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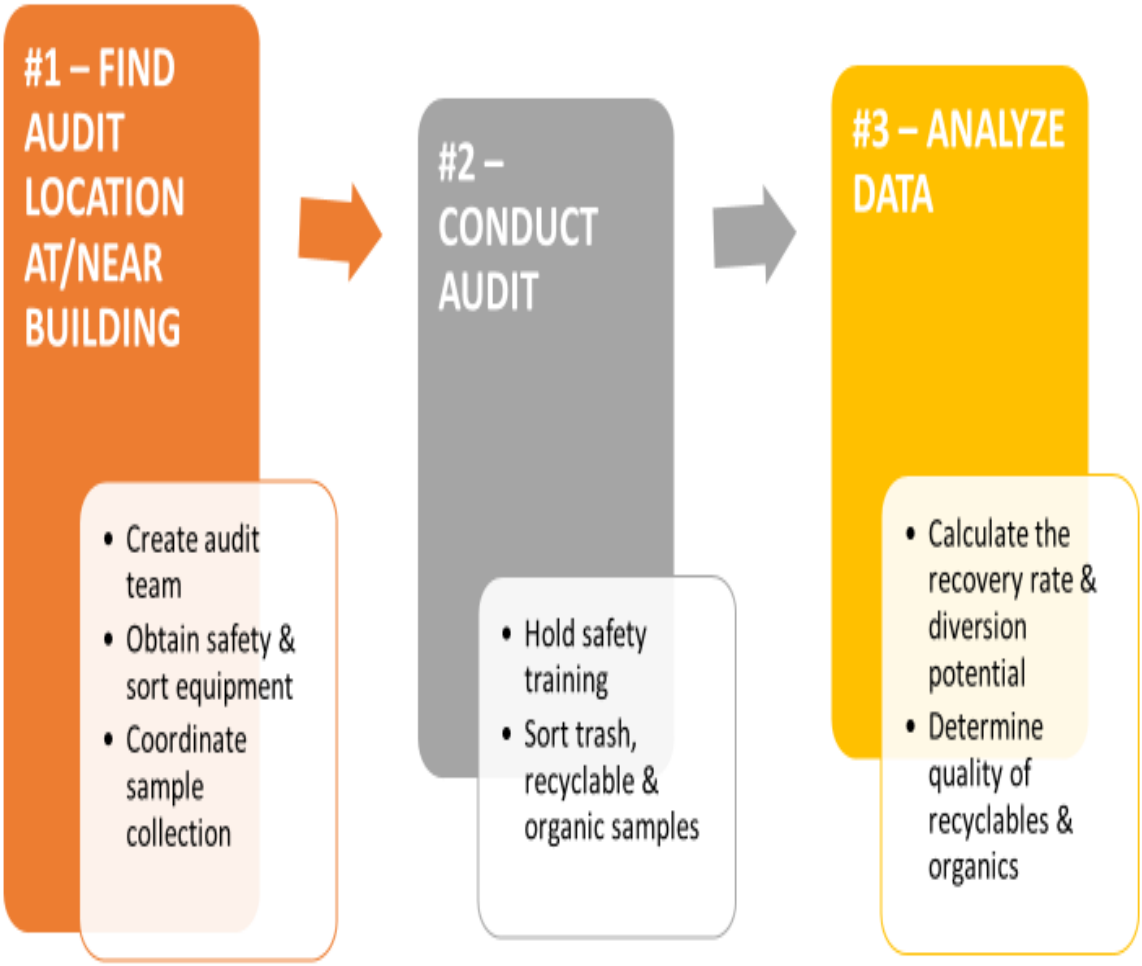
WASTE AUDIT: THE BASICS

Municipal solid waste (MSW) audits are physical measurements of small MSW samples taken to estimate the composition of the overall MSW stream generated in state office, commercial and institutional buildings. Audit results are key to identifying effective best practices, public messaging and waste diversion success. The basic components of an MSW audit are illustrated below.



GETTING STARTED

The Municipal Solid Waste Audit Protocol is a guidance document for conducting MSW audits. It has been modified from nationally-established waste composition procedures[i] for the "short" audits typical of Recycling Resource Economic Opportunity (RREO) grant and other small projects. It is intended to provide a standardized, state-wide approach with a sound yet nimble methodology, and results that are comparable across Colorado. This protocol may be used for:

- Trash stream composition – to determine the potential for waste reduction and diversion through both existing and future policies, programs and infrastructure
- Recyclables stream composition – to determine the types of recyclables collected from employee, maintenance, equipment and other areas as well as the potential for addressing contamination
- Organics stream composition – to determine the types of organics collected from the same areas and the potential for addressing contamination

Audits may target one or more of these streams.

How to Use this Protocol

The protocol is intended to guide any grant recipient or project manager through an audit. Other project and external resources may be available for assistances[ii].

Sort Logistics	p. 4	How to find & organize the sort location, secure staffing & obtain equipment
Safety	p. 8	Personnel protective equipment, potential hazards & safety procedures
Sample Selection	p. 10	How to target representative MSW loads, document sample details & sort appropriate materials for each trash, recyclable & organic stream
Sort Procedures	p. 13	Sequential steps for sampling targeted MSW loads, conducting sorts & documenting results
Data Analysis	p. 17	How to analyze raw data to interpret potential diversion in trash samples & types of contamination in recyclable samples

Definitions

Baseline Quantity Data	Annual MSW quantity data (typically expressed in tons/year) generated within the building or complex being audited & including trash & all other streams (e.g.., recyclables, organics, special wastes, etc.) – this data should be available from janitorial staff or the building's waste hauler & will be used to determine audit team size, estimate diversion potentials & recovery rate
Density	Relative weight of unit of waste volume (typically expressed in pounds per cubic yard)
Hauler	Either a public or private MSW hauler who collects MSW for transfer, disposal or processing
MSW Generator	The companies, workers, janitorial staff, vendors, public and others who utilize the building & generate trash, recyclables, organics & other solid waste
Municipal Solid Waste	That portion of the solid waste stream created by the MSW generators described above including trash, recyclables, organics & other materials
Samples	Targeted trash, recyclable and/or organic material randomly selected from the same generator type & building location & sorted to estimate the overall MSW stream composition – the total sample volume should be equal to at least 50% of all MSW generated in the building over two normal business days
Recovery Rate	Ratio of realized recycling potential (recyclables actually diverted) to the sum or untapped (recyclables placed in trash) & realized recycling potential (expressed as percent by weight)
Recycling Potential	This potential (typically expressed in tons/year) can measure untapped potential, realized potential & total (sum or untapped & realized recycling potential (can also apply to organics)
Targeted MSW	Those recyclables and/or trash materials identified for sorting to provide reasonable representation of the overall MSW stream (can be bagged, otherwise containerized on non-contained materials)
Tare	Empty weight of a container, truck or vehicle typically subtracted from containerized sample measurements (or gross weight) to obtain true sample weight

Abbreviations

C&D	Construction and demolition debris
CY	Cubic yard
MSW	Municipal solid waste
OP	Office paper
OTD	Old telephone directories
PET	Polyethylene terephthalate
PPE	Personal protective equipment
RREO	Recycling Resources Economic Opportunity
TPY	Tons per year

Limitations of "Short" Audits

Given the resources available to most small projects, "short" waste audits that take a snap-shot-in-time are typically conducted. These audits necessarily sample only a small amount of MSW generated over a few days. While "short" audit results are invaluable for informing improved operation or preliminary design parameters for new programming, they should not be construed as being definitively representative of the regional waste stream: All audit findings should reference this limitation and be used judiciously.

SORT LOGISTICS

Most audits include an evaluation of trash composition, while some also include an evaluation of recyclable and organic streams.

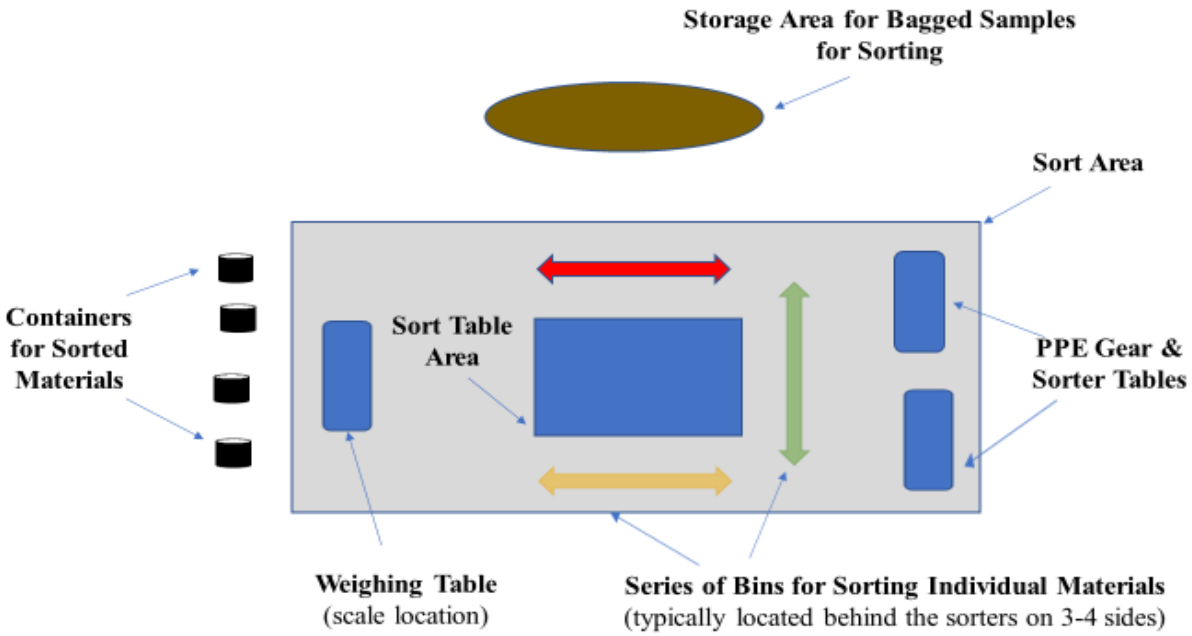
Location

Audits should be conducted at a location that is safe for audit staff and big enough to store bagged material and conducting the sort – ideally it will occur in proximity to existing centralized waste material storage points. In most building audits, this proximity will be near a loading dock, staff/vendor parking areas, maintenance or storage area (the photo below shows a summer audit conducted in a protected location adjacent to the CDPHE building). Outdoor audits will ideally be under cover (i.e., a building awning or tents) to maintain sample integrity and provide sorter comfort. These areas will need to be restricted from other use during the audit.

When multiple buildings or a complex is audited, it may be necessary to conduct multiple audits at multiple locations to ensure adequate sample representation.

Sorting Area

The figure on the next page (not to scale) illustrates a typical audit configuration. The area should be roughly 20' by 20' to provide enough room for sample storage, tables, bins and staff access. Larger areas allow grater mobility and flexibility but are not always available.



The sort area should be a large sorting surface to accommodate 5-6 sorters, such as that created by 2 to 3 banquet tables placed adjacent to one-another by their long sides, covered with a plastic tarp and secured with bungee cords. A separate table should be covered and secured for the data weighing and recording area. One to two tables can be provided for gear and supplies if space allows. Other areas can be assigned for storing samples on the tarped ground prior to sorting and collecting materials after sorting (the photo at the top of the next page shows an indoor sort with multiple sort tables).

Audit Staff

Some audits will use building staff, interns, Green Team members, volunteers and/or janitorial staff. Larger audits may also use environmental groups or temporary labor.

All Audit Staff Should:

- ***Be in good physical condition***
- ***Not be sensitive to odors or dust***
- ***Be able to read warning signs or labels***
- ***Be able to take direction***
- ***Have a current tetanus booster & Hepatitis B shot (optional but recommended)***

Each audit should have a supervisor who is familiar with the audit protocol, understands the sort categories and is able to direct other staff - Where available, up to two supervisors can divide duties. Other experienced personnel or consultants familiar with auditing can also be used.

Ideally there will be 4 to 5 sorters/team in addition to the supervisor – Although time requirements vary, it is probable that a 4- to 5-person sort team can complete an audit for a moderately-sized building or complex (i.e., roughly 1,000 to 1,500 workers) in a 2-day period. The audit should target the equivalent of 100% of the daily average MSW generation for the building(s) being audited. To verify the team size requirement:

- Obtain the annual baseline quantity of MSW generated from janitorial staff or the building's hauler
- Calculate the equivalent daily generation (based on 260 work days/year)
- If the daily quantity is more than 1,500 tpy, a larger sort team or longer audit may be required

When consecutive audits are conducted for the same project, separate sort teams are recommended. The ability to retain the same supervisor and soring staff will minimize retraining and provide greater consistency.

Schedule & Duration

The audit schedule will include set up/break down, training and sorting. The audit should not be scheduled during any holiday period or when it is likely that additional or unusual waste materials will be generated.

Audit scheduling should also consider the sequencing and timing of waste management within the building. Coordination with janitorial and/or Green Team staff will be needed to secure samples suitable for sorting. For example, it will be important to collect trash samples before they are compacted and before any materials are removed from the property for disposal or diversion. Similarly, container capacity to store materials once sorted and prior to off-site hauler removal without overflowing will be important.

Equipment

The audit equipment list (Appendix A) includes the equipment and supplies needed for each audit. Most items don't require long lead times and can be purchased at local hardware or box stores (e.g., Ace Hardware, Target, Home Depot, Harbor Freight, etc.). In some cases, equipment can be borrowed from audits previously conducted by others (contact CDPHE for suggestions – see the References section). Exceptions include:

Scales can be more challenging to obtain and maintain functionality – Scales must be tested regularly (see example weighing station/scale in the photo at the bottom of the page):

- Should be recalibrated as needed (see manufacturer's instructions)
- Should be checked during the audit with an unopened one-gallon jug of water (which should weigh 8.34 pounds)
- Batteries should be charged overnight before each audit day

Emergency eyewash units are infrequently used but critical safety gear – Appendix A includes information for obtaining an emergency eyewash unit. Portable units can be purchased on-line[iii] and filled with potable water prior to use.

SORT SAFETY

Prior to beginning of any sort day with new staff, the supervisor should lead the audit sorters through a training session to ensure that all sorters are properly prepared and informed. The training agenda should include a thorough explanation of the safety equipment and location, safety and sorting procedures.

All audit staff should review this section prior to participating in the audit – This review will facilitate on-site training and reduce the risk from typical waste sort hazards.

Potential Sorting Hazards

Waste audits pose potential health and safety hazards. Sorters may encounter hazardous materials such as pesticides, herbicides, solvents, paints, explosives, hypodermic needles and broken glass. While the quantity of hazardous material that sorters may encounter during waste studies is relatively small, the potential health and safety risks associated with some types of waste can be high.

All hazards should immediately be brought to the attention of the supervisor. If the potential exists for worker injury, the supervisor should clear the area and notify local response agencies as appropriate. Such occurrences include, but are not limited to, any spill that is large, emits an odor, foams or otherwise appears unstable; fires; bombs; or personal injuries requiring medical attention.

Most Frequently Encountered Hazards:

- ***Hypodermic needles and other sharp objects***
- ***Sprains and muscle strains from heavy lifting***
- ***Inhalation of, ingestion of, or direct contact with hazardous substances***
- ***Puncture wounds***
- ***Injuries involving moving vehicles***
- ***Noise exposure***
- ***Slips, trips, and falls***
- ***Fires***

Personal Protective Equipment (PPE)

Sorters' clothing should provide maximum protection from the risks associated with hazardous waste. Safety and protective equipment worn during the audits (listed below) should not be worn off the site to eliminate the possibility of off-site contamination. Appendix B includes a list of potential risks, work practice controls and guidelines for

avoiding hazards.

PPE Includes:

- ***Over-the-ankle boots (hard plastic shanks and steel toes recommended)***
- ***Cotton work clothes & long trousers (not shorts)***
- ***Plastic coveralls (optional)***
- ***Safety glasses or face shields (optional)***
- ***Safety vests – <u>these are required for all audit staff during all audit activities</u>***
- ***Hard hats (optional)***
- ***Filter masks and ear plugs (optional)***
- ***Thick outer gloves***
- ***Inner liner gloves to minimize solid or liquid waste exposure when putting on and removing the outer gloves (optional)***

SELECTING AUDIT SAMPLES

The objective of the audit sample selection process is to obtain samples from targeted hauler loads that provide the best representation of the overall MSW stream in the building(s) being audited. Steps for targeting MSW samples is provided below.

Steps for Targeting MSW Samples:

1. ***Identify the types of generators in the building(s) including;***
   - ***General office locations (e.g., staff offices, conference spaces & copy rooms) - mostly paper materials***
   - ***Staff break rooms/kitchen areas & cafeterias (if any) – mostly food & container materials***
   - ***Bathrooms/restrooms – mostly paper towels***
   - ***Living quarters (if any) – all types of MSW***
   - ***Vendor/retail areas (such as coffee shops, delis or convenience stores, if any)***
   - ***Janitorial & supply storage areas – many MSW materials including cleaners & aerosols***
   - ***Equipment & maintenance areas – may include yard debris, motor vehicle & construction-related waste***

2. ***Determine baseline quantity data for MSW generated at the building or complex;***
   - ***Baseline quantity data will provide important information for interpreting audit results***
   - ***Quantities will ideally be determined for the previous full calendar year and broken into trash & diverted streams (including but not limited to commingled & source-separated reused/recycled materials, donated/composted organics)***

3. ***Exclude materials that are not representative of MSW;***
   - ***Materials that are already separated from the MSW stream for diversion or special handling (e.g., shredded paper, wooden pallets, cardboard, electronics, batteries, etc.) – while helpful in tracking current diversion successes, these materials will not help to identify existing opportunities for additional diversion (baseline quantities should be estimated, however)***
   - ***Non-MSW such as liquid or hazardous waste***

4. ***The equivalent of the daily generation quantity should be sorted;***
   - ***Samples from each building area should be proportional to the amount of total MSW generated***
   - ***Many buildings will not have MSW quantities per area, but Green Team and/or janitorial staff will often have a good sense of how the waste stream is generated***

It is also noted that construction-related debris (C&D) from building renovations or expansions can generate significant waste with important waste diversion opportunities. While not technically an MSW material, it may be appropriate to include C&D debris (when it can be safely sorted and/or measured) if building improvements occur during the audit period to allow consideration of potential reuse and recycling activities.

Number & Weight of Samples

MSW audit samples will include recyclables and/or trash pulled for auditing from the same generator type and location in the building(s) - For example, each of the following would be a discrete sample:

- The bags pulled from the Human Resource offices on the 2nd floor in Building A
- The bags pulled from the employee break room on the 5th floor in Building B
- The bags pulled from vendor in the courtyard
- The bags pulled from the vehicle maintenance facility behind the complex
- The bags pulled from janitorial storage area for the complex

The total sample size should be the equivalent of 100% of the average daily generation quantity - this can include only trash or a combination of trash, recyclables and organics – For a medium-sized building (roughly 1,000 to 1,500 employees, this quantity may be 1,000 or more pounds. Larger buildings or building complexes should include a proportionally larger sample size. The daily quantity can be obtained from 50% of this weight over two days or other equivalency as long as representative samples are sorted.

Building trash and recyclables will often be bagged at the various points of generation and transferred with carts or other wheeled containers by janitorial staff to a centralized location for access by MSW haulers - In most cases, it will be possible to work with the janitorial or Green Team staff to isolate bags collected from targeted areas so they can be identified by generator area (this will be especially important if the building or complex being audited has multiple owner/tenant groups – only samples from those building locations covered by the audit should be collected for sorting).

Some waste – especially that from equipment and maintenance areas – may be bulky, non-containerized material that requires special handling to move to the sort area. In some instances, the audit supervisor may direct sorters to separate and weigh these materials at the point of generation to minimize worker hazards.

Sample Description

Comprehensive information verifying the source and mix of each targeted MSW sample is critical to the integrity and interpretation of audit results. The supervisor should document the following at the top of each sample field log (see Appendices C through E for trash, recyclables and organics, respectively); an example log for a recyclables audit is shown on the next page. Sample description information (shown in the circuled area)

should include:

- Recorder – who observed the sample selection and logged audit results
- Building location – the building being audited, floor identification, worker area, etc.
- Generator type – such as office, vendor, janitorial, kitchen, maintenance, etc.
- Other comments that may impact the sample or audit results – such as weather, difficulty collecting the sample or unusual observations

One log must be completed for each sample and will allow compilation of all the bin measurements for that sample. As there will be multiple samples for each audit, there will be multiple field logs. The logs will subsequently be used to record sorted material weights. Two blank field logs are provided with this protocol and can be copied to meet the needs of each audit.

RECORDER: lba	DATE/TIME: 3/29 9 am	BUILDING LOCATION: 4th floor/northend	SAMPLE NO: #1
GENERATOR TYPE: Mostly offices, 2 conference rooms, kitchen/employee area, 4 bathrooms			
COMMENTS/NOTES: Kitchen waste appears to be mixed with office waste			

MATERIALS	TYPE OF CONTAINER	TARE	GROSS WEIGHTS (from multiple bin measurements within the same sample)								NET WEIGHT CALCULATIONS (these columns are locked for automatic calculations)								TOTAL NET WEIGHT	% BY WEIGHT
			1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8		
Glass Containers	Medium	3.0	3.5	5.0	4.0	4.0					0.5	2.0	1.0	1.0	0.0	0.0	0.0	0.0	4.5	**2.7%**
Aluminum	Medium	3.0	4.0	6.5							1.0	3.5	0.0	0.0	0.0	0.0	0.0	0.0	4.5	**2.7%**
Steel/Tin	Medium	3.0	3.5								0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	**0.3%**
Plastic Containers	Medium	3.0	20.0	8.0	4.0	6.0					17.0	5.0	1.0	3.0	0.0	0.0	0.0	0.0	26.0	**15.4%**
Styrofoam	Medium	3.0	5.0	3.0							2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	**1.2%**
Cardboard	Medium	3.0	9.0	10.0	12.0	11.5	17.0				6.0	7.0	9.0	8.5	14.0	0.0	0.0	0.0	44.5	**26.4%**
Newspaper	Medium	3.0									0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0%**
Office Paper	Medium	3.0	36.0	14.0	13.0	7.0					33.0	11.0	10.0	4.0	0.0	0.0	0.0	0.0	58.0	**34.4%**
Mixed Paper	Medium	3.0	4.0	6.0	5.5						1.0	3.0	2.5	0.0	0.0	0.0	0.0	0.0	6.5	**3.9%**
Contaminants	Medium	3.0	8.0	6.0	11.0	9.0					5.0	3.0	8.0	6.0	0.0	0.0	0.0	0.0	22.0	**13.1%**
TOTALS											66.0	34.5	31.5	22.5	14.0	0.0	0.0	0.0	**168.5**	100.0%

NOTES:	
	Plastics = many packaging materials
	Styrofoam = appears to be mostly from new office equipment unpacking
	Contamination = dirty napking/paper towels (probably from kitchen area)
	(see photos of contaminated bins taken before weighing)

Materials to Sort

The recommended material sort lists for the MSW streams are tabulated in Appendix D. These lists may be revised to accommodate information needs for each building, although these core materials are needed to support composition results and comparable waste composition data state-wide (adding or deleting materials may require revisions to the field logs and analytical models). Slight adjustments can be made in the field by the supervisor, if needed, to ensure that the same materials are sorted from all samples during each audit and for any audits within the same project area.

SORT PROTOCOL

Manual Sample Sorting

Materials will be sorted by manual separation, measured and supported by visual observation. The sequential steps for manual sample sorting include:

1. Sample materials pulled for sorting may be stored on plastic tarps to prevent any contamination with dirt, oil, grease and other contaminants on the sort area floor. This will also protect the building's floor from any sample spills (see the prepared floor example, below left).

2. Bagged materials should be transferred to the sort tables (see the photo, above right). Once the contents are emptied onto the table, empty garbage bags shall be sorted as plastic film/bags/wrap. In some cases, bagged materials may be sorted on the sample tarps (the supervisor should make this determination based on sample weight and sorter safety). Some trash loads with construction, yard waste, motor vehicle waste or other hard-to-manage materials may similarly be sorted directly on the tarps to avoid double handling.

3. To avoid confusing results, the bags from only one sample should be sorted at a time, regardless of the number of total samples or sorters available. Similarly, only the samples from any one materials stream (trash, recyclables or organics) should be samples together. An exception to this rule may occur when separate sort crews and

sort stations are established for separate but simultaneous materials audits. Regardless of the number of audits being conducted, only one sample should be weighed and documented as one time. Mixing sample data will render the information useless.

4. Prior to sorting, one sort bin of each size must be weighed empty to obtain a tare weight (which must ultimately be subtracted from the total or gross weight of the bin plus sorted material to obtain net weight results). This weight will vary with each type of bin. Only one material should be placed in each bin. Different sized containers may be used for different materials (the photo below, left shows small/orange and two medium-sized bins/red and green).

5. Sorters should not scrutinize, read or remove any documentation, correspondence or similar personal or private materials.

6. All sorting should be done with tongs or hand rakes, unless otherwise authorized by the supervisor. Closed or sealed waste materials should not be opened even if this means counting a recyclable as an "other" material. Any suspicious, potentially dangerous or hazardous materials should not be touched directly but instead moved to a hazardous/special waste bin with a shovel (preferred) or hand tools for subsequent observations and weighing.

7. The supervisor should oversee sample weighing and recording. For many samples, multiple sort bins will be filled with the same material and require repeated weights as the sample is sorted. Other materials will only partially fill one bin. At the end of each sample, the supervisor will weigh and record all bins containing sorted materials (see the photo above, right). Any visual observations made by the sorters should be

brought to the attention of the supervisor.

8. Observations may include:
   - Unusual material such as medical waste
   - Difficult-to-sort material including composites
   - Full, capped water bottles
   - Half-full food containers

   Any sample that includes any "other" materials should include a written notation on the Field Log that describe the sorted materials - Weight and observations should be recorded on the MSW audit field logs and photographed. Log sheet recordings will ideally be logged electronically (this is more efficient and allows a direct assessment of sample weights).

9. Once weighed, the sorted materials should be emptied in designated containers or areas (the photo below shows placement of sorted trash materials in the building's trash compactor). Material management (such as transferring trash compactor loads to a landfill or recyclable Dumpsters to a processing facility) will vary by building.

Key Sort Considerations

The table on the next page includes a number of important guidelines for a successful MSW audit.

Supervisor should be familiar with the materials sort lists, train sorters & maintain sort consistency throughout audit – these responsibilities may be assisted by other experts or consultants as needed	In addition to reviewing the tables, it is recommended that the supervisor practice sorting household, office or other small trash samples prior to the audit
Supervisor shall oversee sorting	Supervisor should make all final sorting decisions when questions arise
Sort bagged waste – most materials will be bagged	Bags should be emptied to allow sorting of contents – all plastic bags should be sorted as plastic film, bags & wrap unless there are signs of hazards (see Appendix B)
Sort composite samples items that include a mix of materials (& are not specifically described in the material sort lists) as that material with the apparent greatest weight	For example – signs may be sorted as other metal (despite cardboard backing); clamshell containers as food waste if heavily contaminated (despite plastic packaging); cleaning products as miscellaneous hazardous/special waste (despite plastic containerization)
Adequately describe any materials sorted into "other" trash (all other glass, all other metal, all other plastic, all other paper, all other organics, miscellaneous hazardous/special waste, residue) & recyclable contaminants	There should be a written description & photos of any "other" materials
Supervisor shall determine when sample is fully sampled & how to measure remaining residue ♦ Will include mix of small materials – generally <1-inch that are indistinguishable ♦ Should include less than 10% of the sample	♦ Typically, residue will be collected & measured as a separate category – visual observations concerning content will be made ♦ Some audits may include sorting of residue with a 1-inch minus screen (see General Sorting Protocol section)

DATA ANALYSIS

Data Entry

Following the audit, all field logs (Appendix C) should be reviewed to verify that the key data is documented for each sample. The field logs are provided with this protocol: they are Excel-based spreadsheets and will automatically calculate net weights for the materials in each sample if the raw data is appropriately entered[iv]. The Selecting Audit Samples section includes an example of a completed field log.

Key Data:

- ***Building location***
- ***Generator type***
- ***Bin size, tare & gross weight for each bin filled with sorted material***
- ***Total net material weight for each material (gross minus tare)***
- ***Total net sample weight (all materials)***
- ***Notes & photographs to describe sort findings (required for all "other" materials)***

Basic knowledge of Excel is required for this work. The References & Resources section includes resources that may be available to assist with data analysis.

Key Analyses

All analysis must be conducted on net weights. Results from multiple audits conducted during the same general time period for the same buildings or complex should be analyzed together in the same analytical model. However, the results from trash, recyclable and organics audits (if conducted for the same building or complex) will be kept separate regardless of their completion in the same time period.

1. Net Weights for Each Individual Material in Each Sample –These will be automatically calculated on the field logs (expressed as a percent by weight).

2. Audit Analysis – A Waste Audit Analytical Model has been developed as part of this protocol (see Appendix E). While there will be multiple samples and therefore multiple field logs for each audit, there will be only one trash, one recyclables and one organics model that analyzes the result for the complete material audit:
   - Percent by weight calculations and sample weight from each field log must be uploaded to the model (see the circled cells in the trash audit example, next page)

- The models are also Excel-based and will automatically calculate the necessary analytics if data is accurate and appropriately uploaded
- Results should be manually verified – see the calculations provided in each model

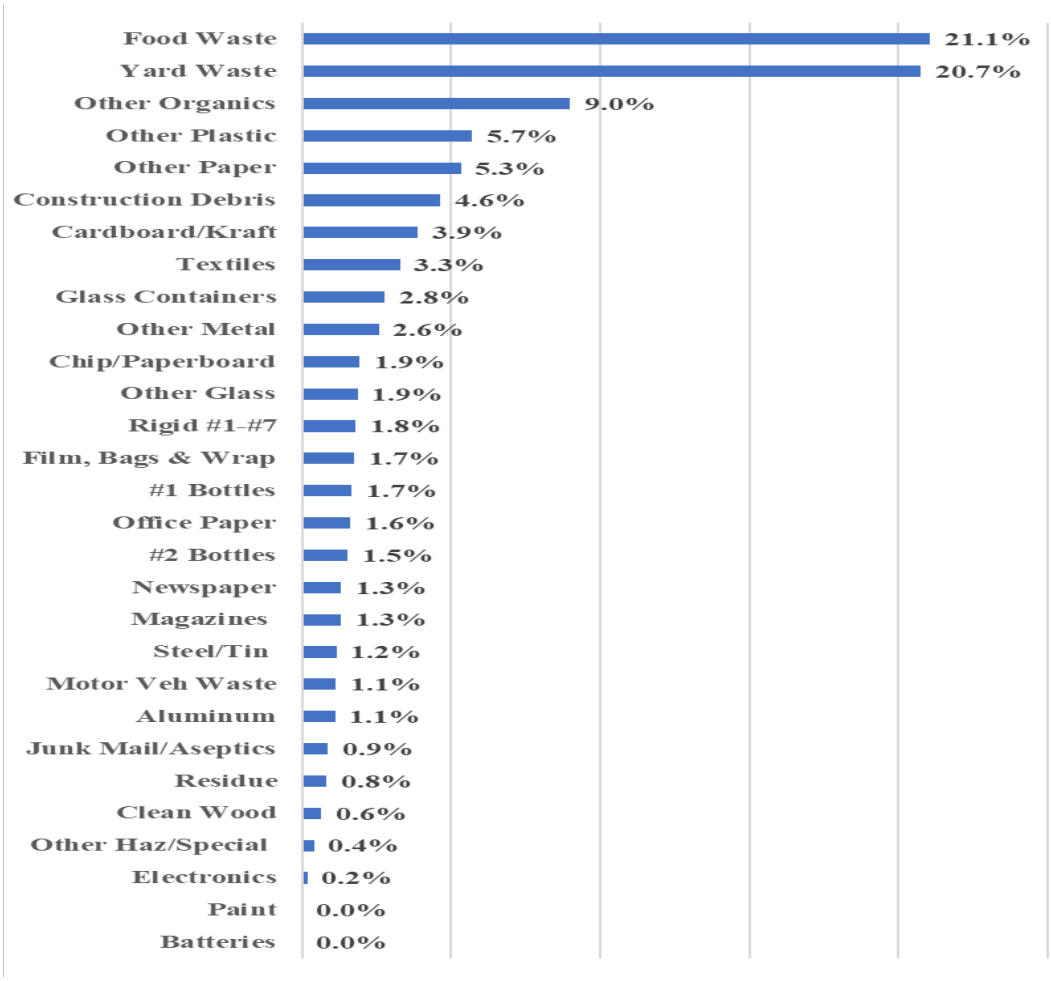
	Percent by Weights & Sample Total Net Weight Uploaded from Individual Field Logs[a]							
MATERIALS	Sample #1	Sample #2	Sample #3	Sample #4	Sample #5	Sample #6	Sample #7	Sample #8
Glass Containers	2.7%	3.5%						
Aluminum	2.7%	5.0%						
Steel/Tin	0.3%	0.2%						
Plastic Containers	15.4%	21.2%						
Styrofoam	1.2%	3.5%						
Cardboard	26.4%	30.5%						
Newspaper	0.0%	1.0%						
Office Paper	34.4%	22.5%						
Mixed Paper	3.9%	4.1%						
Contaminants	13.1%	8.5%						
Raw Total	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Sample Net Weight[b]	168.5	143						
Pro-Ration[c]	0.54	0.46	0.00	0.00	0.00	0.00	0.00	0.00

	Weight Average & Confidence Interval Calculations (these columns are locked for automatic calculations)									
MATERIALS	WEIGHTED AVERAGE[d]	STANDARD DEVIATION[e]	N[f]	T[g]	SQRT N[h]	90% CONFIDENCE INTERVAL[i]		WEIGHTED AVERAGE[i]	
						Lower	Upper	Categories Only	
Glass Containers	3.1%	0.6%	2	6.314	1.414	0.4%	5.7%	Glass	3.1%
Aluminum	3.7%	1.6%	2	6.314	1.414	-3.6%	11.1%	Metals	4.0%
Steel/Tin	0.3%	0.1%	2	6.314	1.414	-0.1%	0.6%		
Plastic Containers	18.1%	4.1%	2	6.314	1.414	-0.1%	36.3%	Plastics	20.3%
Styrofoam	2.2%	1.6%	2	6.314	1.414	-5.1%	9.6%		
Cardboard	28.3%	2.9%	2	6.314	1.414	15.4%	41.2%	Paper	61.7%
Newspaper	0.5%	0.7%	2	6.314	1.414	-2.7%	3.6%		
Office Paper	28.9%	8.4%	2	6.314	1.414	-8.7%	66.6%		
Mixed Paper	4.0%	0.2%	2	6.314	1.414	3.2%	4.7%		
Contaminants	11.0%	3.2%	2	6.314	1.414	-3.4%	25.3%	Contaminants	11.0%
	100.0%	*should be 100%*							100.0%
312	*total weight of all samples*								*should be 100*
1.0	*should be 1.0*								

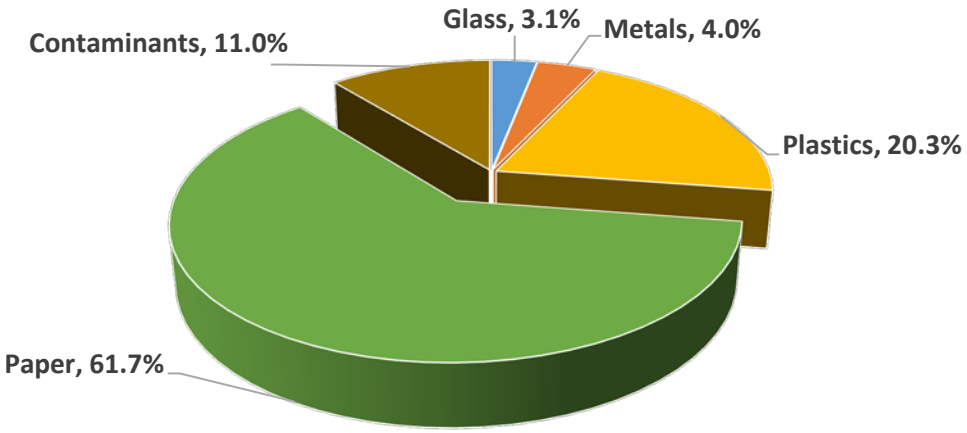
The models will calculate the following:

a. *Sample pro-ration* – to determine the relative importance of each sample within the total audit on the basis of its net weight

b. *Weighted average for material across all samples* – to evaluate each material in each sample based on the sample's pro-ration (this is the basis of the overall audit composition and is expressed as percent by weight);
   - A bar chart depiction of results is recommended (see the example on the next page) - this chart (and others shown on the following pages) can be generated within the model by selecting the data and applying the appropriate chart
   - In some cases, it may be desirable to also analyze sample results for a single generator type, building locations, overall building or complex (e.g., to see what opportunities exist in the office versus equipment maintenance areas)



c. *Total percent by weight of major categories* – to illustrate composition by major category (i.e., paper, plastic, glass, metals, organics, other wastes and residue categories for trash; paper, plastics, glass, metals and contaminants for recyclables; organics and contaminants for organics) – see the example pie chart from a recyclables audit below



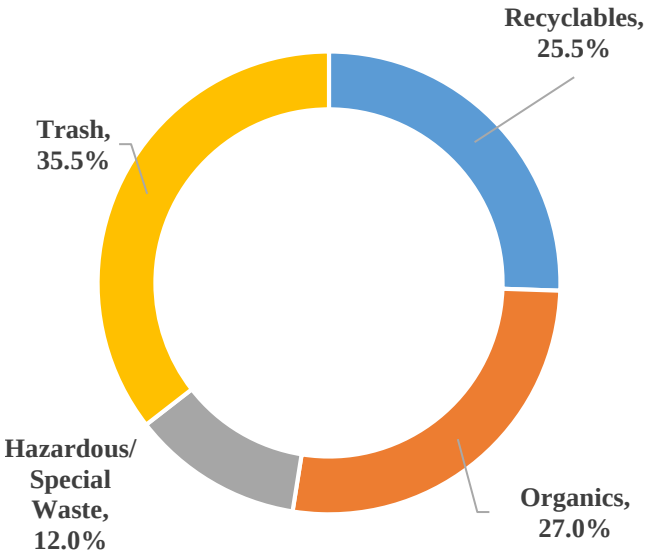
d. *Material confidence intervals (90%)* – to indicate the range within which the material weight will fall in the building's overall MSW 90% of the time;
   - ♦ Confidence intervals should be calculated on each material in all samples and based on standard deviations (which measure how widely each material weight varies around the weighted average of that material)
   - ♦ A high standard of deviation is typical of MSW, which is highly variable
   - ♦ A broader confidence interval is typical in MSW audits as the number of samples is very small and standard deviations are high
   - ♦ The office paper analytics in the example shown earlier exemplifies the magnitude of standard deviations and confidence intervals that can occur with MSW audits

Additional Analyses

Additional analyses will allow the MSW audit results to more effectively inform new or optimized programs. The calculations described below are based on model results but need to be completed manually. They will also require baseline quantity data for the audited building(s). Given the limitations of "short" audits and quantity data, results should be appropriately qualified and used judiciously.

1. Untapped Diversion Potential – This metric will be assessed from trash audit results to represent those recyclables, organics and other materials measured in trash samples that could have been diverted instead of disposed. The potential should be based on materials accepted in diversion programs operating in the community where the building is located - commonly divertible materials will vary. The example doughnut chart below depicts potentially diverted trash audit materials, expressed as percent by weight.

Commonly Diverted Materials:
- ♦ ***Recyclables - glass containers, aluminum, steel/tin, plastics #1/#2, OCC, ONP, OP, OMG, chipboard, junk mail***
- ♦ ***Organics – food waste, yard waste, compostable paper***
- ♦ ***Other materials - plastic film, textiles, electronics, paint, motor vehicle waste***



2. Realized Diversion Potential – This metric represents the quantity of diverted

materials that are recoverable (i.e., diverted materials minus contaminants), and can be used for recycling, organics recovery or other diversion (expressed as tons/year).

3. Total Diversion Potential – This potential is equal to the sum of untapped and realized diversion potential, and can be used for recycling, organics recovery or other diversion (expressed as tons/year).

4. Waste Stream Recovery Rate – This metric reflects the ratio of realized diversion potential to the total diversion potential and indicates how much of divertible materials in the total MSW stream was actually diverted from landfill disposal (expressed as percent by weight).

5. Recycling Rate – The recycling rate is the measurement of realized diversion potential to the total MSW stream (expressed as percent by weight).

The following table estimates diversion potential, recovery and recycling rates for an example building MSW stream. In this example, all diversion and recovery successes are related to recycling; organics recovery can be similarly estimated.

Example Building Baseline Quantity Data (measured as tons/year):	**Trash = 100 tpy** **Recyclables[a] = 25 tpy** **Organics = 0 tpy**
Example Audit Results (expressed as percent by weight):	**Trash Audit = 50% trash** **40% recyclables** **10% other** **Recyclables Audit = 20% contamination**
Untapped Diversion Potential:	100 tpy X 40% = 40 tpy
Realized Diversion Potential[a]:	25 tpy X (100%-20%) = 20 tpy
Total Diversion Potential:	40 tpy + 20 tpy = 60 tpy
Recycling Recovery Rate:	20 tpy / 60 tpy = 33%
Recycling Rate	20 tpy / (100 tpy + 25 tpy) = 16%

[a] The waste audit-measured contamination level will only apply to commingled materials represented by the audit itself. The total recyclables baseline quantity data may also include source-separated materials (e.g., shredded paper, cardboard, etc.)

In other words, the actual recycling efforts in this building yield a diversion rate of 16% with 33% of all potential recyclables diverted. If 60 tpy of recyclables were diverted, the recycling rate would be 48% and the recovery rate 100% - the highest that could be achieved in this example (unless organics were also recovered).

6. Comparison to Previously Collected Audit Data – A final analysis that should be conducted in those project regions where previous MSW audits have been conducted is a comparison to show changes in the trash and recycling stream over time (see an example comparison of audit results on the next page). It is likely that sort protocols and material sorted will vary; major changes in methodology and material sorted

should be identified when conducting the comparison.

Material Type	2008	2016/2017	Difference
Glass	2.3%	5.5%	3.2%
Metals	2.7%	2.5%	-0.2%
Plastic	9.8%	12.8%	3.0%
Paper	14.4%	20.7%	6.3%
Organics	57.2%	47.9%	-9.3%
Hazardous & Special Waste	7.4%	10.6%	4.2%
Residue	6.1%	0%	-6.1%

Reporting

Reporting of waste audit results should include a presentation of calculations, summary charts, comparison against historical results (if any) and a discussion of overall findings including any insight provided by written sort notes and photographs. Example reports can be obtained from the resource list found in the References section.

REFERENCES & RESOURCES

[i] National waste composition study procedures include:

- California Integrated Waste Management Board's Uniform Waste Disposal Characterization Method
- U.S. Green Building Council's LEED Waste Management Policy and Waste Stream Audit Requirements
- American Society for Testing Materials D-5231.

[ii] External sources include:

- CDPHE Pollution Prevention Advisory Board RREO Coordinator, Eric Heyboer – eric.heyboer@state.co.us, 303.335.6932
- LBA Associates, Laurie Batchelder Adams (protocol author & rural/urban audit coordinator) – laurie@lbaassoc.com, 303.733.7943
- Gracestone, Anne Peters (Capitol Complex audit coordinator) – annep@indra.com, 303.494-4934

[iii] Example emergency eyewash unit – see https://www.globalindustrial.com/g/safety/eyewash-stations-and-showers/portable-emergency-eyewash/guardian-portable-eye-face-wash-stations.

[iv] Field logs and analytical models are password-protected, and cells automatic calculations are locked. The password for all files is lbarreo2018 and is case-sensitive.

APPENDIX A
MSW AUDIT EQUIPMENT LIST[a]

Item	Number for Trash Audit	Number for Recyclables Audit	Description	Comments
20’ by 20’ Tent Canopy	1	1	Rental (optional)	For uncovered outdoor sorts only
6’ by 30” Tables	5-6	5-6	Rental or borrowed	
Chairs	5-6	5-6	Rental	
Medium Sort Bins	50	30	Light to medium (~18-gal)	Can be mix of solid & perforated (i.e., laundry basket) - at least 20 must be solid
Small Sort Bins	20	5	5-gal pails	For low-quantity materials
Materials Signs	1 set	1 set	Sealed in plastic	To label sample containers
Plastic Tarps	15-20	6-8	10’ x 12’ or larger with grommets & zip ties	To protect samples & cover sort tables (few tarps for recyclables as minimal organics)
Bungee Cords	8 4’ long cords			To secure tarps to sort tables
Hand Sorting Tools	Plastic or metal garden tongs (2/sorter) & hand rakes (1/sorter)			
Platform Scale	1	1	150-lb/0.05 increment	Portable, digital display, rechargeable
Back-Up Scale &	1	1	Optional	Simple bathroom scale
Magnets	1	1		For sorting, ferrous metals
Small Cones & Markers	5-6	5-6	6” height	For labelling samples – can be reused
Gloves & Liners	Puncture resistant gloves & Latex liners			At least 1 pair of gloves/sorter-day
Tyvek Coveralls	Varying sizes (these run small)			At least 1/sorter-day
Face Masks	2-3/sorter-day			
Hats, Vests, Glasses. Ear Plugs	1 each/sorter – may wear their own eyeglasses/sunglasses instead of safety glasses			
First Aid & Sanitizers	1 first aid kit & 2-3 hand sanitizers			
Fire Extinguisher	1	1		For liquid & electrical fire control
Portable Eyewash	1	1	Minimum 16-gallon, meets ANSI Z358.1-2009	For spills in face, eyes, body
Rakes & Shovels	2-3 each		Bow rakes & wide pan shovels	To maintain & clean site
Miscellaneous	Laptop computer, sealed gallon jug of water, small hand brush, duct tape, black Sharpie markers, scissors or plastic cutters, paper towels, camera, water for flushing injuries, beverage & snacks			

[a] Assumes separate trash and recyclables sorts with no overlapping equipment – if both audits are conducted for the same project, some equipment can be used for both (e.g., bins if cleaned between uses, hand tools, scale, magnet, cones, fire extinguisher, rakes/shovels)

APPPENDIX B
SAFE SORTING PROCEDURES & GUIDELINES FOR AVOIDING HAZARDS

Safe Sorting Procedures

The risks associated with waste studies can be minimized by carefully following safety guidelines described below. See the critical work practice controls that should be followed by all staff below.

Universal Precautions - All waste should be handled as if it were hazardous. Sorters should not allow waste to contact bare skin, inhale waste or handle waste without wearing personal protective equipment and practicing the proper procedures outlined in this plan. The supervisor will be responsible for ensuring that the sorters wear the appropriate equipment and follow safe sorting procedures. A first aid kit and fire extinguisher will be located in the sort area during the sorting event.

Proper Housekeeping & Handling of Waste – The supervisor will manage any biohazardous or hazardous waste that is encountered or suspected. Biohazardous waste will be placed in a plastic bag, tied, weighed, and recorded as medical waste. The supervisor will notify the host facility that biohazardous or hazardous waste has been received and allow it to manage these materials according to their existing procedures.

Work Practice Controls

Containers or other items weighing more than 25 pounds should be lifted on and off the ground and scale by two sorters
Sorters should step around solid waste when sorting on tarps to avoid slipping and falling
Sorters should not wear contact lenses during sorting activities since, in the event of a chemical spill, chemicals can become trapped behind lenses causing serious eye injuries
Tongs and hand rakes should be used to separate and remove all objects from waste sample
Sort large pieces of glass first, then remove clear glass – never use hands to sort
No capped, closed or sealed waste items will be opened to minimize hazards associated with contents (bagged waste should be opened & sorted unless signs of danger identified above are noted)
No batteries will be removed from any product
Syringes or suspicious materials (including any materials with red staining, red-bagged waste, containers taped together, or an unusual amount of ammonia bottles, cold capsules or similar container; these items may indicate methamphetamine paraphernalia) shall be managed by the supervisor only
Other potentially hazardous and special waste materials should be moved to hazardous/special waste basket using shovel (preferred) or hand tools
Sorters should work from tables instead of ground whenever possible (especially for trash samples)
Sorters shall stay inside the coned areas that indicate a separation from dangerous activity
No sorters will operate motorized equipment under any condition
A “line-of-sight” buddy system should always be used – audit staff should be paired during training
Rest and refreshment breaks should be taken as needed to maintain hydration – but no drinking or eating should occur in the immediate vicinity of sort location
No smoking in the sort area – most host facilities will similarly restrict or prohibit
Remove all disposable clothing and gear at the end of each audit day – dispose with other trash materials

Guidelines for Avoiding Hazards

Inhalation, Ingestion, or Direct Skin Contact with Hazardous Substances - To minimize risk of infection through ingestion, inhalation, or direct contact with hazardous or infectious substances, the following activities are prohibited on site until hands and forearms are thoroughly washed with soap and water or waterless cleansing lotion: eating, drinking, and applying lip balm or lotion.

The most likely routes of exposure to infectious or hazardous substances are ingestion and inhalation. Exposure by ingestion can be controlled through proper work practices (i.e., no eating or drinking while sorting) and good personal hygiene (i.e., control of hand-to-mouth activity while on site). Exposure by inhalation can be reduced through proper use of filter masks.

Direct skin contact with hazardous substances can be controlled by proper hand washing practices and by consistent use of coveralls, gloves, boots, and other personal protective equipment. If a hazardous substance meets skin, the area should be flushed with water using the emergency eyewash and appropriate medical care should follow.

Eyes are particularly vulnerable to caustic dusts and vapors. Safety glasses or face shields must be worn to reduce the risk of eye injury. Contact lenses should not be worn during sorting activities due to the potential hazards of dust and chemical exposure. Precautions should be taken to ensure that sorters do not generate unnecessarily high levels of dust in the air while sorting. Sorters should not open unidentified containers that may expose their eyes, skin, or lungs to vapors, dusts or mists. If eyes are exposed to a hazardous substance, the eyes should be thoroughly flushed for 15 minutes using the emergency eyewash. Appropriate medical care should follow.

Puncture Wounds from Contaminated Items - Waste materials may contain broken bottles, hypodermic needles, medical wastes and other sharp objects that can cause puncture wounds. Gloves, safety shoes with steel shanks and proper handling will reduce the likelihood of puncture wounds. Small cuts must be cleaned immediately with antiseptic and bandaged to reduce the risk of infection.

To reduce the risk of slipping and falling onto sharp objects, sorters should minimize stepping on or over waste samples. To protect hands from puncture wounds, small hand rakes should be used to separate and remove dangerous items from waste samples.

Injuries Involving Moving Vehicles – The supervisor will oversee the delivery of waste samples to the sorting area and ensure that all sorters are at least ten feet from the delivery equipment (f applicable). Only authorized delivery vehicles will be permitted in the sorting area. All sorters are restricted to the immediate area around the sorting table.

Sprains and Strains - Each trash sample will weigh 150 to 250 pounds (recycling samples will be slightly less), and sorting activities involve manually moving the material several times before it is finally discarded. To avoid back and muscle strains, small portions of each sample should be raised and lowered as few times and for as short a distance as possible. Bags, barrels, and other objects weighing more than 25 pounds should be lifted by two or more sorters or divided into smaller loads, if possible.

When lifting, the following guidelines should be followed:

- Maintain the natural curves of the spine by keeping the head and chest high, the chin tucked in and the back arched
- Bend the hips and knees
- Stand diagonally (one foot ahead, one foot behind) for a wide, balanced base of support
- Keep the abdominal muscles tight when lifting to help take pressure off the spine
- Consciously lift with the legs - straighten knees and hips at the same time while keeping stomach muscles tight so that the strongest muscles of the legs do the work
- Move smoothly in a well-planned, deliberate manner - be certain of good foot traction and good grip on the object, do not jerk the load since jerking increases stress on the back
- Avoid twisting when lifting - twisting increases stress on the spine, lift straight and then turn the entire body if a directional change is necessary, pivot on the feet instead of at the waist
- Avoid lifting above the shoulders
- Sort samples on a table to eliminate excess stooping and bending

Noise - If working close to heavy equipment, high noise levels may pose a risk. Earplugs should be provided to protect sorters' hearing and should be worn while working in noisy areas. Earplugs are designed to permit spoken communication while filtering out ear-damaging frequencies. Sorters who wear hearing protection will be less tired at the end of the day than those who do not wear ear protection.

Slips, Trips and Falls - The sorting area can become slippery for a variety of reasons. While sorting, sorters should refrain from walking to the other side of the table to place material in a container. Instead, the material should be given to a person who is on the other side of the table so that they can place the material in the appropriate container. This procedure will save time and reduce the risk of accidents.

Fires - No smoking is allowed in the sorting area to avoid the chance of fire (most host facilities will only allow smoking in restricted areas, it at all). In the event of a small fire in sort area, it should be extinguished using the fire extinguisher located on the equipment table. In the event of a larger facility fire, all sorters will immediately stop sorting activities and follow the direction of the host facility.

Emergency Contacts & Medical Care Information – A route map with written directions should be available for the nearest emergency care center. Emergency (mobile phone) contacts should be available for any applicable staff, agency, organization or labor company manager.

APPENDIX C

TRASH FIELD LOG (Sample #1) - BUILDING WASTE AUDITS

RECORDER:		DATE/TIME:			BUILDING LOCATION:															SAMPLE NO: #1	
GENERATOR TYPE:																					
COMMENTS/NOTES:																					
MATERIALS	TYPE OF CONTAINER	TARE	GROSS WEIGHTS (from multiple bin measurements within the same sample)									NET WEIGHT CALCULATIONS[a] (these columns are locked for automatic calculations)								MATERIAL NET WEIGHT[b]	% BY WEIGHT[c]
			1	2	3	4	5	6	7	8		1	2	3	4	5	6	7	8		
Glass Containers												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Other Glass												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Aluminum												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Steel/Tin												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Other Metal												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Plastic Containers												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Styrofoam												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Other Plastic												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Cardboard												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Newspaper												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Office Paper												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Mixed Paper												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Other Paper												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Food Waste												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Yard Waste/Wood												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Other Organics												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Electronics												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Batteries												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Motor Vehicle												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
C&D												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Misc Haz/Special												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Residue												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
TOTALS												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	#DIV/0! *should be 100%*

NOTES:

[a] Net Weight = Gross Weight - Tare (example cell N7 = E7 - D7)

[b] Material Net Weight = Sum of Net Weights (example cell W7 = N7 + O7 + P7 + Q7 + R7 + S7 + T7 + U7)

Sample Net Weight = cell W30 - *upload to master audit spreadsheet*

[c] Percent by Weight = Material Net Weight / Total Sample Net Weight (example cell X7 = W7 / W30) - *upload to master audit spreadsheet*

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APPENDIX C

TRASH FIELD LOG (Sample #2) - BUILDING WASTE AUDITS

1	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
2	RECORDER:		DATE/TIME:			BUILDING LOCATION:												SAMPLE NO: #2					
3	GENERATOR TYPE:																						
4	COMMENTS/NOTES:																						
5	MATERIALS	TYPE OF CONTAINER	TARE	GROSS WEIGHTS (from multiple bin measurements within the same sample)									NET WEIGHT CALCULATIONS[a] (these columns are locked for automatic calculations)									MATERIAL NET WEIGHT[b]	% BY WEIGHT[c]
6				1	2	3	4	5	6	7	8		1	2	3	4	5	6	7	8			
7	Glass Containers												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	#DIV/0!
8	Other Glass												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	#DIV/0!
9	Aluminum												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	#DIV/0!
10	Steel/Tin												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	#DIV/0!
11	Other Metal												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	#DIV/0!
12	Plastic Containers												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	#DIV/0!
13	Styrofoam												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	#DIV/0!
14	Other Plastic												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	#DIV/0!
15	Cardboard												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	#DIV/0!
16	Newspaper												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	#DIV/0!
17	Office Paper												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	#DIV/0!
18	Mixed Paper												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	#DIV/0!
19	Other Paper												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	#DIV/0!
20	Food Waste												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	#DIV/0!
21	Yard Waste/Wood												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	#DIV/0!
22	Other Organics												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	#DIV/0!
23	Electronics												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	#DIV/0!
24	Batteries												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	#DIV/0!
25	Motor Vehicle												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	#DIV/0!
26	C&D												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	#DIV/0!
27	Misc Haz/Special												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	#DIV/0!
28	Residue												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	#DIV/0!
30	TOTALS												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		**0.0**	#DIV/0! *should be 100%*

	NOTES:																						

[a] Net Weight = Gross Weight - Tare (example cell N7 = E7 - D7)

[b] Material Net Weight = Sum of Net Weights (example cell W7 = N7 + O7 + P7 + Q7 + R7 + S7 + T7 + U7)

Sample Net Weight = cell W30 - *upload to master audit spreadsheet*

[c] Percent by Weight = Material Net Weight / Total Sample Net Weight (example cell X7 = W7 / W30) - *upload to master audit spreadsheet*

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APPENDIX C

RECYCLABLES FIELD LOG (Sample #1) - BUILDING WASTE AUDITS

RECORDER:	DATE/TIME:	BUILDING LOCATION:	SAMPLE NO: #1
GENERATOR TYPE:			
COMMENTS/NOTES:			

MATERIALS	TYPE OF CONTAINER	TARE	GROSS WEIGHTS (from multiple bin measurements within the same sample)								NET WEIGHT CALCULATIONS (these columns are locked for automatic calculations)								TOTAL NET WEIGHT	% BY WEIGHT
			1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8		
Glass Containers											0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Aluminum											0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Steel/Tin											0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Plastic Containers											0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Styrofoam											0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Cardboard											0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Newspaper											0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Office Paper											0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Mixed Paper											0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Contaminants											0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
TOTALS											0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	#DIV/0! *should be 100%*

NOTES:

[a] Net Weight = Gross Weight - Tare (example cell N7 = E7 - D7)

[b] Material Net Weight = Sum of Net Weights (example cell W7 = N7 + O7 + P7 + Q7 + R7 + S7 + T7 + U7)

Sample Net Weight = cell W18 - *upload to Master Audit Spreadsheet*

[c] Percent by Weight = Material Net Weight / Total Sample Net Weight (example cell X7 = W7 / W18) - *upload to Master Audit Spreadsheet*

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APPENDIX C

RECYCLABLES FIELD LOG (Sample #2) - BUILDING WASTE AUDITS

RECORDER:	DATE/TIME:	BUILDING LOCATION:	SAMPLE NO: #2
GENERATOR TYPE:			
COMMENTS/NOTES:			

MATERIALS	TYPE OF CONTAINER	TARE	GROSS WEIGHTS (from multiple bin measurements within the same sample)								NET WEIGHT CALCULATIONS (these columns are locked for automatic calculations)								TOTAL NET WEIGHT	% BY WEIGHT
			1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8		
Glass Containers											0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Aluminum											0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Steel/Tin											0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Plastic Containers											0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Styrofoam											0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Cardboard											0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Newspaper											0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Office Paper											0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Mixed Paper											0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Contaminants											0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
TOTALS											0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	#DIV/0!

should be 100%

NOTES:

[a] Net Weight = Gross Weight - Tare (example cell N7 = E7 - D7)

[b] Material Net Weight = Sum of Net Weights (example cell W7 = N7 + O7 + P7 + Q7 + R7 + S7 + T7 + U7)

Sample Net Weight = cell W18 - *upload to Master Audit Spreadsheet*

[c] Percent by Weight = Material Net Weight / Total Sample Net Weight (example cell X7 = W7 / W18) - *upload to Master Audit Spreadsheet*

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APPENDIX C

ORGANICS FIELD LOG (Sample #1) - BUILDING WASTE AUDITS

RECORDER:	DATE/TIME:	BUILDING LOCATION:	SAMPLE NO: #1
GENERATOR TYPE:			
COMMENTS/NOTES:			

MATERIALS	TYPE OF CONTAINER	TARE	GROSS WEIGHTS (from multiple bin measurements within the same sample)								NET WEIGHT CALCULATIONS (these columns are locked for automatic calculations)								TOTAL NET WEIGHT	% BY WEIGHT
			1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8		
Food Waste											0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Yard Waste/ Landscaping & Clean Wood											0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Compostable Paper & Service Ware											0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Contaminants											0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
TOTALS											0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	#DIV/0!

should be 100%

NOTES:

[a] Net Weight = Gross Weight - Tare (example cell N7 = E7 - D7)

[b] Material Net Weight = Sum of Net Weights (example cell W7 = N7 + O7 + P7 + Q7 + R7 + S7 + T7 + U7)

Sample Net Weight = cell W12 - *upload to Master Audit Spreadsheet*

[c] Percent by Weight = Material Net Weight / Total Sample Net Weight (example cell X7 = W7 / W12) - *upload to Master Audit Spreadsheet*

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APPENDIX C

ORGANICS FIELD LOG (Sample #2) - BUILDING WASTE AUDITS

RECORDER:	DATE/TIME:	BUILDING LOCATION:	SAMPLE NO: #2
GENERATOR TYPE:			
COMMENTS/NOTES:			

MATERIALS	TYPE OF CONTAINER	TARE	GROSS WEIGHTS (from multiple bin measurements within the same sample)								NET WEIGHT CALCULATIONS (these columns are locked for automatic calculations)								TOTAL NET WEIGHT	% BY WEIGHT
			1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8		
Food Waste											0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Yard Waste/ Landscaping & Clean Wood											0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Compostable Paper & Service Ware											0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
Contaminants											0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	#DIV/0!
TOTALS											0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	#DIV/0! *should be 100%*

NOTES:

[a] Net Weight = Gross Weight - Tare (example cell N7 = E7 - D7)

[b] Material Net Weight = Sum of Net Weights (example cell W7 = N7 + O7 + P7 + Q7 + R7 + S7 + T7 + U7)

Sample Net Weight = cell W12 - *upload to Master Audit Spreadsheet*

[c] Percent by Weight = Material Net Weight / Total Sample Net Weight (example cell X7 = W7 / W12) - *upload to Master Audit Spreadsheet*

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APPENDIX D
MATERIAL CATEGORIES & DESCRIPTION

Trash

Materials	Description	Sort Bin (see Equip-ment List)
GLASS		
Glass Food & Beverage Containers	All colors of food & beverage bottles, jars & containers – NO LIDS	Medium
All Other Glass	Glass-only materials that don't fit above including mirrors, window/auto glass, ceramic, porcelain, glass cookware, drinking glasses, light bulbs COMPACT FLUORESCENT BULBS sorted as MISCELLANEOUS HAZARDOUS/SPECIAL WASTE	Small & Solid
METAL		
Aluminum Food & Beverage Containers, Foil & Pie Tins	Aluminum, tin, steel & bi-metal beverage & food cans, soft drink & beer cans, foil, food trays and pie tins – NO LIDS	Medium
Steel/Tin Food & Beverage Cans & Containers	Tin, steel & bi-metal beverage & food cans, also empty aerosol cans (nozzles are ok but no lids) EMPTY METAL PAINT CANS sorted as OTHER METAL AEROSOL CANS CONTAINING PRODUCT sorted as MISCELLANEOUS HAZARDOUS/SPECIAL WASTE	Medium
All Other Metal	Metal-only materials that don't fit above including coat hangers, cook pots, non-food containers, copper tubing, brass fittings, piping, metal appliances, all scrap metal & items that are primarily metal including metal container lids/caps	Small
PLASTICS		
Plastic Containers	All bottles, plastic jugs, jars, tubs, cups, trays, non-Styrofoam clamshells & other containers labelled with triangulated resin code #1-#7 – NO LIDS OR CAPS	Large
Styrofoam	Styrofoam (extruded polystyrene foam) packaging, clamshells, food containers, foam cups, coolers, foam egg cartons, etc.	Large
All Other Plastic	Plastic-only materials that don't fit above including grocery & trash bags, plastic sheeting, tarps, bubble wrap, foil-lined chip bags, plastic caps/lids, straws, CD/VHS tapes, plastic cutlery/plates, hoses, toys, furniture, laundry baskets, buckets, pails, flower pots and plastics lacking triangulated resin code	Medium
PAPER		
Cardboard	Corrugated (waffled, multi-layer) cardboard, pizza boxes with minimal food/grease – WAXY COATED IN OTHER PAPER	Medium
Newspaper	Newspaper with all inserts and glossies MAGNETS sorted as OTHER METAL SAMPLE PACKETS as OTHER PLASTIC	Small
Office Paper	"High" grade paper including whole or shredded printer paper, typing paper, copy paper, colored paper, computer paper, sticky notes, envelopes with windows, wrapping paper, brochures, file folders PAPER WITH WAXY LINERS sorted as OTHER PAPER BUBBLE TYEK ENVELOPES sorted as OTHER PAPER	Medium & Solid
Mixed Paper	Chipboard/paperboard (single-layer non-corrugated cereal and cracker	Large

	boxes, paper egg cartons, gift & shoe boxes, paper/toilet paper rolls); "low" grade paper (junk mail, telephone books, paperback books); aspetic containers (multi-layered waxy milk/drink cartons, gable-top juice/soup boxes, tofu/ice creams/frozen yogurt cartons); magazines and catalogues include glossies WAXY COATED sorted as OTHER PAPER	
All Other Paper	Paper products contaminated <25% with food waste or moisture including pizza boxes, napkins, paper towels, hot/cold to-go paper cups, microwave trays, any foil-lined paper, waxy cardboard, carbon paper, neon/bright paper, photographs, waxy coffee cups	Large & Solid
ORGANICS		
Food Waste	All food/beverage waste including bones & rinds, coffee ground, paper products contaminated >25% with food, any food or liquids that can be dumped from other containers without removing lids or caps DO NOT REMOVE ANY LIDS, CAPS OR SEALS OR OPEN CLOSED CONTAINERS	Large & Solid
Yard Waste/Landscaping & Clean Wood	Grass, leaves, weeds, pruning, stumps, shrubs, plants, unpainted or untreated wood, pallets, dimensional lumber, crates, furniture, etc. TREATED WOOD/PLYWOOD/ENGINEERED WOOD sorted as MUNICIPAL C&D	Med & Solid
All Other Organics	Organic-only materials that don't fit above including compostable service ware[a], carpet & padding, diapers, rubber products, upholstery, animal foods & waste, combustibles including wax, soap, briquettes, ash, etc.	Medium & Solid
OTHER WASTES		
Electronics	Electronics with circuit boards including computer monitors, televisions, VCR or DVD players, portable music devices, cell/wireless phones, answering machines, digital cameras, electric razors, newer small household appliances TOASTERS, TOASTER OVENS, OLD/SMALL HOUSEHOLD APPLIANCES sorted as OTHER METAL	**Small**
Non-Automobile Batteries	All AA, AAA, C, D and 9-volt batteries LEAD-ACID VEHICLE BATTERIES sorted as MOTOR VEHICLE WASTE DO NOT REMOVE BATTERIES FROM ANY PRODUCT	**Small**
Motor Vehicle Waste	Automobile/lead-acid batteries, used oil, used filters, tires	**Small**
C&D Debris	C&D demolition/building debris including painted/treated wood, drywall, fiberglass, insulation, sawdust, etc. & road/bridge debris including rock, concrete, brick, soil, etc. ALL NON-CONTAINER METAL sorted as OTHER METAL PAINT/PAINT SUPPLIES sorted as PAINT	**Medium**
Miscellaneous Hazardous/Special Waste	Other hazardous materials that don't fit above including any textiles (clothing, shoes, rags, towels, carpet, carpet padding, upholstery, rugs); latex and oil paint; compact fluorescent bulbs, other consumer products, furniture, mattresses & box springs, electronics or similar devices without circuit boards (such as headsets), thermostats, smoke detectors Antifreeze, pesticides, herbicides, cleaners, adhesives, glues, explosives, asbestos, aerosol containers with product, cosmetics, household chemicals, fuels Medicines, medical/biohazard waste Other hazardous materials or materials that require special handling EMPTY METAL PAINT CANS sorted as OTHER METAL	**Medium & Solid**
RESIDUE	Sand, soil, dirt, inorganic materials not classified elsewhere, mixed MSW fines, recyclables, organics & other materials that are indistinguishable	**Medium**

[a] Compostable service ware should be designated or easily identified as compostable – see https://ecocycle.org/files/pdfs/Compostable_Food_ Serviceware.pdf and similar sources for additional information

Recyclables

Materials	Description
GLASS	
Glass	All colors of food & beverage bottles, jars & containers – NO LIDS
METAL	
Aluminum Food & Beverage Containers, Foil & Pie Tins	Aluminum, tin, steel & bi-metal beverage & food cans, empty aerosol cans, foil, food trays and pie tins NO LIDS
Steel/Tin Food & Beverage Cans	Tin, steel & bi-metal beverage & food cans, also empty aerosol cans (nozzles are ok but no lids) EMPTY METAL PAINT CANS and AEROSOL CANS CONTAINING PRODUCT sorted as CONTAMINANTS
PLASTICS	
Plastic Containers	All bottles, plastic jugs, jars, tubs, cups, trays, non-Styrofoam clamshells & other containers labelled with triangulated resin code #1-#7 NO LIDS OR CAPS
Styrofoam	Styrofoam (extruded polystyrene) packaging, clamshells food containers, foam cups, coolers, foam egg cartons, etc.
PAPER	
Cardboard	Corrugated (waffled, multi-layer) cardboard, pizza boxes with minimal food/grease WAXY COATED as CONTAMINANTS
Newspaper	Newspaper with all inserts and glossies MAGNETS and SAMPLE PACKETS as CONTAMINANTS
Office Paper	"High" grade paper including whole or shredded printer paper, typing paper, copy paper, colored paper, computer paper, sticky notes, envelopes with windows, wrapping paper, brochures, file folders PAPER WITH WAXY LINERS and BUBBLE TYEK ENVELOPES as CONTAMINANTS
Mixed Paper	Chipboard/paperboard (single-layer non-corrugated cereal and, cracker boxes, paper egg cartons, gift & shoe boxes, paper/toilet paper rolls); “low” grade paper (junk mail, telephone books, paperback books); aspetic containers (multi-layered waxy milk/drink cartons, gable-top juice/soup boxes, tofu/ice creams/frozen yogurt cartons); magazines and catalogues including glossies WAXY COATED sorted as CONTAMINANTS
CONTAMINANTS	All other glass, metals, plastic (including plastic bags/film), paper; all organics; all other waste; and all residue

Recyclables will generally be sorted in medium-sized sort bins

Organics

Materials	Description
ORGANICS	
Food Waste	All food/beverage waste including bones & rinds, coffee ground, paper products contaminated >25% with food, any food or liquids that can be dumped from other containers without removing lids or caps DO NOT REMOVE ANY LIDS, CAPS OR SEALS OR OPEN CLOSED CONTAINERS
Yard Waste/Landscaping & Clean Wood	Grass, leaves, weeds, pruning, stumps, shrubs, plants, **u**npainted or untreated wood, pallets, dimensional lumber, crates, furniture, etc. TREATED WOOD/PLYWOOD/ENGINEERED WOOD sorted as CONTAMINANT
Compostable Paper & Service Ware[a]	Paper products contaminated <25% with food waste or moisture including pizza boxes, napkins, paper towels, hot/cold to-go paper cups
CONTAMINANTS	All other glass, metals, plastic, paper, other waste and residue

[a] Compostable service ware should be designated or easily identified as compostable – see https://ecocycle.org/files/pdfs/Compostable_Food_ Serviceware.pdf and similar sources for additional information

Organics will generally be sorted in large, solid sort bins

APPENDIX E
TRASH ANALYTICAL MODEL - BUILDING WASTE AUDITS

Percent by Weights & Sample Total Net Weight Uploaded from Individual Field Logs[a]

MATERIALS	Sample #1	Sample #2	Sample #3	Sample #4	Sample #5	Sample #6	Sample #7	Sample #8
Glass Containers								
Other Glass								
Aluminum								
Steel/Tin								
Other Metal								
Plastic Containers								
Styrofoam								
Other Plastic								
Cardboard								
Newspaper								
Office Paper								
Mixed Paper								
Other Paper								
Food Waste								
Yard Waste/Wood								
Other Organics								
Electronics								
Batteries								
Motor Veh Waste								
C&D								
Other Haz/Special								
Residue								
Raw Total	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Sample Net Weight[b]								
Pro-Ration[c]	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Weight Average & Confidence Interval Calculations (these columns are locked for automatic calculations)

MATERIALS	WEIGHTED AVERAGE[d]	STANDARD DEVIATION[e]	N[f]	T[g]	SQRT N[g]	90% CONFIDENCE INTERVAL[i] Lower	90% CONFIDENCE INTERVAL[i] Upper
Glass Containers	#DIV/0!	#DIV/0!	0	#NUM!	0.000	#DIV/0!	#DIV/0!
Other Glass	#DIV/0!	#DIV/0!	0	#NUM!	0.000	#DIV/0!	#DIV/0!
Aluminum	#DIV/0!	#DIV/0!	0	#NUM!	0.000	#DIV/0!	#DIV/0!
Steel/Tin	#DIV/0!	#DIV/0!	0	#NUM!	0.000	#DIV/0!	#DIV/0!
Other Metal	#DIV/0!	#DIV/0!	0	#NUM!	0.000	#DIV/0!	#DIV/0!
Plastic Containers	#DIV/0!	#DIV/0!	0	#NUM!	0.000	#DIV/0!	#DIV/0!
Styrofoam	#DIV/0!	#DIV/0!	0	#NUM!	0.000	#DIV/0!	#DIV/0!
Other Plastic	#DIV/0!	#DIV/0!	0	#NUM!	0.000	#DIV/0!	#DIV/0!
Cardboard	#DIV/0!	#DIV/0!	0	#NUM!	0.000	#DIV/0!	#DIV/0!
Newspaper	#DIV/0!	#DIV/0!	0	#NUM!	0.000	#DIV/0!	#DIV/0!
Office Paper	#DIV/0!	#DIV/0!	0	#NUM!	0.000	#DIV/0!	#DIV/0!
Mixed Paper	#DIV/0!	#DIV/0!	0	#NUM!	0.000	#DIV/0!	#DIV/0!
Other Paper	#DIV/0!	#DIV/0!	0	#NUM!	0.000	#DIV/0!	#DIV/0!
Food Waste	#DIV/0!	#DIV/0!	0	#NUM!	0.000	#DIV/0!	#DIV/0!
Yard Waste	#DIV/0!	#DIV/0!	0	#NUM!	0.000	#DIV/0!	#DIV/0!
Other Organics	#DIV/0!	#DIV/0!	0	#NUM!	0.000	#DIV/0!	#DIV/0!
Electronics	#DIV/0!	#DIV/0!	0	#NUM!	0.000	#DIV/0!	#DIV/0!
Batteries	#DIV/0!	#DIV/0!	0	#NUM!	0.000	#DIV/0!	#DIV/0!
Motor Veh Waste	#DIV/0!	#DIV/0!	0	#NUM!	0.000	#DIV/0!	#DIV/0!
C&D	#DIV/0!	#DIV/0!	0	#NUM!	0.000	#DIV/0!	#DIV/0!
Other Haz/Special	#DIV/0!	#DIV/0!	0	#NUM!	0.000	#DIV/0!	#DIV/0!
Residue	#DIV/0!	#DIV/0!	0	#NUM!	0.000	#DIV/0!	#DIV/0!
	#DIV/0!	*should be 100%*					
	0	*total weight of all samples*					
	#DIV/0!	*should be 1.0*					

WEIGHTED AVERAGE[j] Categories Only

Glass	#DIV/0!
Metals	#DIV/0!
Plastics	#DIV/0!
Paper	#DIV/0!
Organics	#DIV/0!
Other Haz & Special Waste	#DIV/0!
Residue	#DIV/0!
	#DIV/0!

should be 100%

[a] *Manually upload cells X7 through X28 from each Field Log Sheet - copy selected cells, then Paste Special & Paste Link into model to link data between spreadsheets*

[b] *Manually upload cell W30 from each Field Log Sheet - copy selected cells, then Paste Special & Paste Link into model to link data between spreadsheets*

[c] *Pro-rating calculates the relativity of each sample relative to the total weight of samples (automatically calculated in cell L30) - these values are used to calculate weighted averages (automatically calculated in cells M6 through M27) so that the material weights of larger samples have more "importance" than the weights of smaller samples*

[d] Weighted Average = sum of Percent by Weight X Pro-Ration of Sample Weight for each material, example (C6XC31) + (D6XD31) + (E6XE31) + (F6XF31) + (G6XG31) + (H6XH31) + (I6XI31) + (J6XJ31)

[e] Standard Deviation of Net Percent Weights for each material in all samples (shown in cells O6 through O27) - see STDEV under Formulas, More Functions, Statistical

[f] Number of Samples (shown in cells P6 through P27) - sum number of samples

[g] Student T-Test with 10% Probability that Samples Values are the Same (shown in cells Q6 through Q27) - see T.INV.2T under Formulas, More Functions, Statistical

[h] Square Root of Number of Samples (shown in cells R6 through R27) - see under Formulas, Math & Trig

[i] Minus/Plus 90% Confidence Intervals (minus shown in cells S6 though S27, plus in cells T6 through T27) - subtract/add the (T-test X standard deviation) / square root of number of samples

[j] Summation of materials in each category

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APPENDIX E
RECYCLABLES ANALYTICAL MODEL - BUILDING WASTE AUDITS

Percent by Weights & Sample Total Net Weight Uploaded from Individual Field Logs[a]

MATERIALS	Sample #1	Sample #2	Sample #3	Sample #4	Sample #5	Sample #6	Sample #7	Sample #8
Glass Containers								
Aluminum								
Steel/Tin								
Plastic Containers								
Styrofoam								
Cardboard								
Newspaper								
Office Paper								
Mixed Paper								
Contaminants								
Raw Total	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Sample Net Weight[b]								
Pro-Ration[c]	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Weight Average & Confidence Interval Calculations (these columns are locked for automatic calculations)

MATERIALS	WEIGHTED AVERAGE[d]	STANDARD DEVIATION[e]	N[f]	T[g]	SQRT N[h]	90% CONFIDENCE INTERVAL[i] Lower	90% CONFIDENCE INTERVAL[i] Upper
Glass Containers	#DIV/0!	#DIV/0!	0	#NUM!	0.000	#DIV/0!	#DIV/0!
Aluminum	#DIV/0!	#DIV/0!	0	#NUM!	0.000	#DIV/0!	#DIV/0!
Steel/Tin	#DIV/0!	#DIV/0!	0	#NUM!	0.000	#DIV/0!	#DIV/0!
Plastic Containers	#DIV/0!	#DIV/0!	0	#NUM!	0.000	#DIV/0!	#DIV/0!
Styrofoam	#DIV/0!	#DIV/0!	0	#NUM!	0.000	#DIV/0!	#DIV/0!
Cardboard	#DIV/0!	#DIV/0!	0	#NUM!	0.000	#DIV/0!	#DIV/0!
Newspaper	#DIV/0!	#DIV/0!	0	#NUM!	0.000	#DIV/0!	#DIV/0!
Office Paper	#DIV/0!	#DIV/0!	0	#NUM!	0.000	#DIV/0!	#DIV/0!
Mixed Paper	#DIV/0!	#DIV/0!	0	#NUM!	0.000	#DIV/0!	#DIV/0!
Contaminants	#DIV/0!	#DIV/0!	0	#NUM!	0.000	#DIV/0!	#DIV/0!
	#DIV/0!	*should be 100%*					
	0	*total weight of all samples*					
	#DIV/0!	*should be 1.0*					

WEIGHTED AVERAGE[j] Categories Only

Glass	#DIV/0!
Metals	#DIV/0!
Plastics	#DIV/0!
Paper	#DIV/0!
Contaminants	#DIV/0!
	#DIV/0!

should be 100%

[a] *Manually upload cells X7 through X16 from each Field Log Sheet - copy selected cells, then Paste Special & Paste Link into model to link data between spreadsheets*

[b] *Manually upload cell W18 from each Field Log Sheet - copy selected cells, then Paste Special & Paste Link into model sheet to link data between spreadsheets*

[c] *Pro-rating calculates the relativity of each sample relative to the total weight of samples (automatically calculated in cell L18) - these values are used to calculate weighted averages (automatically calculated in cells M6 through M15) so that the material weights of larger samples have more "importance" than the weights of smaller samples*

[d] Weighted Average = sum of Percent by Weight X Pro-Ration of Sample Weight for each material, example (C6XC19) + (D6XD19) + (E6XE10) + (F6XF19) + (G6XG19) + (H6XH19) + (I6XI19) + (J6XJ19)

[e] Standard Deviation of Net Percent Weights for each material in all samples (shown in cells O6 through O15) - see STDEV under Formulas, More Functions, Statistical

[f] Number of Samples (shown in cells P6 through P15) - sum number of samples

[g] Student T-Test with 10% Probability that Samples Values are the Same (shown in cells Q6 through Q15) - see T.INV.2T under Formulas, More Functions, Statistical

[h] Square Root of Number of Samples (shown in cells R6 through R15) - see under Formulas, Math & Trig

[i] Minus/Plus 90% Confidence Intervals (minus shown in cells S6 though S15, plus in cells T6 through T15) - subtract/add the (T-test X standard deviation) / square root of number of samples

[j] Summation of materials in each category

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APPENDIX E
ORGANICS ANALYTICAL MODEL - BUILDING WASTE AUDITS

Percent by Weights & Sample Total Net Weight Uploaded from Individual Field Logs[a]

MATERIALS	Sample #1	Sample #2	Sample #3	Sample #4	Sample #5	Sample #6	Sample #7	Sample #8
Food Waste								
Yard Waste/ Landscaping & Clean Wood								
Compostable Paper & Service Ware								
Contaminants								
Raw Total	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Sample Net Weight[b]								
Pro-Ration[c]	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Weight Average & Confidence Interval Calculations (these columns are locked for automatic calculations)

MATERIALS	WEIGHTED AVERAGE[d]	STANDARD DEVIATION[e]	N[f]	T[g]	SQRT N[h]	90% CONFIDENCE INTERVAL[i] Lower	90% CONFIDENCE INTERVAL[i] Upper
Food Waste	#DIV/0!	#DIV/0!	0	#NUM!	0.000	#DIV/0!	#DIV/0!
Yard Waste/ Landscaping & Clean Wood	#DIV/0!	#DIV/0!	0	#NUM!	0.000	#DIV/0!	#DIV/0!
Compostable Paper & Service Ware	#DIV/0!	#DIV/0!	0	#NUM!	0.000	#DIV/0!	#DIV/0!
Contaminants	#DIV/0!	#DIV/0!	0	#NUM!	0.000	#DIV/0!	#DIV/0!
	#DIV/0!	*should be 100%*					
	0	*total weight of all samples*					
	#DIV/0!	*should be 1.0*					

WEIGHTED AVERAGE[j] Categories Only

Food	#DIV/0!
Yard Waste/ Landscape & Wood	#DIV/0!
Compostables	#DIV/0!
Contaminants	#DIV/0!
	#DIV/0!

should be 100%

[a] *Manually upload cells X7 through X10 from each Field Log Sheet - copy selected cells, then Paste Special & Paste Link into model to link data between spreadsheets*

[b] *Manually upload cell W12 from each Field Log Sheet - copy selected cells, then Paste Special & Paste Link into model sheet to link data between spreadsheets*

[c] *Pro-rating calculates the relativity of each sample relative to the total weight of samples (automatically calculated in cell L12) - these values are used to calculate weighted averages (automatically calculated in cells M6 through M9) so that the material weights of larger samples have more "importance" than the weights of smaller samples*

[d] Weighted Average = sum of Percent by Weight X Pro-Ration of Sample Weight for each material, example (C6XC13) + (D6XD13) + (E6XE13) + (F6XF13) + (G6XG13) + (H6XH13) + (I6XI13) + (J6XJ13)

[e] Standard Deviation of Net Percent Weights for each material in all samples (shown in cells O6 through O9) - see STDEV under Formulas, More Functions, Statistical

[f] Number of Samples (shown in cells P6 through P9) - sum number of samples

[g] Student T-Test with 10% Probability that Samples Values are the Same (shown in cells Q6 through Q9) - see T.INV.2T under Formulas, More Functions, Statistical

[h] Square Root of Number of Samples (shown in cells R6 through R9) - see under Formulas, Math & Trig

[i] Minus/Plus 90% Confidence Intervals (minus shown in cells S6 though S9, plus in cells T6 through T9) - subtract/add the (T-test X standard deviation) / square root of number of samples

[j] Summation of materials in each category

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