

City of Palo Alto

Waste Characterization Report

January 2013

CITY OF PALO ALTO

CASCADIA CONSULTING GROUP
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Acknowledgments

The project team would like to thank the following entities for their assistance:

City of Palo Alto
GreenWaste of Palo Alto
City of Sunnyvale
Bay Counties Waste Services

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1. Introduction and Summary

The following section outlines the purpose and approach of the study, presents a summary of findings, and provides an overview of the report.

Purpose and Approach

The City of Palo Alto adopted a Zero Waste goal in 2005 and subsequently developed a Zero Waste Operational Plan to achieve that goal. The City's last comprehensive waste characterization study was conducted in 2005 as part of the Zero Waste planning process. Since the last study, the City has selected a new collection contractor and has implemented some of the key programmatic changes outlined in the Zero Waste Operational Plan. To assess the effectiveness of these changes as well as to inform future Zero Waste programs, the City of Palo Alto contracted with Cascadia Consulting Group, Inc. (Cascadia) to conduct a new waste characterization study. This report presents the study's findings.

The composition and quantity data in this report is intended to:

- Identify materials with potential diversion opportunities.
- Provide a baseline for evaluating the future success of current diversion programs.
- Create a foundation for planning for future programs to support the City's Zero Waste goals.

Cascadia hand-sorted 92 waste samples and visually characterized 28 samples from six waste sectors: residential single-family, residential multifamily, commercial front-load, commercial compactor, loose roll-off, and self-haul; as well as MRF residues from the Sunnyvale Material Recycling and Transfer (SMaRT) Station.

The consultant field team collected and sorted samples at the Sunnyvale SMaRT Station in October 2012. Field team members characterized representative samples from the six sectors and the SMaRT Station residuals according to material types. This report presents a statistical analysis of the waste sampling results for Palo Alto, with an emphasis on recyclable and compostable material groups. This report also compares the results of this study with the key findings of the 2005 Palo Alto waste composition study.

Summary of Findings

The consultant team characterized a total of 120 samples selected from random collection routes and vehicles serving the six waste sectors the study considered, and residuals from the SMaRT Station. Field staff sorted samples into a total of 69 standard material types (described in detail in Appendix A: Material Type Definitions). To help identify additional diversion opportunities, each of these 69 types were classified into one of five recoverability groups: **Recyclable Paper**; **Other Recyclables**; **Compostable; Potential Recyclables**; and **Problem Materials**. Material types

Material Designations

Throughout this report, **recoverability groups** such as **Recyclable Paper** and **Compostable** are bolded and capitalized, while specific material types such as *newspaper, PETE water bottles,* and *textiles* are italicized.

included in each of these recoverability groups and the factors that affect recoverability are provided in Section 2. Summary of Methodology.

Key Findings

Overall Waste Stream – City of Palo Alto

- Just over 70% (22,098 tons) of Palo Alto's disposed waste is recoverable through either recycling or composting. Of this amount:
  - Nearly 40% (12,125 tons) of Palo Alto's disposed waste is represented by **Compostable Materials** – including *loose/scrap vegetative food*, *compostable paper*, *loose/scrap non-vegetative food*, *prunings and trimmings*, and *packaged vegetative food*.
  - About 9% (2,998 tons) of total disposal is composed of **Recyclable Paper**, including *uncoated cardboard*, *white ledger*, *magazines and catalogs*, and *newspaper*.
  - Approximately 23% (7,075 tons) of disposed waste is made up of **Other Recyclables**, which include materials such as *glass bottles and containers*, *PETE containers*, *HDPE containers*, *lumber*, and *textiles*.
- The results of this study indicate that food materials, specifically *loose/scrap vegetative* and *loose/scrap non-vegetative food* as well as *packaged vegetative* and *packaged non-vegetative food*, are the single largest component, about 21% (6,668 tons), of the disposed waste in Palo Alto.
- *Remainder/composite organics* are the largest component of **Problem Materials**, and make up 6% (1,966 tons) of total disposal.

SMaRT Station Residuals

- Over 40% of SMaRT Station residuals are **Problem Materials** (11,573 tons), including *mixed residue/MSW*, *remainder/composite organics*, and *other film*.
- **Compostable** materials – including *loose/scrap vegetative food*, *compostable paper*, *remainder/composite organics*, and *loose/scrap non-vegetative food* – represent 35% (9,865) of the residuals.
- *Compostable paper* was the single largest material type present in the SMaRT residuals, composing 18% of the total residuals (5,175 tons).

Organization of the Report

The remainder of this report describes the study methodology and findings, and is organized as follows:

- **Section 2. Summary of Methodology**, defines the six waste sectors and explains the methodology used to design and implement the data collection portion of this study. It also briefly describes the data analysis methods.
- **Section 3. Findings**, presents key findings and waste composition results for each of the six waste sectors and the SMaRT Station residuals.
- **Section 4. Comparison to 2005 Study Results**, compares the key findings of this waste composition study with the key findings of the study performed for Palo Alto in 2005.

- **Appendices** follow the main body of the report. They provide definitions for all material types, a complete explanation of the methodology, the formulas used in the composition calculations, and copies of field forms.

2. Summary of Methodology

The following section summarizes the three main tasks of the study methodology: Develop Plan, Collect Data, and Analyze Data.

Task 1: Develop Plan

Coordinate with Staff and Haulers

Before scheduling the fieldwork, the consultant team coordinated with key staff at the City of Palo Alto, representatives from the haulers, and sampling facility staff. Key personnel from the hauler and sampling facilities included operations supervisors (to coordinate the selection of routes for sampling and the delivery of selected loads) and facility managers (to coordinate the sample collection, sorting logistics, and other details involved with the field data collection effort).

Define Waste Sectors

This study collected samples from six waste sectors, plus residuals from the SMaRT Station. GreenWaste of Palo Alto collects waste from each of the residential, commercial, and roll-off sectors.

- **Single-family Residential Waste** is generated by residential dwellings of four or fewer units.
- **Multifamily Residential Waste** is generated by residential dwellings greater than four units, normally collected on the same routes as commercial front-load waste. During this study, multifamily waste and commercial front-load waste was collected in separate vehicles.
- **Commercial Front-load Waste** is generated by businesses, institutions, public venues, schools, and industrial sources, and collected in front-load packer trucks.
- **Commercial Compactor Waste** is generated by businesses, institutions, public venues, schools, or industrial sources, and collected in compacting drop-boxes.
- **Loose Roll-off Waste** is generated by businesses, institutions, public venues, schools, or industrial sources, and collected in open-top roll-off containers.
- **Self-haul Waste** is collected and delivered to solid waste facilities by parties other than GreenWaste of Palo Alto. It typically arrives at the SMaRT Station in a variety of vehicles, such as cars, pick-up trucks, and small end-dump trucks. This sector includes solid waste delivered to the SMaRT Station by City of Palo Alto vehicles.
- **SMaRT Station Residuals** are produced as by-products from the SMaRT Station's mixed-waste material recovery facility (MRF). Residuals do not include fines material screened from the trommels.

This study included only material hauled to the SMaRT Station, and excluded material hauled directly to any other disposal or recovery facility.

Define Material Classes and Material Types

The consultant team worked with Palo Alto to identify material types and definitions for this study. They are based on CalRecycle's standard list of materials, with small changes to reflect this project's objectives and local solid waste management practices. The material types are grouped into the standard CalRecycle material classes: Paper, Plastic, Glass, Metal, Electronics, Other Organics,

Construction & Demolition, Household Hazardous Waste, Special Waste, and Mixed Residue. See Appendix A: Material Type Definitions for a list of the material types and detailed definitions.

To identify additional diversion opportunities, the consultant team also classified material types according to their recoverability, using five recoverability groups:

- **Recyclable Paper –** Paper materials for which recycling technologies, programs, and markets are well developed, readily available, and currently utilized.
- **Other Recyclables –** Other, non-paper materials (plastic, metal, and glass) for which recycling technologies, programs, and markets are well developed, readily available, and currently utilized.
- **Compostable –** Organic materials typically accepted for use in commercial compost or digestion systems.
- **Potential Recyclables –** Materials for which recycling technologies, programs, and markets exist, but are either not well developed or not currently utilized. Examples include *carpet* and *film products*.
- **Problem Materials –** Materials that are not readily recyclable or face other market-related barriers.

Each material type was assigned to one of the recoverability groups based on the definitions listed above. Table 1 shows how material types are categorized into each recoverability group.

Table 1. Recoverability Groups and Material Types

	Recyclable Paper	Other Recyclables	Compostable	Potential Recyclables	Problem Materials
Paper	Uncoated Cardboard Kraft Paper Bags Newspaper White Ledger Colored Ledger Other Office Paper Magazines and Catalogs Phone Books and Directories Other Misc Paper		Compostable Paper		R/C Paper
Glass		Bottles & Containers Other Colored Bottles & Containers		Flat Glass	R/C Glass
Metal		Tin/Steel Cans Major Appliances Used Oil Filters Other Ferrous Metal Aluminum Cans Other Non-Ferrous Metal			R/C Metal
Electronics		Brown Goods Computer-Related Electronics Other Small Consumer Electr'cs		TVs and Other Items with CRTs	
Plastics		PETE Containers HDPE Containers Misc Plastic Containers Grocery & Merchandise Bags Non-Bag Comm/Ind Pkging Film Durable Plastic Items		Film Products	Trash Bags Other Film EPS R/C Plastic
Organics		Textiles	Packaged Vegetative Food Loose/Scrap Vegetative Food Packaged Non-Vegetative Food Loose/Scrap Non-Vegetative Food Leaves & Grass Prunings & Trimmings Branches & Stumps Agricultural Crop Residues	Manures Carpet	R/C Organics
C&D		Concrete Asphalt Paving Asphalt Roofing Lumber Gypsum Board Rock, Soil & Fines			R/C C&D
HHW		Paint Vehicle & Equipment Fluids Used Oil Batteries			R/C HHW
Special Waste				Bulky Items Tires	Ash Sewage Solids Industrial Sludge Treated Medical Waste R/C Special Waste
Mixed Residue					Mixed Residue/MSW

Allocate and Schedule Samples

Using route information provided by GreenWaste of Palo Alto, the consultant team pre-selected random routes from each of the commercial and residential strata as the final step in the allocation process. Routes were selected using a random number generator and Microsoft Excel.

Due to the limited number of incoming loads at the SMaRT Station, all self-haul and loose roll-off loads from Palo Alto were selected for sampling. For purposes of the study, City vehicles dumping MSW were classified as self-haul.

Samples of SMaRT Station residuals were collected at random intervals during the sampling period.

The number of planned and actual waste samples from each sector is summarized in Table 2.

Table 2. Sample Allocation by Sector

Sector	Planned Number of Samples	Actual Number of Samples
Single-family Residential	20	21
Multifamily Residential	10	10
Commercial Front-load	30	30
Commercial Compactor	10	11
Loose Roll-off	20	6
Self-haul	40	22
SMaRT Station Residuals	30	20
Total	**160**	**120**

For the loose roll-off and self-haul sectors, the number of actual samples was fewer than planned because the number of incoming loads from these sectors were far fewer than anticipated in the study design. Due to a facilty scheduling conflict, the consultant team lost one planned day of sorting of SMaRT Station residuals; this is reflected in the actual number of residuals samples sorted.

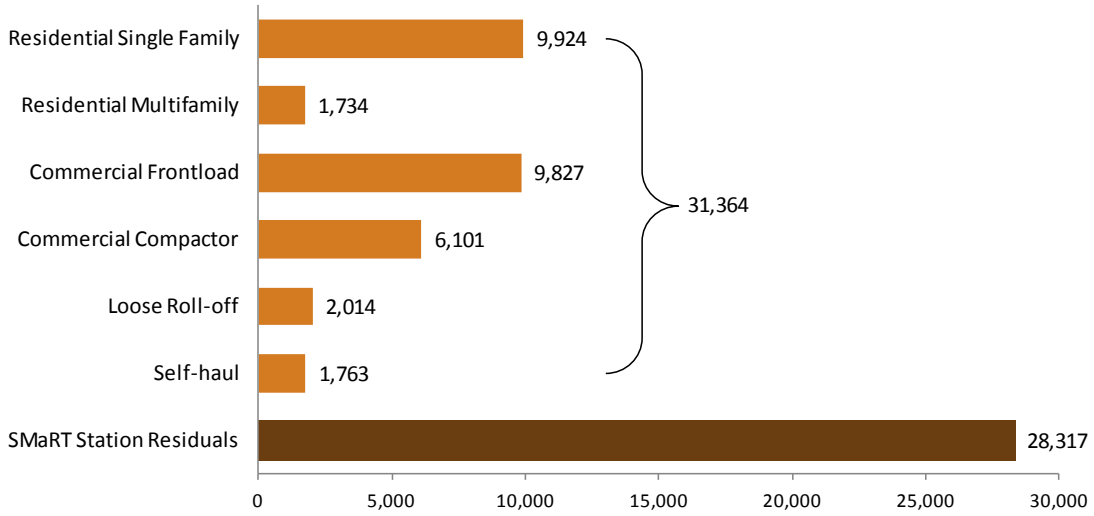
Task 2: Collect Data

Determine Waste Quantities

Cascadia obtained tonnage information for each of the waste sectors from the City. According to the data, the City of Palo Alto disposed of about 31,364 tons of waste at the SMaRT Station in 2011. Residuals from the SMaRT Station attributed to Palo Alto totaled about 28,300 tons.

The disposal tonnage for each sector is shown in Figure 1.

Figure 1. Waste Quantities by Sector (in tons)



Hand Sort MSW Samples

For this study, the consultant team hand sorted all samples from the single-family residential, multifamily residential, commercial front-load, commercial compactor, and SMaRT Station residuals waste sectors. The field crew sorted and weighed each sample into 69 material types. Materials smaller than one-half inch were sorted into the *mixed residue* material type. The crew leader recorded the weight for each sorted material type on the sampling form, reviewed the form, and later entered the data into a custom database for analysis. A full description of the hand sort procedure is included in Appendix B: Study Design.

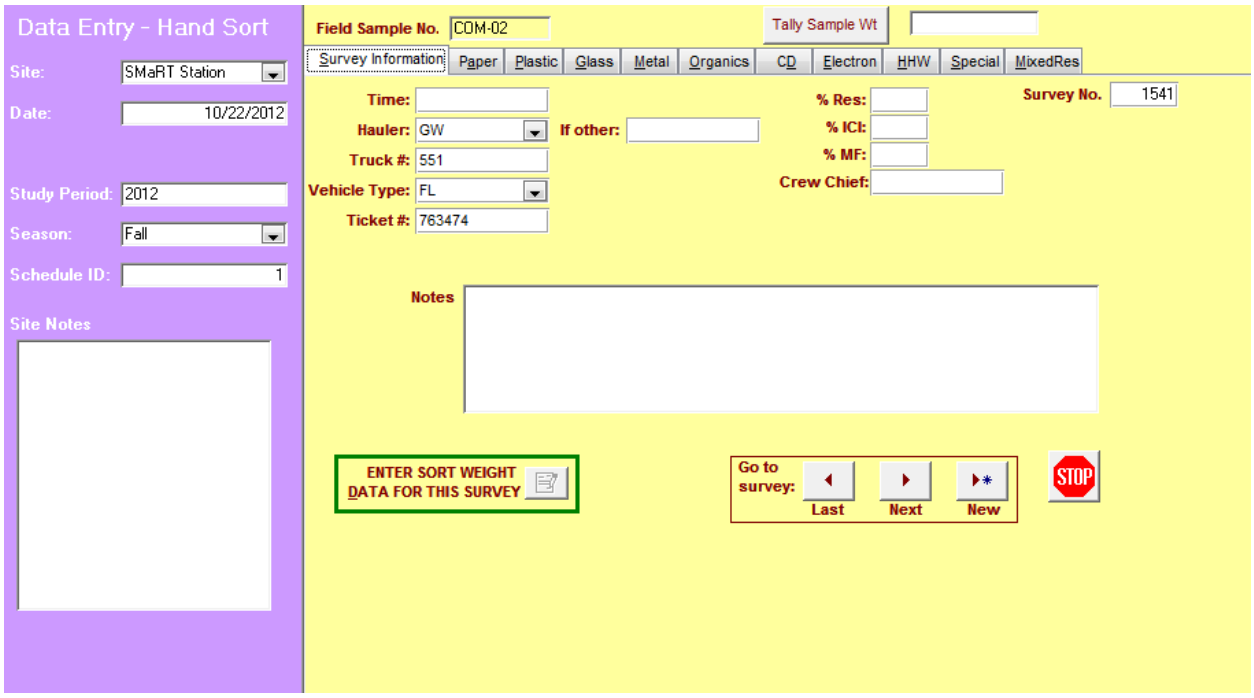
Visually Characterize Self-haul and Loose Debris Box Samples

The field crew visually characterized all selected self-haul and loose debris box loads. The visual characterization method involved correlating the sample's composition estimate, net weight, and volume with industry standard material density factors that Cascadia developed in conjunction with CalRecycle. A trained crewmember used a seven-step process to visually characterize self-haul and loose debris box loads as described in detail in Appendix B: Study Design.

Task 3: Analyze Data

Following on-site data collection, the consultant team entered all data recorded on field forms during hand sorting and visual characterization into a customized database (see Figure 2 for a screenshot of the data entry database). The team calculated waste composition and quantity estimates using the methods described in Appendix B: Study Design. All data entry and analysis underwent a series of extensive quality checks to reduce the possibility of entry and calculation errors. This included: reviewing all field forms, double checking forms against the database entries, and addressing individual outliers with regard to sample and material weights.

Figure 2. Screenshot of Data Entry Database



3. Findings

Interpreting the Results

How Data Are Presented

For the overall disposed waste stream, and for each sector, data are presented in three ways:

- First, an overview of waste composition by **recoverability group** is presented as a pie chart.
- Next, the six most prevalent individual *material types*, by weight, are shown in a table.
- Finally, a detailed table lists the full composition and quantity results for the 69 *material types*. (Please refer to Appendix A: Material Type Definitions for a detailed list of definitions for material types used in the study.)

Means and Error Ranges

The data from the sorting process were treated with a statistical procedure that provided two kinds of information for each of the *material types*:

- The percent-by-weight estimated composition of waste, represented by the samples examined in the study; and
- The degree of precision of the composition estimates.

All estimates of precision were calculated at the 90% confidence level. The equations used in these calculations appear in Appendix C: Waste Characterization Calculation.

The example below illustrates how the results can be interpreted. In this example, the best estimate of the amount of *food* present in the universe of waste sampled is 22.7%. The figure 2.6% reflects the precision of the estimate. When calculations are performed at the 90% confidence level, we are 90% certain that the true amount of *food* is between 22.7% plus 2.6% and 22.7% minus 2.6%. In other words, we are 90% certain that the mean lies between 20.1% and 25.3%.

Material Type	Est. Pct.	+ / -
Food	22.7%	2.6%

Error Range (+/-)

The error range is a measure of the spread of values in a collection of data. For instance, if the quantities of *newspaper* were found to be nearly the same in each of the 120 samples collected for this study, the result would be a very narrow error range. By contrast, if some samples were composed of 75% *newspaper* and others were 0% *newspaper,* the results would show a much broader error range.

Rounding

To keep the waste composition tables and figures readable, estimated tonnages are rounded to the nearest ton, and estimated percentages are rounded to the nearest tenth of a percent. Due to this rounding, the tonnages presented in the report, when added together, may not exactly match the subtotals and totals shown. Similarly, the percentages, when added together, may not exactly match the subtotals or totals shown. Percentages less than 0.05% are shown as 0.0%.

Composition and Recoverability of Waste

This section describes the composition and recoverability for Palo Alto's waste stream, for the city overall and for the each of the sectors studied:

- Overall Waste Stream – Palo Alto
- Single-Family Residential Waste
- Multifamily Residential Waste
- Commercial Front-Load Waste
- Commercial Compactor Waste
- Loose Roll-off Waste
- Self-haul Waste
- SMaRT Station Residuals

Overall Waste Stream – Palo Alto

The overall composition of Palo Alto's waste stream includes disposed materials from all of the studied waste sectors, except for the SMaRT Station residuals. The consultant team characterized 100 samples of waste and extrapolated the results of the characterization to apply to the 31,364 tons of material disposed City-wide on an annual basis. Key findings from this extrapolation are presented below.

Key Findings

Figure 3 summarizes the recovery potential for Palo Alto's overall waste stream, and Table 3 lists the top six materials found in the overall waste stream. These sampling results suggest the following key findings about recovery potential for Palo Alto's overall waste stream:

- Approximately 70% (22,098 tons) of waste from Palo Alto is recyclable or compostable**.**
- Almost 40% (12,125 tons) of the waste stream is **Compostable**, the most prevalent recoverability group. As shown in Table 3, materials in this group were also the top three most common materials in the overall waste stream:
  - *loose/scrap vegetative food* (13% and 4,082 tons)
  - *loose/scrap non-vegetative food* (6.6% and 2,055 tons)
  - *compostable paper* (11.5% and 3,613 tons)
- **Problem materials** is the second most common recoverability group, at 23% (7,252 tons) of Palo Alto's overall waste stream. *Remainder/composite organics* is the most significant **Problem Material** and one of the top six materials in the stream, by weight (6.3% and 1,966 tons). Other **Problem Materials** include:
  - *mixed residue/MSW* (3.0% and 949 tons)
  - *remainder/composite C&D* (2.6% and 819 tons)
  - *other film* (2.8% and 891 tons)
  - *trash bags* (2.6% and 808 tons)
- About 23% of the waste stream is **Other Recyclables** (7,075 tons). The most common material in this recoverability group is *lumber* (5.1% and 1,599 tons), which is also one of the top materials in the overall waste stream. Other key materials in this group include:
  - *textiles* (2.7% and 841 tons)
  - *rock, soil, & fines* (1.8% and 555 tons)
  - *durable plastic items* (2.6% and 807 tons)
  - *HDPE containers* (1.6% and 512 tons)

- **Recyclable Paper** makes up about 9% (2,898 tons) of the waste stream, and includes:
  - *uncoated cardboard* (2.4% and 765 tons)
  - *white ledger* (1.3% and 399 tons)
  - *other miscellaneous paper* (1.5% and 478 tons)
  - *magazines and catalogs* (1.2% and 374 tons)
- About 6% (2,014 tons) of waste consists of **Potential Recyclables,** including the top material *bulky items* (4% and 1,253 tons) as well as the following materials:
  - *carpet* (2.1% and 656 tons)
  - *film products* (0.1% and 37 tons)

Figure 3. Material Recoverability, City Overall

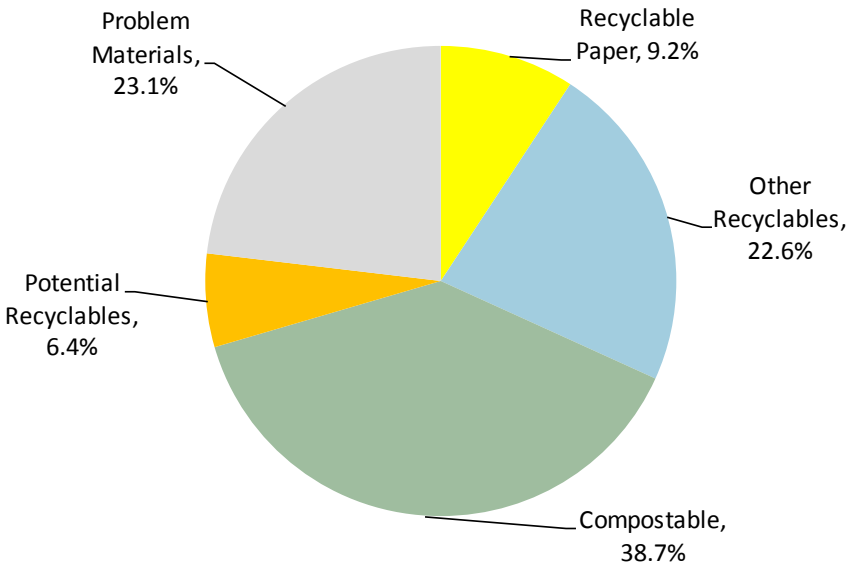


Table 3. Top Six Material Types, City Overall

Material	Est. %
Loose/Scrap Vegetative Food	13.0%
Compostable Paper	11.5%
Loose/Scrap Non-Vegetative Food	6.6%
R/C Organics	6.3%
Lumber	5.1%
Bulky Items	4.0%
Total	**46.4%**

Table 4 identifies the detailed material composition by material class and material type.

Table 4. Detailed Material Composition, City Overall

Class and Material Type	Tons	Est. Mean	+/-
Paper	**6,771.9**	**21.6%**	
Uncoated Cardboard	764.7	2.4%	0.7%
Kraft Paper Bags	254.1	0.8%	0.2%
Newspaper	340.9	1.1%	0.3%
White Ledger	398.8	1.3%	0.5%
Colored Ledger	22.4	0.1%	0.0%
Other Office Paper	219.6	0.7%	0.2%
Magazines and Catalogs	373.5	1.2%	0.4%
Phone Books and Directories	45.8	0.1%	0.1%
Compostable Paper	3613.1	11.5%	1.0%
Other Misc Paper	478.2	1.5%	0.2%
R/C Paper	260.9	0.8%	0.2%
Glass	**725.1**	**2.3%**	
Bottles & Containers	487.8	1.6%	0.3%
Other Colored Bottles & Containers	186.3	0.6%	0.4%
Flat Glass	15.9	0.1%	0.1%
R/C Glass	35.2	0.1%	0.1%
Metal	**937.6**	**3.0%**	
Tin/Steel Cans	160.4	0.5%	0.2%
Major Appliances	0.0	0.0%	0.0%
Used Oil Filters	0.0	0.0%	0.0%
Other Ferrous Metal	182.2	0.6%	0.4%
Aluminum Cans	45.9	0.1%	0.0%
Other Non-Ferrous Metal	186.5	0.6%	0.2%
R/C Metal	362.7	1.2%	0.8%
Electronics	**374.5**	**1.2%**	
Brown Goods	115.2	0.4%	0.3%
Computer-Related Electronics	31.0	0.1%	0.1%
Other Small Consumer Electr'cs	210.5	0.7%	0.3%
TVs and Other Items with CRTs	17.7	0.1%	0.1%
Plastics	**4153.9**	**13.2%**	
PETE Containers	142.0	0.5%	0.1%
HDPE Containers	512.5	1.6%	0.1%
Misc Plastic Containers	370.2	1.2%	0.2%
Trash Bags	807.8	2.6%	0.3%
Grocery & Merchandise Bags	59.0	0.2%	0.0%
Non-Bag Comm/Ind Pkging Film	45.5	0.1%	0.1%
Film Products	37.2	0.1%	0.1%
Other Film	891.0	2.8%	0.3%
Durable Plastic Items	807.5	2.6%	1.4%
EPS	114.3	0.4%	0.1%
R/C Plastic	366.9	1.2%	0.2%

Class and Material Type	Tons	Est. Mean	+/-
Organics	**12,005.5**	**38.3%**	
Packaged Vegetative Food (Donatable)	352.7	1.1%	0.9%
Loose/Scrap Vegetative Food	4,082.1	13.0%	1.6%
Packaged Non-Vegetative Food (Donatable)	178.9	0.6%	0.1%
Loose/Scrap Non-Vegetative Food	2,054.6	6.6%	0.9%
Leaves & Grass	979.4	3.1%	1.5%
Prunings & Trimmings	806.3	2.6%	1.4%
Branches & Stumps	58.0	0.2%	0.3%
Agricultural Crop Residues	-	0.0%	0.0%
Manures	30.4	0.1%	0.1%
Textiles	840.6	2.7%	0.6%
Carpet	656.5	2.1%	2.3%
R/C Organics	1,965.9	6.3%	1.1%
C&D	**3,484.3**	**11.1%**	
Concrete	87.0	0.3%	0.3%
Asphalt Paving	-	0.0%	0.0%
Asphalt Roofing	32.3	0.1%	0.2%
Lumber	1,599.0	5.1%	1.9%
Gypsum Board	391.5	1.2%	1.4%
Rock, Soil & Fines	555.3	1.8%	1.2%
R/C C&D	819.2	2.6%	1.0%
HHW	**93.5**	**0.3%**	
Paint	5.4	0.0%	0.0%
Vehicle & Equipment Fluids	-	0.0%	0.0%
Used Oil	-	0.0%	0.0%
Batteries	21.5	0.1%	0.0%
R/C HHW	66.6	0.2%	0.2%
Special Waste	**1,868.5**	**6.0%**	
Ash	7.3	0.0%	0.0%
Sewage Solids	-	0.0%	0.0%
Industrial Sludge	-	0.0%	0.0%
Treated Medical Waste	546.1	1.7%	2.6%
Bulky Items	1,252.9	4.0%	1.8%
Tires	3.7	0.0%	0.0%
R/C Special Waste	58.5	0.2%	0.1%
Mixed Residue	**949.3**	**3.0%**	
Mixed Residue/MSW	949.3	3.0%	0.5%

Total Percent	**100.0%**
Total Tons	**31,364.1**
Sample Count	**100**

Single-Family Residential Waste

The consultant team hand sorted 21 samples of waste from Palo Alto's single-family residential sector, and extrapolated the results of the characterization to apply to the 9,924 tons of waste this sector disposes annually. Key findings from this extrapolation are presented below.

Key Findings

Figure 4 summarizes the recovery potential for Palo Alto's single-family residential sector, and Table 5 lists the top six materials found in Palo Alto's single-family residential waste stream. Key findings include:

- Almost 74% (7,320 tons) of Palo Alto's single-family waste is recyclable or compostable.
- **Compostable** material represents the most common recoverability group at 51% (5,052 tons) of Palo Alto's single-family waste. The top three most prevalent materials in the single-family waste stream were **Compostable**:
  - *loose/scrap vegetative food* (21.4% and 2,129 tons)
  - *loose/scrap non-vegetative food* (10.2% and 1,009 tons)
  - *compostable paper* (13.4% and 1,327 tons)
- **Problem Materials** represented 25% of single-family waste (2,481 tons), the second most common recoverability group. Two of the most common materials in single-family waste were **Problem Materials**:
  - *remainder/composite organics* (8.5% and 847 tons)
  - *mixed residue/MSW* (5.5% and 547 tons)
- **Other Recyclables** make up about 16% (1,557 tons) of single-family waste. The **Other Recyclables** material *textiles* was one of the top materials in the single-family samples (4% and 395 tons). Other key materials in this recoverability category included:
  - *HDPE containers* (1.8% and 177 tons)
  - *glass bottles and containers* (1.3% and 133 tons)
  - *lumber* (1.7% and 170 tons)
  - *miscellaneous plastic containers* (1.3% and 131 tons)
- **Recyclable Paper** makes up approximately 7% (711 tons) of waste from the single-family sector; the most common material in this group was *other miscellaneous paper* (1.7% and 166 tons), followed by *white ledger* (1.5% and 147 tons).

Figure 4. Material Recoverability, Single Family

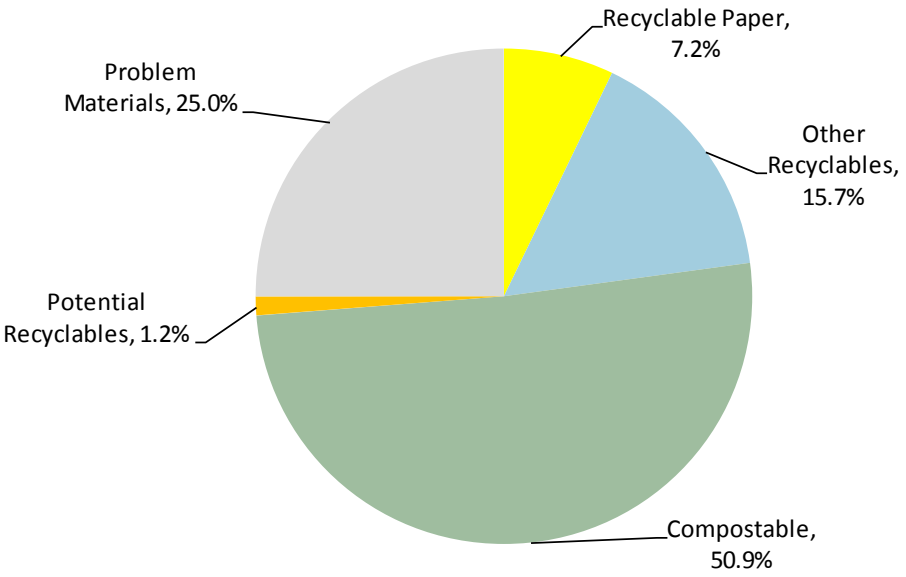


Table 5. Top Six Material Types, Single-family

Material	Est. %
Loose/Scrap Vegetative Food	21.4%
Compostable Paper	13.4%
Loose/Scrap Non-Vegetative Food	10.2%
R/C Organics	8.5%
Mixed Residue/MSW	5.5%
Textiles	4.0%
Total	**63.0%**

Table 6 identifies the detailed material composition by material class and material type.

Table 6. Detailed Material Composition, Single-Family Residential

Class and Material Type	Tons	Est. Mean	+/-
Paper	**2,128.1**	**21.4%**	
Uncoated Cardboard	85.0	0.9%	0.3%
Kraft Paper Bags	84.0	0.8%	0.2%
Newspaper	54.1	0.5%	0.2%
White Ledger	147.2	1.5%	1.3%
Colored Ledger	3.9	0.0%	0.0%
Other Office Paper	64.0	0.6%	0.2%
Magazines and Catalogs	85.2	0.9%	0.3%
Phone Books and Directories	22.1	0.2%	0.3%
Compostable Paper	1327.0	13.4%	1.2%
Other Misc Paper	165.9	1.7%	0.3%
R/C Paper	89.6	0.9%	0.2%
Glass	**240.9**	**2.4%**	
Bottles & Containers	132.7	1.3%	0.4%
Other Colored Bottles & Containers	99.0	1.0%	1.0%
Flat Glass	0.1	0.0%	0.0%
R/C Glass	9.1	0.1%	0.1%
Metal	**194.9**	**2.0%**	
Tin/Steel Cans	35.7	0.4%	0.1%
Major Appliances	0.0	0.0%	0.0%
Used Oil Filters	0.0	0.0%	0.0%
Other Ferrous Metal	5.7	0.1%	0.0%
Aluminum Cans	12.1	0.1%	0.0%
Other Non-Ferrous Metal	79.8	0.8%	0.3%
R/C Metal	61.5	0.6%	0.4%
Electronics	**127.4**	**1.3%**	
Brown Goods	49.1	0.5%	0.8%
Computer-Related Electronics	4.8	0.0%	0.0%
Other Small Consumer Electr'cs	73.4	0.7%	0.2%
TVs and Other Items with CRTs	0.0	0.0%	0.0%
Plastics	**1241.9**	**12.5%**	
PETE Containers	47.4	0.5%	0.1%
HDPE Containers	176.7	1.8%	0.3%
Misc Plastic Containers	130.8	1.3%	0.2%
Trash Bags	244.3	2.5%	0.3%
Grocery & Merchandise Bags	32.0	0.3%	0.1%
Non-Bag Comm/Ind Pkging Film	2.0	0.0%	0.0%
Film Products	0.0	0.0%	0.0%
Other Film	372.5	3.8%	0.3%
Durable Plastic Items	76.5	0.8%	0.3%
EPS	40.9	0.4%	0.2%
R/C Plastic	118.5	1.2%	0.3%

Class and Material Type	Tons	Est. Mean	+/-
Organics	**4,998.9**	**50.4%**	
Packaged Vegetative Food (Donatable)	56.0	0.6%	0.5%
Loose/Scrap Vegetative Food	2,128.5	21.4%	3.1%
Packaged Non-Vegetative Food (Donatable)	83.0	0.8%	0.3%
Loose/Scrap Non-Vegetative Food	1,008.9	10.2%	1.9%
Leaves & Grass	353.6	3.6%	3.3%
Prunings & Trimmings	41.2	0.4%	0.2%
Branches & Stumps	53.8	0.5%	0.9%
Agricultural Crop Residues	-	0.0%	0.0%
Manures	4.2	0.0%	0.1%
Textiles	395.2	4.0%	1.2%
Carpet	27.2	0.3%	0.4%
R/C Organics	847.2	8.5%	1.9%
C&D	**300.5**	**3.0%**	
Concrete	-	0.0%	0.0%
Asphalt Paving	-	0.0%	0.0%
Asphalt Roofing	0.2	0.0%	0.0%
Lumber	169.5	1.7%	1.6%
Gypsum Board	-	0.0%	0.0%
Rock, Soil & Fines	21.4	0.2%	0.3%
R/C C&D	109.4	1.1%	0.4%
HHW	**31.6**	**0.3%**	
Paint	5.2	0.1%	0.1%
Vehicle & Equipment Fluids	-	0.0%	0.0%
Used Oil	-	0.0%	0.0%
Batteries	6.9	0.1%	0.1%
R/C HHW	19.5	0.2%	0.1%
Special Waste	**112.9**	**1.1%**	
Ash	6.7	0.1%	0.1%
Sewage Solids	-	0.0%	0.0%
Industrial Sludge	-	0.0%	0.0%
Treated Medical Waste	1.1	0.0%	0.0%
Bulky Items	87.8	0.9%	1.4%
Tires	3.7	0.0%	0.1%
R/C Special Waste	13.7	0.1%	0.1%
Mixed Residue	**547.2**	**5.5%**	
Mixed Residue/MSW	547.2	5.5%	1.3%

Total Percent	**100.0%**
Total Tons	**9,924.3**
Sample Count	**21**

Multifamily Residential Waste

The consultant team hand sorted 10 samples of multifamily residential waste from Palo Alto, and extrapolated the results of the characterization to apply to the 1,734 tons of multifamily waste disposed annually. Key findings from this extrapolation are presented below.

Key Findings

Figure 5 summarizes the recovery potential for Palo Alto's multifamily residential waste sector, and Table 7 lists the six most common materials, by weight. Key findings include:

- Just over 73% (1,268 tons) of multifamily waste in Palo Alto is recyclable or compostable.
- **Compostable** material, the most common recoverability group, represents 31% (542 tons) of Palo Alto's multifamily waste, and the following **Compostable** materials were among the top six material types found in multifamily waste:
  - *loose/scrap vegetative food* (10.8% and 188 tons)
  - *loose/scrap non-vegetative food* (5.4% and 94 tons)
  - *compostable paper* (5.4% and 94 tons)
- The second most prevalent recoverability group is **Other Recyclables**, which makes up about 31% (534 tons) of multifamily waste. The most common material type in the multifamily waste stream is *lumber* (13.2% and 229 tons). Other significant materials in the **Other Recyclables** recoverability group were:
  - *concrete* (3.0% and 52 tons)
  - *HDPE containers* (2.0% and 36 tons)
  - *glass bottles and containers* (2.9% and 49 tons)
  - *textiles* (1.9% and 33 tons)
- **Recyclable Paper** makes up approximately 11% (192 tons) of the multifamily waste. The most prevalent **Recyclable Paper** material was *uncoated cardboard* (4.4% and 76 tons), followed by:
  - *other miscellaneous paper* (2.0% and 34 tons)
  - *magazines and catalogs* (1.6% and 27 tons)
- **Problem Materials** compose 19% of multifamily waste (335 tons). *Remainder/composite organics* (5.4% and 93 tons) was identified as one of the six most common materials in the multifamily stream; other **Problem Materials** include:
  - *remainder/composite C&D* (5.0% and 87 tons)
  - *other film* (2.4% and 43 tons)
- **Potential Recyclables** makes up almost 8% (132 tons) of the multifamily waste sector, the least prevalent recoverability category. However, *bulky items*, a **Potentially Recyclable** material type, was the third most common material type found in the multifamily waste stream (7.3% and 127 tons).

Figure 5. Material Recoverability, Multifamily Residential

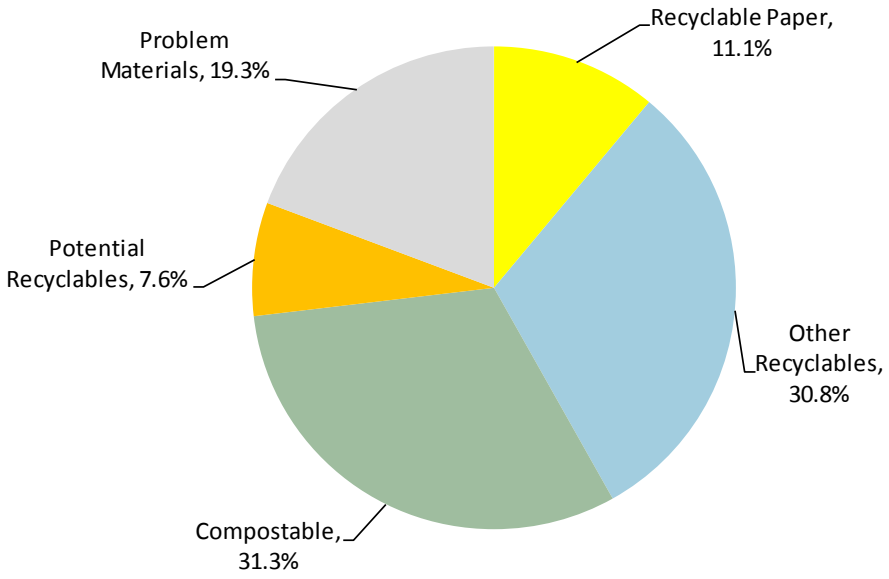


Table 7. Top Six Material Types, Multifamily Residential

Material	Est. %
Lumber	13.2%
Loose/Scrap Vegetative Food	10.8%
Bulky Items	7.3%
Compostable Paper	5.4%
Loose/Scrap Non-Vegetative Food	5.4%
R/C Organics	5.4%
Total	**47.5%**

Table 8 identifies the detailed material composition by material class and material type.

Table 8. Detailed Material Composition, Multifamily Residential

Class and Material Type	Tons	Est. Mean	+/-
Paper	**294.8**	**17.0%**	
Uncoated Cardboard	76.1	4.4%	2.2%
Kraft Paper Bags	10.2	0.6%	0.3%
Newspaper	16.4	0.9%	0.3%
White Ledger	8.8	0.5%	0.6%
Colored Ledger	1.0	0.1%	0.1%
Other Office Paper	14.2	0.8%	0.5%
Magazines and Catalogs	27.3	1.6%	1.2%
Phone Books and Directories	3.7	0.2%	0.2%
Compostable Paper	94.2	5.4%	1.3%
Other Misc Paper	34.0	2.0%	0.7%
R/C Paper	8.9	0.5%	0.2%
Glass	**52.7**	**3.0%**	
Bottles & Containers	49.4	2.9%	0.9%
Other Colored Bottles & Containers	2.9	0.2%	0.2%
Flat Glass	0.0	0.0%	0.0%
R/C Glass	0.3	0.0%	0.0%
Metal	**81.6**	**4.7%**	
Tin/Steel Cans	6.4	0.4%	0.1%
Major Appliances	0.0	0.0%	0.0%
Used Oil Filters	0.0	0.0%	0.0%
Other Ferrous Metal	28.5	1.6%	1.4%
Aluminum Cans	3.8	0.2%	0.1%
Other Non-Ferrous Metal	22.4	1.3%	1.7%
R/C Metal	20.5	1.2%	1.0%
Electronics	**16.1**	**0.9%**	
Brown Goods	4.4	0.3%	0.4%
Computer-Related Electronics	3.9	0.2%	0.3%
Other Small Consumer Electr'cs	7.8	0.4%	0.3%
TVs and Other Items with CRTs	0.0	0.0%	0.0%
Plastics	**185.8**	**10.7%**	
PETE Containers	13.0	0.8%	0.3%
HDPE Containers	35.5	2.0%	0.2%
Misc Plastic Containers	13.5	0.8%	0.3%
Trash Bags	31.9	1.8%	0.6%
Grocery & Merchandise Bags	5.6	0.3%	0.1%
Non-Bag Comm/Ind Pkging Film	1.7	0.1%	0.1%
Film Products	4.9	0.3%	0.5%
Other Film	42.5	2.4%	0.5%
Durable Plastic Items	20.6	1.2%	0.5%
EPS	6.4	0.4%	0.1%
R/C Plastic	10.0	0.6%	0.2%

Class and Material Type	Tons	Est. Mean	+/-
Organics	**573.2**	**33.1%**	
Packaged Vegetative Food (Donatable)	10.4	0.6%	0.7%
Loose/Scrap Vegetative Food	187.7	10.8%	3.9%
Packaged Non-Vegetative Food (Donatable)	8.2	0.5%	0.3%
Loose/Scrap Non-Vegetative Food	93.9	5.4%	1.9%
Leaves & Grass	59.3	3.4%	3.1%
Prunings & Trimmings	85.3	4.9%	5.9%
Branches & Stumps	3.1	0.2%	0.3%
Agricultural Crop Residues	-	0.0%	0.0%
Manures	-	0.0%	0.0%
Textiles	32.5	1.9%	1.4%
Carpet	-	0.0%	0.0%
R/C Organics	92.8	5.4%	2.9%
C&D	**367.3**	**21.2%**	
Concrete	51.5	3.0%	4.8%
Asphalt Paving	-	0.0%	0.0%
Asphalt Roofing	-	0.0%	0.0%
Lumber	229.1	13.2%	7.3%
Gypsum Board	-	0.0%	0.0%
Rock, Soil & Fines	-	0.0%	0.0%
R/C C&D	86.7	5.0%	5.0%
HHW	**3.2**	**0.2%**	
Paint	0.2	0.0%	0.0%
Vehicle & Equipment Fluids	-	0.0%	0.0%
Used Oil	-	0.0%	0.0%
Batteries	1.3	0.1%	0.1%
R/C HHW	1.6	0.1%	0.1%
Special Waste	**134.0**	**7.7%**	
Ash	-	0.0%	0.0%
Sewage Solids	-	0.0%	0.0%
Industrial Sludge	-	0.0%	0.0%
Treated Medical Waste	0.1	0.0%	0.0%
Bulky Items	126.8	7.3%	5.5%
Tires	-	0.0%	0.0%
R/C Special Waste	7.1	0.4%	0.6%
Mixed Residue	**25.7**	**1.5%**	
Mixed Residue/MSW	25.7	1.5%	0.6%

Total Percent	**100.0%**
Total Tons	**1,734.2**
Sample Count	**10**

Commercial Front-Load Waste

The consultant team hand sorted 30 samples from Palo Alto's commercial front-load waste sector, and extrapolated the results of the characterization to apply to the 9,827 tons of material the commercial front-load waste sector generates annually. Key findings from this extrapolation are presented below.

Key Findings

Figure 6 summarizes the recovery potential for Palo Alto's commercial front-load waste sector, and Table 9 lists the top six materials found in Palo Alto's commercial front-load waste stream, by weight. Key findings include:

- Almost 72% (7,036 tons) of Palo Alto's commercial front-load waste is recyclable or compostable.
- **Compostable** material represents the largest recoverability group in Palo Alto's commercial front-load waste at 41% (4,007 tons) of the total. As shown in Table 9, **Compostable** material types represent three of the top materials in front-load waste:
  - *compostable paper* (12.8% and 1,261 tons)
  - *loose/scrap vegetative food* (11.8% and 1,159 tons)
  - *loose/scrap non-vegetative food* (5.9% and 578 tons)
- The second most common recoverability group is **Problem Materials,** composing about 21% (2,104 tons) of front-load waste. One of the most common materials in front-load waste was *remainder/composite organics* (4.6% and 456 tons), which was also the largest **Problem Material**, followed by:
  - *trash bags* (3.3% and 328 tons)
  - *other film* (2.7% and 263 tons)
  - *mixed residue/MSW* (2.5% and 248 tons)
  - *remainder/composite metal* (2.4% and 235 tons)
- **Other Recyclables** make up about 20% (1,986 tons) of front-load waste. *Lumber* (6.0% and 592 tons) is one of the top materials found in front-load waste; prevalent **Other Recyclables** identified also include:
  - *durable plastic items* (2.5% and 245 tons)
  - *textiles* (2.4% and 238 tons)
  - *rock, soil & fines* (1.8% and 179 tons)
  - *HDPE containers* (1.7% and 172 tons)
- **Recyclable Paper** makes up approximately 11% (1,043 tons) of the front-load waste; *uncoated cardboard* (3.5% and 349 tons) was the most common **Recyclable Paper** material type found. Other materials identified included:
  - *white ledger* (1.7% and 169 tons)
  - *other miscellaneous paper* (1.6% and 156 tons)

Figure 6. Material Recoverability, Commercial Front-Load

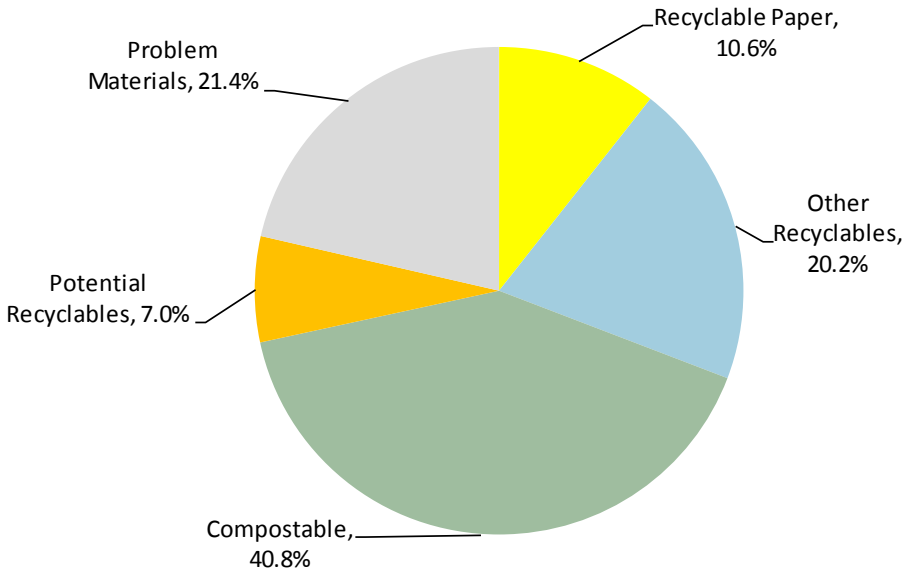


Table 9. Top Six Material Types, Commercial Front-load

Material	Est. %
Compostable Paper	12.8%
Loose/Scrap Vegetative Food	11.8%
Lumber	6.0%
Loose/Scrap Non-Vegetative Food	5.9%
Bulky Items	5.2%
R/C Organics	4.6%
Total	**46.4%**

Table 10 identifies the detailed material composition by material class and material type.

Table 10. Detailed Composition, Commercial Front-load

Class and Material Type	Tons	Est. Mean	+/-
Paper	**2,418.7**	**24.6%**	
Uncoated Cardboard	348.8	3.5%	1.5%
Kraft Paper Bags	68.2	0.7%	0.3%
Newspaper	81.4	0.8%	0.3%
White Ledger	169.2	1.7%	0.8%
Colored Ledger	14.5	0.1%	0.2%
Other Office Paper	89.2	0.9%	0.6%
Magazines and Catalogs	98.1	1.0%	0.4%
Phone Books and Directories	18.2	0.2%	0.2%
Compostable Paper	1261.0	12.8%	2.2%
Other Misc Paper	155.7	1.6%	0.5%
R/C Paper	114.4	1.2%	0.6%
Glass	**139.4**	**1.4%**	
Bottles & Containers	93.1	0.9%	0.3%
Other Colored Bottles & Containers	29.4	0.3%	0.2%
Flat Glass	0.1	0.0%	0.0%
R/C Glass	16.7	0.2%	0.2%
Metal	**413.9**	**4.2%**	
Tin/Steel Cans	32.1	0.3%	0.2%
Major Appliances	0.0	0.0%	0.0%
Used Oil Filters	0.0	0.0%	0.0%
Other Ferrous Metal	85.6	0.9%	1.0%
Aluminum Cans	17.5	0.2%	0.1%
Other Non-Ferrous Metal	44.0	0.4%	0.2%
R/C Metal	234.7	2.4%	2.5%
Electronics	**73.5**	**0.7%**	
Brown Goods	36.6	0.4%	0.5%
Computer-Related Electronics	18.3	0.2%	0.3%
Other Small Consumer Electr'cs	18.6	0.2%	0.1%
TVs and Other Items with CRTs	0.0	0.0%	0.0%
Plastics	**1349.7**	**13.7%**	
PETE Containers	41.0	0.4%	0.1%
HDPE Containers	171.5	1.7%	0.2%
Misc Plastic Containers	114.4	1.2%	0.3%
Trash Bags	328.0	3.3%	0.7%
Grocery & Merchandise Bags	11.5	0.1%	0.0%
Non-Bag Comm/Ind Pkging Film	15.6	0.2%	0.1%
Film Products	12.3	0.1%	0.1%
Other Film	262.6	2.7%	0.4%
Durable Plastic Items	244.5	2.5%	1.4%
EPS	27.3	0.3%	0.1%
R/C Plastic	121.0	1.2%	0.3%

Class and Material Type	Tons	Est. Mean	+/-
Organics	**3,605.5**	**36.7%**	
Packaged Vegetative Food (Donatable)	280.8	2.9%	2.9%
Loose/Scrap Vegetative Food	1,159.3	11.8%	2.9%
Packaged Non-Vegetative Food (Donatable)	57.1	0.6%	0.2%
Loose/Scrap Non-Vegetative Food	578.2	5.9%	1.4%
Leaves & Grass	336.2	3.4%	1.7%
Prunings & Trimmings	334.4	3.4%	2.8%
Branches & Stumps	-	0.0%	0.0%
Agricultural Crop Residues	-	0.0%	0.0%
Manures	26.2	0.3%	0.4%
Textiles	238.3	2.4%	1.1%
Carpet	139.0	1.4%	1.3%
R/C Organics	456.1	4.6%	1.1%
C&D	**968.2**	**9.9%**	
Concrete	0.2	0.0%	0.0%
Asphalt Paving	-	0.0%	0.0%
Asphalt Roofing	0.3	0.0%	0.0%
Lumber	591.6	6.0%	3.9%
Gypsum Board	-	0.0%	0.0%
Rock, Soil & Fines	178.7	1.8%	1.3%
R/C C&D	197.4	2.0%	1.5%
HHW	**39.8**	**0.4%**	
Paint	-	0.0%	0.0%
Vehicle & Equipment Fluids	-	0.0%	0.0%
Used Oil	-	0.0%	0.0%
Batteries	3.0	0.0%	0.0%
R/C HHW	36.8	0.4%	0.5%
Special Waste	**570.3**	**5.8%**	
Ash	0.5	0.0%	0.0%
Sewage Solids	-	0.0%	0.0%
Industrial Sludge	-	0.0%	0.0%
Treated Medical Waste	25.6	0.3%	0.3%
Bulky Items	509.8	5.2%	3.5%
Tires	-	0.0%	0.0%
R/C Special Waste	34.4	0.3%	0.3%
Mixed Residue	**248.0**	**2.5%**	
Mixed Residue/MSW	248.0	2.5%	0.5%

Total Percent	**100.0%**
Total Tons	**9,826.9**
Sample Count	**30**

Commercial Compactor Waste

The consultant team hand sorted 11 samples from Palo Alto's commercial compactor waste sector, and extrapolated the results of the characterization to apply to the 6,102 tons of material the sector disposes on an annual basis. Key findings from this extrapolation are presented below.

Key Findings

Figure 7 summarizes the recovery potential for Palo Alto's commercial compactor sector, and Table 11 lists the top six materials found in Palo Alto's commercial compactor waste, by weight. Key findings include:

- Two-thirds (4,056 tons)of Palo Alto's commercial compactor waste is recyclable or compostable.
- **Compostable** material is the largest recoverability group present in Palo Alto's compactor waste at 36% (2,189 tons). Four of the top materials found in compactor waste were **Compostable**:
  - *compostable paper* (14.6% and 892 tons)
  - *loose/scrap vegetative food* (9.9% and 607 tons)
  - *loose/scrap non-vegetative food* (6.0% and 363 tons)
  - *prunings and trimmings* (4.6% and 279 tons)
- **Problem Materials** compose almost 32% of compactor waste (1,942 tons), making it the second most common recoverability group. The **Problem Material** types *remainder/composite organics* (9.2% and 563 tons) and *treated medical waste* (8.5% and 519 tons) were among the top materials identified in compactor waste. Additional **Problem Materials** found were:
  - *other film* (3.5% and 211 tons)
  - *trash bags* (3.2% and 198 tons)
  - *remainder/composite C&D* (2.3% and 140 tons)
  - *mixed residue/MSW* (2.1% and 128 tons)
- **Other Recyclables** make up about 18% (1,110 tons) of Palo Alto compactor waste. *Glass bottles and containers* (3.0% and 183 tons) was the most common item in the **Other Recyclables** recoverability group, which also included the following materials:
  - *lumber* (2.8% and 169 tons)
  - *HDPE containers* (2% and 124 tons)
  - *durable plastic items* (2% and 123 tons)
  - *miscellaneous plastic containers* (1.6% and 100 tons)
- **Recyclable Paper** represents approximately 12% (757 tons) of the compactor waste. The most common **Recyclable Paper** material types identified were:
  - *uncoated cardboard* (3.4% and 209 tons)
  - *newspaper* (2.9% and 175 tons)
  - *magazines and catalogs* (1.7% and 105 tons)
  - *other miscellaneous paper* (1.6% and 100 tons)

Figure 7. Material Recoverability, Commercial Compactor

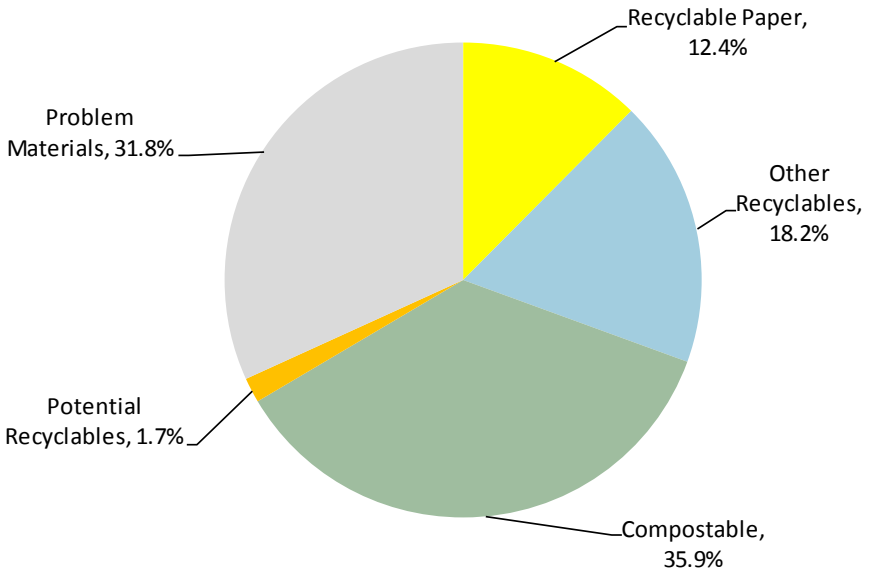


Table 11. Top Six Material Types, Commercial Compactors

Material	Est. %
Compostable Paper	14.6%
Loose/Scrap Vegetative Food	9.9%
R/C Organics	9.2%
Treated Medical Waste	8.5%
Loose/Scrap Non-Vegetative Food	6.0%
Prunings & Trimmings	4.6%
Total	**52.8%**

Table 12 identifies the detailed material composition by material class and material type.

Table 12. Detailed Composition, Commercial Compactors

Class and Material Type	Tons	Est. Mean	+/-
Paper	**1,692.8**	**27.7%**	
Uncoated Cardboard	209.0	3.4%	2.8%
Kraft Paper Bags	54.7	0.9%	0.4%
Newspaper	174.5	2.9%	1.6%
White Ledger	73.3	1.2%	0.7%
Colored Ledger	3.0	0.0%	0.1%
Other Office Paper	36.2	0.6%	0.4%
Magazines and Catalogs	105.2	1.7%	1.0%
Phone Books and Directories	1.8	0.0%	0.0%
Compostable Paper	891.9	14.6%	3.5%
Other Misc Paper	99.6	1.6%	0.4%
R/C Paper	43.5	0.7%	0.4%
Glass	**238.6**	**3.9%**	
Bottles & Containers	182.8	3.0%	1.2%
Other Colored Bottles & Containers	55.0	0.9%	1.0%
Flat Glass	0.0	0.0%	0.0%
R/C Glass	0.9	0.0%	0.0%
Metal	**136.8**	**2.2%**	
Tin/Steel Cans	31.2	0.5%	0.5%
Major Appliances	0.0	0.0%	0.0%
Used Oil Filters	0.0	0.0%	0.0%
Other Ferrous Metal	31.7	0.5%	0.8%
Aluminum Cans	12.1	0.2%	0.1%
Other Non-Ferrous Metal	37.1	0.6%	0.5%
R/C Metal	24.6	0.4%	0.5%
Electronics	**49.0**	**0.8%**	
Brown Goods	25.1	0.4%	0.7%
Computer-Related Electronics	4.0	0.1%	0.1%
Other Small Consumer Electr'cs	19.9	0.3%	0.3%
TVs and Other Items with CRTs	0.0	0.0%	0.0%
Plastics	**924.2**	**15.1%**	
PETE Containers	36.2	0.6%	0.2%
HDPE Containers	123.6	2.0%	0.4%
Misc Plastic Containers	100.1	1.6%	0.5%
Trash Bags	197.6	3.2%	0.8%
Grocery & Merchandise Bags	8.5	0.1%	0.1%
Non-Bag Comm/Ind Pkging Film	21.8	0.4%	0.4%
Film Products	0.0	0.0%	0.0%
Other Film	211.3	3.5%	1.0%
Durable Plastic Items	123.0	2.0%	2.1%
EPS	24.2	0.4%	0.3%
R/C Plastic	77.8	1.3%	0.6%

Class and Material Type	Tons	Est. Mean	+/-
Organics	**1,916.7**	**31.4%**	
Packaged Vegetative Food (Donatable)	5.5	0.1%	0.1%
Loose/Scrap Vegetative Food	606.6	9.9%	3.9%
Packaged Non-Vegetative Food (Donatable)	30.7	0.5%	0.3%
Loose/Scrap Non-Vegetative Food	363.4	6.0%	2.1%
Leaves & Grass	11.9	0.2%	0.2%
Prunings & Trimmings	279.1	4.6%	4.9%
Branches & Stumps	-	0.0%	0.0%
Agricultural Crop Residues	-	0.0%	0.0%
Manures	-	0.0%	0.0%
Textiles	56.3	0.9%	0.8%
Carpet	-	0.0%	0.0%
R/C Organics	563.2	9.2%	4.4%
C&D	**377.6**	**6.2%**	
Concrete	-	0.0%	0.0%
Asphalt Paving	-	0.0%	0.0%
Asphalt Roofing	-	0.0%	0.0%
Lumber	168.9	2.8%	4.2%
Gypsum Board	-	0.0%	0.0%
Rock, Soil & Fines	68.8	1.1%	1.8%
R/C C&D	139.9	2.3%	2.6%
HHW	**11.8**	**0.2%**	
Paint	-	0.0%	0.0%
Vehicle & Equipment Fluids	-	0.0%	0.0%
Used Oil	-	0.0%	0.0%
Batteries	3.5	0.1%	0.1%
R/C HHW	8.3	0.1%	0.1%
Special Waste	**625.6**	**10.3%**	
Ash	-	0.0%	0.0%
Sewage Solids	-	0.0%	0.0%
Industrial Sludge	-	0.0%	0.0%
Treated Medical Waste	519.3	8.5%	13.5%
Bulky Items	102.9	1.7%	2.0%
Tires	-	0.0%	0.0%
R/C Special Waste	3.3	0.1%	0.0%
Mixed Residue	**128.4**	**2.1%**	
Mixed Residue/MSW	128.4	2.1%	0.6%

Total Percent	**100.0%**
Total Tons	**6,101.5**
Sample Count	**11**

Loose Roll-off Waste

The consultant team visually characterized six samples of Palo Alto loose roll-off waste, and extrapolated the results of the characterization to apply to the 2,014 tons of material collected in loose roll-offs per year. The sample size for loose roll-off waste was smaller than planned in the study design due to the lack of available samples during the study period; typically six samples is too small to extrapolate meaningful findings. The detailed composition presented in Table 14 reflects the small sample size in very broad error ranges at the 90% confidence level.

Key Findings

Figure 8 summarizes the recovery potential for Palo Alto's loose roll-off waste, and Table 13 lists the top six materials found in Palo Alto's loose roll-off waste, by weight. Key findings include:

- 68% (1,363 tons) of Palo Alto's loose roll-off waste is recyclable or compostable.
- The primary recoverability group in loose roll-off waste is **Other Recyclables**, which makes up about 46% (937 tons) of the sector's disposed waste. Two of the most common materials found in roll-off waste were **Other Recyclables**: *durable plastic items* (16.5% and 333 tons) and *rock, soil, & fines* (12.6% and 253 tons). Additional **Other Recyclables** identified include:
  - *lumber* (7.4% and 149 tons)
  - *tin/steel cans* (2.7% and 54 tons)
  - *textiles* (2.8% and 56 tons)
  - *other small consumer electronics* (1.8% and 37 tons)
- **Potential Recyclables** is the second most prevalent recoverability group and represents about 25% (508 tons) of Palo Alto's loose roll-off waste. *Carpet* (23.5% and 472 tons) was the most prevalent material in this recoverability group, and was also the most common material found in loose roll-off waste. Other **Potential Recyclables** included:
  - *film products* (0.9% and 18 tons)
  - *TVs and other items with CRTs* (0.9% and 18 tons)
- **Compostable** material is the third most prevalent recoverability group and represents 16% (322 tons) of Palo Alto's loose roll-off waste. The most common **Compostable** material type found was *leaves & grass* (10.4% and 209 tons). Other **Compostable** materials found in roll-off waste were:
  - *prunings and trimmings* (3.2% and 65 tons)
  - *compostable paper* (1.8% and 37 tons)
- **Problem Materials** compose about 7% of loose roll-off waste (142 tons), and consists largely of *remainder/composite C&D* (4.6% and 93 tons), also one of the top materials found in roll-off waste. The following **Problem Materials** were also identified:
  - *remainder/composite plastic* (0.9% and 19 tons)
  - *EPS (0.5% and 10 tons)*
- **Recyclable Paper** makes up approximately 5% (104 tons) of the loose roll-off waste. **Recyclable Paper** materials found in roll-off waste were:
  - *kraft paper bags* (1.8% and 36 tons)
  - *other office paper* (0.7% and 14 tons)
  - *uncoated cardboard* (1.6% and 33 tons)
  - *newspaper* (0.6% and 13 tons)

Figure 8. Material Recoverability, Loose Roll-off

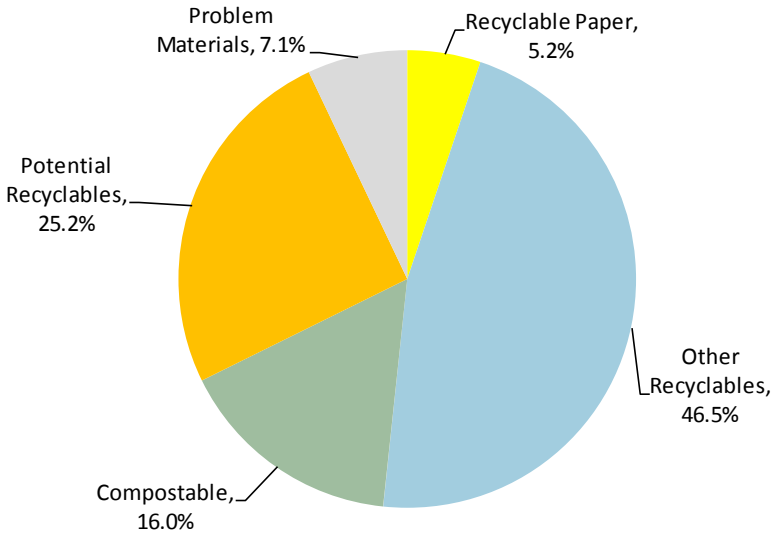


Table 13. Top Six Material Types, Loose Roll-off

Material	Est. %
Carpet	23.5%
Durable Plastic Items	16.5%
Rock, Soil & Fines	12.6%
Leaves & Grass	10.4%
Lumber	7.4%
R/C C&D	4.6%
Total	**74.9%**

Table 14 identifies the detailed material composition by material class and material type.

Table 14. Detailed Composition, Loose Roll-off

Class and Material Type	Tons	Est. Mean	+/-
Paper	**145.9**	**7.2%**	
Uncoated Cardboard	33.2	1.6%	1.8%
Kraft Paper Bags	36.2	1.8%	2.3%
Newspaper	13.0	0.6%	1.1%
White Ledger	0.0	0.0%	0.0%
Colored Ledger	0.0	0.0%	0.0%
Other Office Paper	14.1	0.7%	1.0%
Magazines and Catalogs	7.4	0.4%	0.5%
Phone Books and Directories	0.0	0.0%	0.0%
Compostable Paper	37.2	1.8%	2.6%
Other Misc Paper	0.5	0.0%	0.0%
R/C Paper	4.4	0.2%	0.2%
Glass	**29.2**	**1.4%**	
Bottles & Containers	23.2	1.1%	2.2%
Other Colored Bottles & Containers	0.0	0.0%	0.0%
Flat Glass	0.0	0.0%	0.0%
R/C Glass	6.0	0.3%	0.6%
Metal	**65.9**	**3.3%**	
Tin/Steel Cans	53.9	2.7%	3.1%
Major Appliances	0.0	0.0%	0.0%
Used Oil Filters	0.0	0.0%	0.0%
Other Ferrous Metal	9.9	0.5%	0.8%
Aluminum Cans	0.0	0.0%	0.0%
Other Non-Ferrous Metal	0.0	0.0%	0.0%
R/C Metal	2.1	0.1%	0.2%
Electronics	**55.0**	**2.7%**	
Brown Goods	0.0	0.0%	0.0%
Computer-Related Electronics	0.0	0.0%	0.0%
Other Small Consumer Electr'cs	37.2	1.8%	3.2%
TVs and Other Items with CRTs	17.7	0.9%	1.5%
Plastics	**408.7**	**20.3%**	
PETE Containers	3.9	0.2%	0.3%
HDPE Containers	5.2	0.3%	0.3%
Misc Plastic Containers	11.3	0.6%	0.9%
Trash Bags	5.7	0.3%	0.4%
Grocery & Merchandise Bags	1.1	0.1%	0.1%
Non-Bag Comm/Ind Pkging Film	0.0	0.0%	0.0%
Film Products	18.4	0.9%	1.1%
Other Film	1.7	0.1%	0.1%
Durable Plastic Items	333.3	16.5%	20.4%
EPS	9.5	0.5%	0.7%
R/C Plastic	18.8	0.9%	0.6%

Class and Material Type	Tons	Est. Mean	+/-
Organics	**815.0**	**40.5%**	
Packaged Vegetative Food (Donatable)	-	0.0%	0.0%
Loose/Scrap Vegetative Food	-	0.0%	0.0%
Packaged Non-Vegetative Food (Donatable)	-	0.0%	0.0%
Loose/Scrap Non-Vegetative Food	10.2	0.5%	1.0%
Leaves & Grass	209.4	10.4%	13.3%
Prunings & Trimmings	65.4	3.2%	5.6%
Branches & Stumps	-	0.0%	0.0%
Agricultural Crop Residues	-	0.0%	0.0%
Manures	-	0.0%	0.0%
Textiles	55.7	2.8%	3.9%
Carpet	472.4	23.5%	34.5%
R/C Organics	1.8	0.1%	0.2%
C&D	**494.5**	**24.5%**	
Concrete	-	0.0%	0.0%
Asphalt Paving	-	0.0%	0.0%
Asphalt Roofing	-	0.0%	0.0%
Lumber	149.0	7.4%	8.9%
Gypsum Board	-	0.0%	0.0%
Rock, Soil & Fines	253.0	12.6%	17.1%
R/C C&D	92.5	4.6%	3.5%
HHW	**-**	**0.0%**	
Paint	-	0.0%	0.0%
Vehicle & Equipment Fluids	-	0.0%	0.0%
Used Oil	-	0.0%	0.0%
Batteries	-	0.0%	0.0%
R/C HHW	-	0.0%	0.0%
Special Waste	**-**	**0.0%**	
Ash	-	0.0%	0.0%
Sewage Solids	-	0.0%	0.0%
Industrial Sludge	-	0.0%	0.0%
Treated Medical Waste	-	0.0%	0.0%
Bulky Items	-	0.0%	0.0%
Tires	-	0.0%	0.0%
R/C Special Waste	-	0.0%	0.0%
Mixed Residue	**-**	**0.0%**	
Mixed Residue/MSW	-	0.0%	0.0%

Total Percent	**100.0%**
Total Tons	**2,014.2**
Sample Count	**6**

Self-haul Waste

The consultant team visually characterized 22 samples of Palo Alto's self-haul waste, and extrapolated the results of the characterization to apply to the 1,763 tons of material self-hauled to the SMaRT Station annually. Key findings from this extrapolation are presented below.

Key Findings

Figure 9 summarizes the recovery potential for Palo Alto's self-haul waste, and Table 15 lists the top six materials found in Palo Alto's self-haul waste, by weight. Key findings include:

- Almost 60% (1,055 tons) of Palo Alto's self-haul waste is recyclable or compostable.
- **Other Recyclables** is the largest recoverability group present in self-haul waste, totaling over 54% (952 tons) of the total self-haul waste. Four of the top materials shown in Table 15 are **Other Recyclables**:
  - *gypsum board* (22.2% and 391 tons)
  - *lumber* (16.5% and 291 tons)
  - *textiles* (3.6% and 63 tons)
  - *other small consumer electronics* (3.0% and 54 tons)
- The second most prevalent recoverability group is **Potential Recyclables**, composing about 26% (461 tons) of self-haul waste. The **Potential Recyclables** consisted almost entirely of *bulky items* (24.1% and 426 tons). *Bulky items* were also the largest material type in Palo Alto's self-haul waste sector.
- **Problem Materials** (14% and 248 tons) is the next most prevalent recoverability group. *Remainder/composite C&D* (11.0% and 193 tons) was the most common **Problem Material**, as well as one of the top materials found in self-haul waste. Other significant **Problem Materials** in the self-haul stream included:
  - *remainder/composite plastic* (1.2% and 21 tons)
  - *remainder/composite metal* (1.1% and 19 tons)
- **Recyclable Paper** represents about 5% (90 tons) of the self-haul waste stream. The most common Recyclable Paper materials were *magazines and catalogs* (2.9% and 50 tons) and *other miscellaneous paper* (1.3% and 23 tons).
- **Compostable** material is the smallest recoverability group present in self-haul waste, less than 1% (13 tons) of the total self-haul waste. The **Compostable** recoverability group consisted primarily of *leaves & grass* (0.5% and 9 tons).

Figure 9. Material Recoverability, Self-haul

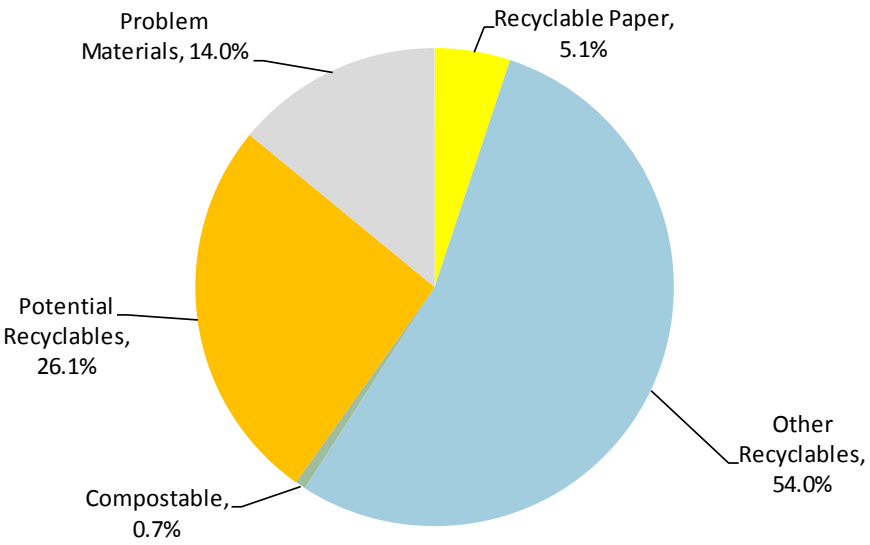


Table 15. Top Six Material Types, Self-haul

Material	Est. %
Bulky Items	24.1%
Gypsum Board	22.2%
Lumber	16.5%
R/C C&D	11.0%
Textiles	3.6%
Other Small Consumer Electr'cs	3.0%
Total	**80.4%**

Table 16 identifies the detailed material composition by material class and material type.

Table 16. Detailed Composition, Self-haul

Class and Material Type	Tons	Est. Mean	+/-
Paper	**91.5**	**5.2%**	
Uncoated Cardboard	12.5	0.7%	0.9%
Kraft Paper Bags	0.8	0.0%	0.1%
Newspaper	1.4	0.1%	0.1%
White Ledger	0.2	0.0%	0.0%
Colored Ledger	0.0	0.0%	0.0%
Other Office Paper	1.9	0.1%	0.2%
Magazines and Catalogs	50.3	2.9%	4.7%
Phone Books and Directories	0.0	0.0%	0.0%
Compostable Paper	1.8	0.1%	0.1%
Other Misc Paper	22.5	1.3%	1.5%
R/C Paper	0.0	0.0%	0.0%
Glass	**24.4**	**1.4%**	
Bottles & Containers	6.6	0.4%	0.3%
Other Colored Bottles & Containers	0.0	0.0%	0.0%
Flat Glass	15.6	0.9%	1.0%
R/C Glass	2.2	0.1%	0.2%
Metal	**44.6**	**2.5%**	
Tin/Steel Cans	1.1	0.1%	0.1%
Major Appliances	0.0	0.0%	0.0%
Used Oil Filters	0.0	0.0%	0.0%
Other Ferrous Metal	20.8	1.2%	0.8%
Aluminum Cans	0.3	0.0%	0.0%
Other Non-Ferrous Metal	3.2	0.2%	0.2%
R/C Metal	19.2	1.1%	1.7%
Electronics	**53.6**	**3.0%**	
Brown Goods	0.0	0.0%	0.0%
Computer-Related Electronics	0.0	0.0%	0.0%
Other Small Consumer Electr'cs	53.6	3.0%	4.5%
TVs and Other Items with CRTs	0.0	0.0%	0.0%
Plastics	**43.6**	**2.5%**	
PETE Containers	0.4	0.0%	0.0%
HDPE Containers	0.0	0.0%	0.0%
Misc Plastic Containers	0.1	0.0%	0.0%
Trash Bags	0.3	0.0%	0.0%
Grocery & Merchandise Bags	0.2	0.0%	0.0%
Non-Bag Comm/Ind Pkging Film	4.4	0.2%	0.4%
Film Products	1.6	0.1%	0.1%
Other Film	0.5	0.0%	0.0%
Durable Plastic Items	9.6	0.5%	0.4%
EPS	6.0	0.3%	0.3%
R/C Plastic	20.7	1.2%	1.2%

Class and Material Type	Tons	Est. Mean	+/-
Organics	**96.3**	**5.5%**	
Packaged Vegetative Food (Donatable)	-	0.0%	0.0%
Loose/Scrap Vegetative Food	-	0.0%	0.0%
Packaged Non-Vegetative Food (Donatable)	-	0.0%	0.0%
Loose/Scrap Non-Vegetative Food	-	0.0%	0.0%
Leaves & Grass	8.9	0.5%	0.6%
Prunings & Trimmings	0.8	0.0%	0.1%
Branches & Stumps	1.1	0.1%	0.1%
Agricultural Crop Residues	-	0.0%	0.0%
Manures	-	0.0%	0.0%
Textiles	62.7	3.6%	2.8%
Carpet	17.9	1.0%	1.2%
R/C Organics	4.8	0.3%	0.3%
C&D	**976.3**	**55.4%**	
Concrete	35.4	2.0%	2.7%
Asphalt Paving	-	0.0%	0.0%
Asphalt Roofing	31.7	1.8%	2.8%
Lumber	290.9	16.5%	13.3%
Gypsum Board	391.5	22.2%	25.1%
Rock, Soil & Fines	33.4	1.9%	1.7%
R/C C&D	193.4	11.0%	9.6%
HHW	**7.1**	**0.4%**	
Paint	-	0.0%	0.0%
Vehicle & Equipment Fluids	-	0.0%	0.0%
Used Oil	-	0.0%	0.0%
Batteries	6.7	0.4%	0.6%
R/C HHW	0.4	0.0%	0.0%
Special Waste	**425.7**	**24.1%**	
Ash	-	0.0%	0.0%
Sewage Solids	-	0.0%	0.0%
Industrial Sludge	-	0.0%	0.0%
Treated Medical Waste	-	0.0%	0.0%
Bulky Items	425.7	24.1%	21.6%
Tires	-	0.0%	0.0%
R/C Special Waste	-	0.0%	0.0%
Mixed Residue	**-**	**0.0%**	
Mixed Residue/MSW	-	0.0%	0.0%

Total Percent	**100.0%**
Total Tons	**1,763.1**
Sample Count	**22**

SMaRT Station Residuals

The consultant team hand sorted 20 samples from the SMaRT Station's residual stream, and extrapolated the results of the characterization to apply to the 28,317 tons of residuals that the SMaRT Station generates annually that are attributable to Palo Alto. Key findings are presented below.

Key Findings

Figure 10 summarizes the recovery potential for the SMaRT Station residuals, and Table 17 lists the top six materials found in the SMaRT Station residuals, by weight. Key findings include:

- Over three-quarters of the SMaRT Station residuals consist of **Problem Materials** and **Compostable** materials.
- **Problem Materials**, the most prevalent recoverability group, compose 41% of the residuals (11,573 tons). **Problem Materials** represented three of the top six materials found in the residual stream:
  - *mixed residue/MSW* (16.4% and 4,644 tons)
  - *other film* (5.1% and 1,454 tons)
  - *remainder/composite organics* (8.3% and 2,359 tons)
- **Compostable** materials are the second greatest recoverability group at nearly 35% (9,865 tons) of the residual stream. **Compostable** materials types were also three of the top six materials in the residual stream:
  - *compostable paper* (18.3% and 5,175 tons)
  - *loose/scrap non-vegetative food* (4.1% and 1,160 tons
  - *loose/scrap vegetative food* (9.1% and 2,587 tons)
- **Other Recyclables** composes almost 16% (4,477 tons) of the residuals. The most common materials in this recoverability group included:
  - *HDPE containers* (3.7% and 1,051 tons)
  - *miscellaneous plastic containers* (2% and 555 tons
  - *textiles* (2.6% and 734 tons)
- **Recyclable Paper** represents about 8% (2,216 tons) of the SMaRT Station residual stream; the most prevalent **Recyclable Paper** materials were:
  - *other miscellaneous paper* (3.3% and 923 tons)
  - *magazines and catalogs* (1.3% and 357 tons)
  - *uncoated cardboard* (1.7% and 468 tons)
- The least common recoverability group is **Potential Recyclables**, making up less than 1% (187 tons) of the residual stream. *Film products* (0.7% and 184) was the primary **Potential Recyclable** material identified in the residuals.

Figure 10. Material Recoverability, SMaRT Station Residuals

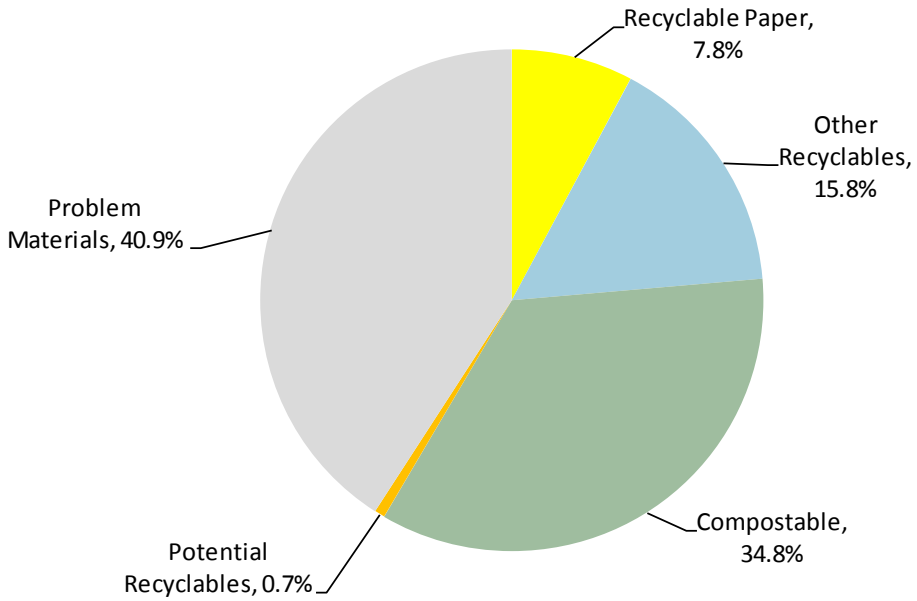


Table 17. Top Six Material Types, SMaRT Station Residuals

Material	Est. %
Compostable Paper	18.3%
Mixed Residue/MSW	16.4%
Loose/Scrap Vegetative Food	9.1%
R/C Organics	8.3%
Other Film	5.1%
Loose/Scrap Non-Vegetative Food	4.1%
Total	**61.4%**

Table 18 identifies the detailed material composition by material class and material type.

Table 18. Detailed Composition, SMaRT Station Residuals

Class and Material Type	Tons	Est. Mean	+/-
Paper	**7,556.2**	**26.7%**	
Uncoated Cardboard	467.7	1.7%	0.4%
Kraft Paper Bags	53.9	0.2%	0.1%
Newspaper	165.5	0.6%	0.2%
White Ledger	177.6	0.6%	0.3%
Colored Ledger	9.3	0.0%	0.0%
Other Office Paper	60.5	0.2%	0.1%
Magazines and Catalogs	357.3	1.3%	0.4%
Phone Books and Directories	0.5	0.0%	0.0%
Compostable Paper	5175.0	18.3%	2.1%
Other Misc Paper	923.3	3.3%	0.6%
R/C Paper	165.6	0.6%	0.3%
Glass	**153.2**	**0.5%**	
Bottles & Containers	28.9	0.1%	0.1%
Other Colored Bottles & Containers	114.5	0.4%	0.7%
Flat Glass	0.5	0.0%	0.0%
R/C Glass	9.3	0.0%	0.0%
Metal	**753.4**	**2.7%**	
Tin/Steel Cans	308.7	1.1%	1.0%
Major Appliances	0.0	0.0%	0.0%
Used Oil Filters	0.0	0.0%	0.0%
Other Ferrous Metal	7.7	0.0%	0.0%
Aluminum Cans	43.1	0.2%	0.0%
Other Non-Ferrous Metal	157.9	0.6%	0.1%
R/C Metal	236.1	0.8%	1.1%
Electronics	**259.0**	**0.9%**	
Brown Goods	0.0	0.0%	0.0%
Computer-Related Electronics	0.0	0.0%	0.0%
Other Small Consumer Electr'cs	259.0	0.9%	0.4%
TVs and Other Items with CRTs	0.0	0.0%	0.0%
Plastics	**5747.7**	**20.3%**	
PETE Containers	212.1	0.7%	0.2%
HDPE Containers	1051.3	3.7%	0.2%
Misc Plastic Containers	554.6	2.0%	0.3%
Trash Bags	1130.0	4.0%	0.6%
Grocery & Merchandise Bags	93.4	0.3%	0.1%
Non-Bag Comm/Ind Pkging Film	82.0	0.3%	0.2%
Film Products	184.1	0.7%	0.6%
Other Film	1454.1	5.1%	0.5%
Durable Plastic Items	293.1	1.0%	0.4%
EPS	169.4	0.6%	0.2%
R/C Plastic	523.5	1.8%	0.3%

Class and Material Type	Tons	Est. Mean	+/-
Organics	**7,785.8**	**27.5%**	
Packaged Vegetative Food (Donatable)	5.5	0.0%	0.0%
Loose/Scrap Vegetative Food	2,587.4	9.1%	1.3%
Packaged Non-Vegetative Food (Donatable)	212.0	0.7%	0.4%
Loose/Scrap Non-Vegetative Food	1,159.5	4.1%	0.5%
Leaves & Grass	343.2	1.2%	0.9%
Prunings & Trimmings	380.9	1.3%	0.3%
Branches & Stumps	1.1	0.0%	0.0%
Agricultural Crop Residues	-	0.0%	0.0%
Manures	-	0.0%	0.0%
Textiles	734.4	2.6%	0.7%
Carpet	2.6	0.0%	0.0%
R/C Organics	2,359.3	8.3%	1.2%
C&D	**1,362.6**	**4.8%**	
Concrete	45.6	0.2%	0.3%
Asphalt Paving	-	0.0%	0.0%
Asphalt Roofing	10.2	0.0%	0.0%
Lumber	305.7	1.1%	0.4%
Gypsum Board	-	0.0%	0.0%
Rock, Soil & Fines	168.4	0.6%	0.4%
R/C C&D	832.8	2.9%	0.6%
HHW	**37.7**	**0.1%**	
Paint	-	0.0%	0.0%
Vehicle & Equipment Fluids	-	0.0%	0.0%
Used Oil	-	0.0%	0.0%
Batteries	6.0	0.0%	0.0%
R/C HHW	31.7	0.1%	0.1%
Special Waste	**17.3**	**0.1%**	
Ash	-	0.0%	0.0%
Sewage Solids	-	0.0%	0.0%
Industrial Sludge	-	0.0%	0.0%
Treated Medical Waste	3.2	0.0%	0.0%
Bulky Items	-	0.0%	0.0%
Tires	-	0.0%	0.0%
R/C Special Waste	14.1	0.0%	0.1%
Mixed Residue	**4,644.2**	**16.4%**	
Mixed Residue/MSW	4,644.2	16.4%	2.1%

Total Percent	**100.0%**
Total Tons	**28,317.1**
Sample Count	**20**

4. Comparison to 2005 Study Results

This section compares the key findings of this waste characterization study with the results of the characterization study conducted in 2005 – specifically, the findings for the overall waste stream and for the SMaRT station residuals are presented, compared, and contrasted below.

Comparison of Key Findings – City Overall

The key findings for the overall waste stream in this waste characterization study are compared below with the results for the overall waste stream in the characterization study conducted in 2005. Figure 11 compares the breakdown of the overall waste stream by recoverability group in the 2005 and 2012 studies. Table 19 summarizes the key findings from the 2005 and 2012 studies, and compares each recoverability group and the top materials within each group.

- Total tons disposed has decreased by **60%**, from 78,200 tons in 2005 to 31,360 tons in 2012.
- The percentage of recoverable material in Palo Alto's waste stream has remained at about **70%**, although the composition of this material has changed.
  - **Compostables** increased as a percentage of the waste stream, from **29%** in 2005 to **39%** in 2012. The key material types, as well as their relative prevalence in the waste stream, are unchanged from 2005 to 2012: *food* (all types), *compostable paper*, *leaves & grass*, *prunings and trimmings*, and *branches & stumps*. The 2012 study classified food in greater detail, and found that even when considered individually, *loose/scrap vegetative food*, *loose/scrap non-vegetative food,* and *packaged vegetative food* were among the top **Compostable** material types.
  - **Recyclable Paper** decreased from **14%** of the waste stream in 2005 to **9%** in 2012. While the portion of recyclable paper in the waste stream has dropped overall, the same key material types were identified in both studies: *cardboard*, *white ledger*, *other miscellaneous paper*, *newspaper*, *magazines & catalogs*.
  - **Other Recyclables** decreased from **29%** in 2005 to **23%** in 2012. Both studies found *lumber/ wood-untreated* and *rock, soil, and fines* to be top material types. However, while all of the top **Other Recyclable** materials in the 2005 study were C&D-related, the 2012 study found that the top materials by weight included *textiles*, *durable plastic items*, *glass bottles & containers*, and *HDPE containers*.
- **Potential Recyclables** increased from **3%** of the waste stream in 2005 to over **6%** of waste in 2012. *Bulky items* and *carpet* were among the most prevalent **Potential Recyclables** in both studies.
- **Problem Materials** decreased slightly as a percentage of Palo Alto's waste, from **25%** in 2005 to **23%** in 2012. While *remainder/composite C&D* was the largest **Problem Material** by weight in 2005, the 2012 study identified *remainder/composite organics* to be the greatest material type.

Figure 11. Overall Recoverability, 2005 vs. 2012

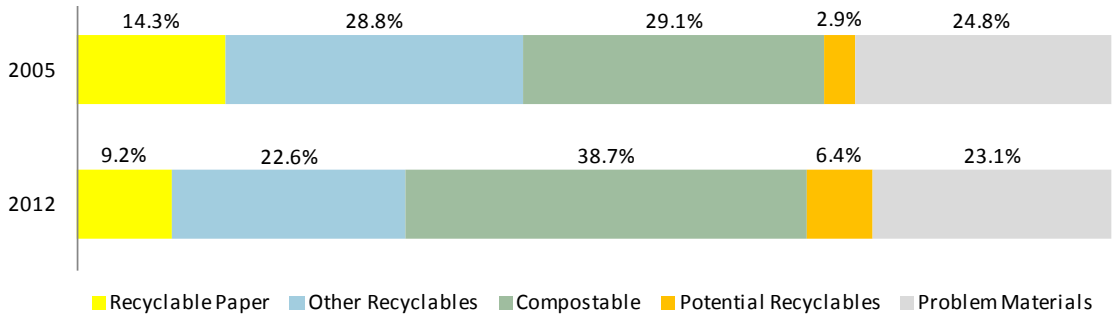


Table 19. Comparison of Overall Findings, 2005 vs. 2012

Metric	2005	2012
Palo Alto disposal	78,200 tons	31,360 tons
Recoverability	72% (56,500 tons) of waste stream is **Recyclable** or **Compostable**	70% (22,100 tons) of waste stream is **Recyclable** or **Compostable**
Compostable material	29% (22,700 tons)	39% (12,125 tons)
	▪ Food	▪ Loose/scrap food
	▪ Compostable paper	▪ Compostable paper
	▪ Leaves & grass	▪ Leaves & grass
	▪ Prunings and trimmings	▪ Pruning and trimmings
	▪ Branches & stumps	▪ Packaged food (vegetative)
Recyclable Paper	14% (11,200 tons)	9% (2,900 tons)
	▪ Other miscellaneous paper	▪ Uncoated cardboard
	▪ Newspaper	▪ Other miscellaneous paper
	▪ Magazines & catalogs	▪ White ledger
	▪ Cardboard	▪ Magazines & catalogs
	▪ White ledger	▪ Newspaper
Other Recyclables	29% (22,500 tons)	23% (7,075 tons)
	▪ Rock, soil and fines	▪ Lumber
	▪ Wood-untreated	▪ Textiles
	▪ Asphalt roofing	▪ Durable plastic items
	▪ Other ferrous metal	▪ Rock, soil and fines
	▪ Gypsum board	▪ HDPE containers
Potential Recyclables	3% (2,300 tons)	6% (2,015 tons)
	▪ Other bulky items	▪ Bulky items
	▪ R/C metal	▪ Carpet
	▪ Carpet	▪ Film products
Problem Materials	25% (19,400 tons)	23% (7,250 tons)
	▪ R/C C&D	▪ R/C organics
	▪ Wood-treated	▪ Mixed residue/MSW
	▪ Other film plastics	▪ Other film
	▪ Diapers	▪ R/C C&D
	▪ R/C paper	▪ Trash bags

Comparison of Key Findings – SMaRT Station Residuals

The key findings for the SMaRT Station residuals in this waste characterization study are compared below with the results for the SMaRT Station residuals from the 2005 characterization study. Figure 12 compares the breakdown of the SMaRT Station residuals by recoverability group in the 2005 and 2012 studies. Table 20 summarizes the key findings from the 2005 and 2012 studies, and compares each recoverability group and the top materials within each group.

- Palo Alto's residual tonnage from the SMaRT Station has decreased by **29%**, from 40,000 tons in 2005 to 28,300 tons in 2012.
- The percentage of the residual stream composed of recoverable material dropped from **77%** in 2005 to about **58%** in 2012.
  - **Compostable** materials account for about the same percentage of the SMaRT Station residuals – **36%** in 2005 and **35%** in 2012. In 2005, *food* was the largest compostable material type; however, in 2012, *compostable paper* was the most prevalent.
  - **Recyclable Paper** decreased from **17%** of the residual stream in 2005 to **8%** in 2012. The two most common **Recyclable Paper** materials in 2005 were *newspaper* and *magazines and catalogs*; in 2012 the top two materials in this recoverability group were *other miscellaneous paper* and *uncoated cardboard*.
  - **Other Recyclables** accounted for **23%** of the residuals in 2005; this dropped to **16%** in 2012. While the top **Other Recyclables** materials in 2005 were largely C&D-related – the most common materials were *rock, soil & fines* and *gypsum board* – by 2012 the top materials in this group had shifted to *HDPE containers* and *textiles*.
- **Problem Materials** accounted for **21%** of the SMaRT Station residuals in 2005; **Problem Materials** increased to **41%** of residuals in 2012. *Other film plastics* and *remainder/composite C&D* were the most common **Problem Materials** in 2005, while in 2012 they were *mixed residue/MSW* and *remainder/composite organics*.
- The **Potential Recyclables** fraction of the residual stream shrank from **2%** in 2005 to **0.7%** in 2012. In 2005 the **Potential Recyclables** consisted of *remainder/composite metal*, *other rubber*, and *carpet*; in 2012 this fraction consisted almost entirely of *film products*.

Figure 12. SMaRT Residuals Recoverability, 2005 vs. 2012

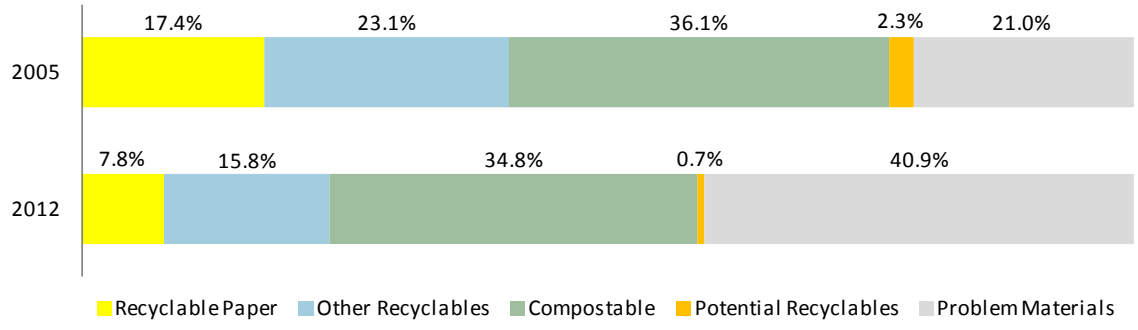


Table 20. Comparison of SMaRT Residuals Findings, 2005 vs. 2012

Metric	2005	2012
SMaRT residuals - Palo Alto	40,000 tons	28,300 tons
Recoverability	77% (30,700 tons) of residual stream is **Recyclable** or **Compostable**	59% (16,557 tons) of residual stream is **Recyclable** or **Compostable**
Compostable material	36% (14,500 tons)	35% (9,865 tons)
	▪ Food ▪ Leaves & grass ▪ Compostable paper ▪ Compostable organics ▪ Prunings and trimmings	▪ Compostable paper ▪ Loose/scrap food (all types) ▪ Pruning and trimmings ▪ Leaves & grass ▪ Packaged food (non-vegetative)
Recyclable Paper	17% (7,000 tons)	8% (2,216 tons)
	▪ Newspaper ▪ Magazines & catalogs ▪ Other miscellaneous paper ▪ Cardboard ▪ White ledger	▪ Other miscellaneous paper ▪ Uncoated cardboard ▪ Magazines & catalogs ▪ White ledger ▪ Newspaper
Other Recyclables	23% (9,200 tons)	16% (4,477 tons)
	▪ Rock, soil and fines ▪ Gypsum board ▪ Other ferrous metal ▪ Textiles ▪ Misc plastic containers	▪ HDPE containers ▪ Textiles ▪ Misc plastic containers ▪ Tin/steel cans ▪ Lumber
Potential Recyclables	2% (900 tons)	0.7% (187 tons)
	▪ R/C metal ▪ Other Rubber ▪ Carpet	▪ Film products ▪ Carpet ▪ Flat glass
Problem Materials	21% (8,400 tons)	41% (11,573 tons)
	▪ Other film plastics ▪ R/C C&D ▪ Diapers ▪ Wood-treated ▪ R/C solid waste	▪ Mixed residue/MSW ▪ R/C organics ▪ Other film ▪ Trash bags ▪ R/C C&D

Appendix A: Material Type Definitions

Paper

1. **Uncoated Corrugated Cardboard** usually has three layers. The center wavy layer is sandwiched between the two outer layers. It 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 boxes such as cereal and tissue boxes.

2. **Paper Bags** means bags and sheets made from kraft paper. The paper may be brown (unbleached) or white (bleached). Examples include paper grocery bags, fast food bags, department store bags, and heavyweight sheets of kraft packing paper.

3. **Newspaper** means paper used in newspapers. Examples include newspaper and glossy inserts found in newspapers, and all items made from newsprint, such as free advertising guides, election guides, and tax instruction booklets.

4. **White Ledger Paper** means bleached, uncolored bond, rag, or stationery grade paper, without ground wood fibers. It may have colored ink on it. When the paper is torn, the fibers are white. Examples include white paper used in photocopiers and laser printers, and letter paper.

5. **Colored Ledger** means colored bond, rag, or stationery grade paper. When the paper is torn, the fibers are colored throughout. Examples include colored photocopy and letter paper. This type does not include fluorescent dyed paper or deep-tone dyed paper such as goldenrod colored paper.

6. **Other Office Paper** means paper used in offices other than ledger and computer paper. Examples include manila folders, manila envelopes, index cards, white envelopes, white window envelopes, notebook paper, ground wood computer paper, junk mail, and carbonless forms. This type does not include white ledger, colored ledger, or computer paper.

7. **Magazines and 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.

8. **Phone Books and Directories** means thin paper between coated covers. These items are bound along the spine with glue. Examples include whole or damaged telephone books, yellow pages, real estate listings, and some non-glossy mail order catalogs.

9. **Compostable Paper** means paper suitable for composting in a commercial-scale facility. Examples include all paper soiled with food such as paper plates, pizza boxes, ice cream cartons, milk cartons, french-fry containers, paper cups, fast food wrappers, napkins, and paper towels, as well as waxed cardboard.

10. **Other Miscellaneous Paper** means items made mostly of paper that do not fit into any of the other paper types. Paper may be combined with minor amounts of other materials such as wax or glues. This type includes items made of chipboard, ground wood paper, and deep-toned or

fluorescent dyed paper. Examples include cereal and cracker boxes, unused paper plates and cups, goldenrod colored paper, school construction paper, butcher paper, frozen food boxes, pulp paper egg cartons, unused pulp paper plant pots, and hard cover and soft cover books.

11. **Remainder/Composite Paper** means items made mostly of paper but combined with large amounts of other materials such as wax, plastic, glues, foil, food, and moisture. Examples include aseptic packages, waxed paper, tissue, blueprints, sepia, onion skin, carbon paper, self adhesive notes, and photographs.

Glass

12. **Glass Bottles and Containers** means clear, green, or brown glass beverage and food containers with or without a CRV label. Examples include whole or broken soda, beer and wine bottles, fruit juice bottles, peanut butter jars, and mayonnaise jars.

13. **Other Colored Glass Bottles and Containers** means colored glass containers and bottles other than green or brown with or without a CRV label. Examples include whole or broken blue or other colored bottles and containers.

14. **Flat Glass** means clear or tinted glass that is flat. Examples include glass window panes, doors and table tops, flat automotive window glass (side windows), safety glass, and architectural glass. This type does not include windshields, laminated glass, or any curved glass.

15. **Remainder/Composite Glass** means glass that cannot be put in any other type. It includes items made mostly of glass but combined with other materials. Examples include Pyrex, Corningware, crystal and other glass tableware, mirrors, light bulbs, and auto windshields.

Metal

16. **Tin/Steel Cans** means rigid containers made mainly of steel. These items will stick to a magnet and may be tin-coated. This type is used to store food, beverages, paint, and a variety of other household and consumer products. Examples include canned food and beverage containers, empty metal paint cans, empty spray paint and other aerosol containers, and bimetal containers with steel sides and aluminum ends.

17. **Major Appliances** means discarded major appliances of any color. These items are often enamel-coated. Examples include washing machines, clothes dryers, hot water heaters, stoves, and refrigerators. This type does not include electronics, such as televisions and stereos.

18. **Used Oil Filters** means metal oil filters used in motor vehicles and other engines, which contain a residue of used oil.

19. **Other Ferrous** means any iron or steel that is magnetic or any stainless steel item. This type does not include tin/steel cans. Examples include structural steel beams, metal clothes hangers, metal pipes, stainless steel cookware, security bars, and scrap ferrous items.

20. **Aluminum Cans** means any food or beverage container made mainly of aluminum. Examples include aluminum soda or beer cans, and some pet food cans. This type does not include bimetal containers with steel sides and aluminum ends.

21. **Other Non-Ferrous** means any metal item, other than aluminum cans, that is not stainless steel and that is not magnetic. These items may be made of aluminum, copper, brass, bronze, lead, zinc, or other metals. Examples include aluminum window frames, aluminum siding, copper wire, shell casings, brass pipe, and aluminum foil.

22. **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 non-ferrous metal combined. Examples include small non-electronic appliances such as toasters and hair dryers, 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.

Electronics

23. **Brown Goods** means generally larger, non-portable electronic goods that have some circuitry. Examples include microwaves, stereos, VCRs, DVD players, radios, audio/visual equipment, and non-CRT televisions (such as LCD televisions).

24. **Computer-related Electronics** means electronics with large circuitry that is computer-related. Examples include processors, mice, keyboards, laptops, disk drives, printers, modems, and fax machines.

25. **Other Small Consumer Electronics** means portable non-computer-related electronics with large circuitry. Examples include personal digital assistants (PDA), cell phones, phone systems, phone answering machines, computer games and other electronic toys, portable CD players, camcorders, and digital cameras.

26. **Televisions and Other Items with CRTs**. Examples include televisions, computer monitors, and other items containing a cathode ray tube (CRT).

Plastics

27. **PETE Containers** means clear or colored PETE (polyethylene terephthalate) containers. 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. The color is usually transparent green or clear. A PETE container usually has a small dot left from the manufacturing process, not a seam. It does not turn white when bent. Examples include soft drink and water bottles, some liquor bottles, cooking oil containers, and aspirin bottles.

28. **HDPE** Containers means natural and colored HDPE (high-density polyethylene) 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. Examples include milk jugs, water jugs, detergent bottles, some hair-care bottles, empty motor oil, empty antifreeze, and other empty vehicle and equipment fluid containers.

29. **Miscellaneous Plastic Containers** means plastic containers made of types of plastic other than HDPE (high-density polyethylene) or PETE (polyethylene terephthalate). Items may be made of PVC (polyvinyl chloride), LDPE (low-density polyethylene), PP (polypropylene), PS (polystyrene),

or mixed resins. When marked for identification, these items may bear the number 3, 4, 5, 6, or 7 in the triangular recycling symbol. Examples include food containers such as bottles for salad dressings and vegetable oils, flexible and brittle yogurt cups, syrup bottles, margarine tubs, microwave food trays, and clamshell-shaped fast food containers. This type also includes some shampoo containers, vitamin bottles, foam egg cartons, and clamshell-like muffin containers.

30. **Trash Bags** means plastic bags sold for use as trash bags, for both residential and commercial use. This type does not include other plastic bags, like shopping bags, that might have been used to contain trash.

31. **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. This type includes dry cleaning bags intended for one-time use, newspaper bags, produce bags, and bread bags.

32. **Non-Bag 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.

33. **Film Products** means plastic film used for purposes other than packaging. Examples include agricultural film (films used in various farming and growing applications, such as silage greenhouse films, mulch films, and wrap for hay bales), plastic sheeting used as drop cloths, and building wrap.

34. **Other Film** means all other plastic film that does not fit into any other type. Examples include other types of plastic bags (sandwich bags, zipper-recloseable bags, and frozen vegetable bags), food wrappers such as candy bar wrappers, mailing pouches, bank bags, X-ray film, metallized film (wine containers and balloons), and plastic food wrap.

35. **Durable Plastic Items** means plastic items other than containers and film plastic that are often made to last for more than one use. These items may bear the numbers 1 through 7 in the triangular recycling symbol. Examples include plastic outdoor furniture, plastic toys and sporting goods, CDs, tooth brushes, and plastic housewares, such as mop buckets, dishes, cups, and cutlery. This type also includes building materials such as house siding, window sashes and frames, housings for electronics such as computers, televisions and stereos, fan blades, impact-resistant cases such as tool boxes and first aid boxes, and plastic pipes and fittings.

36. **EPS means** items made from expanded polystyrene foam. Examples include drinking cups, egg cartons, meat trays, packing blocks, packing peanuts, plates and bowls, and take-out containers.

37. **Remainder/Composite Plastic** means plastic that cannot be put in any other type. These items are usually recognized by their optical opacity. 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, cup lids, produce trays, cookie trays found in cookie packages, plastic strapping, and new Formica, vinyl, or linoleum.

Other Organic

38. **Packaged Vegetative Food—**any vegetative food item such as pasta, grains, baked goods, beans, fruits, vegetables, sauces, soda, tea, juice and water where the package has remained

intact. In the sorter's judgment, packaged vegetative food items *could* have been donated to a food bank or similar organization, rather than disposed. This category may include fresh fruits and vegetables (packaged in waxed boxes, for example) if, in the sorter's judgment, the food was not spoiled at the time of disposal.

39. **Unpackaged or Scrap Vegetative Food—**any vegetative food item such as pasta, grains, backed goods, beans, coffee grounds, fruits, vegetables, sauces, soda, tea bags, juice, water, and ice where the package has been opened or broken, the item is unpackaged, or where the vegetative food is found in scraps or pieces. In the sorter's judgment, theses food items *would not have been* acceptable for donation.

40. **Packaged Non-vegetative Food—**any non-vegetative food item such as fresh or canned meat or fish, cheeses, eggs, dairy items, and chili or soup containing meat, where the package has remained intact. In the sorter's judgment, packaged non-vegetative food items *could* have been donated to a food bank or similar organization, rather than disposed.

41. **Unpackaged, or Scrap Non-vegetative Food—**any non-vegetative food item such fresh or canned meat or fish, cheeses, eggs, dairy items, and chili or soup containing meat, where the package has been opened or broken, the item is unpackaged, or where the food is found in scraps or pieces. In the sorter's judgment, theses food items *would not have been* acceptable for donation.

42. **Leaves and Grass** means plant material, except woody material, from any public or private landscapes. Examples include leaves, grass clippings, plants, and seaweed. This type does not include woody material or material from agricultural sources.

43. **Prunings and Trimmings** means woody plant material up to 4 inches in diameter from any public or private landscape. Examples include prunings, shrubs, and small branches with branch diameters that do not exceed 4 inches. This type does not include stumps, tree trunks, branches exceeding 4 inches in diameter, or material from agricultural sources.

44. **Branches and Stumps** means woody plant material, branches, and stumps that exceed 4 inches in diameter, from any public or private landscape.

45. **Agricultural Crop Residues** means plant material from agricultural sources. Examples include orchard and vineyard prunings, vegetable by products from farming, residual fruits, vegetables, and other crop remains after the usable crop is harvested. This type does not include processed residues from canneries, wineries, or other industrial sources.

46. **Manures** means manure and soiled bedding materials from domestic, farm, or ranch animals. Examples include manure and soiled bedding from animal production operations, race tracks, riding stables, animal hospitals, and other sources.

47. **Textiles** means items made of thread, yarn, fabric, or cloth. Examples include clothes, fabric trimmings, draperies, and all natural and synthetic cloth fibers. This type does not include cloth covered furniture, mattresses, leather shoes, leather bags, or leather belts.

48. **Carpet** means flooring applications consisting of various natural or synthetic fibers bonded to some type of backing material. This type does not include carpet padding.

49. **Remainder/Composite Organic** means organic material that cannot be put in any other type. This type includes items made mostly of organic materials, but combined with other material types. Examples include leather items, cork, hemp rope, garden hoses, rubber items, hair, carpet padding, cigarette butts, diapers, feminine hygiene products, small wood products (such as Popsicle sticks and tooth picks), sawdust, animal carcasses and animal feces.

Construction and Demolition

50. **Concrete** means a hard material made from sand, aggregate, gravel, cement mix and water. Examples include pieces of building foundations, concrete paving, and concrete/cinder blocks.

51. **Asphalt Paving** means a black or brown, tar-like material mixed with aggregate used as a paving material.

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

53. **Lumber** means processed wood for building, manufacturing, landscaping, packaging, and processed wood from demolition. Examples include dimensional lumber, lumber cutoffs, engineered wood such as plywood and particleboard, wood scraps, pallets, wood fencing, wood shake roofing, and wood siding.

54. **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. Gypsum board may also be called sheetrock, drywall, plasterboard, gypboard, gyproc, or wallboard.

55. **Rock, Soil and Fines** means rock pieces of any size and soil, dirt, and other matter. Examples include rock, stones, sand, clay, soil and other fines. This type also includes non-hazardous contaminated soil.

56. **Remainder/Composite Construction and Demolition** means construction and demolition material that cannot be put in any other type. This type may include items from different types combined, which would be very hard to separate. Examples include brick, ceramics, tiles, toilets, sinks, and fiberglass insulation. This type may also include demolition debris that is a mixture of items such as plate glass, wood, tiles, gypsum board, and aluminum scrap.

Household Hazardous Waste

57. **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.

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

59. **Used Oil** means the same as defined in Health and Safety Code section 25250.1(a). Examples include spent lubricating oil such as crankcase and transmission oil, gear oil, and hydraulic oil.

60. **Batteries** means any type of battery including both dry cell and lead acid. Examples include car, flashlight, small appliance, watch, and hearing aid batteries.

61. **Remainder/Composite Household Hazardous** means household hazardous material that cannot be put in any other type. This type also includes household hazardous material that is mixed. Examples include household hazardous waste which if improperly put in the solid waste stream may present handling problems or other hazards, such as pesticides, caustic cleaners, and fluorescent light bulbs.

Special Waste

62. **Ash** means a residue from the combustion of any solid or liquid material. Examples include ash from fireplaces, incinerators, biomass facilities, waste-to-energy facilities, and barbecues. This type also includes ash and burned debris from structure fires.

63. **Sewage Solids** means residual solids and semi-solids from the treatment of domestic waste water or sewage. Examples include biosolids, sludge, grit, screenings, and septage. This type does not include sewage or waste water discharged from the sewage treatment process.

64. **Industrial Sludge** means sludge from factories, manufacturing facilities, and refineries. Examples include paper pulp sludge, and water treatment filter cake sludge.

65. **Treated Medical Waste** means medical waste that has been processed in order to change its physical, chemical, or biological character or composition, or to remove or reduce its harmful properties or characteristics, as defined in Section 25123.5 of the Health and Safety Code.

66. **Bulky Items** means large hard to handle items that are not defined elsewhere in the material types list, including furniture, mattresses, and other large items. Examples include all sizes and types of furniture, mattresses, box springs, and base components.

67. **Tires** means vehicle tires. Examples include tires from trucks, automobiles, motorcycles, heavy equipment, and bicycles.

68. **Remainder/Composite Special Waste** means special waste that cannot be put in any other type. Examples include asbestos-containing materials such as certain types of pipe insulation and floor tiles, auto fluff, auto bodies, trucks, trailers, truck cabs, untreated medical waste/pills/hypodermic needles, and artificial fireplace logs.

Mixed Residue

69. **Mixed Residue** means material that cannot be put in any other type or category. This category includes mixed residue that cannot be further sorted. Examples include clumping kitty litter and residual material from a materials recovery facility or other sorting process that cannot be put in any other material type, including remainder/composite types.

Appendix B: Study Design

This section presents the study plan as it was written prior to collecting and characterizing waste samples.

Sampling Universe and Sampling Strata

The first step in planning a waste characterization study is to identify and carefully define the waste streams that will be studied, or the "universe" of waste. In this study, the universe will include six waste sectors. A sector is determined by the particular generation, collection, or composition characteristics that make it a unique portion of the total waste stream.

The six sectors considered in this characterization include single-family waste, multifamily waste, commercial front-load and compactor waste, commercial loose roll-off waste, self-haul waste, and SMaRT Station residuals.

- **Residential** waste is generated by single family and multifamily residences.
    1. **Single-family waste** is waste GreenWaste of Palo Alto collects from single-family residences (single family homes and townhouses or buildings with up to four residential units). It typically arrives at the SMaRT Station in packer trucks (e.g., side loaders, front loaders, etc.).
    2. **Multifamily waste** is waste GreenWaste of Palo Alto collects from multifamily residences (apartments or condominiums with more than four residential units). It typically arrives at the SMaRT Station in packer trucks (e.g., front loaders). GreenWaste typically collects multifamily waste in the same truck as commercial waste. During this study GreenWaste will collect multifamily waste on a special route separate from commercial waste.
- **Commercial waste** is waste GreenWaste of Palo Alto collects from businesses, institutions, public venues, schools, and industrial sources. It typically arrives at the SMaRT Station in packer trucks (e.g., front loaders), compactor units, or open-top roll-off containers. For the purposes of this study, commercial waste will be divided based on collection vehicle/container type:
    3. **Commercial packer** (a front-load, side-load, or rear-load self-contained compacting vehicle) **and compactor** (a roll-off compactor unit) **waste**.
    4. **Commercial loose roll-off waste** (an un-compacted open-top roll-off container, commonly referred to as a "debris box" or "drop-box").
- **Self-haul waste** includes all waste that is brought to solid waste facilities by parties other than GreenWaste of Palo Alto. It typically arrives at the SMaRT Station in a variety of vehicles, such as cars, pick-up trucks, and small end-dump trucks, or in drop boxes.
- **SMaRT Station residuals** are waste produced as by products from the SMaRT Station's material recovery facility (MRF). Residuals do not include fines material screened from the trommels.

Sampling Calendar and Allocation of Samples

A total of 160 samples will be characterized for this study. Table 21 summarizes the sample targets by sector.

Table 21. Sampling Allocation by Sector

Sector	Number of Samples	Sorting Method
Residential waste	**30**	
Single-family waste	*20*	*Hand-sort*
Multifamily waste	*10*	*Hand-sort*
Commercial waste	**60**	
Packer and compactor waste	*40*	*Hand-sort*
Loose roll-off	*20*	Visuals
Self-haul	**40**	Visuals
SMaRT Station Residuals	**30**	*Hand-sort*
Total	**160**	

Sampling will occur over 10 days between October 22nd and November 1st, 2012 at the SMaRT Station. The following table presents the daily sample targets by sector.

Table 22. Daily Sample Targets By Sector

	Residential		Commercial				
Day	Singlefamily	Multifamily	Packer & compactor	Loose Roll-off	Self-haul	SMaRT Residuals	Total
10/22/2012	2	1	5	4	6	2	**20**
10/23/2012	3	1	4	4	6	2	**20**
10/24/2012	2	2	4	4	6	2	**20**
10/25/2012	3	1	4	4	6	2	**20**
10/26/2012	3	1	4	4	6	2	**20**
10/27/2012	0	0	3	0	10	7	**20**
10/29/2012	2	1	4	0	0	3	**10**
10/30/2012	2	1	4	0	0	3	**10**
10/31/2012	2	1	4	0	0	3	**10**
11/1/2012	1	1	4	0	0	4	**10**
Total	**20**	**10**	**40**	**20**	**40**	**30**	**160**

Selecting and Characterizing Samples

Load Selection

The procedures field crews will use to select a load for sampling will vary by the waste sector. Loads from sectors with regularly scheduled waste collection will be pre-selected, while loads from sectors without regularly scheduled waste collection will be systematically selected on each day of sampling. The SMaRT Station residuals will be selected throughout each sampling day at pre-determined time intervals. Table 23 summarizes the load selection method to be used for each sector.

Table 23. Load Selection Method by Jurisdiction and Sector

Sector	Load Selection Method
Residential waste	
Single-family waste	*Pre-selected*
Multifamily waste	*Pre-selected*
Commercial waste	
Packer and compactor waste	*Pre-selected*
Loose Roll-off	Systematic Selection
Self-haul	Systematic selection
SMaRT Station Residuals	Sampled throughout day at pre-determined intervals

The three selection methods are described below.

Pre-selected Loads

Loads of single-family, multifamily, and commercial packer and compactor waste will be pre-selected for sampling. A driver often tips more than one load per route; in these instances, a specific tip (first tip, second tip, etc.) will be designated for sampling. As a starting point for load selection, GreenWaste will provide a list all of their Palo Alto routes. The list of loads (including tip number) will be sorted by day of service. Loads will be randomly selected using Excel's random number generator until the daily load selection goals are realized. Daily *Vehicle Selection Forms* will summarize selected loads for each sampling day. See Appendix B for examples of all field forms.

The scale house staff will receive a list pre-selected loads and expected truck numbers for each sampling day. When a designated vehicle arrives at the scale house and is selected for sampling, the scale house operator will place a *Sample Placard* on the windshield of the vehicle and direct the vehicle to the sorting area.

The manager of the sampling crew will have a list of the eligible routes and vehicles for each day. When a single-family, multifamily, or commercial load is directed to the sampling crew, the sampling manager will verify the vehicle against the list and will verify that the vehicle contains the correct type of waste.

Systematically Selected Loads

For loose roll-off and self-hauled loads, Cascadia shall present the scale house staff with a separate *Vehicle Selection Form* for choosing vehicles to send to the sampling area at designated intervals. Scalehouse attendants will use the *Vehicle Selection Form* to select loads using systematic selection: selecting every "n^{th}" vehicle that enters the facility after a randomly selected start time. The sampling interval (n) will be determined for each sector by dividing the day's expected vehicle count in that sector by the number of samples needed in that sector on that day. The day's expected vehicle count will be based on vehicle traffic data provided by the SMaRT Station. When a roll-off or self-haul vehicle is selected for sampling, the attendant will place a *Sample Placard* on that vehicle's windshield or ask the driver to place it on the vehicle dashboard. The attendant will direct the selected loads to the designated sampling area.

SMaRT Station Residuals

SMaRT Station residuals will be sampled at randomly selected intervals throughout the sampling period. The manager of the sampling crew will work with the loader operator to obtain samples at intervals throughout the week. The manager of the sampling crew will be responsible for coordinating sample relocation throughout the sampling day.

Sample Characterization

Depending on the sector, samples will be either hand-sorted or visually characterized using the methods described in this section. The following table identifies which method will be used and the target sample size for each waste sector.

Table 24. Sample Characterization Method by Sector

Sector	Characterization Method	Approximate Target Sample Size
Residential waste		
Single-family waste	*Hand-sort*	*200 pounds*
Multifamily waste	*Hand-sort*	*200 pounds*
Commercial waste		
Packer and compactor waste	*Hand-sort*	*200 pounds*
Loose roll-off	*Visual*	*Entire load*
Self-haul	Visual	Entire load
SMaRT Station Residuals	Hand-sort	100 pounds

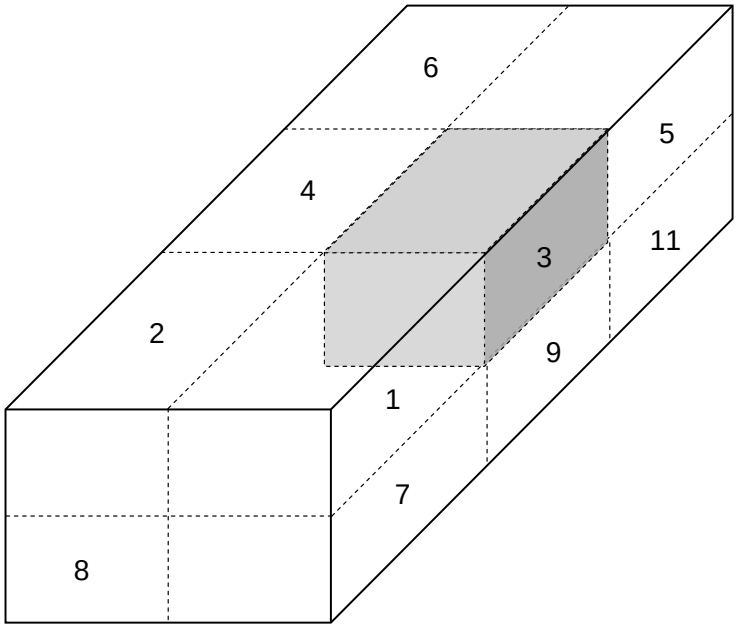
Sample Characterization – Hand Sort

A sampling crew will use the following protocol to characterize single-family, multifamily, and commercial packer and compactor samples. When a selected vehicle arrives at the sampling area, the sampling manager will retrieve the *Sample Placard* and record the load information on the *Material Weight Tally Sheet.* The sampling manager will also record all subsequent sampling data on the *Material Weight Tally Sheet*.

After the driver dumps a selected load in an elongated pile, the sampling manager will superimpose an imaginary 16-cell grid over the dumped material. The sampling manager will identify a randomly selected cell from that grid and will direct the loader operator to extract a sample of waste from that cell weighing approximately 200 pounds. The loader will place the extracted material on a clean tarp.

Figure 13 is an example of the imaginary grid that is used to visually divide each selected load. In this example, cell three is selected.

Figure 13. Rectangular Representation of a Load Showing "Cells" of Material



After the sample is extracted from the load, the sampling manager and a sampling crew will sort the sample using the following procedure.

Step 1. Photograph the sample. Using a digital camera, the sampling manager will take at least two photographs of the sample. The *Sample Placard* that identifies each load will be positioned so it is visible in each photograph.

Step 2. Sort the sample. The sampling crew will sort samples by material type into plastic laundry baskets. The sampling manager will monitor the homogeneity of material in the baskets as they accumulate, rejecting any materials that are improperly classified. Each sample will be sorted to the greatest reasonable detail. Any remaining fines will be categorized as *mixed residue*.

Step 3. Weigh and record data. The sampling manager will verify the purity of each material as it is weighed in its basket using a pre-calibrated scale, and shall record each material weight on the *Material Weight Tally Sheet*.

Sample Characterization – Visual

The sampling crew's visual characterization specialist will use the following protocol to characterize commercial loose roll-off and self-hauled loads. For these samples, the specialist will visually characterize the entire load. Characterizing the entire load produces findings that are more accurate than sub-sampling for loads that contain heavy, bulky, and highly variable materials. This visual characterization method is described below.

When a selected vehicle arrives at the sampling area, the visual characterization specialist will retrieve the *Sample Placard* and record the load information on the *Sample Characterization Form*. Then, the

visual characterization specialist will use the seven-step visual characterization protocol to characterize the samples. All sampling data will be recorded on the *Sample Characterization Form*.

Step 1. Photograph the load. Using a digital camera, the visual characterization specialist will take at least two photographs of the load. The *Sample Placard* that identifies each load will be positioned so it is visible in each paragraph.

Step 2. Record major material classes that are present. The visual characterization specialist will walk entirely around the sample and indicate on the *Sample Characterization Form* which major material classes are present.

Step 3. Estimate composition by volume for each major material class. Beginning with the largest major material class, by volume, the visual characterization specialist will estimate the volumetric percentage of the class and record it on the form. An example of a major material class is **Paper**. This process will be repeated for the next most common material class, and so forth, until the volumetric percentage of every material class has been estimated.

Step 4. Estimate composition by volume for each specific material component. The visual characterization specialist will then estimate the volumetric percentage of each specific material component in each class. For example, the visual specialist will estimate the volumetric percentage of **Paper** materials that is composed of *newspaper*. The visual specialist will then do the same for every other specific material component within the **Paper** material class (such as *uncoated corrugated cardboard* and *office paper*).

Step 5. Check and reconcile percentage data. The visual characterization specialist will then check to ensure that the volumetric percentage estimates for the major material classes add up to 100 percent, and that the volumetric percentage estimates for the specific material components within the major classes total 100 percent.

QA/QC Procedures

To minimize data collection errors and maximize composition estimate accuracy, Cascadia will implement the following quality assurance/quality control procedures.

- Train the scale house personnel to select samples.
- Train the sampling crew to capture and weigh samples.
- Check all sample characterization field forms to ensure that forms are complete and data is properly recorded.
- Enter all characterization data into a customized Microsoft Access database.
- Conduct an inspection of randomly selected records to monitor the accuracy of the data entry process.

Safety Procedures

All personnel involved in surveying and sampling will comply with SMaRT Station safety protocols and will wear appropriate safety gear, including:

- High visibility clothing,

- A hard hat,
- Steel toe boots, and
- Safety glasses.

In addition, gloves, hearing protection, and dust masks will be worn as needed.

Method for Obtaining Tonnage Data

Accurate tonnage information is necessary to compile the composition and quantity analysis. It is expected that the City of Palo Alto will provide annual tonnage data for each of the six sampling sectors:

- Single-family waste
- Multifamily waste
- Commercial packer waste
- Commercial loose roll-off waste
- Self-haul waste
- SMaRT Station Residuals

Appendix C: Waste Characterization Calculations

Estimating Waste Composition

Waste composition estimates were calculated using a method that gave equal weighting or "importance" to each sample within a given stratum. Confidence intervals (error ranges) were calculated based on assumptions of normality in the composition estimates.

In the descriptions of calculation methods, the following variables are used frequently:

- *i* denotes an individual sample;
- *j* denotes the material type;
- c_j is the weight of the material type *j* in a sample;
- *w* is the weight of an entire sample;
- r_j is the composition estimate for material *j* (*r* stands for *ratio*);
- *s* denotes a particular sector or subsector of the waste stream; and
- *n* denotes the number of samples in the particular group that is being analyzed at that step.

Estimating the Composition

The following method was used to estimate the composition of Palo Alto's waste.

For a given stratum (that is, for the samples belonging to the same waste sector within the same jurisdiction), the composition estimate denoted by r_j represents the ratio of the component's weight to the total weight of all the samples in the stratum. This estimate was derived by summing each component's weight across all of the selected samples belonging to a given stratum and dividing by the sum of the total weight of waste for all of the samples in that stratum, as shown in the following equation:

$$r_j = \frac{\sum_i c_{ij}}{\sum_i w_i}$$

where:

- *c* = weight of particular component;
- *w* = sum of all component weights;
- for *i* = 1 to *n*, where *n* = number of selected samples; and
- for *j* = 1 to *m*, where *m* = number of components.

For example, the following simplified scenario involves three samples. For the purposes of this example, only the weights of the component *carpet* are shown.

	Sample 1	**Sample 2**	**Sample 3**
Weight (*c*) of carpet (in lbs)	5	3	4
Total Sample Weight (*w*) (in lbs)	80	70	90

$$r_{Carpet} = \sum \frac{5+3+4}{80+70+90} = 0.05$$

To find the composition estimate for the component *carpet*, the weights for that material are added for all selected samples and divided by the total sample weights of those samples. The resulting composition is 0.05, or 5%. In other words, 5% of the sampled material, by weight, is *carpet*. This finding is then projected onto the stratum being examined in this step of the analysis.

The confidence interval for this estimate was derived in two steps. First, the variance around the estimate was calculated, accounting for the fact that the ratio included two random variables (the component and total sample weights). The variance of the ratio estimator equation follows:

$$\mathrm{Var}(r_j) \approx \left(\frac{1}{n}\right)\left(\frac{1}{\overline{w}^2}\right)\left(\frac{\sum_i \left(c_{ij} - r_j w_i\right)^2}{n-1}\right)$$

where:

$$\overline{w} = \frac{\sum_i w_i}{n}$$

(For more information regarding Equation 2, refer to *Sampling Techniques, 3rd Edition* by William G. Cochran [John Wiley & Sons, Inc., 1977].)

Second, precision levels at the 90% confidence level were calculated for a component's mean as follows:

$$r_j \pm \left(z\sqrt{\mathrm{Var}(r_j)}\right)$$

where *z* = the value of the *z*-statistic (1.645) corresponding to a 90% confidence level.

Composition results for strata were then combined, using a weighted averaging method, to estimate the composition of larger portions of the waste stream. The relative tonnages associated with each stratum served as the weighting factors. The calculation was performed as follows:

$$O_j = \left(p_1 * r_{j1}\right) + \left(p_2 * r_{j2}\right) + \left(p_3 * r_{j3}\right) + \ldots$$

where:

- p = the proportion of tonnage contributed by the noted waste stratum (the weighting factor);
- r = ratio of component weight to total waste weight in the noted waste stratum (the composition percent for the given material component); and
- for j = 1 to m, where m = number of material components.

For example, the above equation is illustrated here using three waste strata.

	Stratum 1	**Stratum 2**	**Stratum 3**
Ratio (r) of carpet	5%	10%	10%
Tonnage	25,000	100,000	50,000
Proportion of tonnage (*p*)	14.3%	57.1%	28.6%

To estimate the portion of larger portions of the waste stream, the composition results for the three strata are combined as follows.

$$O_{Carpet} = (0.143 * 0.05) + (0.571 * 0.10) + (0.286 * 0.10) = 0.093 = 9.3\%$$

Therefore, 9.2% of this examined portion of the waste stream is *carpet*.

The variance of the weighted average was calculated as follows:

$$\mathrm{Var}(O_j) = \left(p_1^2\ \mathrm{Var}(r_{j1})\right) + \left(p_2^2\ \mathrm{Var}(r_{j2})\right) + \left(p_3^2\ \mathrm{Var}(r_{j3})\right) + \ldots$$

Estimating Composition of Palo Alto's Overall Disposed Waste Stream

Composition results for all waste sectors were combined, using a weighted averaging method, to estimate the composition of the entire Palo Alto waste stream. The relative tonnages associated with each sector served as the weighting factors. The calculation was performed as follows:

$$O_j = \left(p_1 * r_{j1}\right) + \left(p_2 * r_{j2}\right) + \left(p_3 * r_{j3}\right) + \ldots$$

where:

- p = the proportion of tonnage contributed by the noted waste sector (the weighting factor);
- r = ratio of component weight to total waste weight in the noted waste sector (the composition percent for the given material component); and
- for j = 1 to m, where m = number of material components.

The following scenario illustrates the above equation. This example involves the component *carpet* in three waste sectors.

	Waste Sector 1	Waste Sector 2	Waste Sector 3
Ratio of carpet (*r*)	0.05	0.10	0.15
Proportion of Tonnage (*p*)	50%	25%	25%

$$O_{Carpet} = (0.50 * 0.05) + (0.25 * 0.10) + (0.25 * 0.15) = 0.0875$$

So, it is estimated that 0.0875 or 8.75% of the entire waste stream is composed of *carpet*.

The variance of the weighted average was calculated as follows:

$$\mathrm{Var}(O_j) = \left(p_1^2 \ \mathrm{Var}(r_{j1})\right) + \left(p_2^2 \ \mathrm{Var}(r_{j2})\right) + \left(p_3^2 \ \mathrm{Var}(r_{j3})\right) + \ldots$$

Appendix D: Example Field Forms

This appendix contains examples of the field forms used throughout the study, including:

- Vehicle selection sheet
- Sample placard
- Sample tally sheet

Scalehouse Vehicle Selection Sheet

If found please call 408-533-0745, reward offered

2012 Waste Characterization Study

Facility Vehicle Selection Form

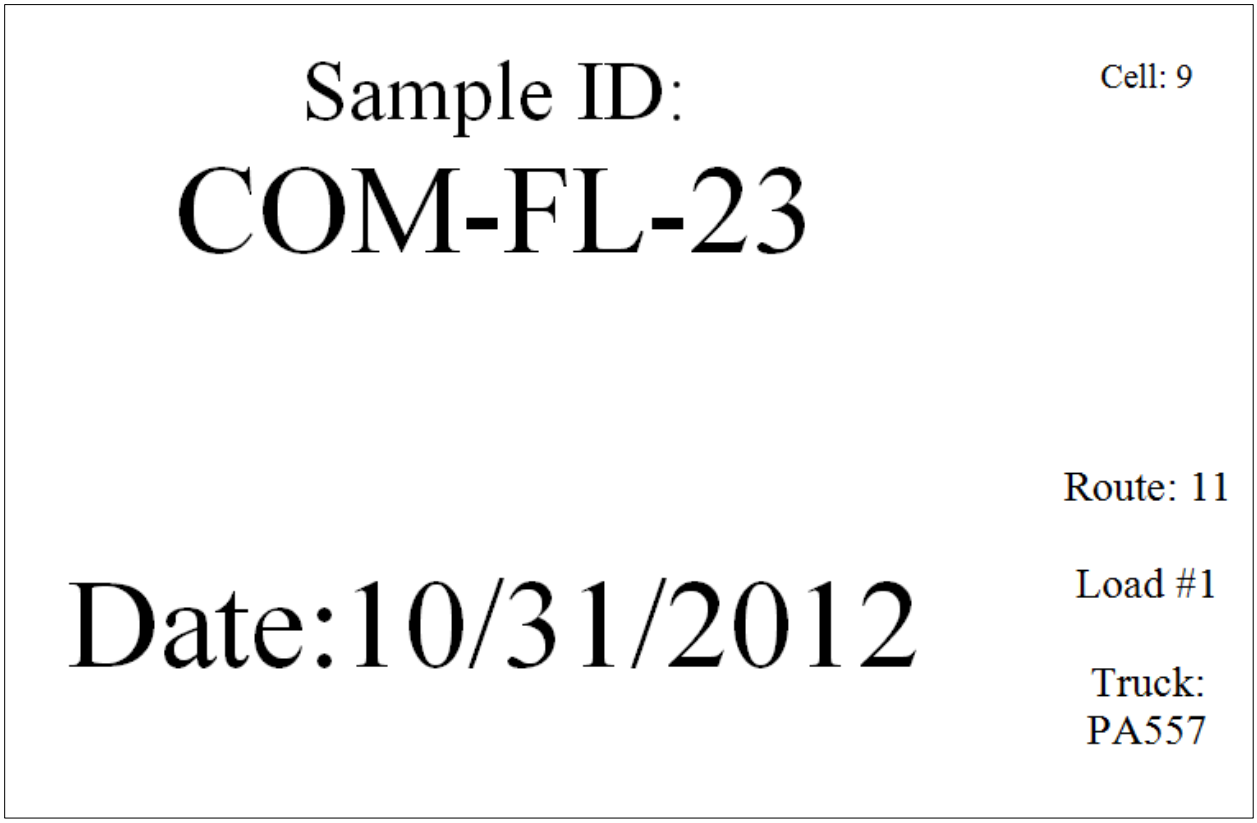
Date: **Friday October 26, 2012**

Facility: **SMaRT Station**

When the driver of the following loads arrive at your facility please direct them to tipping area set aside for selected study vehicles.

Truck #	Hauler	Rte	City/Origin	Res, Comm, SH	Comments/Notes
PA561	GreenWaste	M2	Palo Alto	Res	Truck arrives around 8:45am.
PA565	GreenWaste	M6	Palo Alto	Res	Truck arrives around 8:30am.
PA564	GreenWaste	M5	Palo Alto	Res	Truck arrives around 9:00am.
PA562	GreenWaste	M3	Palo Alto	Res	Truck arrives around 9:00am.
	GreenWaste	Special	Palo Alto	Res	This is a special Multifamily route. Truck arrives after 8:00 am.
PA557	GreenWaste	11	Palo Alto	Comm	Truck arrives around 7:30am.
PA555	GreenWaste	22	Palo Alto	Comm	Truck arrives around 10:00am.
PA551	GreenWaste	20	Palo Alto	Comm	Truck arrives around 10:45am.
PA554	GreenWaste	21	Palo Alto	Comm	Truck arrives around 11:15am.
Roll Off	GreenWaste	30	Palo Alto	Comm	Send first compactor from Palo Alto to sampling area. (1) 2 3 4 5 6 7 8 9 10
Roll Off	GreenWaste	30	Palo Alto	Comm	Send every open-top roll-off from Palo Alto to sampling area.
			Palo Alto	SH	Send every self-haul from Palo Alto, including City vehicles

Sample Placard



Hand-sort Data Entry Sheet

Page 1

City of Palo Alto WCS Refuse Sort Field Data Sheet

Sample ID:_____ Crew Chief: _____

Date: _____ Time: _____ Location: _SMaRT_

	No.	Material Group	Gross Weight	Weight (Circle if net weight)
PAPER	1	Uncoated Corrugated Cardboard		
	2	Kraft Paper Bags		
	3	Newspaper		
	4	White Ledger Paper		
	5	Colored Ledger		
	6	Other Office Paper		
	7	Magazines/Catalogs		
	8	Phone Books & Directories		
	9	Compostable Paper		
	10	Other Miscellaneous Paper		
	11	Remainder/Composite Paper		
PLASTIC	12	#1 PETE Containers		
	13	#2 HDPE Containers		
	14	Miscellaneous Plastic Containers		
	15	Trash Bags		
	16	Retail Plastic Bags		
	17	Non-Bag Commercial Film		
	18	Film Products		
	19	Other Film		
	20	Durable Plastic Items		
	21	Expanded Polystyrene		
	22	Remainder/Composite Plastic		
GLASS	23	Glass Bottles/Containers		
	24	Other Color Glass Bottles/Cont.		
	25	Flat Glass		
	26	Remainder/Composite Glass		
METAL	27	Tin/Steel Cans		
	28	Major Appliances		
	29	Other Ferrous		
	30	Aluminum Cans		
	31	Other Non-Ferrous		
	32	Remainder/Composite Metal		

Notes:

Sample ID:_____ **Refuse**

Date: _____ Time: _____ Location: SMaRT

	No.	Material Group	Gross Weight	Weight (Circle if net weight)
ORGANIC	33	Packaged Vegetative Food		
	34	Unpackaged Vegetative Food		
	35	Packaged Non-Vegetative Food		
	36	Unpackaged Non-Vegetative Food		
	37	Leaves and Grass		
	38	Prunings and Trimmings <4"		
	39	Branches and Stumps >4"		
	40	Agricultural Crop Residue		
	41	Manures		
	42	Textiles		
	43	Carpet		
	44	Remainder/Composite Organic		
C&D	45	Concrete		
	46	Asphalt Paving		
	47	Asphalt Roofing		
	48	Lumber		
	49	Gypsum Board		
	50	Rock/Soil/Fines		
	51	Remainder/Composite / Inerts		
ELECTRON	52	Brown Goods		
	53	Computer-Related Electronics		
	54	Other Small Electronics		
	55	Televisions & Other CRTs		
HHW	56	Paint		
	57	Vehicle and Equipment Fluids		
	58	Used Oil		
	59	Used Oil Filters		
	60	Batteries		
	61	Remainder/Composite HHW		
SPECIAL WASTE	62	Ash		
	63	Sewage Solids		
	64	Industrial Sludge		
	65	Treated Medical Waste		
	66	Bulky Items		
	67	Tires		
	68	Remainder/Composite Waste		
	69	Mixed Residue		

Visual Characterization Data Entry Sheet

Sample ID:_____ Truck #_____ Date:_____/_____/_____ Palo Alto Visual Tally Form 2012

Step 1:

Load info (circle)

Truck: RO (open) SH

Hauler: GW Public CPA

Other: _____

Step 2a: Measure & record load volume.

Dimensions:

_____ft. X _____ft. X _____ft.

OR Total Yards in Truck_____

Step 2b. Record net weight of load.

Net Wt. of Load_____

Step 3: Photograph load.

Step 4: Identify and record all broad material categories (in bold) that appear in the load.

Step 5: Estimate composition of load by volume for each broad material category (in bold).

Step 6: For each material category, estimate comp by volume of each material component.

Step 7: Make sure material categories AND material component EACH total 100%.

☐ **Paper: ____%**

	Uncoated Cardboard
	Kraft Paper Bags
	Newspaper
	White Ledger
	Colored Ledger
	Other Office Paper
	Magazines and Catalogs
	Phone Books and Directories
	Compostable Paper
	Other Misc Paper
	R/C Paper
%	***Subtotal (must equal 100%)***

☐ **Metal: ____%**

	Tin/Steel Cans
	Major Appliances
	Used Oil Filters
	Other Ferrous Metal
	Aluminum Cans
	Other Non-Ferrous Metal
	R/C Metal
%	***Subtotal (must equal 100%)***

☐ **Glass: ____%**

	Bottles & Containers
	Other Colored Bottles & Containers
	Flat Glass
	R/C Glass
%	***Subtotal (must equal 100%)***

☐ **Plastics: ____%**

	PETE Containers
	HDPE Containers
	Misc Plastic Containers
	Trash Bags
	Grocery & Merchandise Bags
	Non-Bag Comm/Ind Pkging Film
	Film Products
	Other Film
	Durable Plastic Items
	EPS
	R/C Plastic
%	***Subtotal (must equal 100%)***

☐ **Electronics: ____%**

	Brown Goods
	Computer-Related Electronics
	Other Small Consumer Electr'cs
	TVs and Other Items with CRTs
%	***Subtotal (must equal 100%)***

☐ **C&D: ____%**

	Concrete
	Asphalt Paving
	Asphalt Roofing
	Lumber
	Gypsum Board
	Rock, Soil & Fines
	R/C C&D
%	***Subtotal (must equal 100%)***

☐ **Organics: ____%**

	Packaged Vegetative Food (Donatable)
	Loose/Scrap Vegetative Food
	Packaged Non-Vegetative Food (Donatable)
	Loose/Scrap Non-Vegetative Food
	Leaves & Grass
	Prunings & Trimmings
	Branches & Stumps
	Agricultural Crop Residues
	Manures
	Textiles
	Carpet
	R/C Organics
%	***Subtotal (must equal 100%)***

☐ **HHW: ____%**

	Paint
	Vehicle & Equipment Fluids
	Used Oil
	Batteries
	R/C HHW
%	***Subtotal (must equal 100%)***

☐ **Special Waste: ____%**

	Ash
	Sewage Solids
	Industrial Sludge
	Treated Medical Waste
	Bulky Items
	Tires
	R/C Special Waste
%	***Subtotal (must equal 100%)***

☐ **Mixed Residue/MSW: ____%**

	Mixed Residue/MSW
%	***Subtotal (must equal 100%)***

Grand Total:_____%
(Must equal 100%)

Notes: