WASTE COMPOSITION STUDY REPORT

for

Waste Audit and Data Collection Services
Of Green Up Day 2009 Waste Samples
To the Vermont Department of Environmental Conservation
Solid Waste Program

Submitted July 27, 2009
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Green Up Day 2009:
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REPORT

Executive Summary

The Solid Waste Program of the Vermont Agency of Natural Resources (ANR) Department of Environmental Conservation (DEC) granted the Association of Vermont Recyclers (AVR) $2,350 to provide Waste Audit Services and Data Collection on Green Up Day, May 2, 2009.

Green Up Vermont Day (GUD) collects and hauls roadside litter in an effort to beautify roadways and dispose of waste. Roadside litter has been a previously unmeasured waste stream in Vermont.

Nineteen (19) samples of roadside waste, bagged/collected by GUD volunteers according to GUD procedures, was collected by AVR from ten (10) towns in five Waste Management Districts of Vermont. Samples were taken from pre-determined standard road lengths along four common road types: Rural/Highway, Residential, City, and Interstate in each region. Samples were sorted according to fifteen (15) predetermined categories; categorized materials were weighed and counted to generate data on the composition of GUD waste for the purpose of comparative analysis against other waste stream data sets and to assess the potential for diverting GUD materials from the waste stream.

Purpose

The purpose of the *GUD 2009: Waste Composition Study* was to collect comprehensive roadside litter samples for type, weight and volume comparison against data from more typical household waste (MSW) audits in order to set a baseline for understanding the make up of road-side litter, such that comparative data may be analyzed for future use in policy or procedure implementation. A secondary goal of this audit is to provide data regarding the composition of GUD materials to assess the potential for diverting some of these materials from the waste stream.

Auditing and analysis of roadside litter for comparison to other available waste stream audit data is an important tool for future analysis of litter prevention programs, waste management policy, and AOT, ANR, and Green Up Day procedures. This small, efficient sampling methodology will provide sufficient data for the generation of a comparative data set and recommendations for future, more expansive research.

Background

Available Comparative Data:

During the summer of 2001, DSM Environmental Services, Inc. (DSM) was contracted by the Solid Waste Program of the Vermont Department of Environmental Conservation (VT DEC) to conduct a waste composition study at the Waste USA landfill in Coventry, VT and the WSI transfer station in Burlington, VT.

The primary objective of the DSM waste composition study was to collect data on the composition of the waste stream for use by the VT DEC to better target future waste reduction and diversion programs. As such, the categories selected for sorting were based on what can currently be recycled in Vermont as well as materials that might have potential for future diversion (such as food waste). The second objective was to search for categories of concern, such as electronics wastes and potentially hazardous wastes. Finally, VT DEC was interested in the potential for additional diversion of construction and demolition wastes.

Potential for diversion as part of GUD methodology:

GUD exists to beautify Vermont roads throughout the state by organizing volunteers and providing materials in order to collect accumulated roadside litter. Unfortunately, evidence indicates that some waste collected by volunteers has been illegally dumped or added to the collection stream by people anticipating proper, cost-free disposal will result due to GUD volunteers and haulers. GUD enjoys significant volunteer commitment and energy to beautify the roadside landscape and direct ‘waste’ that has been left along VT roadsides into the formal waste stream. However, GUD collection and hauling lacks any protocol for or facilitation of waste diversion. This results in the unfortunate fact that much of what is collected may be unnecessarily relegated to the landfill. One reason for undertaking this study was to provide data as to whether GUD could be modified to allow for waste diversion as a part of the GUD protocol.

Original Research Design

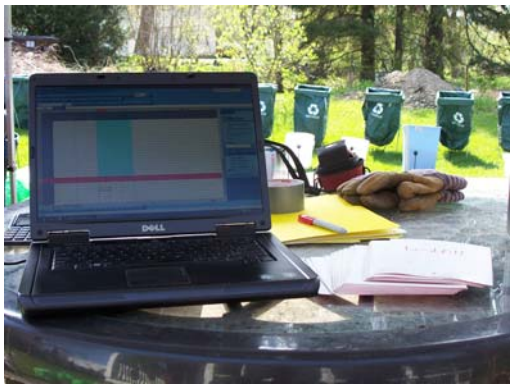
The design of this waste composition study was undertaken by AVR on behalf of ANR. The design was proposed by staff at AVR with input and review from program staff at ANR. The study was designed to ascertain basic data on the composition of materials collected on GUD based on a practical yet representative sampling of those materials. The study was also designed to generate data that could be used for comparison and analysis against the data generated in the *Vermont Waste Composition Study* conducted for the VT DEC by DSM Environmental Services in 2002.

Samples of bagged GUD materials were collected along pre-determined standard road lengths from four common road types: Rural/Highway, Residential, City, and Interstate. Samples were collected from several regions of the state. At a central location, all the materials from each sample collection site were sorted into fifteen (15) predetermined categories. Categorized materials from each collection point were all measured by weight. Materials in five (5) categories were counted. Observational data was regularly recorded for two (2) specific categories; and observational notes were taken when appropriate for other categories as well.

While AVR had considered the implementation of a secondary methodology for cleaning, emptying, and re-measuring collected materials due to contamination. This secondary methodology proved to be unwarranted. Given the condition of the materials, the data collected from such an effort would not have been significantly different nor would it have been particularly useful.

Early in the study design process, the collection of an equal # of samples from each road type was considered. The intent of this idea was to provide a data set which allowed for comparison of categorical materials from one road type to another. However, no data is available as to the volumes of material collected by road type as a percentage of the total materials collected on GUD. This fact and the limited resources available for this study led to the decision that a comparative analysis by road type be undertaken based simply on the samples available for each road type. It is worth noting that this decision resulted in a larger and more diverse set of samples than was originally considered for this particular study

It is also worth noting that during the design period another vision of this study involving an even larger number of samples collected from a wider geographical distribution was considered. However, the relatively limited budget for this project and a relatively short planning/coordination period dictated a scale of sampling that was no larger than needed to achieve reasonable results. Thus, this study was carefully designed to leverage the resources and time available as efficiently as possible toward generating a quality data set regarding the composition of GUD materials and the condition of those materials.



Methodology

Collection Methodology:

On April 28th and 29th, state employee volunteers working with Wayne Gamble out of the District 1 AOT Garage collected green-up materials along I-89 from Montpelier to Northfield. On April 30th AVR staff picked up 4 bags of non-source-separated materials from that effort. On May 2nd and 3rd, AVR collected seventeen, non-source-separated, samples from ten towns in Vermont representing the following regions: the Capital Area, the Mad River Valley, the Northeast Kingdom, the Connecticut River Valley, and the Stowe Region. Samples were collected from four different predetermined road types: residential roads, city/downtown sites, state highways/rural roads, and the interstate. Each sample was labeled by town name, road type and road name and the location of collection. Then samples were transported to the sorting location.

Audit Methodology:

Following the collection of samples, AVR staff audited each sample, separating the materials into predetermined waste-stream categories (see category descriptions below) and measuring each categorical sample according to weight. For categories consisting of discrete materials, sorted materials were also counted. As a result of their relative uniformity and the unique challenges they pose to traditional waste stream management, tires were counted, but not weighed. Observational data was also recorded; both in general and for certain pre-determined categories.

Categorical sorting was carried out with intent toward two major objectives:

- to provide data that could be effectively compared with existing data sets (specifically considered was the 2002 DSM Waste Audit)
- to identify and assess GUD materials that have the potential to be diverted from landfills and recaptured as resources.

To this end the categories used were designed to be reasonably compatible with those used in the 2002 DSM Waste Audit. Categories were also distinguished according to the availability of mechanisms for diverting certain materials from the landfill and recapturing those materials as resources rather than waste. Categories that were considered 'Divertible' included:

- Beverage containers
- Returnables
- Plastics
- Metals
- Uncontaminated Cardboard
- Uncontaminated Paper
- Compostables/Organics

AVR staff spread the contents of each sample on a clean tarpaulin and hand-separated materials into fifteen (15) pre-determined categories as described in the table below. It is worth noting that a category for Electronics was considered, however no materials fitting this category were found in the samples. As a result, we have not included the category in this study. The sorted materials were then weighed by category and counted where appropriate. Observational data regarding sample materials was also recorded.

The following table lists and details the categories used in this study:

CATEGORY	DESCRIPTION
C&D	Items associated with construction and demolition, as well as miscellaneous larger materials that didn't fit in GUD bags and didn't fit another category.
Plastic Shopping Bags	Any plastic shopping bags from grocery or other retail stores.
Beverage Containers*	Any recyclable plastic, glass or aluminum single or multiple serving drink containers lacking a returnable deposit. Any liquids were removed prior to weighing and caps were added to Landfill Bound materials.
Coffee & Soda Cups	Plasticized single-serving paper cups from convenience stores and fast food restaurants used to hold hot or cold beverages. Lids were included in the weight but not the count. Any liquids were removed prior to weighing.
Returnable Bottles and Cans*	Any beverage container with returnable deposit for the state of Vermont. Liquids were removed prior to weighing and caps were added to Landfill Bound materials.
Fast Food Packaging	Packaging from take-out foods or fast food restaurants as well as pre-packaged foods from convenience or grocery stores. This generally included food and candy wrappers but the occasional juice box as well. It excluded the 'Beverage Container', 'Coffee & Soda Cups' and 'Returnable Bottles and Cans' categories.
Plastics*	Recyclable Plastics #1-#7 that were not Beverage Containers or Returnable Bottles.
Metals*	Recyclable metals. Not including beverage cans.
Uncontaminated Corrugated Cardboard*	Corrugated cardboard that was deemed clean/dry enough for recycling.
Uncontaminated Paper*	Recyclable paper that was deemed clean/dry enough for recycling.
Compostables*	Any organic materials suitable for residential or commercial composting programs. Including contaminated paper and cardboard items.
Tires	Tires from cars, trucks, tractors, motorcycles, etc.
Household Hazardous Waste (HHW)	Non-commercial hazardous chemical products that should be disposed of at a WMO household hazardous waste event. These materials were calculated in ounces as most of the HHW material was liquid and in small containers, sized and labeled by volume in ounces. The assumption was made that 16 ounces of HHW equals 1 pound. When converting the data to pounds for calculation and inclusion in GUD waste composition data, the conversion to pounds was made to one decimal place.
Auto Parts	Any non-toxic item intended for use on or attachment to, removed from or broken off of a truck, car or motorcycle.
Landfill Bound Waste	Items that did not fit into any of the above categories and could not be diverted through any known regionally available programs.

*** indicates materials that that were considered 'Divertible'**

Results and Analysis

Table 1 - Sample Descriptions

Sample	Street	Town	Number of Bags	Location Code	SWM Unit	Total by Sample Local (lbs.)	Total % by Sample Local	Notes
1	Gould Hill (	Montpelier	2	Rural	CVSWMD	43	5.40%	
2	McCocullo(	Middlesex	1	Rural	CVSWMD	9	1.10%	Also one sock
3	Rt. 100	Stowe	1	City	LRSWMD	24	3.00%	
4	Rt 2	Marshfield	2	Rural	NEK	18	2.30%	Included (1) 18 lb bag of clearly illegally dumped household trash- not sorted per safety priority
5	Rt 5	St. Jay	1	Residential	St. J	19.5	2.50%	
6	Rt. 302	Barre Tow	2	Residential	CVSWD	52	6.60%	Diapers, clothing, and lots of other "socio-economicly" suggestive materials
7	Rt. 2	Moretown	3	Hiqhway	MRRMA	67	8.50%	
8	Rt 302	Barre City	3	City	CVSWMD	45.5	5.80%	Lots of aeresols- likely whippits
9	Rt 100	Morrisville	1	Rural	LRSWMD	9	1.10%	Mostly compostables should have been left… bones and wood.
10	Pioneer St	Montpelier	2	Residential	CVSWMD	41	5.20%	
11	A Street	Morrisville	2	Residential	LRSWMD	21.1	2.70%	
12	I- 89	Berlin/Nortl	1	Interstate	CVSWMD	41.5	5.20%	Note this was a 60 gal bag, versus GUD 34s
13	I- 89	Montpelier/	3	Interstate	CVSWMD	25	3.20%	Fast Food 50/50 Resturant packing
14	Jersey Wa	Morrisville	1	Residential	LRSWMD	22.4	2.80%	Bag included what appears to be a bag of neat car trash included in a GUD bag
15	Audy Way	Morrisville	1	Residential	LRSWMD	5	0.60%	Compost was all yard waste
16	Howard Av	Waterbury	1	Residential	MRRMA	17.5	2.20%	
17	City Hall	Montpelier	2	City	CVSWMD	25.5	3.20%	
18	Stump Dur	Rt 12 Mon	2	Rural	CVSWMD	50	6.30%	
19	Rt 2	St. Jay	2	City	St. J	254.5	32.20%	plus a toaster, sled, 2 flower pots, CRT Monitor,
Totals			**33 bags**			**790.5**		
% by Category							**100.00%**	

Table 2 – Divertibles

Sample	Town	Location Code	Bevi Containers (lbs.)	Bevi Containers #	Returnables (lbs.)	Returnables #	Plastics (lbs.)	Metals (lbs.)	Clean Cardboard (lbs.)	Clean Paper (lbs.)	Compostables (lbs.)
1	Montpeli	Rural	5.5	15	14	13	0	0	0	0	6
2	Middlese	Rural	6	11	3	12	0	0	0	0	0
3	Stowe	City	9	21	4	19	0	0	0	0	4
4	Marshfiel	Rural	4	3	0	4	0	0	0	0	3.5
5	St. Jay	Residential	3.5	11	3	8	0	0	0	0	3.5
6	Barre Town	Residential	4.5	16	3.5	12	4	0.5	0.5	0	7.5
7	Moretow	Hiqhwa	3.5	11	13.5	35	0.5	0	0.5	0	3
8	Barre	City	5	11	4	7	1.5	0.5	0	0	2.5
9	Morrisvill	Rural	0	0	0	2	0	0	0	0	5
10	Montpelier	Residential	3.5	8	5.5	14	0.5	0.5	0	0	3
11	Morrisville	Residential	0	2	0	2	0	0	0	0	4
12	Berlin/Northfield	Interstate	9.5	32	11	84	0.5	0.5	0.5	0	2.5
13	Montpelier/Northfi	Interstate	5	20	5	24	0.5	0.5	0	0	0
14	Morrisville	Residential	3	6	2.5	5	0	2	0	0	5
15	Morrisville	Residential	0	1	0	0	0	0	0	0	4.5
16	Waterbury Center	Residential	5	4	4	11	2.5	0	0	0	0.5
17	Montpeli Rt 12	City	4	5	0	2	0	0	0.5	0.5	3.5
18	Monpteli	Rural	3.5	3	4	4.5	0	10	0	0	11
19	St. Jay	City	3	3	3	8	0	0.5	0.5	0	5
Totals			**77.5**	**183**	**80**	**266.5**	**10**	**15**	**2.5**	**0.5**	**74**
% by Category			**9.80%**		**10.10%**		**1.30%**	**1.90%**	**0.30%**	**0.10%**	**9.40%**

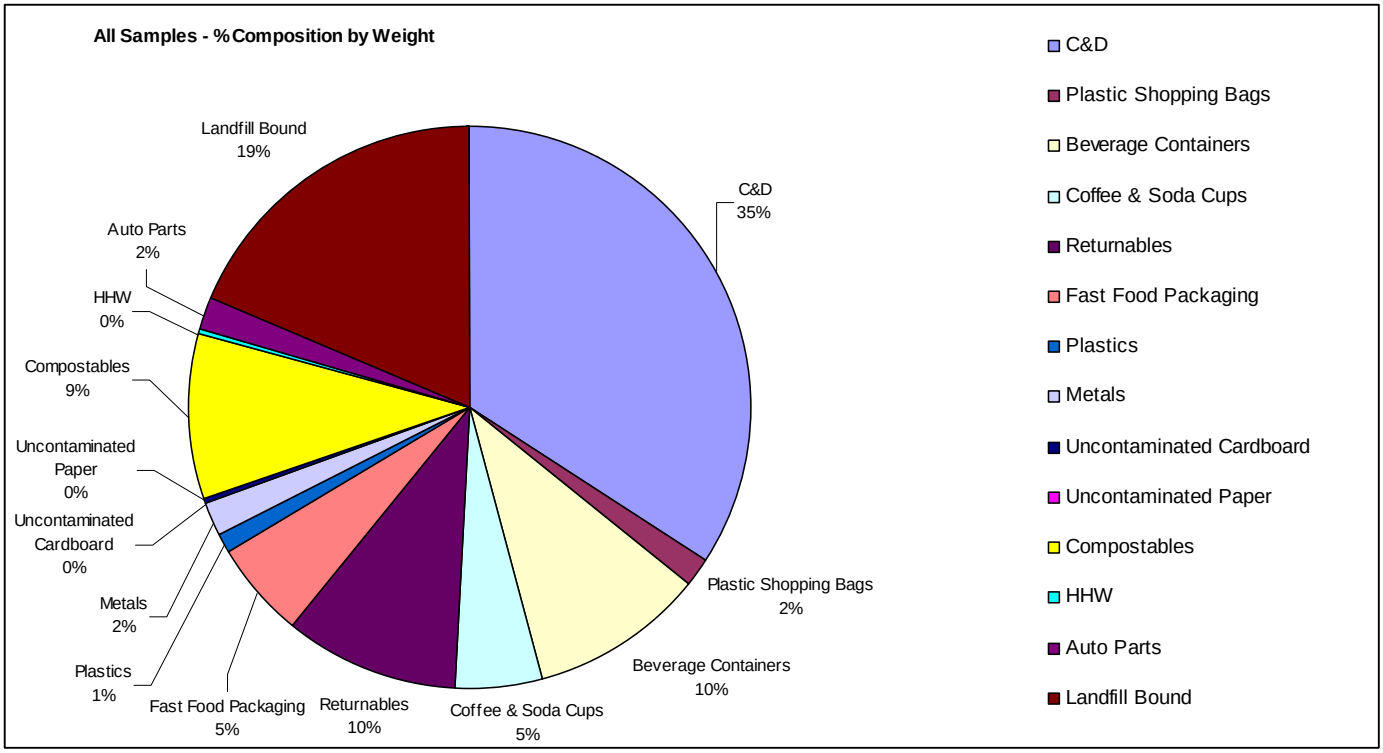
Table 3 – Food and Packaging

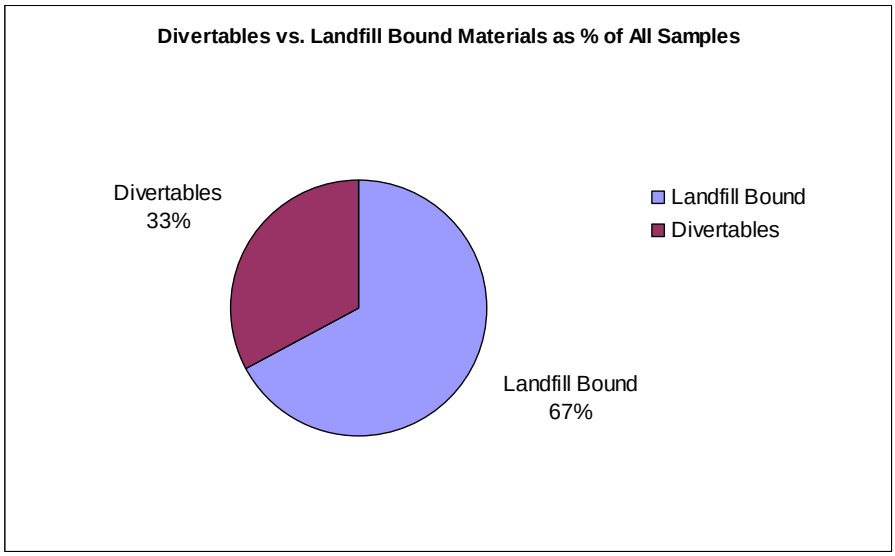
Sample	Town	Location Code	Plastic Shopping Bags (lbs.)	Plastic Shopping Bags #	Coffee & Soda Cups (lbs.)	Coffe & Soda Cups #	Fast Food Packaging (lbs.)	Notes
1	Montpelier	Rural	0	5	3.5	26	4	prepagaged Food wrappers
2	Middlesex	Rural	0	1	0	1	0	
3	Stowe	City	0	3	2	4	0	prepackaged Foods
4	Marshfield	Rural	0	0	1	0	2.5	prepackaged Foods
5	St. Jay	Residential	0	4	2	9	2.5	prepackaged Foods
6	Barre Towr	Residential	0	11	3.5	18	3	prepackaged Foods
7	Moretown	Hiqhway	3	9	3	14	3	prepacaked
8	Barre City	City	3.5	14	4	23	3	more resturant than others
9	Morrisville	Rural	0	3	0	1	0	coffe kup bakery
10	Montpelier	Residential	0	3	3.5	11	5	Mcdonalds, sandwiches, traditional fast food
11	Morrisville	Residential	0	0	3	7	3	prepackaged Foods
12	Berlin/Nortl	Interstate	3	5	3	15	4	resturant food
13	Montpelier/	Interstate	0	2	3.5	22	3.5	prepackaged Foods
14	Morrisville	Residential	0	3	3	5	2.5	prepackaged Foods
15	Morrisville	Residential	0	0	0	1	0	Chinese food and drink box
16	Waterbury	Residential	0	0	2.5	2	0	0
17	Montpelier	City	0	0	0	4	0	wrappers
18	Rt 12 Mon	Rural	2	0	2.5	6	3.5	take out and wrappers
19	St. Jay	City	3	4	0	4	3	prepackaged Foods
Totals			**14.5**	**67**	**40**	**173**	**42.5**	
% by Category			**1.80%**		**5.10%**		**5.40%**	

Table 4 – Landfill Bound

Sample	Town	Location Code	C&D (lbs.)	Tires #	HHW (lbs.)	HHW Notes	Auto Parts (lbs.)	Landfill Bound (lbs.)
1	Montpelier	Rural	1	0	0		0	9
2	Middlesex	Rural	0	4	0		0	0
3	Stowe	City	1	0	0		0	4
4	Marshfield	Rural	0	0	0		2	5
5	St. Jay	Residential	1	0	0		0	4
6	Barre Town	Residential	1	0	0		3	21
7	Moretown	Hiqhway	22	0	0		3	12
8	Barre City	City	0	0	1	Flux	1	19.5
9	Morrisville	Rural	0	0	0		0	4
10	Montpelier	Residential	6	0	0		3	10.5
11	Morrisville	Residential	4	0	0.1	Antifreeze	0	7
12	Berlin/Northfield	Interstate	0	0	0		0.5	6.5
13	Montpelier/Northfield	Interstate	0	0	0		1.5	5.5
14	Morrisville	Residential	0	0	0.9	hh bug spray	0	3.5
15	Morrisville	Residential	0	0	0		0	0.5
16	Waterbury Center	Residential	0	0	0		0	3
17	Montpelier	City	5.5	0	0		0.5	11
18	Rt 12 Monptelier	Rural	3	0	0		0.5	10
19	St. Jay	City	225	5	0		0.5	11
Totals			**269.5**	**9**	**2**		**15.5**	**147**
% by Category			**34.10%**		**0.30%**		**2.00%**	**18.60%**

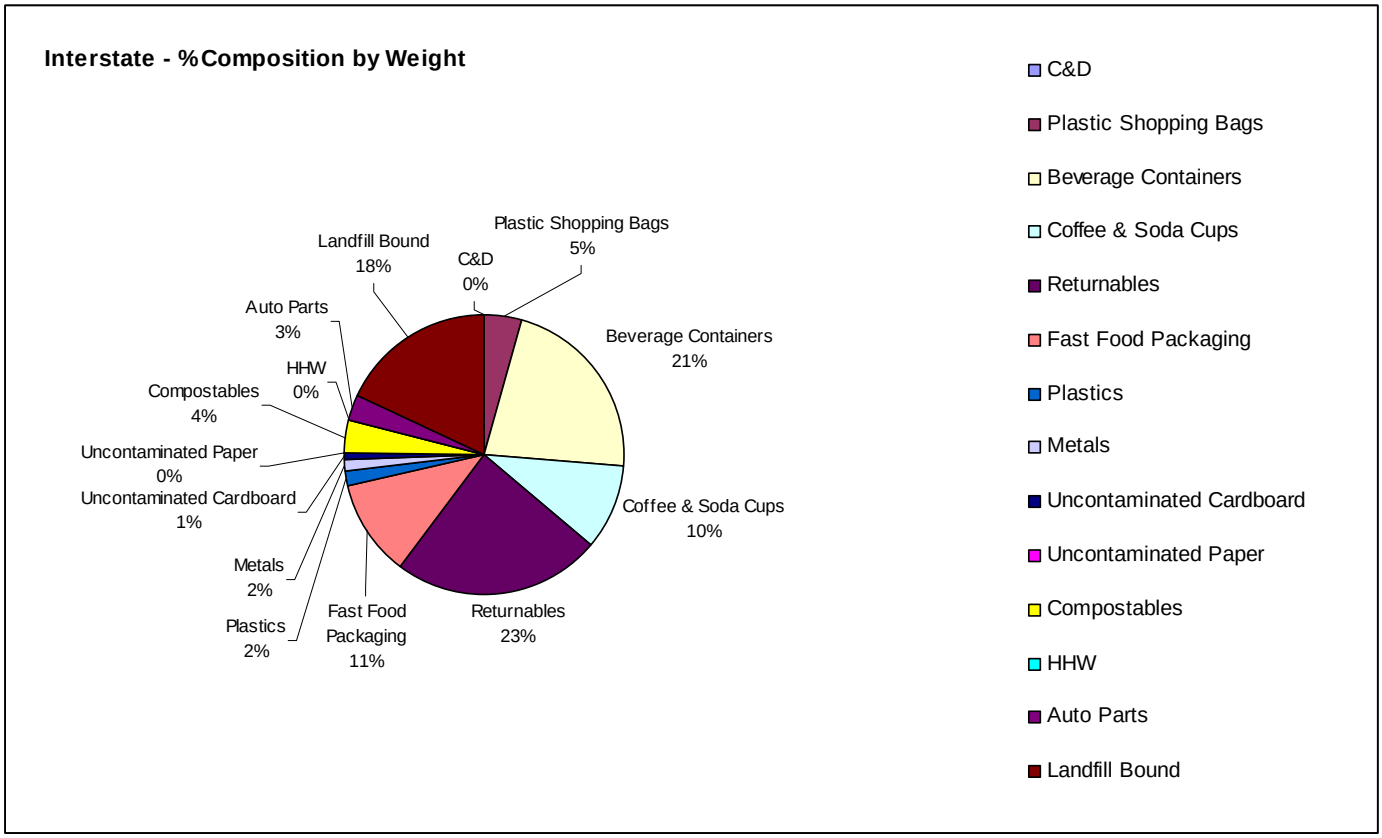
Composition of the Average GUD Bag

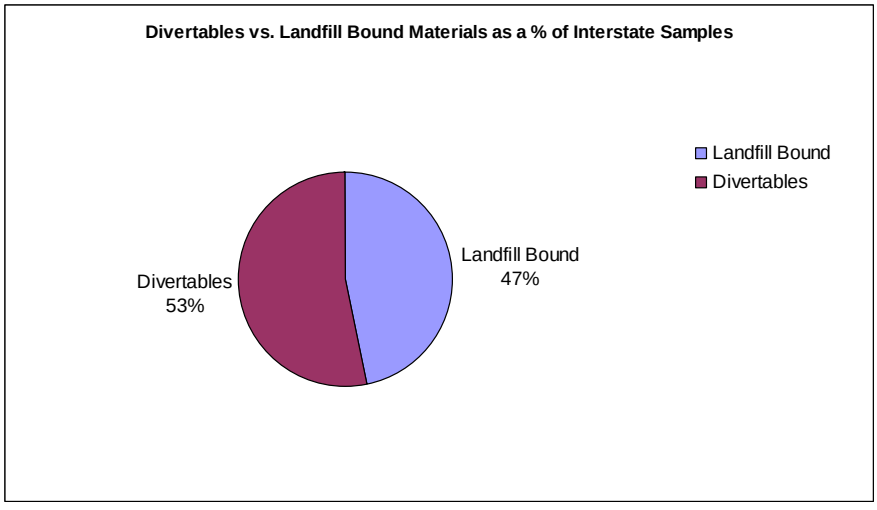




The average weight of a single bag of roadside litter collected by GUD volunteers was 23.95 lbs. The typical GUD bag will contain 2 plastic grocery/shopping bags, 5.5 non-deposit beverage bottles/cans, 5.24 coffee/soda cups, 8.08 beverage bottles/cans returnable for deposit, and a variety of other materials that were assessed by weight only. On average one tire is collected for every 4 bags. Also, the average GUD bag is accompanied by larger un-bagged materials (primarily C&D materials) averaging 52% the weight of the GUD bag. By percentage of total weight the typical GUD bag will consist of the following: 9.8 % non-deposit beverage containers, 5.1% coffee/soda cups, 10.1 % refundable beverage containers, 5.4% fast food packaging, 1.3% recyclable plastics, 1.9% metals, 0.3% uncontaminated cardboard, 0.1% uncontaminated paper, 9.4% compostables/organics, 0.3% HHW, 2% automotive waste, and 18.6% landfill bound materials.

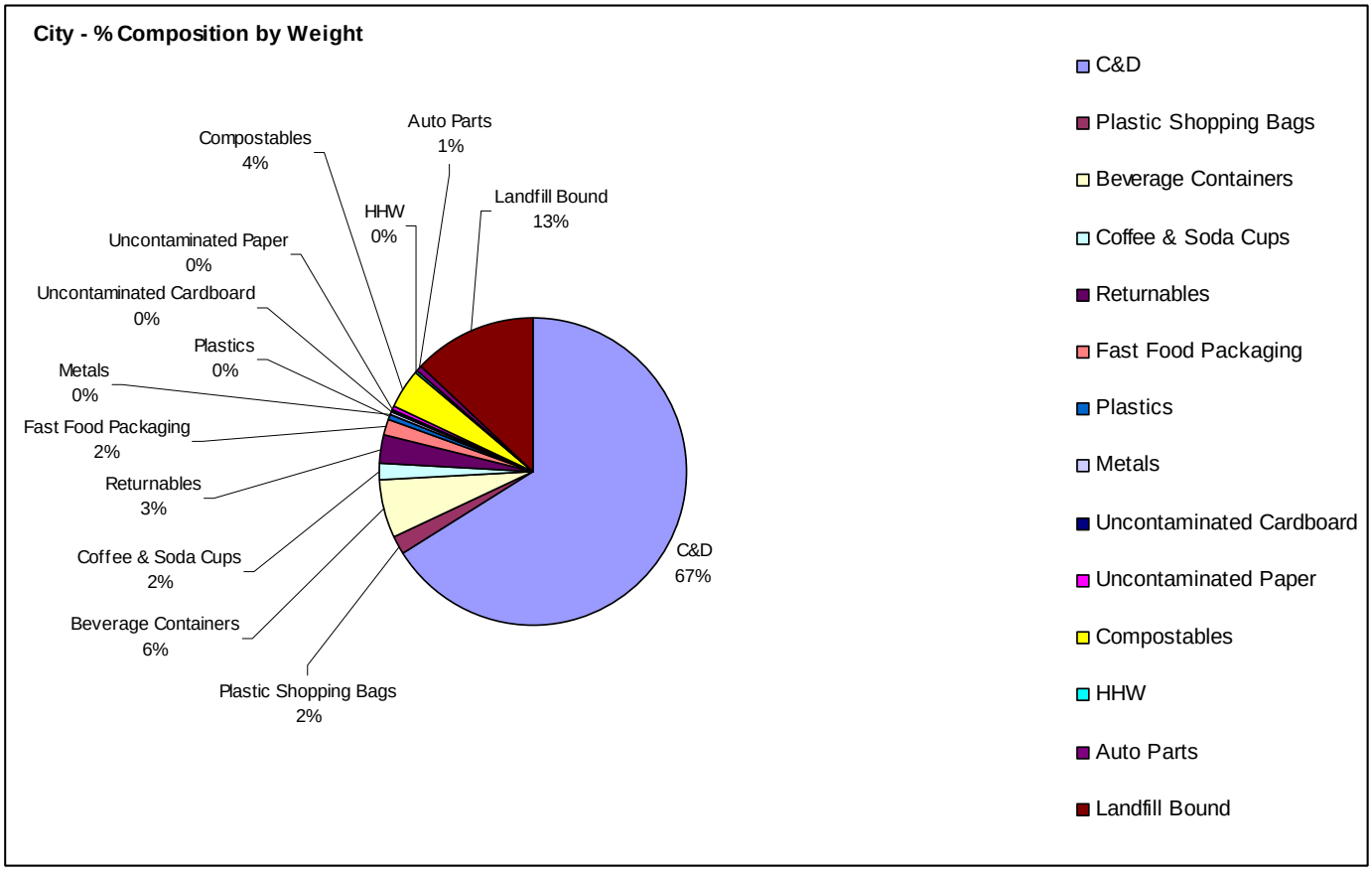
Results by Road Type: Interstate

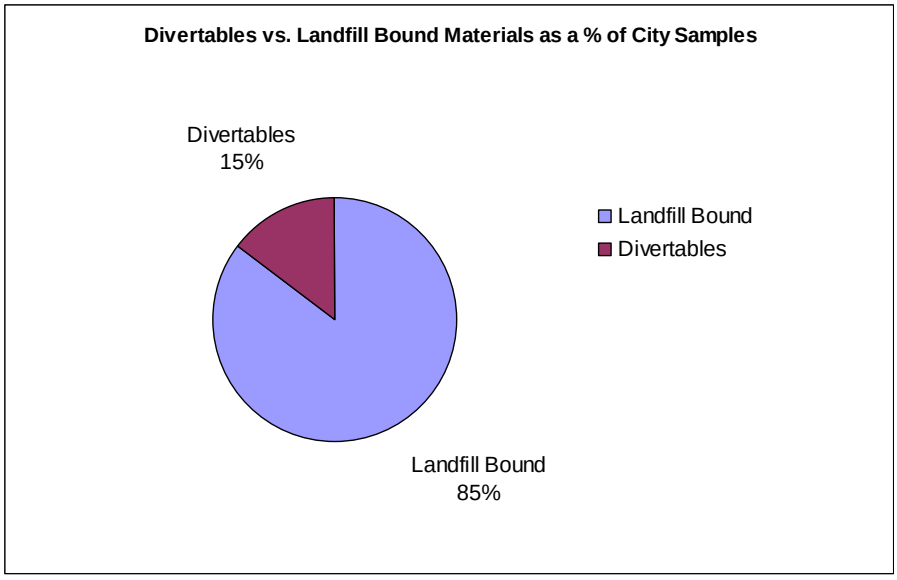




GUD bags collected along interstates vary most dramatically from the state wide norm in both the category of C&D materials and those categories associated with food and beverage packaging. Whereas C&D materials make up 35% of the state-wide average, interstate collections comprised no materials in this category. Materials associated with food and beverage packaging comprise 30% of the total materials measured state-wide. However, along interstates 65% of the materials collected fell into these categories. The average interstate bag is comprised of: 11% Fast Food Packaging, 23% Returnables, 10% Coffee and Soda Cups, and 21% Non-returnable Beverage Containers. Interstate materials are also comprised of only 4% Compostable Materials, along with City samples (also having only 4% Compostables) this represents the lowest % of Compostables found by road type. At 53%, more than half of the materials collected along the interstate were Divertibles.

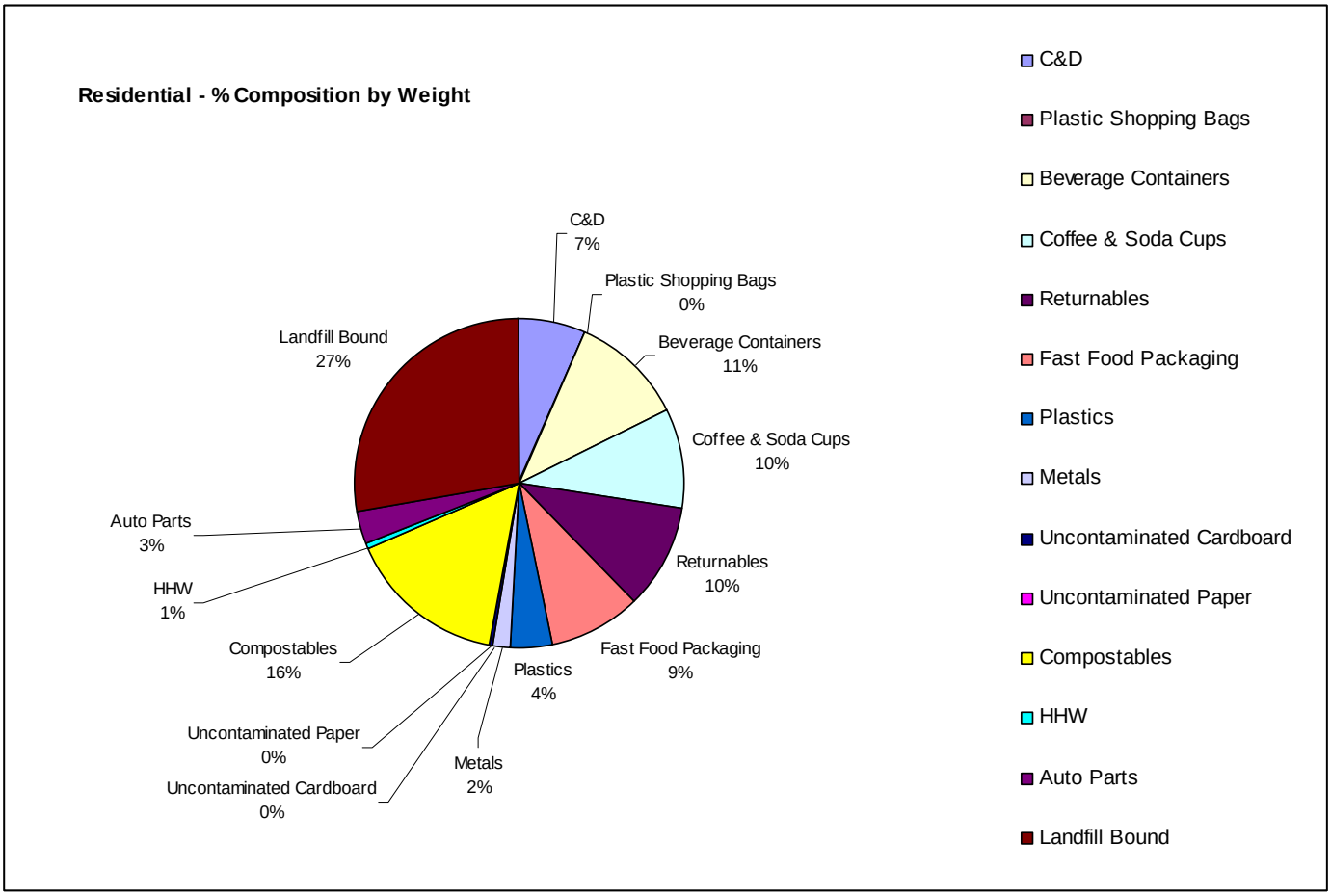
Results by Road Type: City



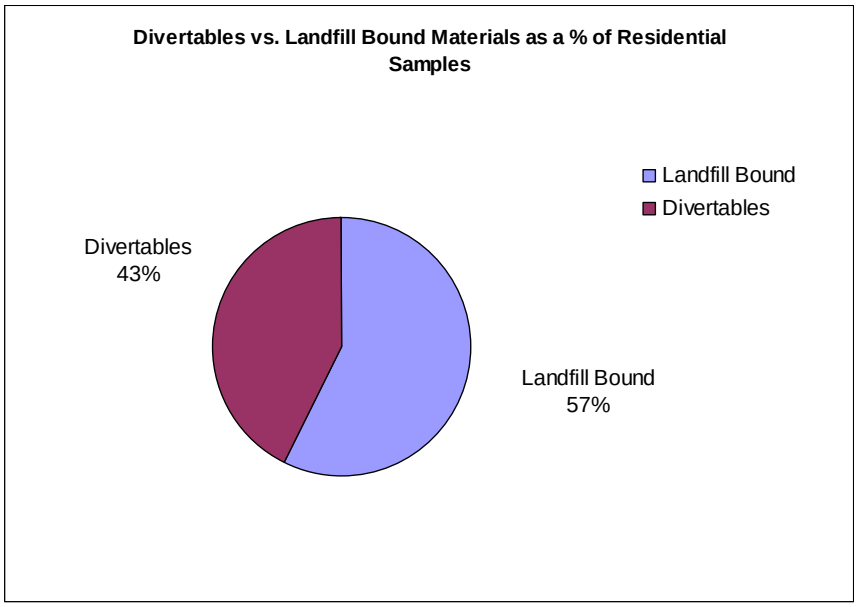


City samples also varied most dramatically from the State-wide norms in the area of C&D waste. However, City samples represent the other end of the spectrum in this regard. City samples were comprised of 67% C&D materials, versus the state-wide average of 35%. Since no other category had more than 13% C&D materials, it is clear that the high volume of C&D materials in City samples was the primary source of these materials. City samples also differed dramatically in the area of materials associated with food and beverage packaging, with only 13% of the total materials collected coming from those categories. Another unique result of the City samples was that only 13% of the materials collected were Divertibles, less than half the percentage of the next lowest road type for these categories.

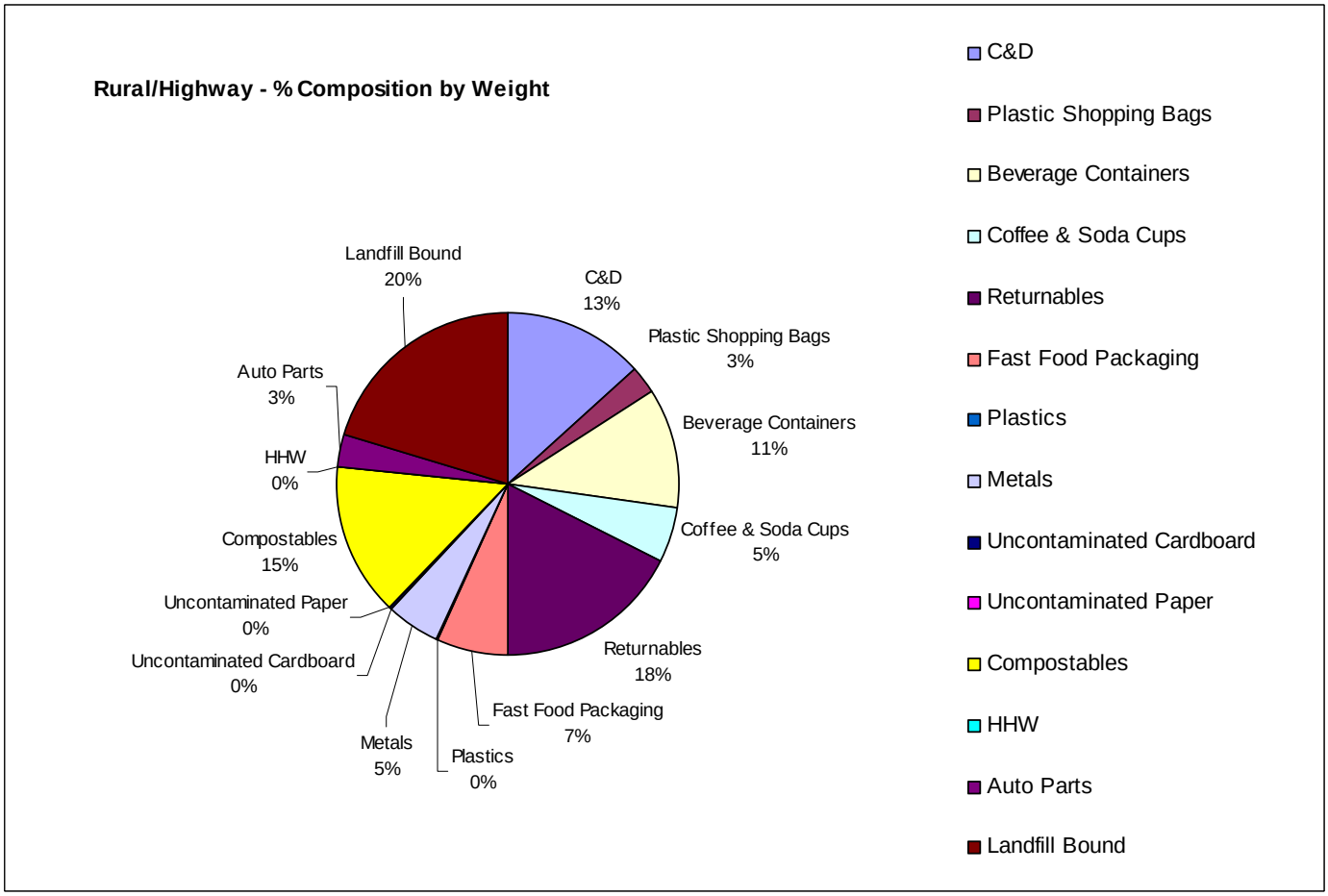
Results by Road Type: Residential

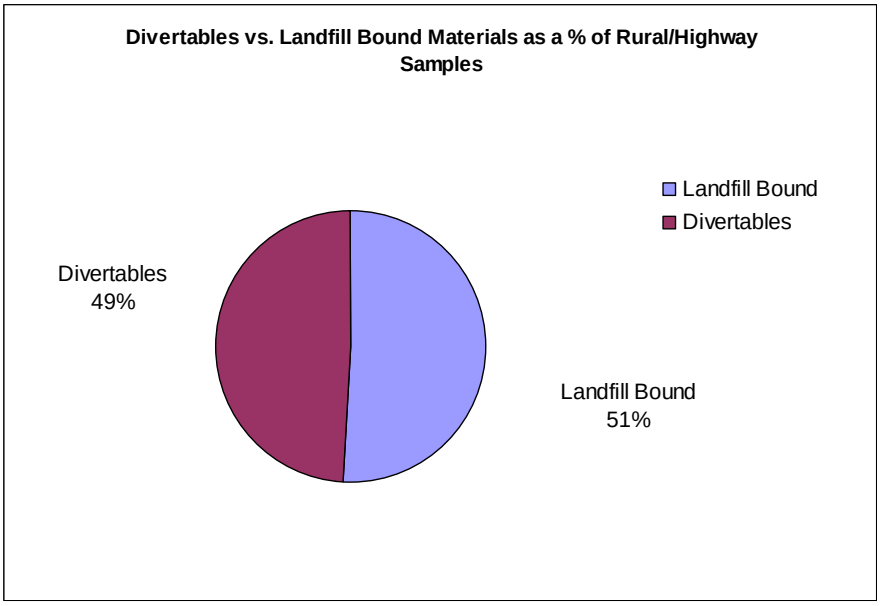


With Landfill Bound materials making up 27% of the materials in this category, the Residential road type contained the highest percentage of true 'waste' as compared to all road types. At the same time, with a combined total of 43% this road type has the second highest percentage of Divertibles. Samples from Residential road types consisted of 16% Compostables, the highest of any road type, and it was noted that at least one Residential sample was 90% yard waste.



Results by Road Type: Rural/Highway





The Rural/Highway road type had the most evenly distributed materials by category. By percentage of total weight the typical Rural/Highway sample will consist of the following: 11 % non-deposit beverage containers, 5 % coffee/soda cups, 18 % refundable beverage containers, 7% fast food packaging, 0 % recyclable plastics, 5 % metals, 0 % uncontaminated cardboard, 0 % uncontaminated paper, 15 % compostables/organics, 0 % HHW, 3 % automotive waste, and 20 % landfill bound materials. Of the total materials collected along the Rural/Highway road type, 49 % were Divertibles.

Analysis and Observations

Clear Differences Between the 4 Road Types

By any analysis, we found a very clear difference in the composition of materials collected along the 4 distinct road types. This was unexpected and might suggest that GUD procedures and instructions could be tailored to address these differences and improve overall efficiency, as well as the handling and disposal or diversion of materials from each road type.

Recyclable Materials

As a result of crushing, many of the refundable containers sorted were not in a suitable condition for 'deposit' return. However, it is important to note that all the refundable containers as well as all the other materials sorted into the recyclable categories were in acceptable condition for diversion to the recycling stream at the transfer station. With the exception of the actions that were performed as a part of our sorting procedure - removing caps and emptying liquids, no extra cleaning or other special efforts were needed to prepare any of these materials for recycling.

Compostables

The fact that 9 % of the materials collected were found to be compostable is well worth noting. There are well known negative impacts associated with organic resources being landfilled, these include: unwanted methane generation, general unpleasantness at the landfill, and the significant loss of resources valuable for soil building or energy generation. This fact points to a need for changes in GUD policy and procedures toward the collection and handling of organics/compostables.

Abuse of GUD for Free Disposal

There were, in several instances clear signs of abuse regarding materials accepted for GUD. One sample included, among other legitimate materials, a bag of materials that appeared to have been collected from someone's car and disposed of for free in a GUD bag. One bag contained a significant number of used diapers and other household waste. Another bag contained a large number of aerosol whipped cream cans. One sample was 90% yard waste, and yet another sample appeared to be entirely household waste. All of these were clearly disposed of for free in GUD bags.

Construction & Demolition Materials

Another unexpected but significant finding deals with the amount of C&D materials collected. It was assumed going into the study that C&D would represent very little of the materials collected. However, the study found that C&D comprised a startling 35% of the materials collected on GUD. Whether this is a result of intentional GUD abuse, people using GUD to dispose of larger and unwieldy materials for free, or whether these materials are regularly left by the roadside cannot be determined here. However, given the volume of these materials as a percentage of those collected on GUD, this phenomenon may deserve further study and consideration.

Food Related Waste

In the category of Fast Food Packaging, we also had unexpected results. Even the title of this category points to our expectation that it would be dominated by Franchise/Carryout restaurant waste. However, the actual findings of the study indicate that the majority of roadside food packing comes from pre-packed snacks and foods that would have originated from gas stations, mini-marts or grocery stores. This fact may relate to the two pronged fact that there are relatively few franchise fast food restaurants in most regions of Vermont while general stores, gas stations and mini-marts are ubiquitous along the state's roadways.

One Aberrant Collection Site

One site from which samples were taken stood out as unusual. In most cases, samples were collected by taking all the bags and materials apparently associated with a pre-determined road length. However, one site we sampled had an extremely unusual volume and make-up of materials. For Sample # 19 it was noted that there were approximately 3 or 4 cubic yards of materials present at the collection point. This included a large number of GUD bags, a toaster, 2 sleds, a lot of tires, one CRT monitor, and miscellaneous large furniture. These specifics of the site were noted. Then, based on the assumption that this was a central collection site for more than one length of road, a sample of two bags was taken for sorting. The intent of this decision was that this would be roughly representative of a single road length, based on other single road length samples that had been collected.

Recommendations

Regarding Green Up Day Policies and Procedures:

The findings of this study clearly indicate that there is room for improvement in the policies and procedures of GUD, both in terms of efficiency and in terms of diverting significant resources away from the landfill-bound waste stream. Based on the make-up, condition and volume of the Divertible materials found in this study, it is clearly indicated that diversion of non-waste materials as a part of GUD is possible and warranted. It is our recommendation that new policies and procedures be developed for future GUDs to make improvements toward resource diversion. This recommendation applies to both Recyclables and Compostables. Each of these categories would require some unique elements in terms of procedural changes and both will require an element of education and training. A practical approach to this may be to develop a 'Train-the-Trainer' program explaining any new policies and procedures to GUD Coordinators, who could then train local volunteers. The changes here would not be too dramatic. First, volunteers would need to be able to recognize the difference between Divertibles and Waste. Next, they would need to remove caps and empty liquids as they collected materials. Volunteers could also be educated about not collecting organics which would be best left at the roadside. A possible mechanism for facilitating diversion on GUD would be the inclusion of blue recycling bags, for separating divertible materials, along with the traditional green bags used on GUD.

In carrying out this study, we did observe issues regarding the safety of volunteers. Our samples included broken glass and some other physically dangerous materials, toxics substances, bodily fluids and human waste, uncooked animal bones, and other potentially hazardous materials. At a minimum, volunteers should be wearing gloves to participate in GUD and perhaps some other measures need to be taken as well to insure volunteer safety.

We did see clear signs of disposal abuse, people using GUD bags to dispose of personal wastes for free. However, our study is not designed to identify any particular solution to this problem. We can only confirm that abuse is occurring on a regular basis.

The composition of food related packaging waste points toward a targetable group of businesses that might be included in finding solutions to this problem. While we are not in a position to make any real recommendations on this issue, we can suggest some ideas that arose while carrying out this study. Some GUD outreach toward businesses like general stores, gas stations, and groceries may be warranted. Perhaps some directed involvement of these entities with GUD efforts could be instituted in some manner. Prepackaged food producers might also be brought to the table and involved in GUD efforts as well. Perhaps a GUD related 'trash bags for cars' program could be instituted with any of these related businesses as partners.

Regarding ANR and Future Research Efforts

While this study has provided a good initial wave of information regarding GUD materials composition and divertibility, it has also identified areas for future study. The early vision of this study had included a more rigorous methodology intended to provide more information regarding geographic differences across the state. To a degree these ideas were omitted in an effort to streamline costs and time demands. However, future studies could include elements designed to capture more expansive geographical data for analysis and comparison. Another element of future research might include assessing the effectiveness of new GUD procedures and policies. Specific predetermined locations in each region of the state could be identified as test sites to carry out and assess the effectiveness of new GUD policies and procedures.

Summation

The results of this study provide information critical to both our objectives. First the data generated by this study gives us a good baseline of information regarding the composition and distribution of roadside litter. Second, it is clear that a major portion of the materials gathered on GUD can be diverted from the landfill bound waste stream, thus significantly reducing the waste of resources that might be recaptured and limiting the impacts of their inappropriate disposal.

This study clearly points to benefits that can be gained by developing and implementing new policies and procedures for future GUDs.