphalt Pavement, Brick, and Concrete includes asphalt pavement, brick, and concrete from construction activities and demolition of buildings, roads, and bridges and similar sources. Asphalt pavement also includes other black or brown, tar-like material mixed with aggregate and used as a paving material. Brick also includes masonry brick, landscaping or walkway brick. Concrete also includes pieces of building foundations, concrete paving, and cinder blocks.

39. Aggregates, Stone, Rock, Soil, Fines includes non-organic material from construction and landscaping activities. May also include products made predominately from these materials (i.e. granite counters).

40. Wood - Treated means wood that contains an adhesive, paint, stain, fire retardant, pesticide or preservative.

41. Wood - Untreated refers to any wood which does not contain an adhesive, paint, stain, fire retardant, pesticide or preservative; includes such items as pallets, skids, spools, packaging materials, bulky wood waste or scraps from newly built wood products. Does not including land clearing debris or yard waste prunings and trimmings

42. Asphalt Roofing means composite shingles and other roofing material made with asphalt. Examples include asphalt shingles and attached roofing tar and tar paper.

43. Drywall/Gypsum Board means interior wall covering made of a sheet of gypsum sandwiched between paper layers. Examples include used or unused, broken or whole sheets of sheetrock, drywall, gypsum board, plasterboard, gypsum board, gyproc, and wallboard.

44. Carpet and Carpet Padding means flooring applications consisting of various natural or synthetic fibers which maybe bonded to some type of backing material and plastic, foam, felt, or other material used under carpet to provide insulation and padding.

45. Remainder/Composite Construction and Demolition means construction and demolition material that cannot be put in any other type or subtype. This type may include items from different types combined, which would be very hard to separate.

Household Hazardous Waste

46. Ballasts, CFLs, and Other Fluorescents include ballasts, which are devices that electrically control fluorescent light fixtures and that include a capacitor, CFLs, which are compact fluorescent bulbs, and other fluorescent lighting, which includes tubular fluorescent lamps, neon lamps, black lights, and other lamps used for sanitation or cosmetic purposes.

47. Batteries – Lead Acid means lead acid storage batteries most commonly used in vehicles such as cars, trucks, boats, etc.

48. Batteries – Other means alkaline (including alkaline rechargeable) or household batteries such as AA, AAA, C, D, 4.5 volt, button cell, rechargeable and 9 volt used for flashlights, small appliances, and electronic devices.

49. Paint means containers with paint in them. Examples include latex paint, oil based paint, and tubes of pigment or fine art paint. This type does not include dried paint, empty paint cans, or empty aerosol containers.

50. Bio-Hazardous - means discarded animal or human medical/treatment wastes including needles, first aid wastes, diapers and other products which are used in relation to animal or human care. This category does not include cat litter or animal feces.

51. Vehicle and Equipment Fluids in containers and oil filters means containers with fluids used in vehicles or engines. Examples include antifreeze, oil, and brake fluid. This type does not include empty vehicle and equipment fluid containers. Oil filters include vehicle engine oil filters.

52. Empty Metal, Glass, and Plastic Containers (that originally contained toxic materials) means all containers that are empty but that at one time contained toxic or hazardous fluids or other materials. Examples include empty antifreeze, oil, or lye containers.

53. Pesticides and Fertilizers means households and commercial products used to destroy or control organisms, pests or enhance plant growth.

54. Other Hazardous or Household Hazardous Waste means all household or commercial products characterized as toxic, corrosive, flammable, ignitable, radioactive, poisonous, or reactive.

Electronics

55. Computer-related Electronics includes computer CPUs, laptop computers, notebook computers, processors, printers, scanners, keyboards, etc. This category does not include automated typewriters or typesetters, portable handheld calculators, portable digital assistants or other similar devices.

56. Other "Brown Goods" includes cell phones, iPODs, PDAs, small electronic appliances such as toasters, telephones, stereos, radios, clocks, hair dryers etc.

57. Televisions and Computer Monitors means a stand-alone display system containing a CRT or any other type of display primarily intended to receive video programming via broadcast. Examples also include non-CRT units such as plasma and LCD monitors.

Other Materials

58. Tires and other rubber means a continuous solid or pneumatic rubber covering intended for use on any type of vehicle (including bicycles), or trailer to be used in tandem with any type vehicle and other rubber products.

59. Textiles means natural or man-made textile materials such as cottons, wools, silk, nylon, polyester. Includes clothing, curtains, towels and other fabric materials.

60. Bulky Materials means products made from multiple materials and large in size, which are meant for extended use. Includes mattresses, furniture (non-plastic), sinks, toilets, and other non-metal items

61. Restaurant Fats, Oils and Grease means any fats, oils and grease generated from the food preparation process.

62. Other Miscellaneous means any other type of waste not listed in any other sort category.

APPENDIX B

SAMPLE SELECTION AND TRACKING FORM

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Covanta
Daily Sample Selection and Tracking Form

Facility Name _____ **Field Supervisor** _____ **Date** _____ **Sampling Target** _____

Truck Type	Truck Type	Surveys Needed	Surveys Taken	Samples Taken
Frontload	FL			
Rear/Sideload	RL / SL			
Compactor	COMP			
Rolloff Open Top	RO-OT			
Rolloff Closed Top	RO-CT			

						Approximate % Composition			
Sample ID	Time	Truck #	Truck Type	Ticket Number	Weight	RES%	ICI%	Acceptable Y/N	Notes

Precipitation _____ **Temperature** _____

MSW CONSULTANTS

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APPENDIX C

FIELD DATA SHEET

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Covanta Energy
2019 Waste Characterization Study
Covanta Springfield
Season 1

WasteInsight by MSW Consultants

Date Sorted	
Sample ID Number	
Crew Chief	

Running Total Sorted Weight:	**0.0**

Enter Pre-weights below:

Pre-Weight Total 0

No	CATEGORY	GROSS WEIGHTS			NET WEIGHTS			TOTAL	Tare Average
1	Uncoated Corrugated Cardboard/Kraft Paper							0.00	5.28
2	Waxed Cardboard							0.00	5.30
3	High Grade Office Paper							0.00	5.25
4	Magazines/Catalogs							0.00	5.25
5	Newsprint							0.00	5.25
6	Other Reyclable Paper							0.00	5.35
7	Compostable Paper							0.00	5.33
8	Remainder/Composite Paper							0.00	5.25
9	#1 PET Beverage Containers (non-MA deposit)							0.00	5.38
10	PET Containers other than Beverage							0.00	5.30
11	Plastic MA Deposit Beverage Containers							0.00	5.30
12	#2 HDPE Natural/Colored Bottles							0.00	5.83
13	Plastic Tubs and lids (HDPE, PP, etc)							0.00	5.55
14	Plastic Containers #3-#7							0.00	5.78
15	Food Grade Expanded Polystyrene							0.00	5.28
16	Non-food Grade Expanded Polystyrene							0.00	5.25
17	Bulk Rigid Plastic Items							0.00	5.33
18	Film (non-bag clean commercial and industrial packaging film)							0.00	5.23
19	Grocery and other Merchandise Bags							0.00	5.28
20	Other Plastic Film							0.00	5.48
21	Remainder/Composite Plastic							0.00	5.30
22	Aluminum Beverage Containers (non-MA deposit containers)							0.00	5.30
23	Aluminum MA Deposit Beverage Containers							0.00	5.33
24	Tin/Steel Containers							0.00	5.40
25	Other Aluminum							0.00	5.25
26	Other Ferrous and Non-Ferrous							0.00	5.28
27	White Goods							0.00	0.00
28	Remainder/Composite Metal							0.00	5.25
29	Glass Beverage Containers (non-MA deposit containers)							0.00	5.28
30	Other Glass Packaging Containers (non-MA deposit containers)							0.00	5.40
31	Glass MA Deposit Beverage Containers							0.00	5.28
32	Remainder/Composite Glass							0.00	5.25
33	Food Waste							0.00	5.68
34	Branches and Stumps							0.00	0.00
35	Prunings, Trimmings, Leaves and Grass							0.00	5.38
36	Manures							0.00	5.25
37	Remainder/Composite Organic							0.00	5.30
38	Asphalt Pavement, Brick, and Concrete							0.00	5.25
39	Aggregates, Stones, Rock							0.00	5.30
40	Wood – Treated							0.00	5.23
41	Wood – Untreated							0.00	5.20
42	Asphalt Roofing							0.00	5.33
43	Drywall/Gypsum Board							0.00	5.25
44	Carpet and Carpet Padding							0.00	5.25
45	Remainder/Composite C&D							0.00	5.33
46	Ballasts, CFLs, and Other Fluorescents							0.00	5.38
47	Batteries – Lead Acid							0.00	5.28
48	Other Batteries							0.00	5.28
49	Paint							0.00	5.38
50	Bio-Hazards							0.00	5.38
51	Vehicle and Equipment Fluids							0.00	5.38
52	Empty Metal, Glass, and Plastic Containers (that originally contained toxic materials)							0.00	5.38
53	Other Household Hazardous Waste							0.00	5.38
54	Computer-related Electronics							0.00	5.20
55	Other “brown goods”							0.00	5.33
56	Televisions and Computer Monitors							0.00	5.25
57	Tires and Other Rubber							0.00	5.25
58	Textiles							0.00	5.33
59	Bulky Materials							0.00	5.38
60	Mattresses							0.00	5.28
61	Restaurant Fats, Oils and Greases							0.00	5.28
62	Other Miscellaneous							0.00	5.38

Sample Notes

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