MSWCONSULTANTS

KEEP AMERICA BEAUTIFUL, INC.
STAMFORD, CONNECTICUT

2009 NATIONAL VISIBLE LITTER SURVEY AND LITTER COST STUDY

Final Report

September 18, 2009

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EXECUTIVE SUMMARY

ES 1. INTRODUCTION

The non-profit organization Keep America Beautiful, Inc. (KAB) is the nation's largest volunteer-based community action and education organization. KAB has a network of nearly 1,000 affiliate and participating organizations, with which it forms public-private partnerships and programs that engage individuals to take greater responsibility for improving their community's environment. KAB is dedicated to community improvement primarily through litter prevention, beautification and recycling.

One of KAB's focal points since inception has been to spread awareness of and develop abatement strategies for litter on our nation's roadways, public spaces, and waterways. Beginning in 1968 and continuing through the present, KAB has sponsored numerous studies to inform about various aspects of litter. In 2008, KAB continued this trend with help from project sponsor Philip Morris USA (PMUSA), an Altria Company. Specifically, PMUSA funded a KAB-direct research project (performed in 2008 but completed in 2009 and referred to as the 2009 Study) that represents the most comprehensive analysis to date of the issue of litter. The major components of the 2009 Study included:

- Statistically representative and defensible estimates of the quantity and characterization of visible litter on our nation's roadways;
- Detailed investigation into the quantity and characterization of visible litter on selected non-roadway sites; and
- National estimates of the direct and indirect cost of litter abatement expended by our nation's municipalities, institutions, residents, and businesses.

The ultimate goal of this research was to supply defensible, comprehensive data to aid KAB in its ongoing efforts to elevate the issue of litter among national and local leaders as an important quality-of-life issue, and suggest actionable strategies based on conclusions in the final report.

ES 2. RESEARCH HIGHLIGHTS

This study represents the most comprehensive effort to date to measure the quantity, composition, sources, and costs of litter incurred by public, private, and institutional organizations. While the study yielded extensive data that may prove useful for more in-depth analysis, the key findings of the study are as follows:

- There are over **51 billion pieces** of litter on our nation's roadways, 4.6 billion of which are larger than four inches in size.
- Litter costs U.S. governments, businesses, educational institutions, and volunteer organizations almost $**11.5 billion annually.**
- **Tobacco products continue to be the most prevalent** aggregate litter item, comprising roughly 38 percent of all litter.

- Visible litter on rural interstate and primary roads has decreased significantly since 1969, according to a detailed comparative analysis of this 2009 Study and the first national litter study conducted by KAB in 1969. This comparative analysis suggests that **visible litter has decreased approximately 61 percent in the past 40 years**.
- **Paper, metal, glass, and beverage container litter has decreased significantly** since the last national study was conducted in 1969. However, **the incidence of plastic items in the litter stream has increased over 165 percent**. This plastic has the ability to end up in storm drains and eventually in our waterways causing significant harm to marine life or on land to wildlife.
- **Packaging litter comprises 18 percent** of all litter; two-thirds of packaging material is plastic packaging.
- Fast food packing, Snack Packaging, and Other packaging items **comprised 41 percent** of litter 4 inches and greater
- The vast majority of litter – 76 percent – **appears to originate from motorists and pedestrians**.
- **The highest incidence of non-roadway litter was found at "transition points,"** which are entrances to movie theaters, bus stops, and other places where someone consuming a food or tobacco product is required to discard the product before entering.

These highlights are among the numerous quantitative findings contained in the main body of the report. This Executive Summary expands on these and other findings of particular interest.

ES 3. LITTER ON OUR NATION'S ROADWAYS

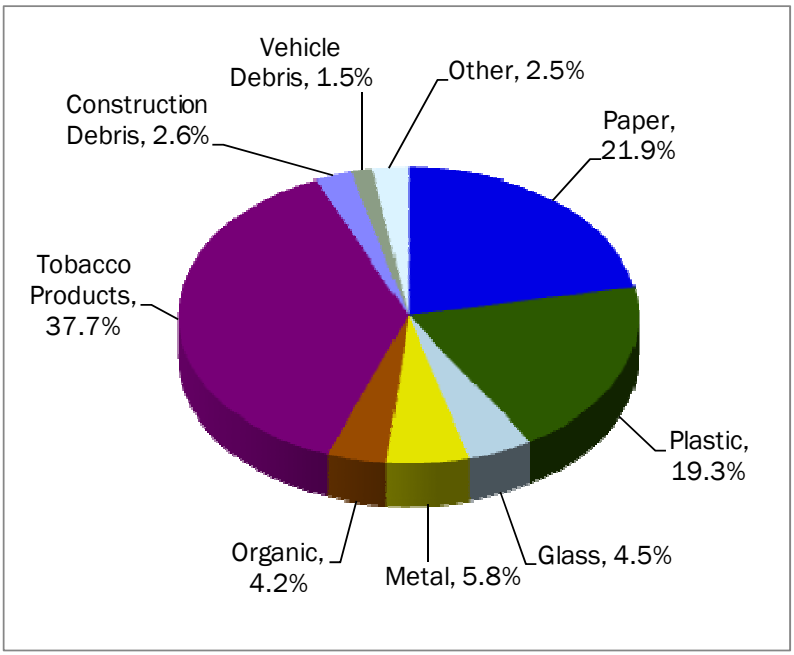
ES 3.1. INTRODUCTION

This executive summary highlights the findings of the aggregate litter stream. The body of the report also shows results separately for items of litter that are four inches or more at their largest dimension.

ES 3.2. NATIONAL LITTER QUANTIFICATION AND COMPOSITION

This study found that there were approximately **51.2 billion** pieces of litter on our nation's roadways. Of this total, 46.6 billion (91.0 percent) litter were less than four inches in size while the remaining 4.6 billion items (9.0 percent) were larger than 4 inches. Figure ES-1 summarizes the aggregate composition of littered items projected to be on our nation's roadways in 2008.

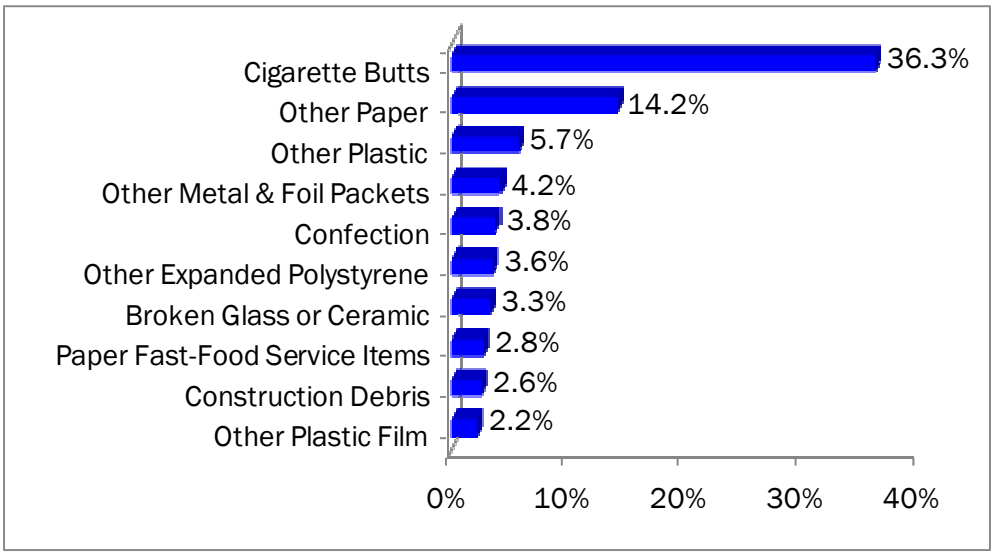
Figure ES-1 Aggregate Composition of Litter, All U.S. Roadways



As expected based on past litter studies, tobacco products – primarily cigarette butts (but can include cigars, chewing tobacco, and packaging among other items), are the single largest type of litter (38%), followed by paper (22%) and plastic items (19%).

Figure ES-2 on the following page highlights the top ten individual types of litter, which collectively contribute 40.3 billion pieces of litter. Results are shown in terms of the number of pieces per mile of roadway. Consistent with prior litter studies, cigarette butts continue to be the most common litter item by a wide margin. The presence of confection litter and paper fast-food items on this list is notable. In total, these top ten litter items make up 79 percent of all litter.

Figure ES-2 Top 10 Aggregate Litter Items, All U.S. Roadways



ES 3.3. Quantity of Litter by Roadway Type

Table ES-1 summarizes the breakdown of litter by roadway type. The total litter items shown in this table are driven to a great degree by the underlying roadway miles for each road type. However, there is a greater amount of litter on national and state roads compared to county and municipal roads.

Table ES-1 Aggregate Litter Incidence by Roadway Type

Roadway Type	Average Items per Mile	U.S. Road Shoulder Miles	U.S. Litter (billion)
Urban Roads	7,784	1,983,892	15.4 billion
Rural Roads	6,357	5,621,252	35.7 billion
Subtotal	*6,729*	*7,605,144*	*51.2 billion*
National Roads	19,186	93,216	1.8 billion
State Roads	13,011	1,461,288	19.0 billion
County Roads	5,539	3,562,828	19.8 billion
Municipal Roads	4,277	2,487,812	10.6 billion
Subtotal	*6,729*	*7,605,144*	*51.2 billion*
All Roads	**6,729**	**7,605,144**	**51.2 billion**

As shown, including the shoulders of roads to a 15 foot depth, U.S. roadways in general have 6,729 items of litter per mile or about 1.3 pieces per foot. These data show:

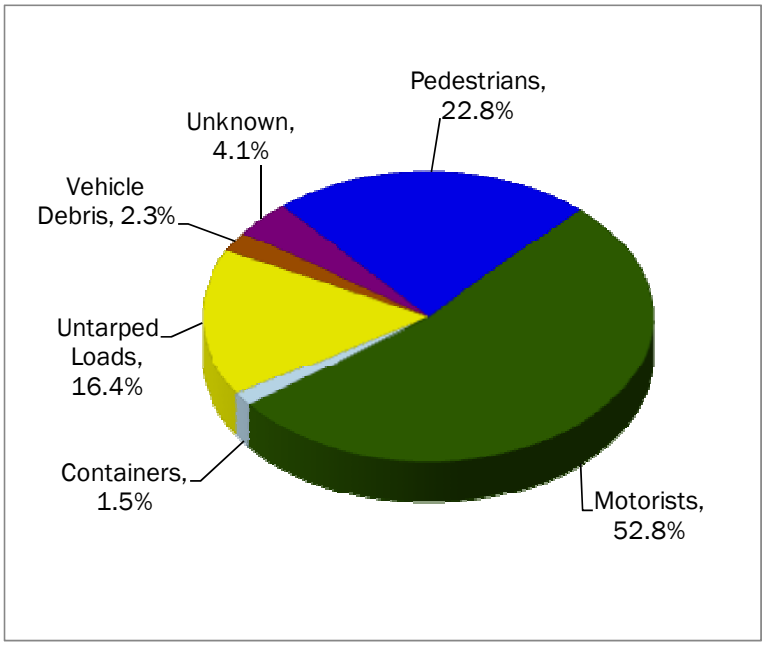
- **Urban v. Rural**: Rural roads and urban roads were found to have a roughly comparable litter items per mile, but rural roads contribute about 2.3 times more litter because there are many more road miles.

- **Road Type**: The number of litter items per mile decreases as one goes from national down to municipally maintained roads. National roads are the most heavily littered per mile, due to heavy traffic and limited access, yet contribute relatively little to the overall litter rate because of the low number of road miles. State roads are also highly littered, and contribute over one-third of all litter. Although County roads exhibit a lower number of litter items per mile, they also contribute roughly one-half of all litter because of the high number of roadway miles. Municipal roads have the lowest litter incidence per mile, yet also contribute 20 percent of all litter.

ES 3.4. SOURCES OF LITTER ON ROADWAYS

One of the unique aspects of this study included the use of "context clues" to determine the *likely* source of litter for each of the individual items that were documented on the 240 roadways sites. Figure ES-3 summarizes the sources of aggregate litter on all roadway types based on a first-of-its-kind attempt to categorize litter by source.

Figure ES-3 Sources of Aggregate Litter on All U.S. Roadways



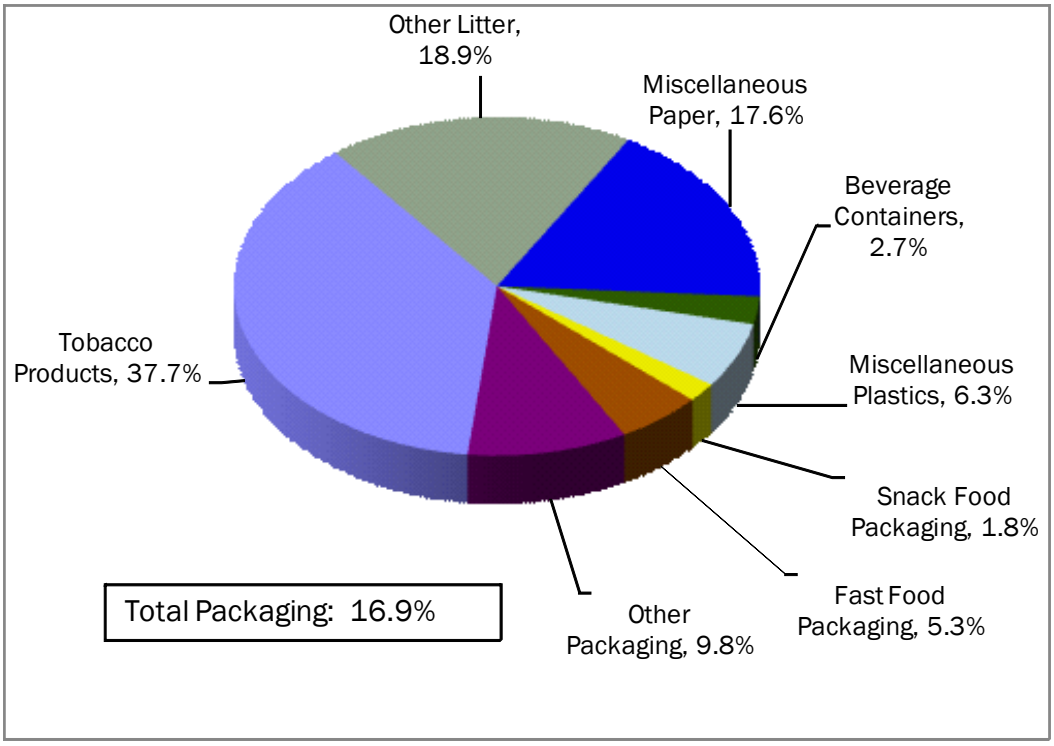
Not unexpectedly, the dominant sources of litter for all items on all roads are Motorists (52.8%) and Pedestrians (22.8%), which contributed a combined 76 percent of all litter. This suggests that education campaigns targeting individual behavior should continue to prevail as a strategy for influencing litter generation.

ES 3.5. FOCUS ON SPECIFIC MATERIAL TYPES

KAB has identified a number of litter types which are of particular interest for future abatement initiatives. These are shown in Figure ES-4. As shown, tobacco products (primarily cigarette butts) comprised 38 percent of the total litter. Snack, fast food and other packaging totaled 16.9 percent while beverage containers totaled 2.7 percent of all items. Taken together, these items comprise 80 percent of all litter, so any initiatives to reduce litter

from any of these sources (especially from tobacco products) could have significant positive consequences.

Figure ES-4 Litter Types of Interest (Aggregate)



ES 3.6. COMPARISONS WITH 1969 NATIONAL LITTER SURVEY

Another goal of this project was to compare the roadway results of the 2009 Study to a similar national litter survey that had been conducted in 1968 and 1969, also sponsored by KAB. In order to align differences in the methodologies of each study, results from the 1969 study were compared to large litter items (four inches) on rural interstates and rural primary roads sampled in 2008. It is important to note that the U.S. population has increased from 200 million people in 1969 to 300 million in 2008 – an increase of 50 percent. All else being equal, it would be expected that the number of litter items per mile would increase by roughly the same percentage as the overall population. The number of litter items per mile has therefore been normalized to account for the impact of population growth on littering. Figure ES-5 and Table ES-2 compare the ROW-adjusted, population-normalized 1969 Study results to the 2009 Study results.

Figure ES-5 Change in Visible Litter on Rural Interstates and Primary Roads Since 1969

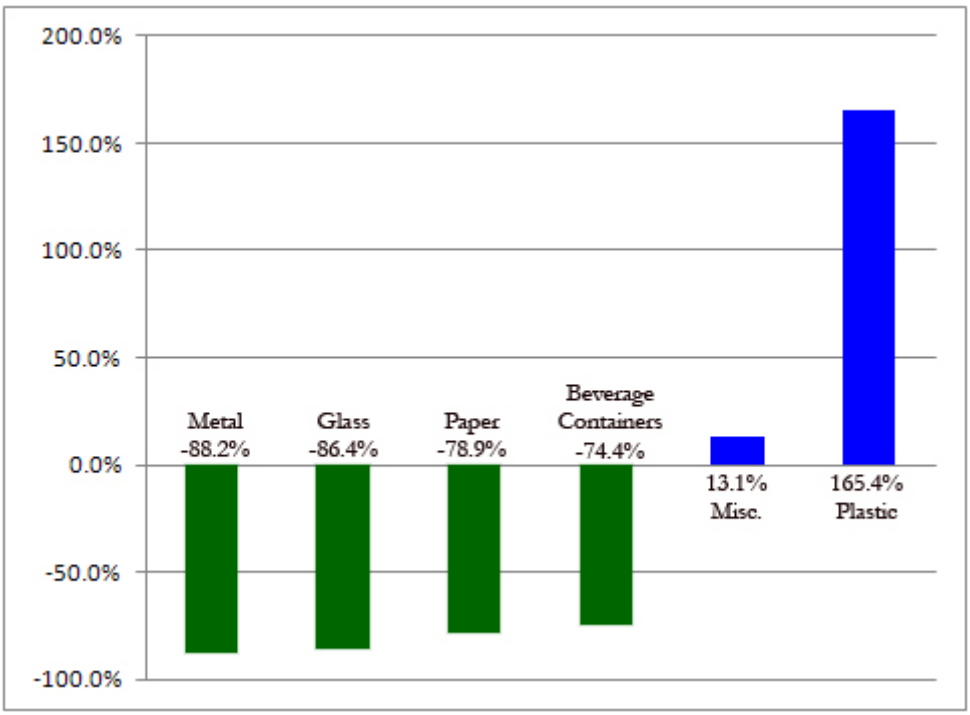


Table ES-2 Comparison of 1969 and 2009 Study Results: Visible Litter on Rural Interstates and Primary Roads [1]

Material	Change in Litter
Paper	-78.9%
Metal	-88.2%
Plastic	165.4%
Misc	13.1%
Glass	-86.4%
Total	**-61.1%**
Beverage Containers [2]	-74.4%

[1] The results in this table are based on a comparison of the results of the 1969 and 2009 National Litter Studies. In order to enable reasonable comparisons, the 1969 Study data was statistically adjusted to capture only the first 15 feet of the right-of-way, and results were also normalized to account for the 50 percent growth in population that occurred from 1969 to 2008.

[2] Beverage containers were segregated in both the 1969 and 2009 Studies and are shown separately. In the case of beverage containers only, data from the 2009 Study includes all beverage containers, regardless of size (e.g. 4" and greater and less than 4"). Because beverage containers are recognizable in their own specific category, it was considered likely that the surveyors from the 1969 Study counted all beverage containers – regardless if they had been crushed or were still intact.

Several significant conclusions can be drawn when comparing the 1969 and 2009 litter surveys:

- The actual count of overall litter is down 61 percent since 1969.
- This decrease, a result of successful education, ongoing cleanup efforts and changes in packaging, is reflected in dramatic reductions of paper, metal and glass litter since 1969.
- Plastic litter has increased by 165 percent since 1969.

Taken together, these data show that visible litter on our nation's roads has declined significantly in the past 40 years. However, changes to the mix of packaging materials and the physical characteristics of some items leave additional opportunities for future improvement.

ES 4. LITTER ON NON-ROADWAY SITES

ES 4.1. INTRODUCTION

Six non-roadway areas were evaluated in this study:

- Transition Points;
- Loading Docks;
- Storm Drains;
- Retail Areas;
- Recreational Areas; and
- Construction Sites

Unlike the roadway surveys, there are no national databases that compile the "universe" of non-roadway sites, and therefore it is not possible to provide a national estimate of litter on non-roadways. Rather, the results presented herein are intended to convey the extent of litter as an observable problem on a range of non-roadway areas that have been found or believed to harbor meaningful quantities of litter.

ES 4.2. NON-ROADWAY LITTER SURVEY RESULTS

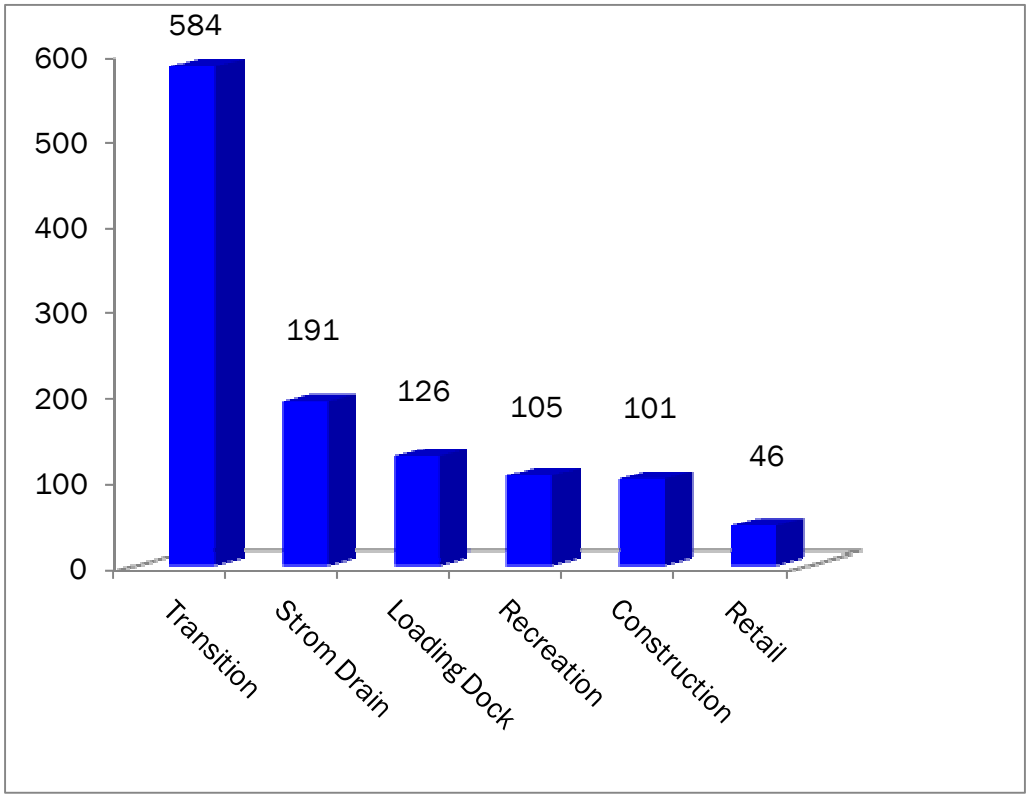
Table ES-3 below displays the top five most common items of litter found at each of the non-roadway sites. As is shown, cigarette butts are the number one item found in five of the six non-roadway sites, with confection litter also among the top five at multiple non-roadway types.

Table ES-3 Top 5 Most Common Litter Items at Non-Roadway Sites (Items/1,000 sq ft)

Ranking	Transition Points	Loading Docks	Storm Drains	Retail Areas	Recreational Areas	Construction Sites
1	Confection Litter	Cig. Butts	Cig. Butts	Cig. Butts	Cig. Butts	Cig. Butts
2	Cig. Butts	Other Metal and Foil	Confection Litter	Confection Litter	Confection Litter	Other Paper
3	Vehicle Debris	Wooden Pallets	Other Paper	Other Paper	Other Paper	Other Plastic
4	Broken Glass or Ceramic	Other Plastic	Broken Glass or Ceramic	Paper Fast Food Service	Food Waste	Confection Litter
5	Other Paper	Other Paper	Other plastic	Plastic Bags	Other Plastic	Other Metal and Foil

It is informative to evaluate the litter results of the six non-roadway areas in comparison to one another. Figure ES-6 compares the relative number of litter items per 1,000 square feet at non-roadway sites targeted in this project.

Figure ES-6 Comparison of Litter Incidence by Non-roadway Area (items per 1,000 sq.ft.)



As shown, on a per 1,000 square foot basis, transition areas are significantly more littered than any other non-roadway type, at more than twice the litter as the second closest litter rate. Retail areas harbor the least litter.

ES 5. THE COST OF LITTER ABATEMENT

ES 5.1. INTRODUCTION

Litter is known to financially impact a wide range of entities and organizations in a variety of ways. For example, many entities (local government, institutions, and businesses) incur direct costs by expending resources (personnel, equipment, disposal fees, etc.) for collecting litter. Indirect costs may also be incurred if litter reduces the value of a parcel of real estate or deters a customer from entering the premises of a business because of litter or other debris. There is a great breadth of litter abatement efforts that are ongoing in our economy on a regular basis.

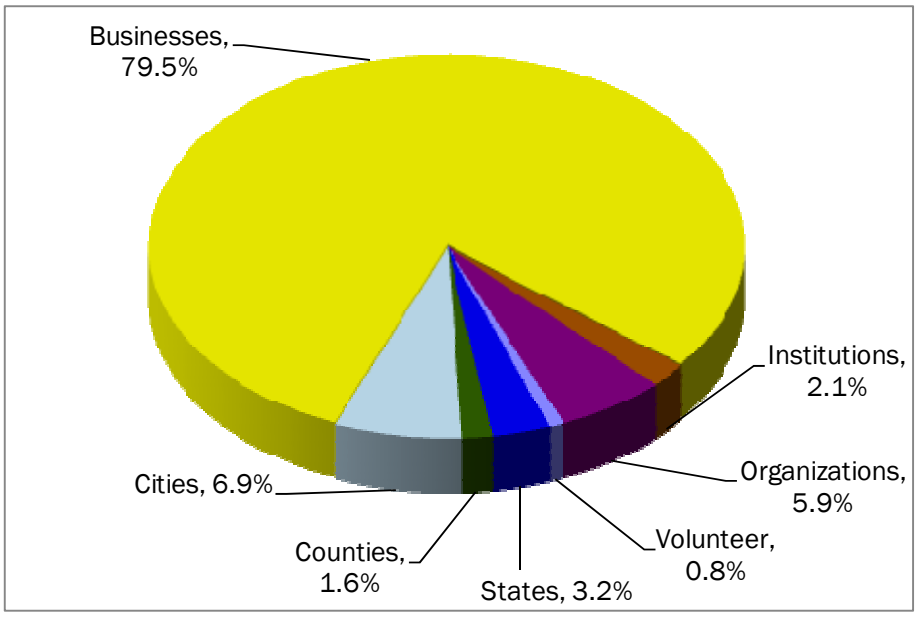
Despite the intuitive awareness that a great deal is expended on litter abatement, there are few means of quickly and accurately measuring the costs associated with these abatement efforts. Therefore, a critical part of this project was to develop a far-reaching research protocol that spanned a wide range of entities involved in litter abatement.

To investigate the estimated direct costs of litter borne by a wide range of public and private entities in the U.S., this project utilized a series of surveys of national databases of governments, institutions, and businesses which were in turn benchmarked over a three month time span.

ES 5.2. LITTER COST SURVEY RESULTS

This study suggests that public, private, and institutional organizations spend at least $11.5 billion annually in direct costs to clean up litter. The majority of this cost is borne by businesses. The relative breakdown of litter costs from each entity type is shown in Figure ES-7 below.

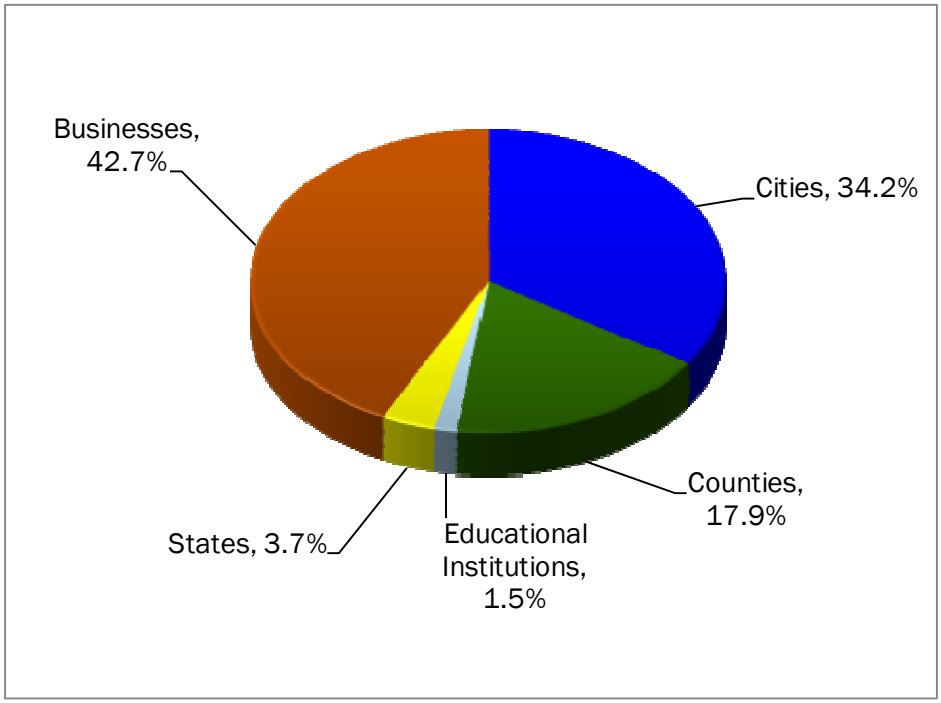
Figure ES-7 Breakdown of Direct & Indirect Litter Costs in the U.S.



ES 5.3. LITTER AND ILLEGAL DUMPING QUANTITIES

This study also sought to quantify the amount of litter collected by states, counties, cities, businesses and educational institutions on an annual basis in the United States. This effort determined that an estimated 4,660,930 tons of litter (43 percent of which is collected by businesses) is collected each year by these various entities. For perspective, this is more than the total residential waste generated in the five boroughs of New York City in a one year time frame. Figure ES-8 below shows the percent breakout of the aggregate litter collected by entity type.

Figure ES-8 Breakdown of Litter and Illegal Dumping Quantities in the U.S.



ES 6. CONCLUSIONS AND RECOMMENDATIONS

The following broad conclusions can be made from the work performed in this study.

- The amount of visible litter (4" and greater) found on rural interstates and primary roads has decreased 61 percent since 1969. This decrease is reflected in significant reductions of paper, glass, and metal litter items, offset in part by an increase in plastic litter.
- Litter is pervasive. Perhaps ironically, because litter abatement efforts along our nation's highways have become commonplace in many jurisdictions, the true extent of litter is likely obscured.
- The cost to clean up litter for all entities is significant.
- Many entities have no idea of the costs they incur to clean up litter.
- Many entities depend on volunteers to clean up litter, a trend that will likely grow in the current economic climate.

- Litter consists of a matrix of different problems involving individual carelessness and negative littering behavior. Thus, there continues to be a need for multiple strategies to combat the problem.
- Continuing population growth of about 3.5 million/year will continue to put pressure on litter abatement efforts. Even if litter is reduced on a per capita basis, more people will still tend to result in more litter.
- As the U.S. struggles through the difficult economic situation in 2009, budget cuts may prove detrimental to litter clean-up programs among many public and private entities.

As with any field of study, initial efforts lead to ideas that may enhance future understanding. In the case of litter, improved understanding serves to inform policy makers, political and business leaders, community activists, and the public at large about litter as a critical issue. With these ideas in mind, the following are considerations for future study.

- **Continue Tracking National Litter Rates**: This national study should optimally be repeated every five to 10 years to provide trend data that can defensibly document changes in litter rates and inform leaders and the public at large.
- **Improve Access to Litter-related Data**: The results of this study are conducive to placement on a dynamic, query-driven web-site that allows users to project litter quantities and composition based on an underlying roadway profile. Such an on-line interactive web page, which provides rough projections on the quantity and composition of litter given underlying roadway types and miles, would provide KAB and its affiliates with detailed data regarding litter across the U.S.
- **Enlist Industry Participation for Litter Cost Research**: This study took a broad-based approach to determining litter costs. However, it is hypothesized that it would be highly informative to recruit a single industry (e.g., fast food restaurants) or a single large company (e.g., McDonalds) and to enlist assistance at the corporate level to study the hard and soft costs of litter throughout the organization. This strategy is appealing for two reasons. First, it starts with a corporate commitment at the top level, which provides greater chance of success. Second, it will provide KAB with a reason to approach a wider range of corporations to explore the problem of litter in a way that may ultimately broaden support.
- **Advanced Sampling Protocol for Non-Roadway Sites:** Visible, volumetric and weight based litter studies have been conducted on various types of roadways within the United States over the last 30 plus years. To obtain a truly holistic picture of the amount and cost of litter in the United States, it would be necessary to develop methods to representatively sample the many non-roadway locations that are known to harbor litter. A basic methodology for this could entail field surveying of randomly selected parcels in a city or county, with the goal of measuring (a) the incidence of litter per unit area covered by the parcel, and (b) the range of characteristics (such as number of storm drains, transition points, retail areas, litter and ash receptacles, etc.) contained in the parcel. This idea would require significant effort to expand into a workable study methodology, but the results, if successful, could significantly improve the understanding of the total quantities, dispersion, and composition of litter on non-roadway sites.

A complete discussion of the project methodology, results, and conclusions can be found in the body of this report.

1. INTRODUCTION

1.1. LITTER: THE PROBLEM DEFINED

Litter is a form of pollution caused by the willful or careless mishandling or improper disposal of waste materials. People litter for many reason, but broadly littering behavior stems from a lack of personal ownership. Citizens sometimes assume that littering is acceptable because they believe that someone else will take responsibility to clean up that litter. When waste materials are handled carelessly, such as waste paper blowing out the open widow of a vehicle or an empty beverage bottle discharged from an unsecured truck bed, it only adds to the problem. Both forms of litter become a costly issue to be dealt with by our communities, institutions, residents, and businesses. As the U.S. population continues to grow, and as our society becomes increasingly multi-cultural and multi-lingual, the issue of effective litter abatement has become more important than ever.

The problem of litter has continued to be difficult to solve precisely because it is not perceived to be among the many critical issues facing our nation's environmental policymakers. Litter competes with climate change, renewable resources, alternative energy sources, air and water pollution, traditional waste management, and other environmental issues for media coverage, funding, and policy making. Yet, while recycling rates have grown steadily since the concept of recycling reached the national consciousness litter rates have stayed stubbornly high in many parts of the country.

George Kelling's landmark research contained in *Broken Windows* has shown that seemingly minor problems such as litter can serve as the starting point for a broader community decline, highlighting the importance for all citizens to assume responsibility for the state of their community. Viable solutions must include community involvement, ongoing public education and willingness to volunteer. Ultimately, the ability of politicians, industry leaders, community leaders, policymakers, and planners to effectively deal with litter will require defensible data about the extent, causes, costs, and possible solutions to the problem. This study is intended to greatly expand the dialog on the topic of litter.

1.2. BACKGROUND

Non-profit organization Keep America Beautiful, Inc. (KAB) is the nation's largest volunteer-based community action and education organization. KAB has a network of nearly 1,000 affiliate and participating organizations, with which it forms public-private partnerships and programs that engage individuals to take greater responsibility for improving their community's environment. KAB is dedicated to community improvement primarily through litter prevention, beautification and recycling.

One of KAB's focal points since inception has been to spread awareness of and develop abatement strategies for litter on our nation's roadways, public spaces, and waterways. In 1968 KAB sponsored what was at the time a revolutionary study on the incidence of litter. This research led to a groundbreaking study in the 1970s that identified seven major sources of litter:

- Pedestrians or cyclists who do not use receptacles.

- Motorists who do not use car ashtrays or litter bags.
- Business dumpsters that are improperly covered.
- Loading docks and commercial or recreational marinas with inadequate waste receptacles.
- Construction and demolition sites without tarps and receptacles to contain debris and waste.
- Trucks with uncovered loads on local roads and highways.
- Household trash scattered before or during collection.

Together, these early research efforts inspired what today has become an ever improving set of procedures and tools for measuring and tracking litter generation and subsequently communicating effectively about the implications of the issue.

Philip Morris USA, An Altria Company (PMUSA), manufacturer of tobacco products which are known to be a major contributor to litter, has long sponsored KAB in its pursuit of litter research and abatement. In 2006, PMUSA awarded Keep America Beautiful a grant to conduct research that would provide a revised look at the sources and causes of littering in America. The findings from this research would become the backbone for a revised campaign to address littering issues and bring the significance of this problem to the public.

In 2008, PMUSA continued their commitment to the issue of litter by funding another KAB-directed research project that would represent the most comprehensive analysis to date of the issue of litter. Taken together, the grant encompassed the following components of litter:

- National estimates of the quantity and characterization of visible litter on roadway and non-roadway sources;
- National estimates of the direct and indirect cost of litter abatement expended by our nation's municipalities, institutions, residents, and businesses; and
- Groundbreaking behavioral research to identify the environmental and social constructs that lead to littering.

The ultimate goal of this research was to supply defensible, comprehensive data to aid KAB in its ongoing efforts to elevate the issue of litter among national and local leaders as an important quality-of-life issue, and suggest actionable strategies based on conclusions in the final report. To successfully complete this important research, KAB retained MidAtlantic Solid Waste Consultants (MSW Consultants) to implement the visible litter survey and litter cost research components of the grant.[1]

1.3. PROJECT OBJECTIVES

The primary objectives of this project were to:

- **Comprehensively quantify and characterize litter found on U.S. roadways**, stratified based on the entity responsible for roadside litter abatement: national/federal highways,

[1] The research component involving littering behavior was awarded to a second firm, Action Research, which specializes in such analysis.

state-maintained roads, county-maintained roads, and municipally-maintained roads (city, town, borough, etc.).

- **Quantify and characterize litter found on the six types of non-roadway areas**: construction sites, loading docks, recreational areas, storm drains, retail shopping, and transition points (i.e., places such as bus stops where people must discard food, drinks, or lit tobacco products before entering).
- **Quantify the direct costs of litter collection, education and enforcement** to cities, counties, businesses, colleges and universities, school districts, and all 50 states and the District of Columbia.
- **Qualitatively explore the indirect costs of litter** by surveying a random sample of real estate brokers, property appraisers, homeowners, and business development officers regarding the suspected effect of litter on the values of homes and on the efforts of cities and states to persuade businesses to locate in their communities.

1.4. REPORT ORGANIZATION

The full report is divided into the following remaining sections:

- **Section 2 – Visible Litter Survey Methodology:** This section provides a detailed overview of the methodology used to representatively sample, survey, and statistically analyze roadway and non-roadway litter.
- **Section 3 – Visible Litter Survey Results:** This section presents national projections of the quantity and characterization of litter on our nation's roadways, as well as findings of interest about litter in non-roadway areas. It also explores factors that correlate to litter generation. Comparative data are shown by roadway type and by non-roadway area. Finally, this section also contains a comparison of the findings of this study against a prior study conducted by KAB in 1968and completed in 1969.
- **Section 4 – Litter Cost Survey:** This project included an ambitious survey effort aimed at public and private organizations of all kinds that might be engaged in litter abatement and clean-up. This section outlines the universe of entities targeted for surveying, details the survey methodology, and summarizes the results.
- **Section 5 – Conclusions and Recommendations:** While much remains to be accomplished, this section attempts to offer some conclusions and recommendations based on the implications of the research performed.
- **Appendices**: The report contains a range of appendices that contain more in-depth results to certain segments of the analysis, as well as supporting study documentation.

1.5. PROJECT TEAM

The professional staff assembled for this project brought together nationally recognized experts on the subject of litter. Key experts who participated in this project included:

- **John Culbertson, Principal of MSW Consultants**, has extensive experience developing innovative and statistically rigorous waste stream characterization sampling plans and field data collection projects. He has conducted state-level and national survey research

projects based on rigorous sampling and statistical analysis. Mr. Culbertson co-managed the project with a focus on internal project performance and provided quality control throughout the analysis and development of the final report.

- **Steven Stein, Principal of Environmental Resources Planning, LLC,** has managed and performed visible litter studies in North Carolina, New Jersey, California, Georgia, and Tennessee and has provided pro bono services to Ocean Conservancy's National Marine Debris Management project and to Potomac Watershed Initiative. He has participated in extensive research regarding the quantification and sources of litter throughout the U.S., including participation in the National Litter Forum during which this project was conceived. Mr. Stein, who was employed by MSW Consultants at the time of the study, developed the overall project approach, served as subject matter expert on litter and marine debris, and co-managed the project.
- **Kristian Ferguson, Litter Analyst for MSW Consultants**, has performed visible litter studies in Mississippi, North Carolina, New Jersey, California, Georgia, and Tennessee. Mr. Ferguson provided day-to-day support throughout the field data collection effort, co-wrote the national litter survey report and also developed, performed and managed the litter cost portion of the study. In addition, Mr. Ferguson conducted a white paper on the amount of plastic bag litter in the overall waste stream from land and water based sources, for a major industrial trade organization. Mr. Ferguson also has worked pro bono for the Ocean Conservancy's National Marine Debris Management program and to the Potomac Watershed Initiative in Washington, D.C.
- **Katie Kennedy is a Project Manager for subconsultant Cascadia Consulting Group**, a leading West Coast firm in the performance of waste and recycling stream characterization studies. Ms. Kennedy has in depth experience with several important litter-related projects, including most recently the State of Washington Litter Study in 2004 and a study of street basket waste for New York City in 2005. Ms. Kennedy advised on elements of both the visible litter survey and the indirect cost research.

Together, the MSW Consultants Project Team was assembled to provide KAB with the litter management leadership, statistical sampling expertise, and breadth of experience in litter-related work to assure that the outcome of this project reflects best practices and is informative to a wide population.

2. METHODOLOGY

2.1. INTRODUCTION

Keep America Beautiful first commissioned a study of nationwide litter generation in the late 1960s. Published in September 1969, this first study was performed by the Highway Research Board of the National Academy of Sciences – National Academy of Engineering.[1] This report (1969 Study) indicated that it was attempting the first-ever comprehensive analysis of the composition and quantity of litter on the nation's "primary rural highways" in the United States.

While the 1969 Study was groundbreaking for many reasons, it ultimately relied on field observations from only 29 states as the basis for tabulating results. As a consequence, the 1969 Study authors cited as an opportunity for improvement the development of a nation-wide master sample of all states to assure complete representativeness of the study findings. The 2009 National Visible Litter Survey and Litter Cost Study (2009 Study) has sought to develop a true national sample not only for rural roads but for all roadway types, while also applying current visible litter study best data collection and analysis practices. This section of the report describes the overall approach to the project, covering the sampling plan, field data collection procedures, and analytical methods.

2.2. MATERIAL DEFINITIONS

Items of litter found in the field were characterized according to a list of 61 material types. The list of 61 material types was developed based on a review of contemporary surveys to highlight items currently drawing interest.[2] Table 2-1 summarizes the materials and material groups used for this study. A complete list of material types and definitions is included in Appendix A.

2.3. DEFINING AND DETERMINING LITTER SOURCES

Changes in waste management, transportation infrastructure and cultural attitudes have contributed to significant changes in littering sources and rates. Understanding the percentages attributable to various sources of litter is critical to addressing the problem of littering. When communities target litter reduction education and enforcement, the emphasis tends to be inordinately placed on litter that is generated by pedestrians and motorists.

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[1] "National Study of the Composition of Roadside Litter," a Report from the Highway Engineering Board of the Division of Engineering, National Research Council, National Academy of Sciences – National Academy of Engineering; prepared for Keep America Beautiful; prepared by A. L. Finkner, Director, Statistics Research Division, Research Triangle Institute (Research Triangle Park, NC), September 12, 1969.

[2] The 61 material types were drawn from prior litter studies in conducted in Australia (1997-2007), California (1975, 2005), Federal Highway Administration Highway Litter Survey (1974), Florida (1997-2002), Georgia (2006), Iowa (2001-2003), Ireland (2000-2004), National Academy of Sciences' (1968); New Jersey (2004), Ohio (2004), San Francisco (2007), Tennessee (2006) Texas (1975-2004), Washington State (1975-2005) and the 2007 Literature Review on Litter conducted for Keep America Beautiful.

However, unintentional sources of litter – such as debris escaping from commercial refuse collection trucks as they drive their routes in residential communities – may not get the level of attention commensurate with their contribution to the problem. Consequently, programs may, at times, spend inordinate amounts of their allocated budgets targeting only one source of litter and leave other significant sources inadequately addressed. Litter reduction programs can become more effective once sources are more clearly identified for targeting.

Table 2-1 Litter Material Categories

Material Group	Material Category	Material Group	Material Category
Paper	OCC	Plastic	Plastic Soft Drink Bottles
	Kraft bags		Plastic Wine & Liquor Bottles
	Office Paper & Discarded Mail		Plastic Sports & Health Drink Bottles
	Newspaper & Inserts		Plastic Juice Bottles
	Magazines & Books		Plastic Tea Bottles
	Advertising Signs & Cards		Plastic Water Bottles
	Receipts		Plastic Jugs
	Paper Fast-Food Service Items		Other Plastic Containers
	Aseptic & Gable-Top Containers		Other Beverage Packaging
	Beverage Carriers & Cartons		Plastic Bags
	Paper Home Food Packaging		Food Packaging Film
	Other Paper		Other Plastic Film
Glass	Glass Beer Bottles		Plastic Fast Food Service Items
	Glass Soft Drink Bottles		EPS Fast Food Service Items
	Glass Water Bottles		Other Expanded Polystyrene
	Glass Wine & Liquor Bottles		Plastic Home Food Packaging
	Glass Sports and Health Drink Bottles		Other Plastic
	Glass Juice Bottles	Metal	Aluminum Beer Cans
	Other Glass Bottles		Aluminum Soft Drink Cans
	Broken Glass or Ceramic		Metal Sports & Health Drink Cans
	Other Glass		Metal Juice Cans
Organic	Human Waste		Metal Tea Cans
	Food Waste		Other Metal Cans
	Confection Litter		Other Metal Beverage Packaging
Other	Other Hazardous		Metal Home Food Packaging
	Road Debris		Other Metal & Foil Packets
	Bulky Items	Construction Debris	Construction Debris
	Textiles & Small Rugs	Vehicle Debris	Vehicle Debris
	Toiletries & Sundries	Tobacco	Cigarette Butts
	Entertainment Items		Cigar Butts
	Other Items		Other Tobacco Related

While it is conceptually simple to recognize that there are multiple sources of litter, in practice it is more complicated (and at times impossible) to determine the source of a littered item. Specifically, unless the litter item is observed when it is actually littered, the process of assigning a source is educated guesswork.

Nonetheless, a goal of this visible litter survey was to attempt to determine the actual source of items of litter based on context clues. At the outset of the study, the MSW Project Team, working with KAB, developed and refined a set of rules to use as a guide to help determine the likely source of litter items on both roadway and non-roadway locations. The likely sources of litter used during the field sampling originated from Keep America Beautiful's seven primary sources of litter, which are: 1) pedestrians or cyclists; 2) motorists; 3) improperly covered business dumpsters; 4) loading docks, and commercial or recreational marinas with inadequate waste receptacles; 5) construction and demolition sites; 6) trucks with uncovered loads; and 7) household trash scattered before or during collection. However, for the KAB national litter study, these seven likely sources of litter were modified based on MSW Consultants staff's prior field experience as well as input from KAB.

Ultimately, for this project, the following six sources of litter were defined and used:

- **Motorists**: On the surface, this would appear to be the most common form of litter, which occurs when a motorist discards trash while driving.
- **Pedestrians**: Similarly, pedestrians traversing the sidewalk by the roadside or otherwise walking through a non-roadway area can also discard trash improperly.
- **Improperly Secured Loads**: Whether a small pick-up truck with loose paper wrappers in the bed of the truck, or commercial trucks hauling construction debris in a 40-yard roll-off box, carelessness and inadequacy of the material containment method can result in litter. This is a form of negligent litter. An example of a vehicle with an improperly secured load is shown in Figure 2-1.
- **Overflowing Containers**: While many communities have deployed litter receptacles, and most businesses have commercial refuse containers, there are many opportunities for these containers to overflow, causing litter in the immediate proximity. Also a form of negligent litter, an example of an overflowing container is shown in Figure 2-1.
- **Vehicle Debris**: Byproducts of road transportation create their own form of negligent litter, which includes tire retread and other parts that may disengage from an otherwise operational vehicle, as well as the range of particles and items that are generated during traffic accidents. The negligence in this case comes from a lack of responsibility for anyone to recognize that littering has taken place and to clean up the litter.
- **Unknown**: Despite the best use of context clues, it is to be expected that the source of some litter items cannot be reasonably determined.

Examples of the types of context clues that were used to make the determination of the likely source of litter include:

- Cigarette butts on national highways were reasoned to be from motorists because there is no meaningful pedestrian traffic, nor are other sources likely contributors;
- Fast food wrappers and packaging found on the street next to a fast food restaurant with an overflowing container would suggest the overflowing container as the most likely source;
- Spillage of papers on an exit ramp headed toward a recycling facility suggests that a recycling collection vehicle (i.e., an unsecured load) would be the most likely source; and
- Snack packaging found at a corner where there was a traffic light, but no bus stop, suggests that motorists would be the most likely source.

Figure 2-1 Sources of Litter

Improperly Secured Loads **Overflowing Containers**

While the examples above are straightforward, in many cases the rules are more nuanced. As an example, a corrugated box that is crushed, but is otherwise without a putrescible stain or odor, may have been discarded by a motorist or perhaps from an unspecified unsecured load. If that same crushed box has a putrescible stain or odor, or is coated with significant powder residue, it is more likely to have fallen from a trash collection or construction vehicle and its source can be considered an unsecured load.[3] The complete set of litter sourcing rules developed for use in this project is contained in Appendix B. Ultimately, the decision was made to attempt to assign as many litter items as possible to a source (i.e., our attempts were aggressive). While field crews made every attempt to follow the litter sourcing rules for this study, it is possible that some mischaracterization of the likely source(s) of litter occurred.

[2] Spillage and uncollected residue from residential trash and recyclables collection are a known source of litter. However, statistically representing the portion of litter attributable to that source would have required field crews to only survey on days when both residential trash and recyclables were being collected. Since a number of the sites randomly selected were not adjacent to such collection, it was not feasible to determine the percentage of litter attributable to such sources. This may represent an area of future study.

2.4. ROADWAY SITE SAMPLING PLAN

2.4.1 ROADWAY TYPES AND SAMPLING TARGETS

For the study results to defensibly project litter on our nation's roadways, it was critical to develop a sampling plan that representatively captured the different roadway types. In the litter industry, roadway types are defined primarily based on the entity that maintains the road (and therefore has responsibility for litter abatement). Specifically, there are four main types of roads that were considered for this study:

- **National Roads**: Primarily interstates, these are the roadways maintained at the federal level.
- **State Roads**: Roads that are maintained by state departments of transportation;
- **County Roads**: Roads that are in the unincorporated area of a county; and
- **Municipal Roads**: These are the local roads in incorporated cities, towns, boroughs, villages, etc. that receive local maintenance.

In addition to roadway type, the study also sought to segment roads based on the population density of the surrounding area. Therefore, for each of the four roadway types, the study captured samples from both urban and rural roadway segments.

Table 2-2 summarizes the total roadway mileage for each road type, based on data provided by the Federal Highway Administration.

Table 2-2 U.S. Total Roadway Mileage

	Centerline Mileage		Percent of Mileage	
Roadway Type	Urban Roads	Rural Roads	Urban Roads	Rural Roads
National	15,703	30,905	2%	1%
State	125,210	605,434	13%	22%
County	182,696	1,598,718	18%	57%
Municipal	668,337	575,569	67%	20%
Total	**991,946**	**2,810,626**	**100%**	**100%**

Source: Federal Highway Administration

As shown, there are 3,802,572 total centerline miles of roadway in the U.S. National roads, including all interstates, comprise only a minor percentage of both urban (2 percent) and rural (1 percent) roads, although the traffic levels on these roads are significantly higher than other roads that are not generally intended for high-speed travel.

Although an objective of the study was to develop national estimates, a secondary consideration was to compare and contrast litter generation among the different roadway types. Consequently, the sampling plan for this study sought to acquire a sufficient number of samples from each roadway stratum. Ultimately, the study targeted 240 total roadway samples, allocated evenly across the eight roadway types. Table 2-3 shows the targeted versus actual roadway samples for the study.

Table 2-3 Targeted and Actual Roadway Samples

Roadway Type	Sub Category	Example (Connecticut)	Samples Targeted	Samples Acquired	Difference
National Roads	Urban	I-95	30	30	0
	Rural	I-95	30	26	-4
State Roads	Urban	SR 106	30	25	-5
	Rural	SR 106	30	37	+7
County Roads	Urban	None	30	38	+8
	Rural	None	30	34	+4
City Roads	Urban	N/A	30	30	0
	Rural	N/A	30	23	-7
Totals			**240**	**243**	**+3**

As shown in the table, roughly 30 samples were targeted from each of the eight roadway strata. The reasons for variations to the sample targets are described below.

2.4.2 SEASONALITY

A significant amount of research has been done to test the seasonality of litter generation, noting summer as the highest generation season and winter as the lowest in most areas. Although the possibility of seasonal sampling was considered, it was determined at the outset of the study that only a single season of sampling, in the summer of 2008, would be performed, due to project schedule constraints. Field sampling was initiated immediately following Memorial Day and was completed by August 2008.

It should be noted that summer vacations typically begin in June in many areas, and summer weather is more conducive to driving with the windows down. Further, it is hypothesized that pedestrian traffic on roads with sidewalks is also higher in the summer. For this reason, it is possible that the amount of litter encountered in this project may have been higher than had the field study been performed at other times of the year or if there were multiple seasonally distributed samplings.[4]

2.4.3 METROPOLITAN AREA SELECTION PROCESS

In state-wide litter studies, it is desirable to sample roadway segments based on transportation metrics such as street centerline mileage or daily vehicle miles (DVM). For more limited geographic areas such as a state, it is possible to obtain highly accurate GIS data for the entire roadway system. For this study, which not only was national in scope but also targeted 100

[3] It should also be noted that many other factors can influence the quantity of litter observed, including the depth of the surface area to be surveyed, the assumptions made about sampling on medians or in areas that may be unsafe because of roadside barriers, and other factors. The MSW Project Team believes the data obtained from a single season of sampling was reasonably representative of visible litter on our nation's roadways.

percent of the nation's roads from interstates down to local residential streets, it was not possible to utilize solely a national transportation metric as the basis for sampling.

Rather, a two-step process was used. Step one involved randomly distributing the targeted number of samples for each roadway type (30 per type) based on centerline miles within each of the 50 U.S. states. In general, this resulted in states with more miles of a particular road type to have more samples allocated to them, while states with fewer miles of a particular road type to have fewer samples allocated. For example, Florida has the most urban county roadway miles of any state, and as might be expected had allocated to it the largest number of urban county roadway samples. Likewise for the remaining seven roadway types, although it was important to note that the universe of centerline miles all had statistically equal chance of being selected. Table 2-4 summarizes the results of this allocation process.

Table 2-4 Allocation of Roadway Sampling Targets to States

	Rural				Urban				
State	National	State	County	City	National	State	County	City	Total
AK	0	0	0	0	0	0	0	0	0
AL	0	1	0	1	1	0	0	1	4
AR	0	2	0	1	2	0	0	0	5
AZ	0	0	1	0	1	0	0	0	2
CA	2	0	1	0	0	1	1	4	9
CO	1	1	1	0	1	0	0	0	4
CT	0	0	0	2	1	0	0	0	3
DC	0	0	0	0	0	0	0	0	0
DE	0	0	0	0	0	0	0	0	0
FL	1	0	0	0	1	1	12	1	16
GA	1	0	0	1	0	3	4	0	9
HI	0	0	0	0	0	0	0	0	0
IA	1	0	0	0	0	1	0	0	2
ID	2	4	0	0	0	0	0	1	7
IL	2	1	0	3	1	1	0	1	9
IN	2	0	4	1	1	0	0	1	9
KS	0	1	1	0	0	0	0	0	2
KY	0	2	1	0	0	0	0	0	3
LA	1	0	1	0	1	0	2	0	5
MA	0	0	0	0	0	2	0	4	6
MD	0	0	0	0	1	0	3	0	4
ME	0	0	0	1	0	0	0	0	1
MI	0	0	4	0	2	0	3	1	10
MN	0	2	1	4	1	1	0	1	10
MO	1	0	1	0	2	0	1	0	5
MS	1	0	0	1	0	0	0	0	2
MT	1	0	1	0	0	0	0	1	3
NC	0	4	0	0	1	3	0	1	9
ND	2	0	1	2	0	0	0	0	5
NE	0	0	2	1	1	0	0	0	4
NH	0	0	0	0	0	0	0	0	0

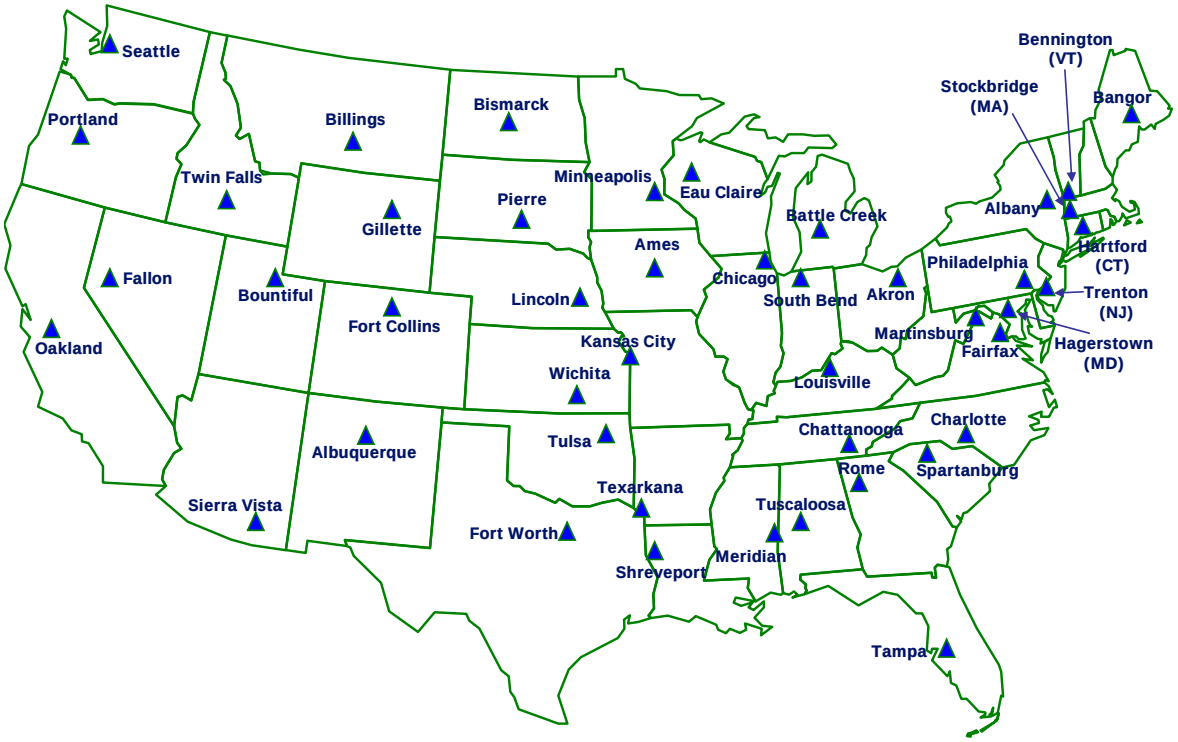
State	Rural				Urban				Total
	National	State	County	City	National	State	County	City	
NJ	0	0	0	0	1	1	0	2	4
NM	0	0	0	0	3	0	0	0	3
NV	0	0	0	0	0	1	0	0	1
NY	1	1	1	2	1	1	0	2	9
OH	1	0	0	1	0	0	0	2	4
OK	0	0	0	0	2	0	0	0	2
OR	2	0	0	0	0	0	0	0	2
PA	3	2	0	2	3	3	0	0	13
RI	0	0	0	0	0	0	0	0	0
SC	0	0	1	0	0	1	2	0	4
SD	1	1	0	3	0	0	0	1	6
TN	0	0	2	0	0	1	1	1	5
TX	1	4	3	1	1	4	1	2	17
UT	0	1	0	0	0	1	0	0	2
VA	0	2	0	0	0	2	0	1	5
VT	1	0	0	0	0	0	0	1	2
WA	1	0	2	0	0	0	0	1	4
WI	0	0	0	3	1	0	0	0	4
WV	0	1	0	0	0	1	0	0	2
Total	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**240**

As shown, the ultimate sample allocation captured roadway segments in 45 out of the 50 states, with only Alaska, Delaware, Hawaii, New Hampshire, and Rhode Island not having a sufficient number of roadway miles in any of the eight roadway types to warrant on-site sampling.

The second step of the national sampling process was to select metropolitan areas that would serve as the sampling centroids (or "hubs") within each state. From a purely academic standpoint, the optimal sampling process would literally give every mile of each type of roadway an equal chance at being selected. The result would be 240 geographically dispersed data points, each of which could require extensive travel just to reach the sampling site. However, for budgetary purposes, purely random sampling of roadway sites was not feasible.

Rather, once the allocation of samples to each state was made based on state-level centerline miles, a metropolitan area was selected in each state from which to base field sampling operations in that state. Metropolitan areas were selected, not randomly, but rather to be reasonably dispersed from one another (e.g. not adjacent), yet to minimize travel time and costs during the course of field sampling. In other words, the selection of the metropolitan areas was performed with field logistics in mind. Figure 2-2 shows a map of the metropolitan areas that were ultimately selected.

Figure 2-2 Metropolitan Areas Selected for Litter Surveying



Note that this method of allocating samples around individual metropolitan areas was driven by two other factors. The first is that the project also required sampling of non-roadway sites, many of which would have been difficult if not impossible to find in rural areas of the country. The second factor involves direction received from KAB, which expressed an interest in focusing on areas of population density ("where people live").

2.4.4 METROPOLITAN AREA GIS-BASED SURVEY SITE SELECTION

Once the randomly selected number of samples was allocated to the metropolitan hub areas selected for the field sampling process, GIS software was used to randomly select sites within each metropolitan area based on roadway data. The U.S. Census Bureau's TIGER® (Topologically Integrated Geographic Encoding and Referencing) format was used as the underlying GIS database. TIGER® shows land attributes such as roads, rivers, etc. as well as areas such as political designations as counties, census tracts, Metropolitan Statistical Areas (MSAs), etc. Specifically, the 2007 TIGER/Line Shapefiles are extracts containing selected geographic and cartographic information from the Census Bureau's MAF/TIGER database. The MAF/TIGER database was developed at the Census Bureau to support a variety of geographic programs and operations including functions such as mapping, geocoding, and geographic reference files that are used in decennial and economic censuses and sample survey programs.

Within each metropolitan area, the universe of roadways to be surveyed was divided into the eight road types defined for this study. Once again to minimize travel time, the random selection of specific sites in each metropolitan area was first confined to a radius of 10 miles

from the metro area centroid. In other words, all of the samples for each roadway type (urban interstate, urban state, urban county, etc.) were plotted within the 10-mile radius.

However, for many metropolitan areas, the 10-mile radius was not sufficient to capture rural road types (e.g., Chicago). For these metropolitan areas, primarily those with a population greater than 500,000, the radius was extended to 40 miles to assure that it was possible to find both urban and rural sample sites.

Several additional samples beyond the targeted number of samples were selected within each metropolitan area for each road type. This was done to allow for sample sites that were found to be unsafe or otherwise inappropriate for field sampling. Ultimately, limitations with the underlying GIS data source, as well as recent road modifications and a high incidence of unsafe or inappropriate field sampling locations, resulted in a greater number of samples being inaccessible than was anticipated in the planning stages of the process. In such cases, substitute samples of other roadway types were made to assure that global sampling targets were met. In several instances both the originally selected site and the back-up site were found to be unsuitable for visual surveying. In these instances, the field data collection team relied on local maps to identify the closest point on a like roadway type, which was then substituted for the primary and back-up sample.

It is the opinion of MSW Consultants that no statistical bias was introduced by the replacement of the randomly selected sites by the field surveyors. This is because field surveyors used a systematic approach to make the replacement (i.e., they selected the closest discernible replacement location based on a local map).

2.5. NON-ROADWAY SITE SAMPLING

In conjunction with the roadway sampling, this project also sought to obtain samples from the following six non-roadway sites that are known to be sources of various types of litter:

- **Construction Sites**, including active residential or commercial construction;
- **Loading Docks**, typically situated behind retail and wholesale entities where various products are loaded or unloaded from large trucks and trailers;
- **Recreational Areas**, including parks, beaches, courts, and open areas where people congregate for leisure activities;
- **Storm Drains**, which are located primarily in street gutters along roadways and in areas which experience heavy rainfall or flooding, are designed to drain excess rain from paved streets, parking lots, etc. Most storm drains have gratings to prevent large objects from falling into the sewer system. The bars are widely spaced so that water flow is not impeded, but consequently, smaller items of litter and trash can fall through and travel into waterways or to various treatment facilities;
- **Retail Shopping**, including shopping centers, strip malls, and convenience stores;
- **Transition Points** refer to points such as entrances to movie theaters, bus stops, and other places where someone consuming a food or tobacco product is required to discard the product before entering.

Contrary to the roadway sampling, which was driven by rigorously applied statistical sampling, the non-roadway site sampling was performed on an opportunistic basis by the field sampling

teams. In other words, non-roadway sites were primarily sampled as they were encountered during the roadway sampling process. This was done as practical matter, as there are no readily available national databases of the various non-roadway sites that could serve as the universe of sites to be sampled. Although the non-roadway survey results are highly informative and provide excellent insight on the relative litter generation occurring at each site type, it should be noted that the non-roadway visible litter survey result do not purport to provide a nationally representative snapshot of litter generation.

It should also be noted that, to improve the variability of non-roadway sites surveyed, each field data collection team was instructed to vary the sub-category type and location of their non-roadway sites. For instance, if a field data collection team had a total of five recreational areas to sample, the team was instructed to sample various types of recreational facilities (for example a community playground, a county park, a beach, and a state park).

The study targeted 180 total non-roadway samples, allocated evenly across the eight roadway types. As shown in Table 2-2, it was possible to obtain the targeted number of samples.

Table 2-5 Targeted and Actual Non-Roadway Samples

Non-Roadway Type	Samples Targeted	Samples Acquired
Construction Sites	30	30
Loading Docks	30	30
Recreational Areas	30	30
Storm Drains	30	30
Retail Shopping	30	30
Transition Points	30	30
Total	**180**	**180**

2.6. FIELD METHODOLOGY

The MSW Project Team developed and applied a uniform set of procedures to tabulate litter items in the roadway and non-roadway sites.

2.6.1 ROADWAY SITE SURVEY METHODOLOGY

Field sampling was performed by two-person teams of professional staff. The following is a description of the procedure that each field team used when surveying the public right-of-way areas adjacent to the various roadway locale types.

- Proceed to the sample site based on the randomly selected coordinates
- Pull over at a safe distance from the road with no barriers or hazards blocking the sample area.

- Fill out the field log as complete as possible. The field log recorded the location, road type, weather and other characteristics of each site.
- Fill out the top of the roadway Litter Tally Sheets (site number, ID, dimensions, influencing factors, etc.).
- Measure the 300 x 15 foot full sampling area and the 15 x 15 sub-sample area along the edge of the roadway.
- Perform a "meander count" of the 300 by 15 foot area to tabulate only those items that were 4 inches and larger ("4 inch-plus").
- As the meander count of 4 inch+ objects was in progress, the second field crew person performed a secondary "cross section sub-count" of objects 4 inches and under, including cigarette butts ("4 inch-minus"). This sub-count began at the same spot that the meander count began.
- Using the litter source rules, assign each litter item to one of the five defined sources, or else classify as "unknown."
- Photograph the survey site.
- Ensure all equipment has been collected, all forms are filled out, and proceed to the next sample site.

In no case did field crew walk on or attempt to sample litter on the roadway itself due to safety concerns.

In addition to the visible count of litter and the source determination performed on the various roadways, the field observation team also noted whether any of the following eight (8) "influencing factors" were present either within or adjacent to the sampling area:

- Was the site in or adjacent to a Residential neighborhood?
- Were any Fast Food Restaurants nearby?
- Were any Convenience Stores nearby?
- Were any Other Commercial parcels nearby?
- Was the site near a Construction Site?
- Was the site near a Loading Dock?
- Were there any schools, churches, libraries, or other public buildings nearby?
- Were Litter Receptacles present? Was the roadway segment in or adjacent to a Beautification Zone (an area that had been actively landscaped)?

As a final evaluation, the state of the area was assigned a numerical score from one to five, with one being extremely littered and five being perfectly maintained (no litter). The basis for the scoring criteria is the KAB litter scale scoring system[5]. Specific evaluation criteria definitions are shown below:

[5] Keep America Beautiful, Inc. Community Appearance Index: State of the Community, 2008.

- **Extremely Littered**: A continuous amount of litter is one of the first things noticed about the site. Major illegal dumpsites might be witnessed. Equipment and/or extra manpower for removal are required. There is a strong impression of a lack of concern about litter in the site. No beautification or landscaping efforts exist.
- **Very Littered**: Visible litter can readily be seen throughout the area, likely requiring an organized effort for removal. This area is "very littered" and clearly needs to be addressed. It would require two or three individuals and several hours to clean up. Landscaping, maintenance and beatification efforts have not been realized in some time.
- **Littered**: Visible litter can readily be seen sporadically throughout the sub-area, likely requiring an organized effort for removal. This area is "littered" and clearly needs to be addressed. One or two individuals could clean up the area within a few hours. Landscaping, maintenance and beatification efforts have been performed, but perhaps not recently.
- **Slightly Littered**: Upon careful inspection, a small amount of litter is obvious. The litter in the site could be collected by one or two individuals in a short period of time. While the site has a small amount of litter, the eye is not continually grabbed by litter items. Obvious and apparent landscaping and/or beautification efforts although perhaps not recent.
- **No Litter**: Virtually no litter can be observed in the site being scored. The scorer has to look hard to see any litter, perhaps a very occasional litter item or two in a city block, or equivalent. Any litter seen could be collected quickly by one individual. The entire site has a generally neat and tidy appearance. Nothing grabs the eye as being littered or messy. Obvious and apparent landscaping and/or beautification efforts recently performed or maintained.

2.6.2 NON-ROADWAY SITE SURVEY METHODOLOGY

Non-roadway samples were performed in roughly the same manner as the roadway sites, although the surface area to be surveyed was dictated by the specific non-roadway site. Descriptions of the field surveying procedure that were used for non-roadway sites are provided in Table 2-6.

Table 2-6 Collection Provider Summary

Non-roadway Sampling Area	Sampling Procedure
Construction Sites	15' outside the perimeter of the construction site spanning 300' or entire perimeter, whichever is less
Loading Docks	The interior of the loading dock plus a 25' circumference around loading dock borders that are not walled. Walled areas (if present) represent the perimeter of the site.
Recreational Areas	Maximum area of 4,500 sq ft. May be many dimensions depending on specific features of each area. Surveyed area targeted perimeter of high use areas (courts, picnic tables, walkways, etc).
Storm Drains	5' circumference around the sample area
Retail Shopping	300' x 15' linear count or entire retail frontage, whichever is less (similar to roadway sampling methodology)
Transition Points	Entire Transition Point Area. Normally, this would be a 10 foot circumference around the front doors to theaters, public facilities, etc.

Specific site surveying procedures are described below.

Construction Sites, Loading Docks and Retail Shopping: Within construction sites, loading dock areas and shopping centers, a 300' x 15' linear section of the site was visibly sampled. For these areas, all items four inches and greater were sampled first. After the initial sample was performed, a sub-sample count of items less than four inches was performed in an area measuring 15' x 15' beginning in the same point where the initial linear count was performed.

Recreational Areas: For purposes of this study, recreational areas included state and national parks and forests, beaches, waterways, fairgrounds, and other recreation sites. For each of the recreational sites, the Project Team attempted to identify the "high-use" areas. High use areas are defined as areas where users tend to congregate, such as courts, picnic tables, pavilions, and walkways. In order to help determine high-use areas, personnel at the recreational sites (if present) were consulted and a listing of the high-use areas was determined.

If no park personnel were present, the Project Team members walked or drove around the area to determine the high-use areas. When the sample site was determined the Project Team measured an area no larger than 4,500 square feet (equivalent to 300' by 15' area used for linear samples). For these areas, all items four inches and greater were counted first. After the initial sample was performed, a sub-sample count of items less than four inches was performed in an area measuring 15' x 15' beginning in the same point where the initial count was performed.

Storm Drains: Various storm drains were randomly selected while field crews were in the field sampling. Each field team attempted to sample storm drains observed while conducting sampling of other areas. In addition to the storm drain itself, an area five feet on all four sides

of the storm drain was sampled. This was done as litter within this zone can easily end up in the storm drain due to rain, wind, or other factors.

Transition Points: Transition points are places beyond which citizens are not allowed to bring certain products such as lit cigarettes, beverages and certain food products into a given area. Transition points may include bus stops or entrances to theaters, shopping malls, libraries and schools. Transition points are of particular interest because they are known to cause the generation of wastes (as people discard their food, beverage or cigarettes), and thus, the opportunity to litter arises. Transition point sampling zones included an area approximately 10 feet in all directions outward from the transition point (e.g. doorway, bus loading zone, etc.).

2.7. DATA ANALYSIS

Given the breadth of data collection, a critical component of the effort involved management and assembly of the data for statistical analysis.

The field data collection effort relied on field forms to be completed by hand. Based on experience of the MSW Project Team, this is the best method for collecting complex data in a variety of outdoor weather conditions. On a daily basis, field survey teams assembled and organized their field forms according to the pre-assigned sampling sites. Field forms reflected the location, date and time of collection to eliminate the potential for mis-classified samples.

On a regular basis (in most cases nightly, but sometimes after two or three days), field forms were transmitted for data entry. Field data was entered into a custom database that tracked survey site characteristics, litter piece counts, and all other data collected.

Ultimately, results were tabulated according to the roadway and non-roadway strata targeted in the study. However, it was first necessary to normalize the survey area of each site for statistical analysis. For roadway sites, all field data was normalized to reflect the number of pieces per mile of roadway to a depth of 15 feet from the edge of the road. For non-roadway sites, litter counts were normalized to reflect litter counts per 1,000 square feet.

Litter counts were averaged over each sample in each roadway and non-roadway strata to arrive at average litter counts by type and by source on a per mile or per-1,000-square-foot basis, respectively. The per-mile litter counts were subsequently applied to national centerline miles – multiplied by two to capture both sides of the road – to project national totals for each roadway type. It is therefore important to note that the roadway litter totals projected in this report likely underestimate the total litter for the following reasons:

- No attempt was made to estimate litter in the median. While many roads do not have medians, it is certain that additional litter accumulates in the median on the roads that have medians.
- Visible litter observations stopped at a depth of 15 feet from the road's edge. In reality, many road miles have public rights-of-way that go beyond 15 feet.
- Certain roadway areas – especially intersections and on/off ramps – were observed to accumulate litter at a higher rate compared to stretches of roadway with no such intersections. However, because of the requirement for field crews to take appropriate safety precautions, many such areas that were observed to have large litter accumulations could not be captured in the study. (It seems possible that one of the reasons these sites

have a higher accumulation of litter is that litter clean-up crews also face the same safety concerns and cannot safely reach these sites on a frequent basis.)

2.7.1 LITTER SOURCE PROXIMITY ANALYSIS

In addition to tabulating the quantity and characterization of litter, this study also sought to explore the impact of certain variables on litter generation and accumulation. Specifically, this study tested the correlation between observed litter and the following variables:

- Was the site in a Residential Area?
- Were there any convenience establishments nearby?
- Were there any Fast Food establishments nearby?
- Were there loading docks in the observable vicinity?
- Were litter receptacles present at or near the site?
- Was the area a school, church, or other public area?
- Were there signs of beautification efforts (e.g. flowers) in the area?
- Cleanliness of the area (coded as Level 1 through Level 5)

Through the use of regression analysis, the relationships between the potentially explanatory variables (collected by field teams based on observation) and total litter items were identified and quantified. The statistical model examined took the form:

$Y_i = f(X_i)$

where Y is the number of total litter items, and X is an array of one or more of the explanatory variables. The explanatory variables were binary in nature (1/0 responses). A multi-linear model was utilized in this analysis.

2.7.2 WASTE AND RECYCLING FACILITY PROXIMITY ANALYSIS

As a final step, the study performed a detailed analysis of the impact on solid waste and recycling facility proximity and litter generation. This phase of the analysis was performed by overlaying a national database of solid waste and recycling facilities[6] over the GPS coordinates of the randomly selected sample sites, followed by testing of the litter generation.

Once the solid waste and recycling facility locations were plotted, a similar econometric analysis was performed to evaluate the impact of proximity of these facilities on litter. This model took the form:

$Y_i = f(X_1, X_{2-1}, X_{5-2})$ where Y is the number of total litter items, X_i is the number of waste and recycling facilities within "i" miles. So X_1 is the number of waste and recycling facilities within 1 mile of the observed litter, X_{2-1} is the additional number of waste and recycling facilities within 2 miles, and X_{5-2} is the additional number of waste and recycling facilities within 5 miles. A linear model was examined in this particular analysis.

[5] Directory and Atlas of Non-Hazardous Waste Sites 2007, *Waste Business Journal*, San Diego, CA.

2.7.3 COMPARISON WITH PRIOR RESULTS

As a final step, the 2009 Litter Study results were compared against the results of the 1969 Study performed by KAB to measure national litter rates. Ultimately, there were limitations to making a meaningful comparison. These limitations included demographic and roadway mileage increases and a different sample methodology. The 1969 Study focused specifically on rural interstate and rural primary roads and as such, could only be compared to compatible roadway types sampled in the 2009 Study. Section 3.3 and Appendix H of this report compare the composition and generation litter between the 1969 and 2009 visible litter studies in greater detail.

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3. VISIBLE LITTER SURVEY RESULTS

3.1. INTRODUCTION

This section provides comprehensive results of the visible litter survey, including both roadway and non-roadway sources of litter. Given the volume of data that was collected and assembled for this project, this section strictly presents national aggregate results.

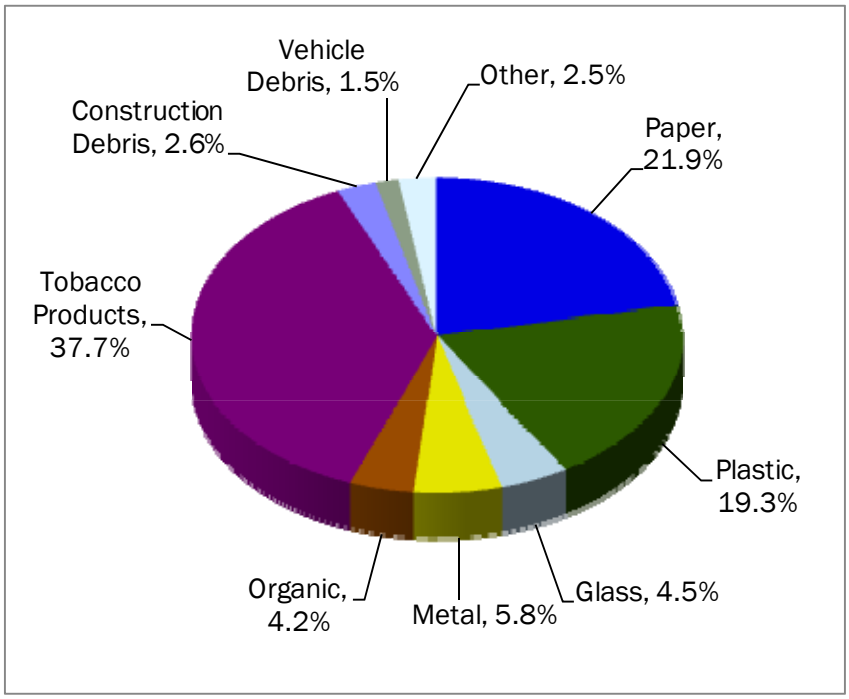
Because this study separated litter items at a four-inch threshold, and the vast majority of litter items were 4-inch-minus in particle size, the larger litter items are obscured in the aggregate results. Therefore, this report will provide parallel results for the 4-inch-plus litter items in addition to litter in the aggregate. Four-inch-plus litter items are those that are most visible to passing motorists and pedestrians, and so are more likely to reflect a "littered" environment. However, the 4-inch-plus litter results effectively exclude the impact of cigarette butts. Both aggregate litter and 4-inch-plus litter results are presented throughout the section.

3.2. ROADWAY LITTER SURVEY RESULTS

3.2.1 QUANTITY AND CHARACTERIZATION

This study found that there were approximately 51.2 billion pieces of litter on our nation's roadways. Of this total, 46.6 billion (91.0 percent) litter were less than four inches in size while the remaining 4.6 billion items (9.0 percent) were larger than 4 inches. Figure 3-1 summarizes the breakdown of litter items projected to be on our nation's roadways in 2008.

Figure 3-1 Aggregate Composition of Litter, All U.S. Roadways

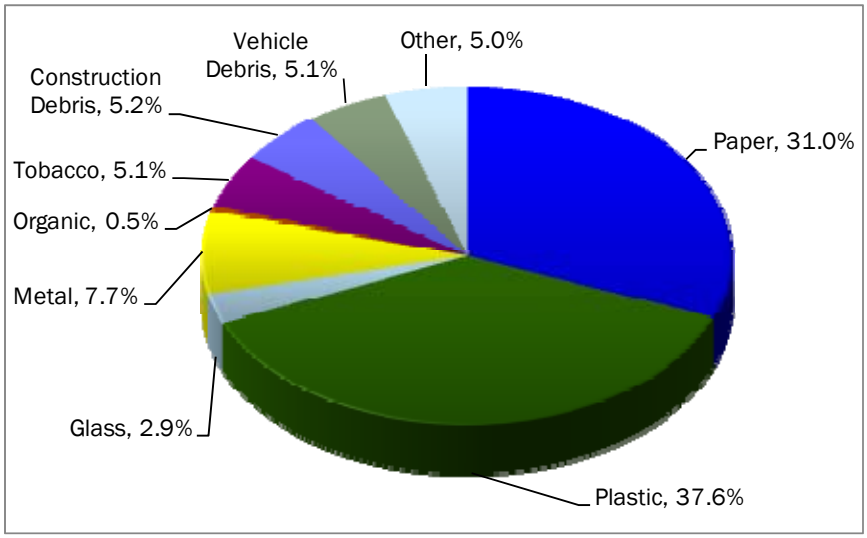


3. VISIBLE LITTER SURVEY RESULTS

As expected based on past litter studies, tobacco products – primarily cigarette butts, but including cigars, chewing tobacco, and packaging among other items – are the single largest type of litter, followed by paper (21.9 percent) and plastic (19.3 percent) items.

Figure 3-2 shows the breakdown of the 4.6 billion pieces of 4 inch-plus litter found to be on our nation's roadways.

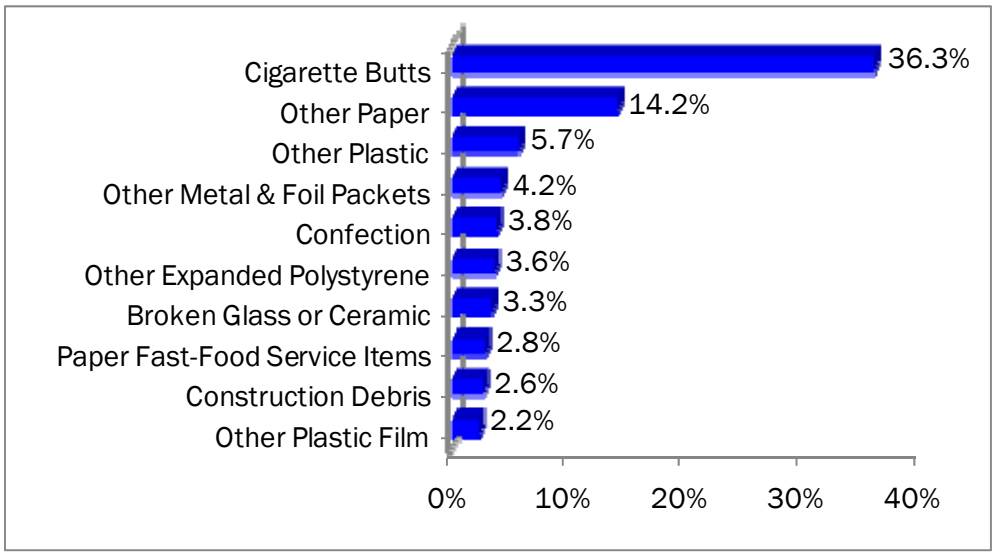
Figure 3-2 Composition of 4-inch-plus Litter, All U.S. Roadways



As shown in Figure 3-2, plastic (at almost 38 percent) is the most common large litter item, followed closely by paper products, which comprised 31 percent of the large items of litter. Interestingly, vehicle debris and construction related debris comprised over 10 percent of all large items of litter. This leads credence to the notion that accident and construction sites are not properly cleaned up.

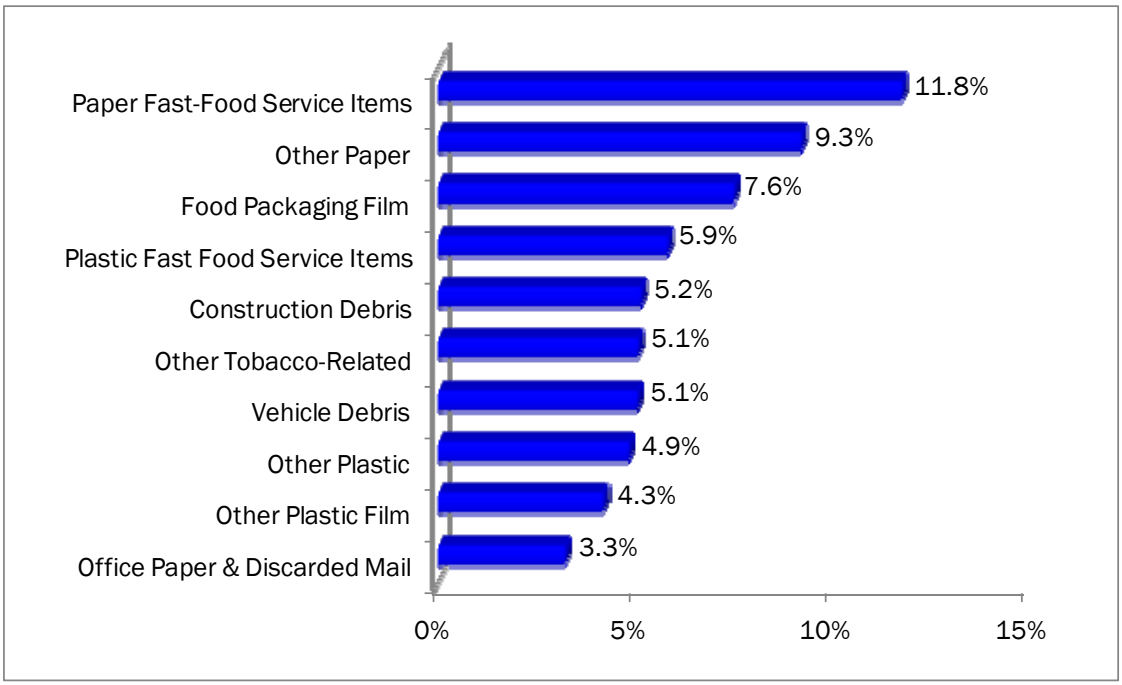
Figure 3-3 below highlights the top ten individual types of litter (aggregated), which collectively contribute 40.3 billion individual pieces of litter. It should be noted that while this study had multiple individual categories of plastic and paper, only certain individual categories were prevalent enough to make the top ten list of items shown in the figure. Consistent with prior litter studies, cigarette butts continue to be the most common litter item by a wide margin. Because this graphic is dominated by the under 4-inch litter items, it is also not surprising that miscellaneous paper, plastic and broken glass are on the list. The presence of confection litter and paper fast-food items is notable. In total, these top ten litter items make up 79 percent of all litter.

Figure 3-3 Top 10 Aggregate Litter Items, All U.S. Roadways



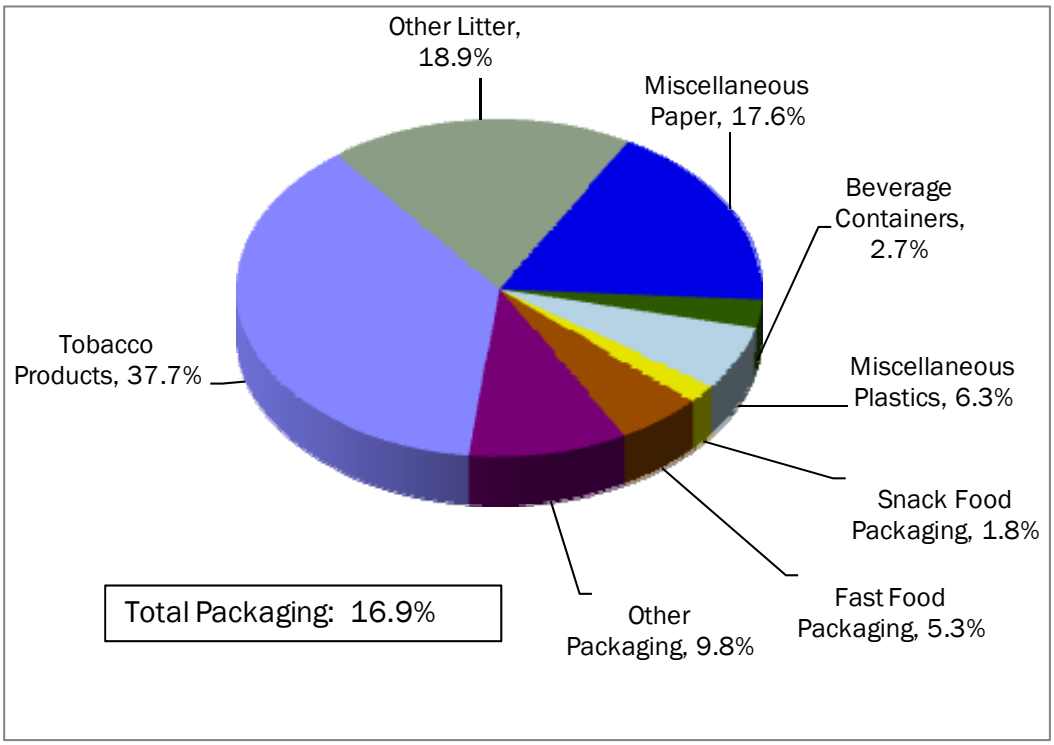
In addition to the aggregate number of items of litter found on our nations roadways, an analysis of items four inches and greater was performed. Figure 3-4 below shows the top ten most common litter items greater than four inches. Focusing on the large items presents a far different picture. As shown, the most common larger litter items include a range of packaging materials among other categories. It should be noted that "other plastic" does not include items such as plastic water bottles which are excluded from this table as they were not in the top ten. Together, there were 2.9 billion of these top ten 4-inch-plus items, making up 62 percent of all 4-inch-plus litter.

Figure 3-4 Top 10 4-inch-plus Litter Items, All U.S. Roadways



In addition to the aggregate composition of litter and the top ten aggregated litter items, KAB identified several classes of litter that are of particular interest to the field of study. These classes of litter are Miscellaneous Paper, Miscellaneous Plastic, Fast Food Packaging, Beverage Containers, Snack Food Packaging, Other Packaging and Tobacco Products. Together, these litter classes make up 80 percent of all litter, comprising over 40 billion litter items. The aggregate breakdown of these materials is shown in Figure 3-5.

Figure 3-5 Litter Types of Interest (Aggregate)



As shown in the Figure, tobacco products (primarily cigarette butts) comprised 38 percent of total litter. Total packaging comprises 17 percent of the aggregate litter stream. Beverage containers, snack food packaging and fast food packaging are minimized in the total litter stream, based largely on the significance of tobacco products, especially cigarette butts.

The same data for 4 inch-plus litter items – which effectively removes tobacco products so as not to obscure the contribution of the other items of interest – paints a different picture. This is shown in Figure 3-6. As shown, there were relatively few tobacco-related items above four inches, and all of these products were packaging. Fast food packaging, snack packaging and beverage containers make a far larger contribution to the 4 inch-plus litter. When items (mostly cigarette butts) less than 4 inches were removed, total packaging litter (excluding tobacco packaging) equates to almost 46 percent. This is quite significant as items over 4 inches are more likely to be visible to pedestrians and motorists alike.

3. VISIBLE LITTER SURVEY RESULTS

Figure 3-6 Litter Types of Interest (4 inch-plus)

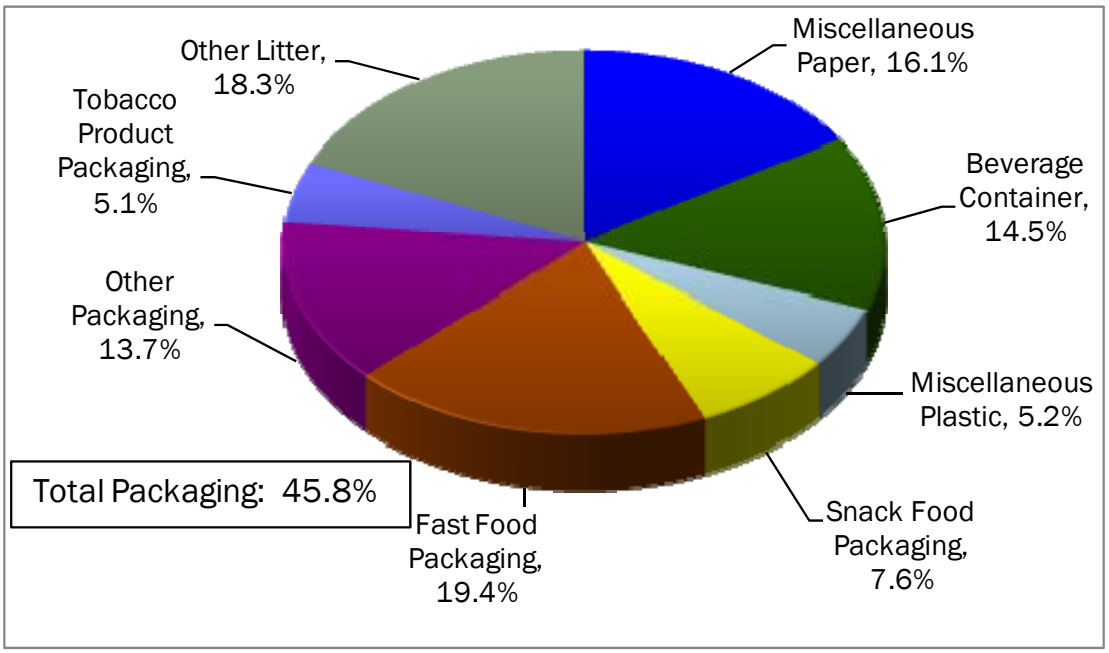


Table 3-1 summarizes the breakdown of litter by roadway type. Of course, the total litter items shown in this table are driven to a great degree by the underlying roadway miles for each road type. However, there is a dramatic increase in the incidence of litter items on national and state roads compared to county and municipal roads.

Table 3-1 Aggregate Litter Incidence by Roadway Type

Roadway Type	Average Items per Mile	U.S. Road Shoulder Miles	U.S. Litter (billion)
Urban Roads	7,784	1,983,892	15.4 billion
Rural Roads	6,357	5,621,252	35.7 billion
Subtotal	*6,729*	*7,605,144*	*51.2 billion*
National Roads	19,186	93,216	1.8 billion
State Roads	13,011	1,461,288	19.0 billion
County Roads	5,539	3,562,828	19.8 billion
Municipal Roads	4,277	2,487,812	10.6 billion
Subtotal	*6,729*	*7,605,144*	*51.2 billion*
All Roads	**6,729**	**7,605,144**	**51.2 billion**

As shown, including the shoulders of roads to a 15 foot depth, U.S. roadways in general have 6,729 items of litter per mile or about 1.3 pieces per foot. These data show:

- **Urban v. Rural**: Rural roads and urban roads were found to have a roughly comparable litter items per mile, but rural roads contribute about 2.3 times more litter because rural roads make up 74 percent of all road miles.

- **Road Type**: The number of litter item per mile decreases as one goes from national down to municipally maintained roads. National roads are the most heavily littered per mile, due to heavy traffic and limited access, yet contribute relatively little to the overall litter rate because of the low number of road miles. State roads are also highly littered, and contribute over one-third of all litter. Although County roads exhibit a lower number of litter items per mile, they also contribute roughly one-half of all litter because of the high number of roadway miles. Municipal roads have the lowest litter incidence per mile, yet also contribute 20 percent of all litter.

Table 3-2 provides parallel results of the breakdown of 4-inch-plus litter by roadway type. These results track reasonably closely with the relationships documented in Table 3-1 for all litter items.

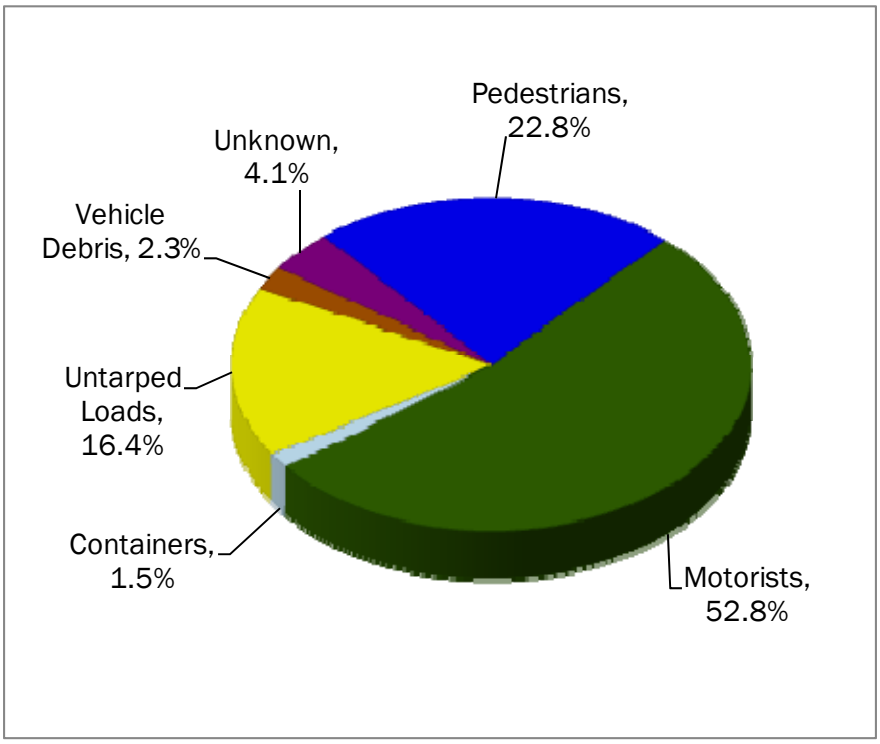
Table 3-2 4-inch-plus Litter Incidence by Roadway Type

Roadway Type	Items per Mile	U.S. Road Shoulder Miles	Litter Items in Billions	Percent of Total Items
Urban Roads	674	1,983,892	1.3 Billion	28.9%
Rural Roads	586	5,621,252	3.3 Billion	71.1%
Subtotal	*608*	*7,605,144*	*4.6 Billion*	*100.0%*
National Roads	1,484	93,216	0.14 Billion	3.0%
State Roads	869	1,461,288	1.3 Billion	27.5%
County Roads	654	3,562,828	2.3 Billion	50.4%
Municipal Roads	357	2,487,812	0.90 Billion	19.2%
Subtotal	*608*	*7,605,144*	*4.6 Billion*	*100.0%*
All Roads	**608**	**7,605,144**	**4.6 Billion**	**100.0%**

3.2.2 SOURCES OF LITTER

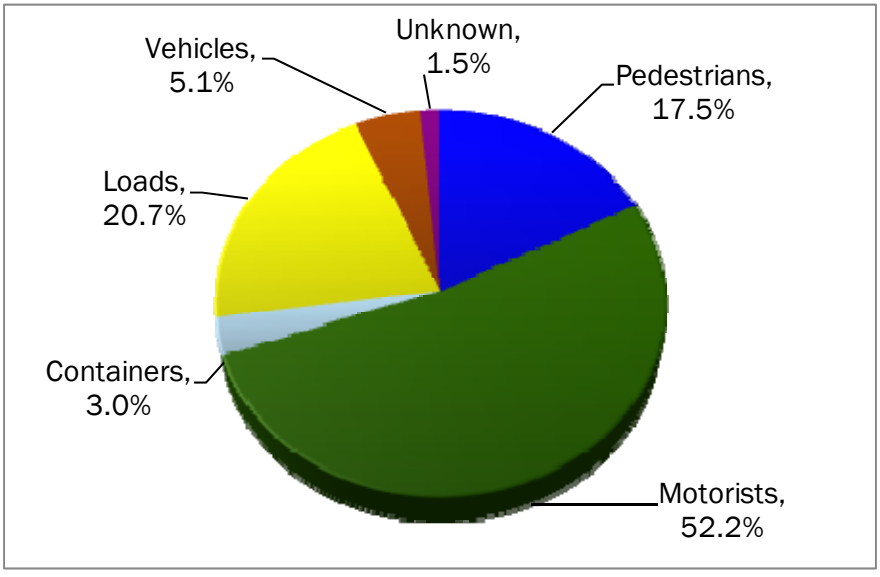
Figure 3-7 summarizes the sources of aggregate litter on all roadway types based on the context clues described in Section 2 of this report.

Figure 3-7 Sources of Aggregate Litter on All U.S. Roadways



Not unexpectedly, the dominant sources of litter for all items on all roads are Motorists and Pedestrians, which contributed a combined 76 percent of all litter. This suggests that education campaigns targeting individual behavior should continue to prevail as a strategy for influencing litter generation. However, focusing on 4-inch-plus litter items paints a slightly different picture. Figure 3-8 shows the sources of 4-inch-plus litter observed in the study.

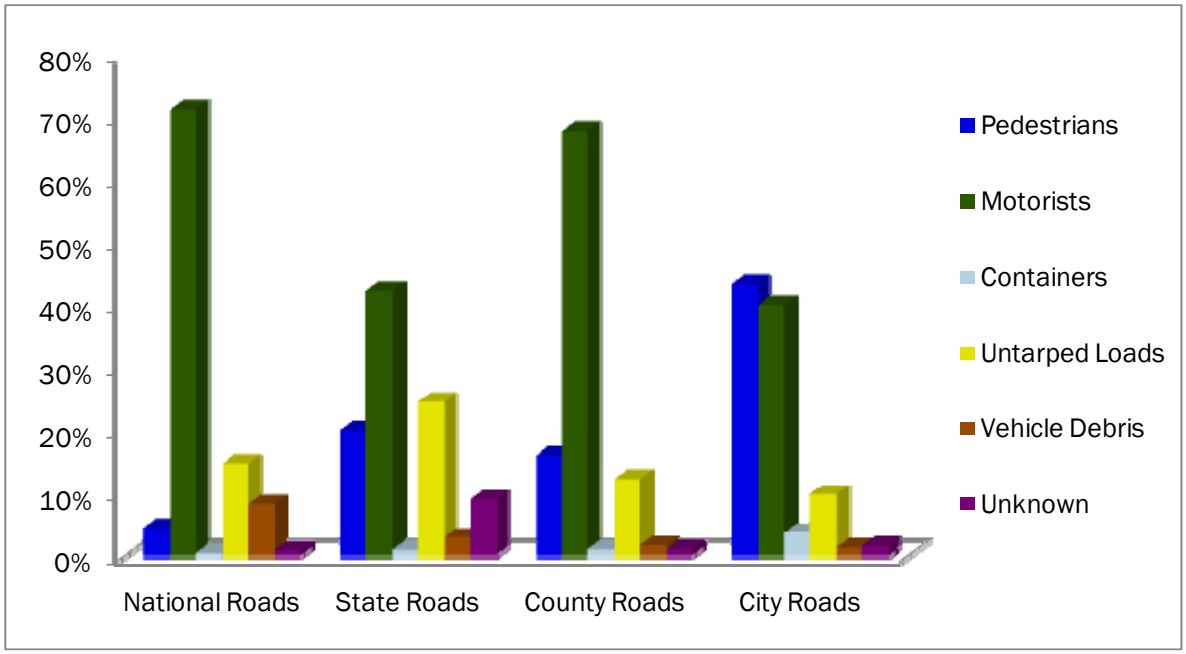
Figure 3-8 Sources of 4-inch-plus Litter on All U.S. Roadways



The source of 4 inch-plus litter shifts more items from pedestrians to negligent forms of litter, including unsecured loads and overflowing containers. This is largely due to eliminating the cigarette butts, which only originate from pedestrians or motorists.

Figure 3-9 compares the sources of aggregate litter among the four roadway types included in this study. Motorists remain the most common source of litter on three of the four road types – however, on city roads this study found that motorists and pedestrians contribute roughly comparable amounts. Note that these results are driven highly by the presence of cigarette butts.

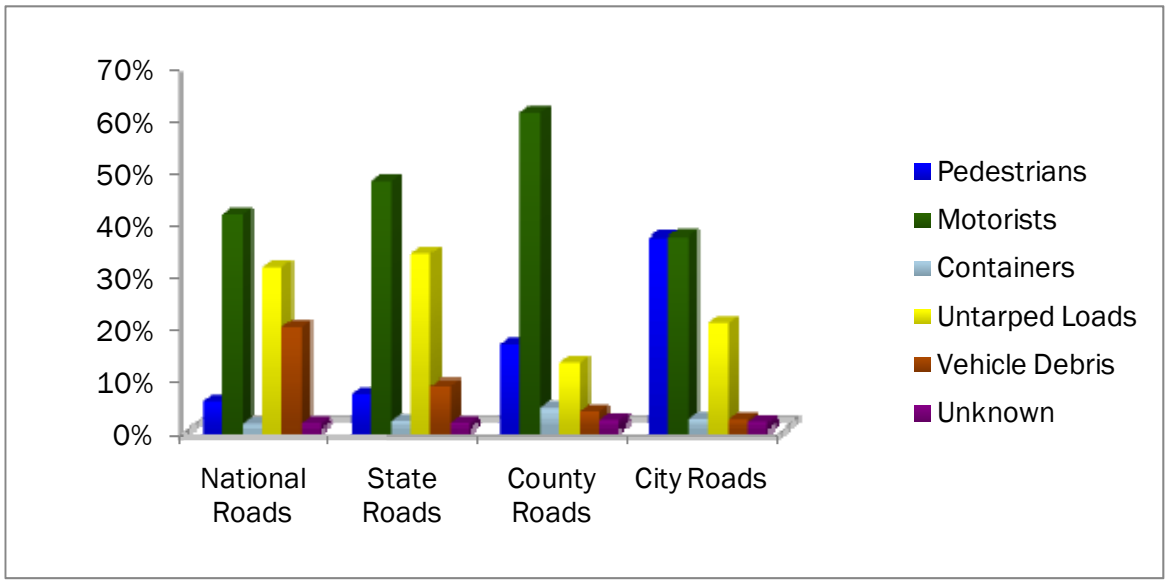
Figure 3-9 Comparison of the Source of Aggregate Litter by Roadway Type



As national roads are predominantly highways with limited access, motorists are responsible for 71 percent of the litter along those roadways and unsecured loads are responsible for 15 percent. The numbers shift slightly on county roads, where motorists are still the dominant source of litter (68 percent), while pedestrians (16 percent) and unsecured loads (13 percent) are still issues as well. On state and city roads, the data shifts further away from motorists (42 percent and 40 percent) and more toward pedestrians (20 percent and 43 percent) as well as unsecured loads (25 percent and 10 percent).

Figure 3-10 provides similar data for the 4-inch-plus litter items.

Figure 3-10 Comparison of the Source of 4-inch-plus Litter by Roadway Type



Focusing only on 4 inch-plus items, it is shown that negligent litter on national and state roads increases significantly, which corroborates previous staff research identifying improperly secured loads as a major source of litter on certain roadways.

It is also of interest to compare the sources of litter between urban and rural roads. This is shown for aggregate litter in Figure 3-11.

Figure 3-11 Comparison of the Source of Aggregate Litter by Urban vs. Rural Roadway Type

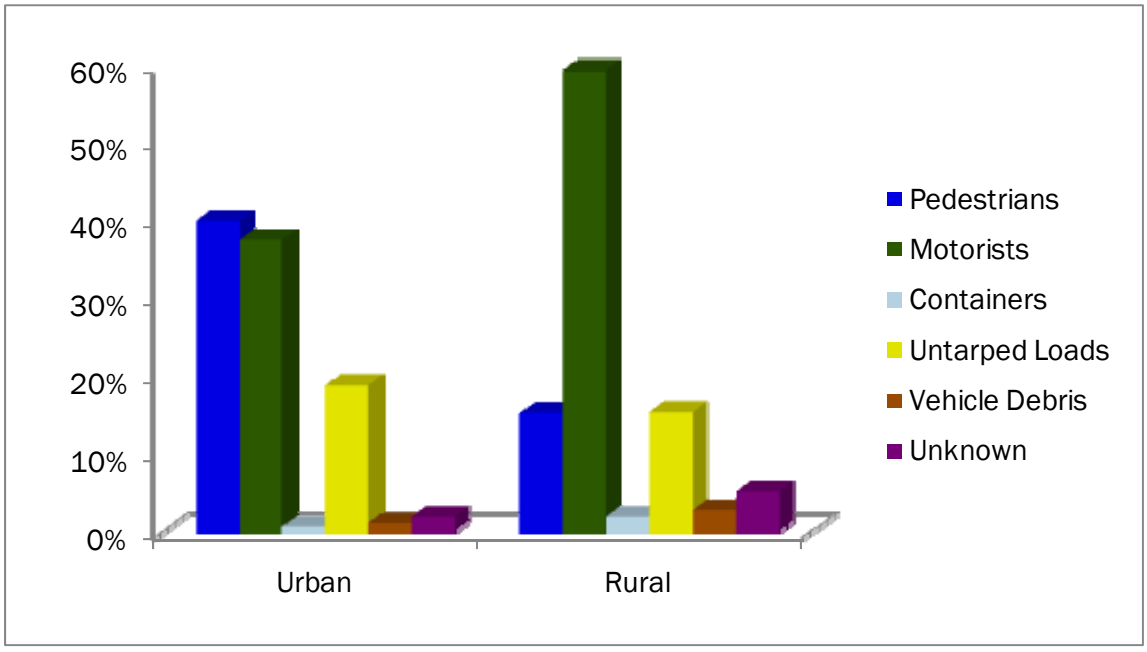
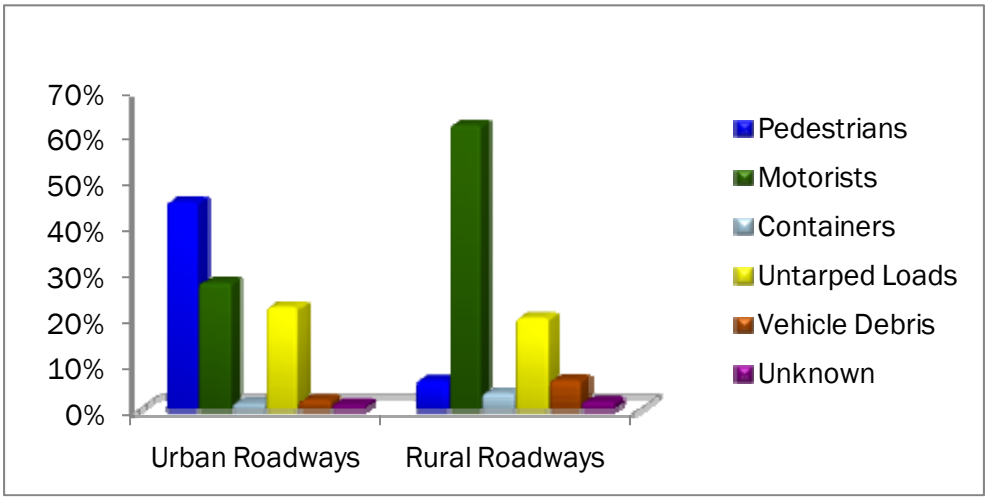


Figure 3-12 shows the same comparison for urban roads and rural roads for litter 4" and greater.

Figure 3-12 Comparison of the Source of 4-inch-plus Litter by Urban vs. Rural Roadway Type

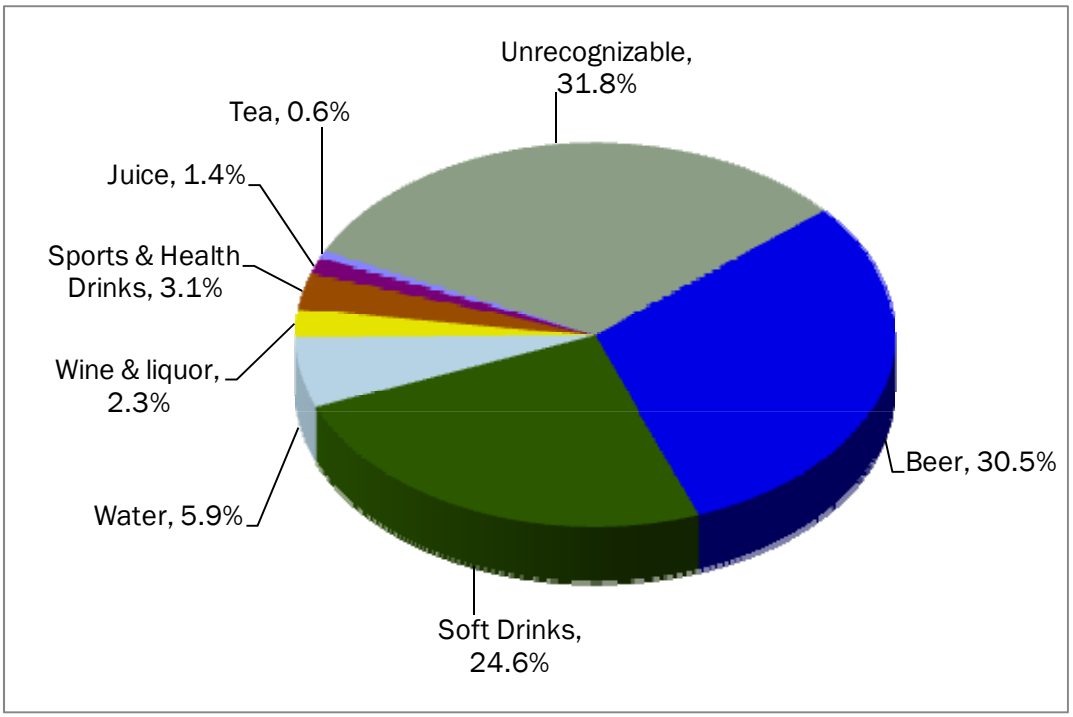


3.2.3 FOCUS ON BEVERAGE CONTAINERS

Throughout the history of litter studies, there has been emphasis on beverage containers. The litter categories were defined in this study to enable detailed analysis of beverage container litter, the results of which are presented here. Note, however, that combined there were 1.4 billion beverage containers estimated on all U.S. roadways.

Figure 3-13 shows the breakdown of all beverage containers regardless of size by type of beverage on our nation's roads, while Figure 3-14 shows the breakdown of beverage containers 4" and greater.

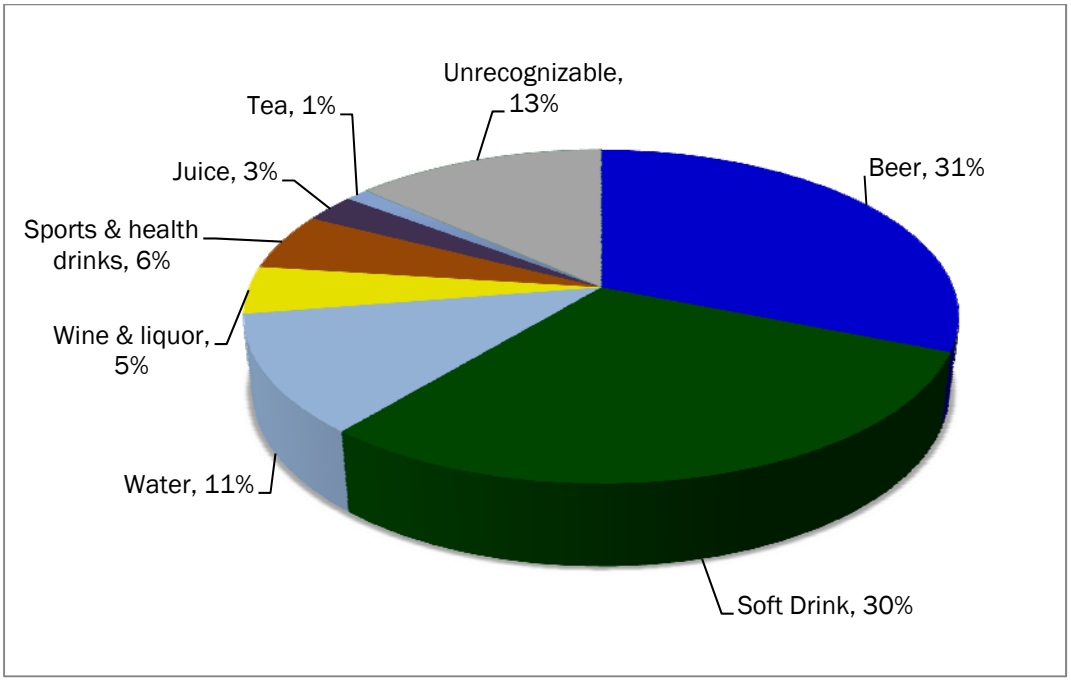
Figure 3-13 Types of Beverage Containers, All U.S. Roadways



Breaking down the beverage container category into its component parts showed that beer containers (31 percent) and soft drink containers (25 percent) were most frequently littered beverage container types. However, these results are likely understated because over 30 percent of the beverage containers observed in the study were unrecognizable[1] due to damage sustained before or after littering occurred. Aside from beer and soft drink containers, no other type of beverage container contributed more than six percent.

[1] The Unrecognizable category also includes Other Beverage Containers including aseptic packages (1 percent) and plastic milk jugs (4 percent). However, the vast majority of the containers in this category were other beverages that could not be recognized due to exposure to the elements and the fact that a number of them had been shredded by mowing machines.

Figure 3-14 Types of Beverage Containers (4 inch plus), All U.S. Roadways



The majority of beverage containers 4" and greater were soft drink and beer containers. Beverage containers four inches and greater were more easily recognized compared to beverage containers and fragments smaller than 4 inches.

Figure 3-15 shows the sources of beverage containers by type of beverage on our nation's roads.

Figure 3-15 Sources of Beverage Containers, All U.S. Roadways

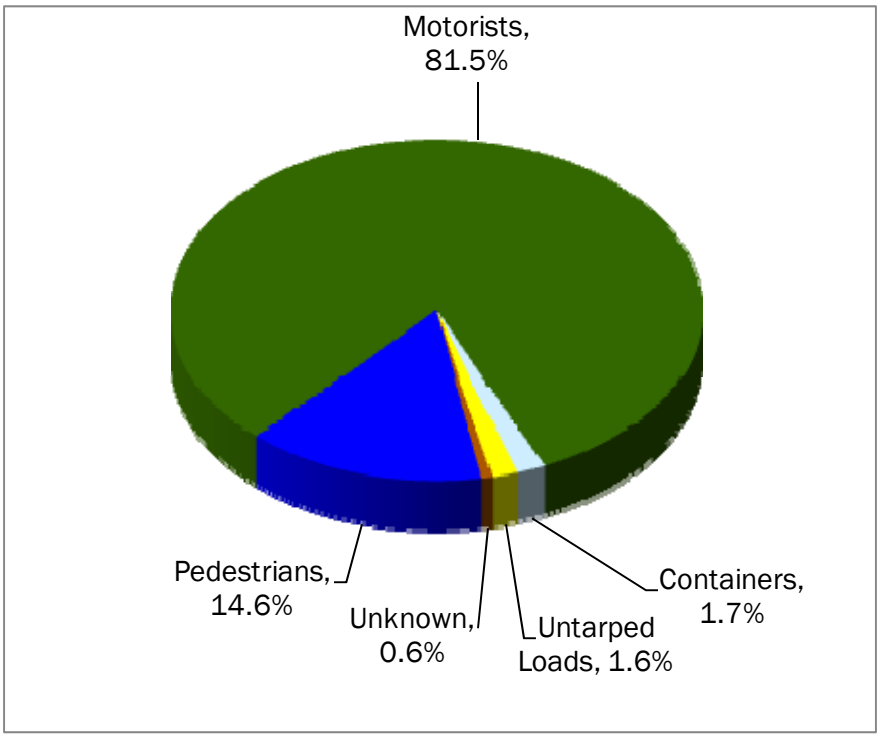


Table 3-3 shows the incidence of beverage containers by roadway type.

Table 3-3 Aggregate Beverage Container Incidence by Roadway Type

Roadway Type	Containers per Mile	Percent of All Litter	Total Beverage Containers
All Roads	179	2.7%	1.4 Billion
Urban Roads	142	2.1%	0.3 Billion
Rural Roads	192	2.9%	1.1 Billion
National Roads	392	5.8%	0.04 Billion
State Roads	173	2.6%	0.3 Billion
County Roads	236	3.5%	0.8 Billion
Municipal Roads	93	1.4%	0.2 Billion

3.2.4 FOCUS ON TOBACCO PRODUCTS

Tobacco products (which can consist of cigarette butts, cigars, chewing tobacco and packing) comprise over 37 percent of all litter items, and there are over 19.3 billion tobacco-related items estimated to be on all U.S. roadways in 2008. Table 3-4 summarizes the different

components of tobacco litter. Cigarette butts make up more than 96 percent of tobacco litter. This may be due, in part, to the fact that cigarette butts may not be targeted during cleanups as much as larger items of litter.

Table 3-4 Tobacco-related Products

Litter Type	Items per Mile	Percent of All Litter	U.S. Total
Cigarette Butts	2,444	36.3%	18.6 Billion
Tobacco Packaging	75	1.1%	0.6 Billion
Cigar Butts	17	0.3%	0.1 Billion
Total	**2,536**	**37.7%**	**19.3 Billion**

Table 3-5 shows the breakdown of tobacco litter by roadway type. Tobacco litter is virtually the same percent of litter for all roadways except national roads, where it is a larger fraction of all litter.

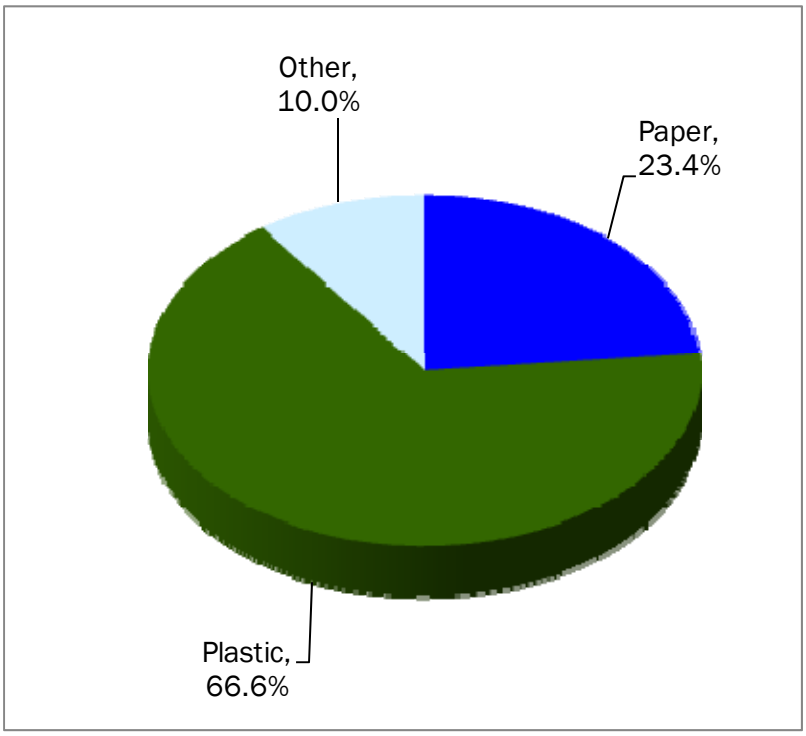
Table 3-5 Tobacco Litter by Roadway Type

Roadway Type	Items per Mile	Percent of All Litter	Total Tobacco Litter
All Roads	2,536	38%	19.3 Billion
Urban Roads	2,759	35%	5.5 Billion
Rural Roads	2,457	39%	13.8 Billion
National Roads	9,084	47%	0.8 Billion
State Roads	4,725	36%	6.9 Billion
County Roads	2,179	39%	7.8 Billion
Municipal Roads	1,514	35%	3.8 Billion

3.2.5 FOCUS ON PACKAGING LITTER

Prior litter studies have identified packaging material as contributing to litter rates. Packaging litter comprised 17 percent of the total amount of litter found during the study. This section focused on packaging litter. Figure 3-16 shows the breakdown of packaging litter by material.

Figure 3-16 Packaging Litter by Material, All U.S. Roadways



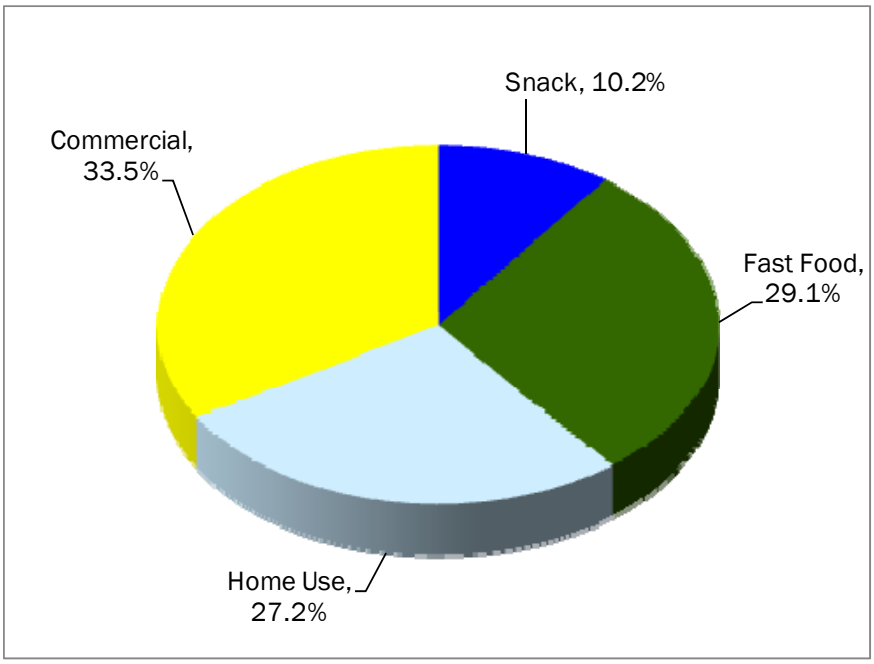
As shown, about two-thirds of all packaging was plastic, while about one-forth was paper. Other materials such as glass and metal only made up 10 percent of packaging. As a percentage of the entire litter stream comprised of packaging, four percent was paper packaging, 11 percent was plastic packaging, and two percent was other packaging.

In an effort to better inform about packaging type, packaging was examined to determine which components were commercial in nature, home use, fast food or snack. Each category is defined below. It is of interest to note that commercial packaging was most prominent, followed by fast food and home use packaging which were similar. At 10 percent, snack packaging was less prominent than expected.

- **Commercial Packaging**: This includes all packaging that serves to transport products from manufacturing or wholesale locations to retail establishments. Examples of commercial packaging include corrugated cardboard boxes, shrink wrap and strapping.
- **Home Use Packaging**: Packaging that is used to bring products from the retailer to the home.
- **Fast Food Packaging**: Wrappers for single-use items that originate from drive-through eateries, taverns, concessions, the fast-food section of a grocery store, and other such establishments.
- **Snack Packaging**: Wrappings or bags used to package candy, gum, chips, or other food items.

Figure 3-17 summarizes the type of packaging found in the study.

Figure 3-17 Packaging Litter by Type, All U.S. Roadways



3.2.6 CORRELATION OF ROADWAY LITTER TO CERTAIN CONDITIONS

While the science of tabulating litter is well established, study is ongoing to identify and better quantify the factors and local site conditions that contribute to the prevalence of litter. An objective of this study was to record, for each survey site, the presence of seven potential predictors of litter to quantitatively test their predictive ability.

This analysis was performed by testing to what extent the existence of one or more of the factors in close proximity to the litter survey site appeared to impact litter relative to a "base" litter rate (i.e., the amount of litter that would have been found had that factor or condition not existed), which was found to be 1,267 pieces of litter per site (+/- 219 pieces) This base rate signifies the expected litter that would be at a site that was not influenced by any of the factors below. Table 3-6 shows the results of these tests, which were run at a 90 percent level of confidence.

Table 3-6 Roadways – Variable Impacts

Condition Tested	Impact on Litter Items	Percent Change	Uncertainty (# of Items)
The roadway site was close to a residential area	- 513	-40%	135
The roadway site was close to a convenience store	137	11%	80
The roadway site was close to a commercial establishment	137	11%	80
There were litter receptacles in proximity	-74	-6%	40
There were loading docks in close proximity	-363	-29%	146
The site benefited from some form of landscaping effort	471	37%	243
Improvement from being poorly maintained to being maintained to an average or higher level	-179	-14%	252
Improvement from being an average maintained to a perfectly maintained level	-296	-23%	122
Improvement from a well maintained level to a perfectly maintained level	-189	-15%	94

In summary, for each condition tested, the table shows how many more (positive number) or fewer (negative number) litter items were found compared to the base litter rate. So, for example, if the roadway site were located in a residential area, there are projected to be 513 fewer pieces of litter on that site. The statistical analysis also developed confidence intervals at a 90 percent level of confidence to measure the uncertainty associated with the impact. So, in the residential area example, although the mean impact is 513 fewer pieces, the actual impact of a litter site being in a residential area may be as large as 648 (513 + 135 pieces) or as small as 378 (513 - 135 pieces). Technically, these values are the standard errors of the coefficients shown in the "Impact" column.

The following observations arise from these data:

- **Residential Areas**: Sites near residential areas tended to be 40 percent less littered than other sites.
- **Convenience Stores**: Sites near convenience stores tended to be 11 percent more littered than other sites.
- **Commercial Establishment:** Sites near places of business other than convenience stores tended to be 11 percent more littered than other sites.
- **Litter Receptacles**: Sites where litter receptacles were found nearby tended to be 6 percent less littered than other sites.

- **Loading Docks**: Sites near loading docks tended to be 29 percent less littered than other sites.
- **Landscaping**: Sites near intentionally planted landscaping such as neatly trimmed bushes or flower beds tended to be 37 percent more littered than other sites.
- **Site Maintenance Condition**: Note that the impacts shown for State of the Area levels are marginal in nature. For example, if the area is classified as Level 4, the total impact would be the sum of the impacts shown for State of the Area>1 (-179) and State of the Area>3 (-296).

Of the results obtained, most are intuitive: locations near convenience stores and other commercial areas increase observed litter, while locations near residential areas, where receptacles are located, and improving 'state of the area' indicators all decrease litter. Some results may appear counterintuitive, although convincing explanations may be forthcoming. For instance, the presence of Loading Docks reduces the number of items found. In addition, roadway sites that exhibited some form of beautification appear to attract more litter. One example of an explanation for this latter result might be that flower beds are considered to be a form of beautification. However, certain types of flower beds and landscaping, due to their design and prevailing local wind patterns can end up instead acting as traps for wind-blown litter.

3.2.7 CORRELATION OF LITTER TO WASTE FACILITIES

Litter is an issue faced by virtually every solid waste landfill, regardless of size or location. Landfill litter is defined as any solid waste that is blown away from a landfill, whether it came from the active area or not. Although definitions of landfill litter and associated mitigation requirements vary from state to state, federal landfill regulations address litter control through a requirement for cover material to be placed at certain intervals, as necessary, to ensure that impacts from blowing litter are minimized.

A number of factors influence the likelihood of fugitive landfill litter including prevailing winds, landfill slope, type of landfill cover material used and the frequency of cover, weather conditions (wind velocity), local tarping requirements and enforcement, and local climate (number of dry days annually). Further, whether a solid waste facility is receiving wastes or recyclables, and regardless of the type of facility, numerous vehicles arrive at the facility every day carrying materials that are susceptible to blowing out of an improperly secured vehicle.

The following tables summarize the apparent impacts of solid waste facilities on litter generation. These tables provide incremental litter generation on a pieces-per-mile basis for survey sites that were found to be located within one, two or five miles of one or more solid waste or recycling facilities. As the radius is expanded, survey sites were found to be proximate to more than one solid waste recycling facility.

Eighteen of the roadway survey sites were within range of one solid waste or recycling facility. The litter generation for these 18 sites is compared with the remaining 225 sites in Table 3-7. It is of interest that these 18 sites were found to have slightly *lower* litter generation compared to sites that had no facility within the one mile radius.

Table 3-7 Litter Generation Test: Sites within 1 Mile of Facility (ies)

# of Waste Facilities within Proximity	# Survey Sites	Avg. Pieces of Litter/Mile
1 facility	18	904
0 facilities	225	1,003

When the test radius was expanded to two miles, a total of 54 survey sites potentially fell under the influence of local solid waste and recycling facilities. The analysis of these survey sites revealed a clearer correlation. Survey sites that fell within two miles of two or three waste or recycling facilities had litter rates that were 60 percent greater than sites within range of only one such facility. Further, survey sites that fell within two miles of any facility had 27 percent more litter than sites that fell outside the test radius. This is shown in Table 3-8.

Table 3-8 Litter Generation Test: Sites Within 2 Miles of Facility (ies)

# of Waste Facilities within Proximity	# Survey Sites	Avg. Pieces of Litter/Mile
2 or 3 facilities	12	2,838
1 facility	43	1,147
0 facilities	188	843

When the test radius was expanded to five miles, a total of 108 survey sites potentially fell under the influence of local solid waste and recycling facilities. The analysis of these survey sites also shows a correlation between litter generation and the number of solid waste and recycling facilities. These results are shown in Table 3-9. As shown in the right-hand column of the table, the number of litter items per mile increases with the number of solid waste and recycling facilities that are located within a five mile radius.

Table 3-9 Litter Generation Test: Sites Within 5 Miles of Facility (ies)

# of Waste Facilities within Proximity	# Survey Sites	Avg. Pieces of Litter/Mile
4-6 facilities	11	2,875
2-3 facilities	36	1,391
1 facility	61	921
0 facilities	135	770

Table 3-10 ties the data together by showing the projected increase in the number of litter items that would be expected depending on the distance of a site to a solid waste or recycling facility. For example, for each waste facility between one and two miles from the observation, it is estimated that 775 additional pieces of litter will be observed. For each waste facility

between two and five miles from the observation, we estimate that 328 additional pieces of litter will be observed.

Table 3-10 Impact of Solid Waste and Recycling Facilities on Litter Generation

Distance from Survey Site to Facility	Additional Litter Items Observed*	Range of Uncertainty (No. of Litter Items)
1 mile or less	0	N/A
1 mile to 2 miles	775	373
2 miles to 5 miles	328	166

* per waste facility

This analysis suggests the following conclusions:

- **No Correlation within One Mile**: Survey sites within range of one waste or recycling facility did not support higher litter generation. While it was beyond the scope of this study to explain this outcome, the relatively small number of samples that fell within this radius may not have represented the most common access roads to the facilities where littering might be expected to occur. Alternatively, it may be that the facilities themselves receive greater litter clean-up effort within close proximity in a direct attempt to minimize litter that could be attributable to the solid waste or recycling facilities.
- **Strong Correlation within Two and Five Miles**: Expanding the analysis to two and five miles showed a strong correlation between solid waste/recycling facilities and litter rates.
- **Strong Correlation by Number of Facilities**: Similarly, an increase in the number of nearby solid waste or recycling facilities also correlates to more litter generation.

Again, it was beyond the scope of this study to investigate the range of other causes that might explain this phenomenon, and it must at least be noted that solid waste and recycling facilities, if they are in urban or suburban areas, are uniformly located in industrially zoned areas with other businesses that receive significant truck traffic and possibly receive a lower level of effort towards litter remediation and beautification. However, the results may also suggest that improperly secured waste and recycling vehicles may contribute to local litter rates as they converge on their destination facilities. This would be consistent with qualitative littering field observations made in prior litter surveys.

3.3. COMPARISONS WITH 1969 NATIONAL LITTER SURVEY

An important component of this project was to compare the results of the 2009 Study to the 1969 Study sponsored by Keep America Beautiful. However, differences in study design, methodology, and underlying demographic and transportation metric data complicated the study comparisons. To more fully explore the similarities and differences of the 1969 and 2009 Studies, a detailed comparative analysis of the Studies is contained in Appendix H to this report, and interested readers are encouraged to review this appendix for a more thorough discussion. The results of the comparative analysis are summarized here.

The comparisons were limited because the 1969 Study sampled only rural interstate and primary roads. When reviewing these results, readers should be aware that comparisons are therefore limited to the following subsets of the 2009 Study:

- Rural roadways only;
- Interstate and primary roads only; and
- Larger (> 4") litter items only.

It is also important to note that the unadjusted results from the 1969 Study encompass the entire width of the right-of-way (ROW) for each roadway segment analyzed – specifically, litter was measured as far back as 500 or more feet from the edge of the road, and the average ROW width was reported to be 169 feet as calculated using a weighted average. In contrast, the 2009 Study measured litter in the ROW only to a width of 15 feet from the roadway's edge. It was therefore necessary to adjust the 1969 Study results to reflect only the first 15 feet of ROW.

Finally, it is noted that the U.S. population has increased from 200 million people in 1969 to 300 million in 2008 – an increase of 50 percent. All else being equal, it would be expected that the number of litter items per mile would increase by roughly the same percentage as the overall population. The number of litter items per mile has therefore been normalized to eliminate the impact of population growth on littering.

Figure 3-18 and Table 3-11 compare the ROW-adjusted, population-normalized 1969 Study results to the 2009 Study results. The percent change shown in Table 3-11 were calculated from a series of weighting factors.

Figure 3-18 Change in Visible Litter on Rural Interstates and Primary Roads Since 1969

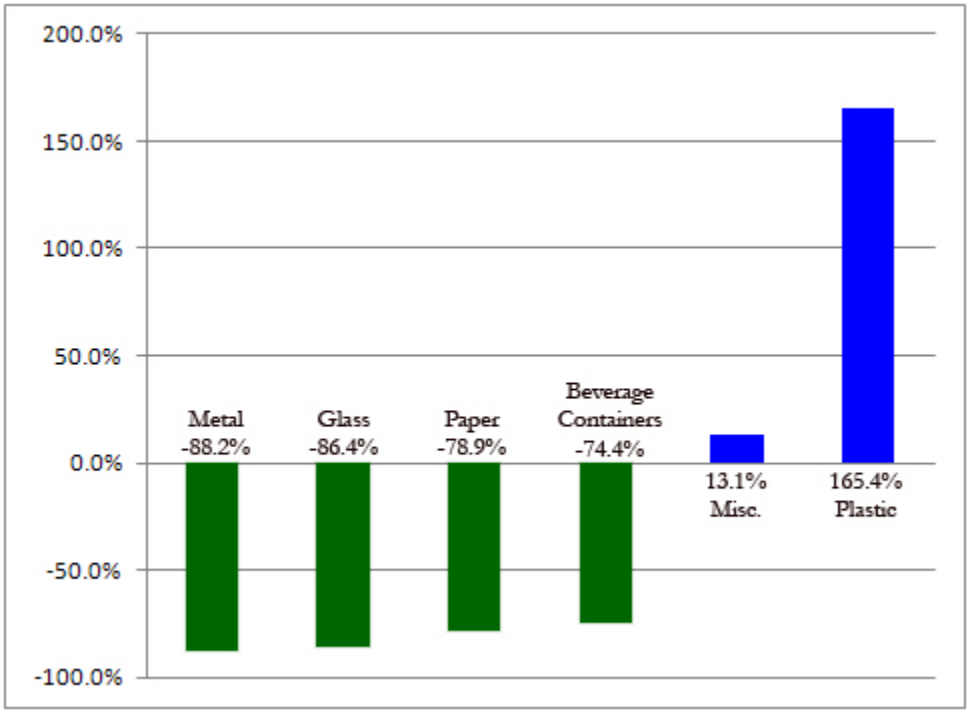


Table 3-11 Comparison of 1969 and 2009 Study Results: Visible Litter on Rural Interstates and Primary Roads [1]

Material	Change in Litter
Paper	-78.9%
Metal	-88.2%
Plastic	165.4%
Misc	13.1%
Glass	-86.4%
Total	**-61.1%**
Beverage Containers [2]	-74.4%

[1] The results in this table are based on a comparison of the results of the 1969 and 2009 National Litter Studies. In order to enable reasonable comparisons, the 1969 Study data was statistically adjusted to capture only the first 15 feet of the right-of-way, and results were also normalized to account for the 50 percent growth in population that occurred from 1969 to 2008.

[2] Beverage containers were segregated in both the 1969 and 2009 Studies and are shown separately.

As shown above, the comparison of the 1969 and 2009 Studies shows a 61 percent decline in overall litter. This decline is reflected in the significant reduction of visible paper, glass, metal, and beverage container litter on our nation's roadways. Conversely, the comparison shows there has been a significant increase – 165.4 percent – in visible plastic litter.

These results also indicate a slight increase in miscellaneous litter, which includes automotive parts and accessories, tires and retread, lumber and other construction/demolition/renovation materials, and non-container metals and glass items. Readers should bear in mind that it was not possible to precisely align the materials captured under miscellaneous litter between the 1969 and 2009 Studies, and some of the apparent increase to miscellaneous litter may be the result of a more comprehensive material list used in the 2009 Study. Appendix H contains a detailed overview of the 1969 Study, and also documents the methodology and assumptions used to arrive at the comparative results shown above.

While it was beyond the scope of this study to determine the causes of the apparent changes to litter incidence and composition since 1969, the lower overall litter rate may be due, in part, to a significant increase in educational efforts and litter cleanups since 1969. The Adopt-A-Highway program, by itself, which began in 1985, now has about 1,000,000 volunteers nationwide that cleanup litter on close to 500,000 miles of roadways. Similarly, it is possible to point to the significant increase in the use of plastics for numerous uses – from beverage containers to packaging materials to vehicle parts – to explain the rise of plastic litter. As plastic containers and packaging have become more widespread, glass and metal containers have decreased.

Several significant conclusions can be drawn when comparing the 1969 and 2009 litter surveys:

- The actual count of overall litter is down 61 percent since 1969.

- This decrease, a result of successful education, ongoing cleanup efforts and changes in packaging, is reflected in dramatic reduction in paper, metal and glass litter since 1969.
- Plastic litter has increased 165 percent since 1969.

3.4. NON-ROADWAY LITTER SURVEY RESULTS

There were six non-roadway areas evaluated in this study. Unlike the roadway surveys, there are no national databases that compile the "universe" of non-roadway sites, and therefore it is not possible to provide a national estimate of litter on non-roadways. Rather, the results presented herein are intended to convey the extent of litter as an observable problem on a range of non-roadway areas that have been found or believed to harbor meaningful quantities of litter. The presentation of results for each non-roadway site contains parallel information, including:

- Particular background data about the sites selected for sampling:
- The average items of litter per thousand square feet for that non-roadway site;
- Top 10 most common litter items;
- Composition of litter at the site; and
- Sources of litter at the site.

3.4.1 TRANSITION POINTS

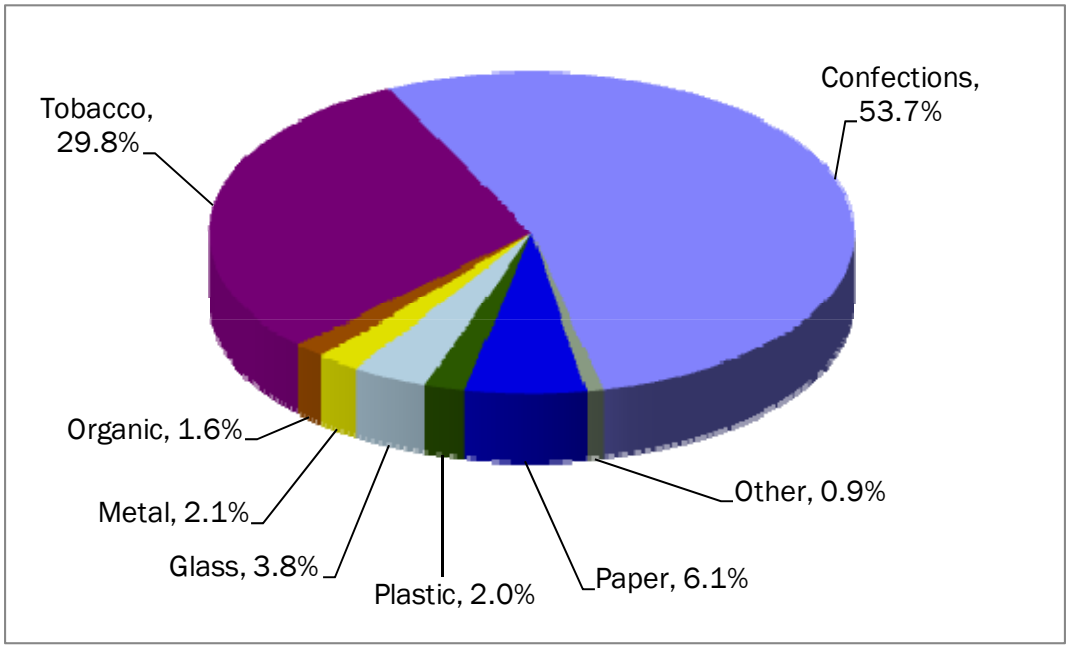
A total of 30 transition points were surveyed. A summary of the specific transition points is shown in Table 3-12. Like other non-roadway sites, these locations were chosen as the field crew came upon them in their travels between roadway sites.

Table 3-12 Summary of Transition Points Surveyed

Transition Point Type	Total
Bus Stop	11
Conv. Store Entrance	6
Movie Theater Entrance	6
Mall Entrance	1
Rest Area Entrance	1
Train Station Entrance	1
Educational Center Entrance	1
Post Office Entrance	1
Fast Food Establishment Entrance	1
Hotel Entrance	1
Total	**30**

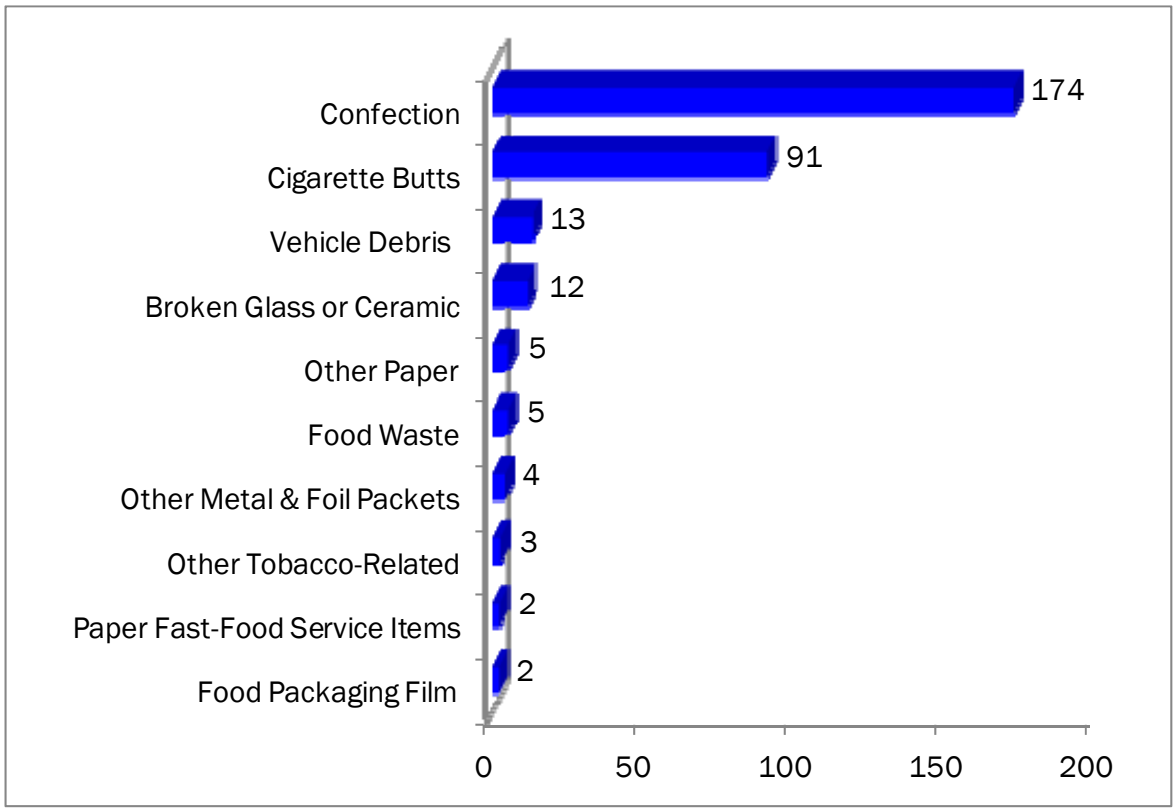
Survey results showed that there was an average of 859 items of litter (large and small items combined) per 1,000 square feet at transition points. The average area of transition points measured for this study was 187 square feet. Figure 3-19 shows the composition of these litter items.

Figure 3-19 Composition of Litter at Transition Points



As shown, confection litter was the predominant type of litter observed at transition points, followed by tobacco products. Figure 3-20 breaks down the ten most commonly occurring litter items at transition points.

Figure 3-20 Top 10 Most Common Litter Items at Transition Points (Items/1,000 sq ft)

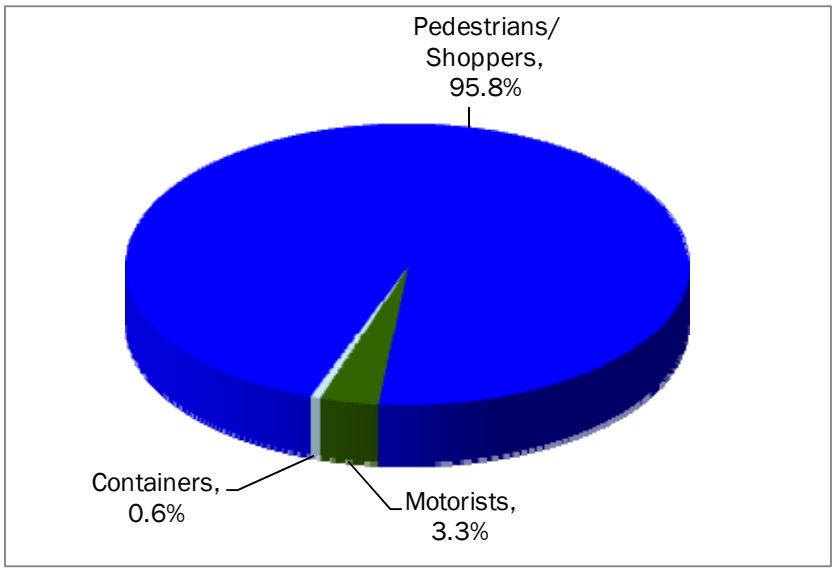


*Per 1,000 square feet of Transition Area.

Confection litter was the predominant component of litter at these sites followed by cigarette butts. Confection litter is most likely to reflect an accumulation as it is difficult and expensive to clean up. Virtually all litter found in transition areas (97 percent) were small items.

Figure 3-21 shows the breakdown of litter by source. As expected, most of the litter found at transition points was deposited by pedestrians. Motorists were deemed responsible for 10 percent, due to certain items of litter such as broken glass found at bus stops.

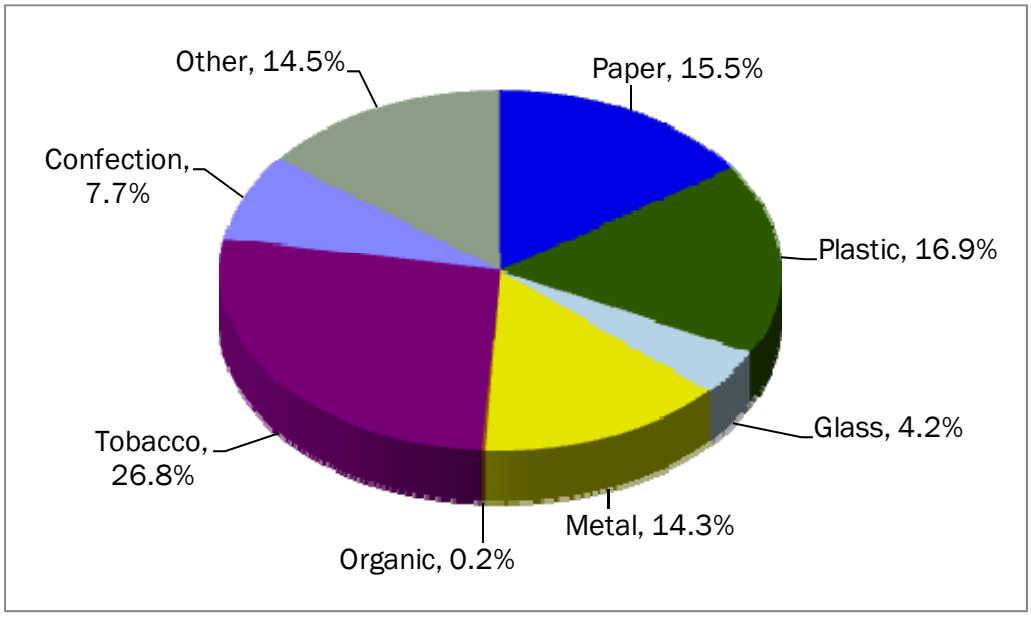
Figure 3-21 Sources of Litter at Transition Points



3.4.2 LOADING DOCKS

Survey results showed that there was an average of 126 items per thousand square feet of litter (large and small items combined) at loading docks. The average loading dock area of the sites measured for this study was 452 square feet. Figure 3-22 shows the composition of these litter items.

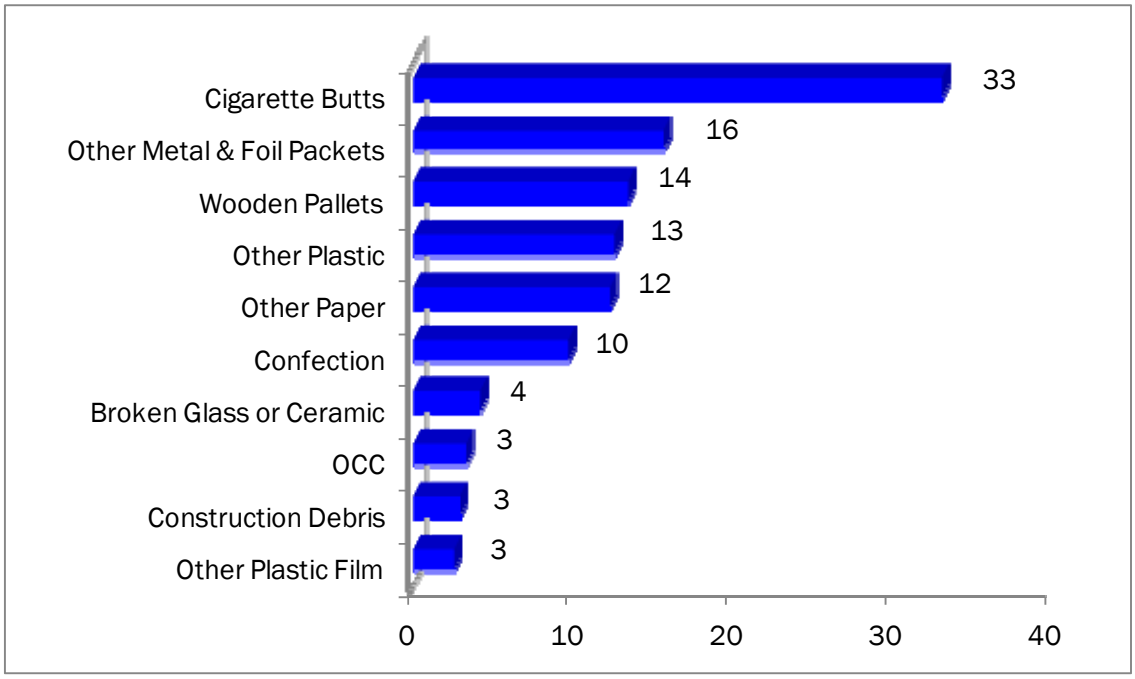
Figure 3-22 Composition of Litter at Loading Docks



It should also be noted that Loading Docks contained by far the most otherwise unclassifiable materials that were grouped in the "Other" category. Specifically, loading docks were frequently found to contain broken pallets and a wide range of construction debris that did not fall under any of the 61 categories defined for this project.

Figure 3-23 breaks down the ten most commonly occurring litter items at loading docks.

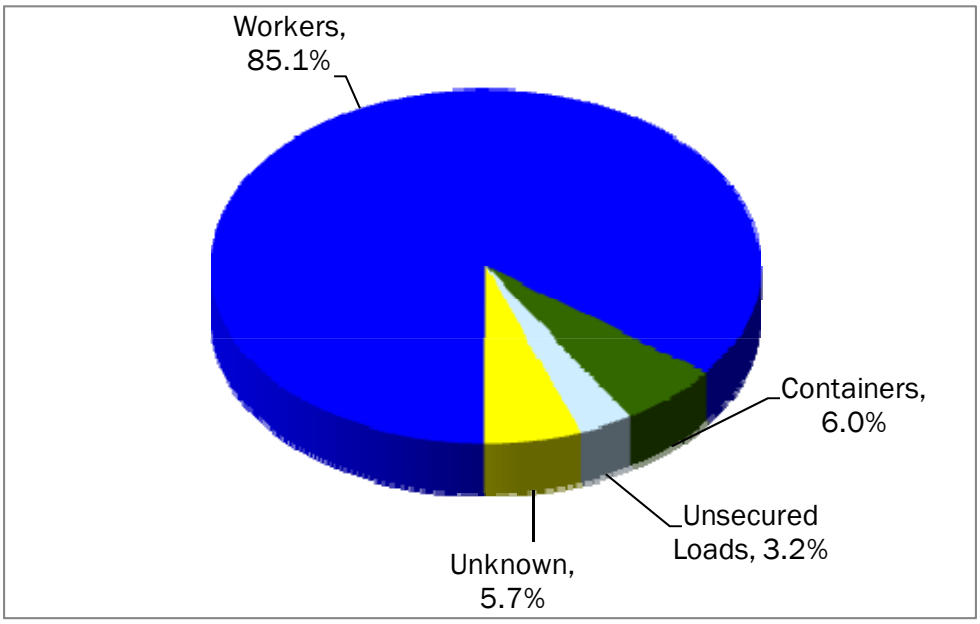
Figure 3-23 Top 10 Most Common Litter Items at Loading Docks (Items/1,000 sq ft)



Cigarette butts were the predominant component of litter found in loading dock areas. Other notable components were foil packets and small pieces of plastic and paper. Most of the items found at loading docks were smaller pieces (86 percent).

Figure 3-24 shows the breakdown of loading dock litter by source. Most litter (85 percent) found on loading docks was attributable to workers loading and unloading goods. Note that this figure references "workers" in place of "pedestrians," simply because workers or employees (of either the business itself or the hauling company) was used as the main source in this category instead of "pedestrians," as logic dictates that within a loading dock zone, the majority of persons would be considered workers as very few non-workers or pedestrians frequent these areas. Overloaded containers, at six percent, were the second highest source of litter within loading docks.

Figure 3-24 Sources of Litter at Loading Docks



3.4.3 STORM DRAINS

Survey results showed that there was an average of 191 items per thousand square feet of litter (large and small items combined) at storm drains. The average storm drain area of the sites measured for this study was 120 square feet. Figure 3-25 shows the composition of these litter items.

Figure 3-25 Composition of Litter at Storm Drains

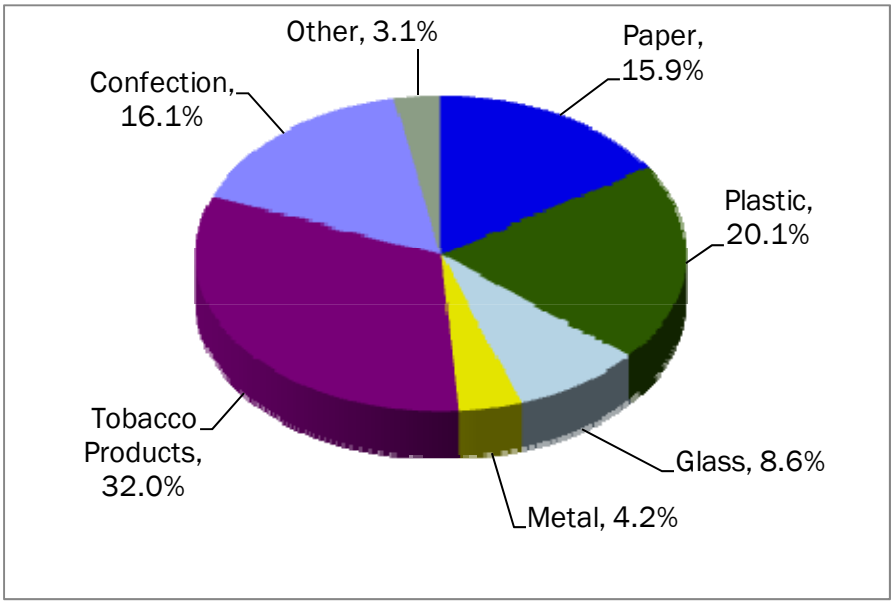
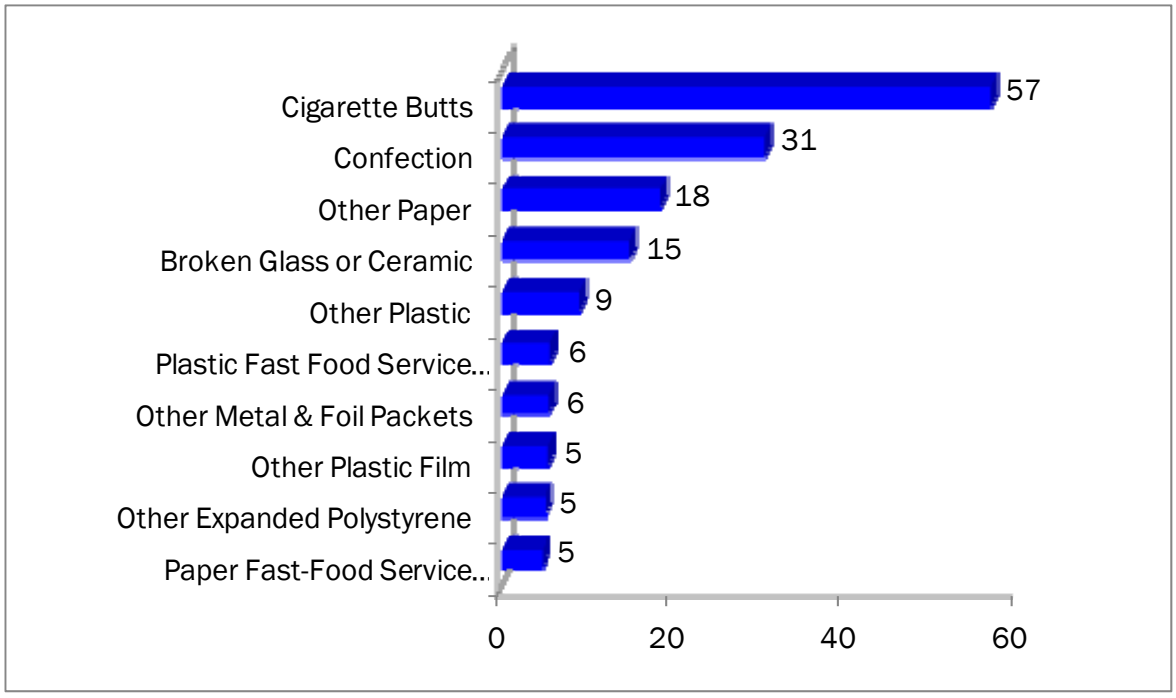


Figure 3-26 breaks down the ten most commonly occurring litter items at storm drains.

Figure 3-26 Top 10 Most Common Litter Items at Storm Drains (Items/1,000 sq ft)



As is shown in Figure 3-27, litter near storm drains was predominantly cigarette butts and confection litter. Most litter observed in these sites was smaller items (83 percent). Field crews also made notes regarding litter that had already been washed into the storm drains and was still visible. These items included smaller plastic bags filled with trash. It was not possible to accurately quantify the materials that had fallen into the storm drains.

Because storm drains lead to waterways, there are certain types of litter that are of particular interest around storm drains. Plastics can pose a potential hazard to marine life if this material ends up in our nation's water ways. As is displayed in the above figure, plastic items account for four of the top ten most common littered items found at storm drains. To further quantify the percent of various plastic materials at storm drain sites Figure 3-27 below details the incidence of plastic drink products, plastic bags, plastic fast food service items, and other plastic materials within the storm drain sample area. As shown, these various types of plastic comprise roughly 20 percent of all material (large and small items combined) found.

Figure 3-27 Plastic and Other Materials at Storm Drains

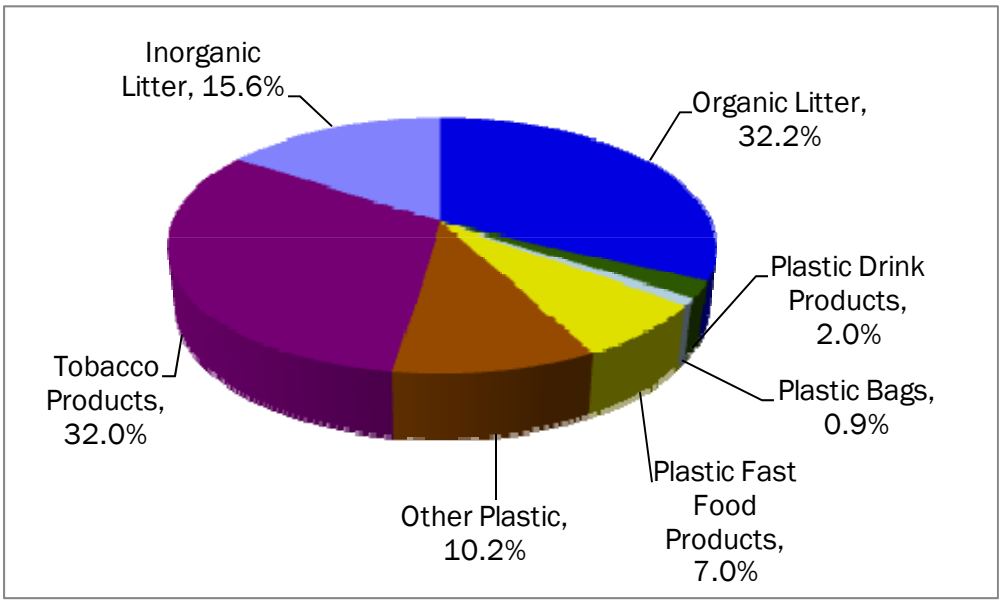
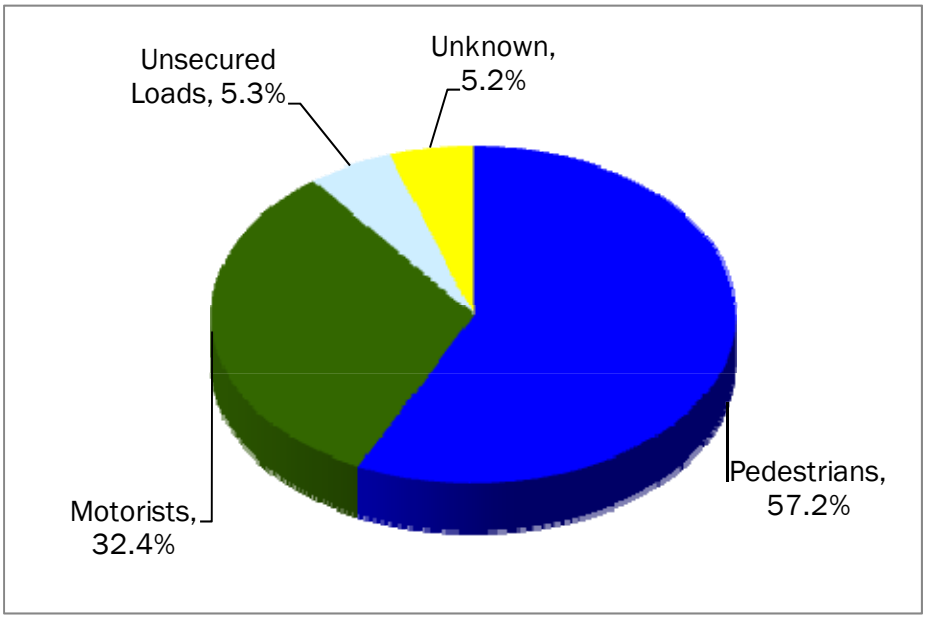


Figure 3-28 shows the breakdown of storm drain litter by source. Many storm drains were equally accessible to pedestrians and motorists and were evaluated with this dynamic in mind. Pedestrians were deemed responsible for 59 percent of this litter while motorists were responsible for 32 percent.

Figure 3-28 Sources of Litter at Storm Drains



3.4.4 RETAIL AREAS

Survey results showed that there was an average of 46 items per thousand square feet of litter (large and small items combined) at retail areas. The average retail area of the sites measured for this study was 2,621 square feet. Figure 3-29 shows the composition of these litter items.

Figure 3-29 Composition of Litter at Retail Areas

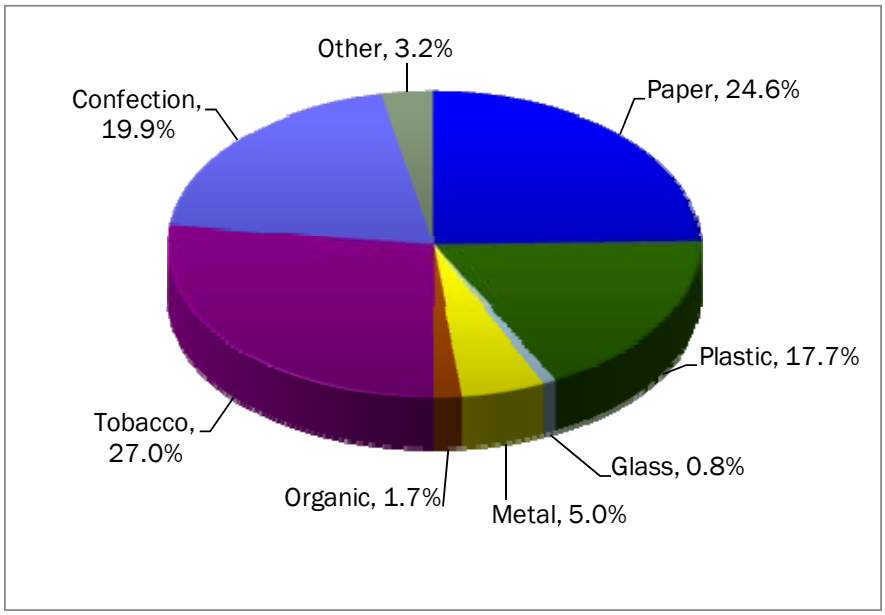
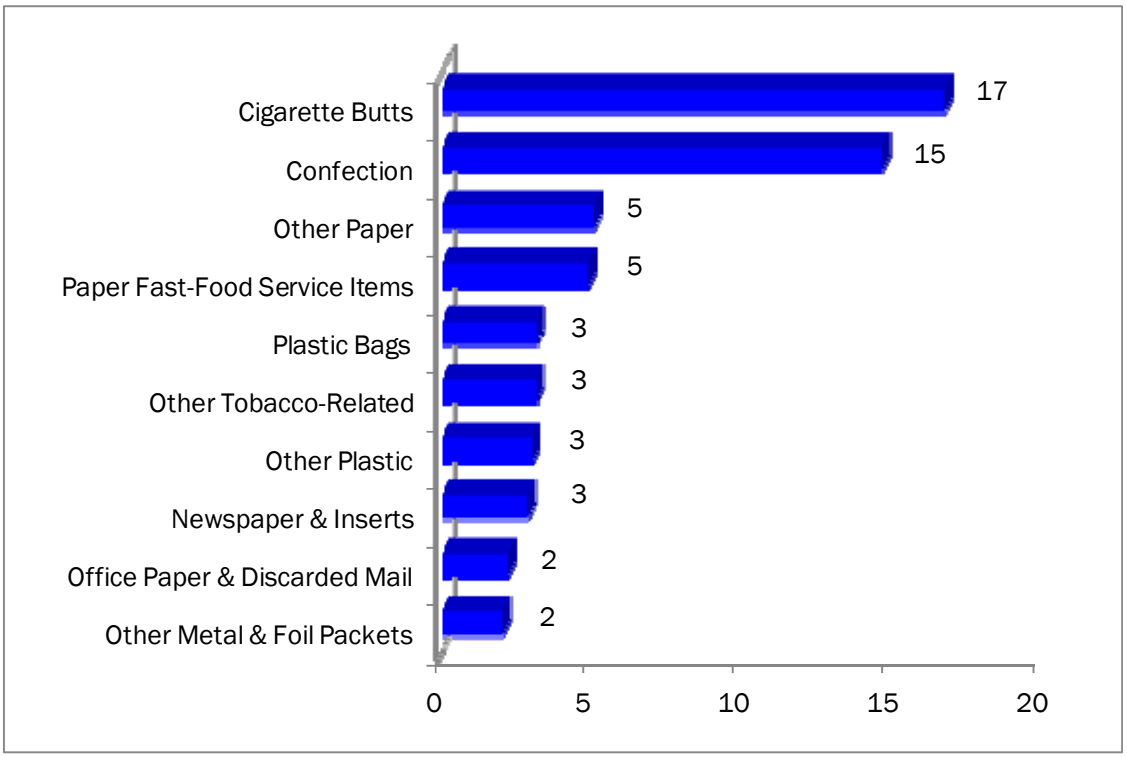


Figure 3-30 breaks down the ten most commonly occurring litter items at retail areas.

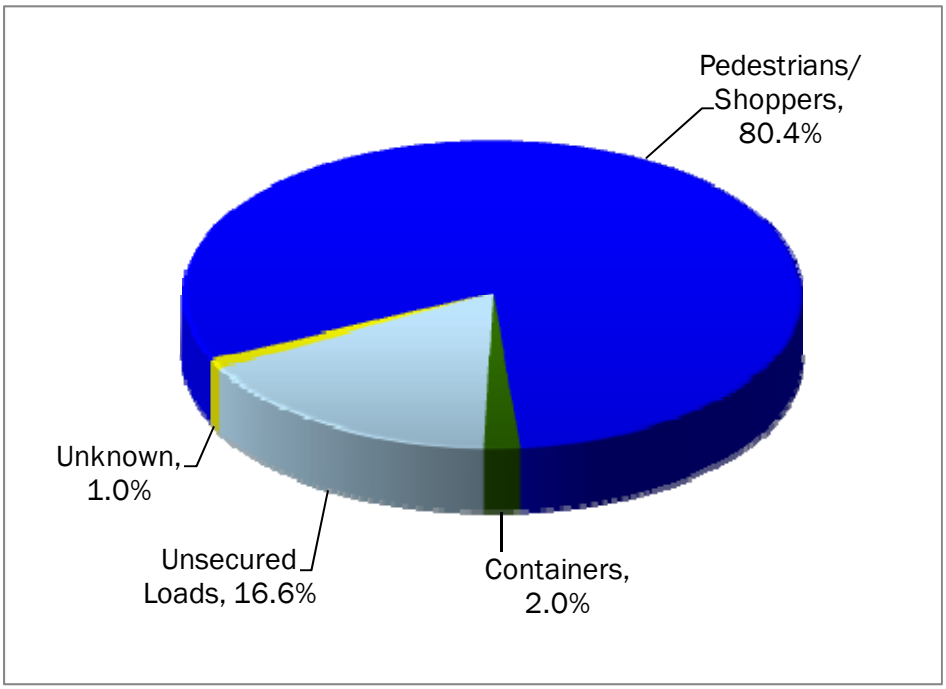
Figure 3-30 Top 10 Most Common Litter Items at Retail Areas (Items/1,000 sq ft)



Because cleanups were observed in many of the retail sites that were surveyed, the litter found was more likely to be fresh litter (recently occurring litter) rather than accumulated litter. Exceptions to this are confection litter and cigarette butts (it is uncertain whether these items were cleaned up regularly). Small items comprised most litter found in these sites (83 percent). Very little litter was found in these sites other than these items. All 30 retail areas surveyed were shopping centers.

Figure 3-31 shows the breakdown of retail area litter by source. Shoppers were deemed responsible for most litter in retail areas (92 percent), while unsecured loads were noted as a minor issue (6 percent).

Figure 3-31 Sources of Litter at Retail Areas



3.4.5 RECREATIONAL AREAS

A total of 30 recreational areas were surveyed for this study. These are shown in Table 3-13.

Table 3-13 Summary of Recreational Areas Surveyed

Recreation Area Type	Total
Parks	25
Beaches	2
Community Centers	1
Mountain	1
School Rec. Area	1
Total	**30**

Although the recreational areas were predominantly classified as "parks," the sites themselves were extremely diverse and ranged from small local parks with one or two courts or playgrounds to large county and state parks with vast acreage of open space. Throughout, field surveyors sought out areas of the parks that experienced the greatest use before making litter observations. So, it must be noted that the litter rates for recreational areas are not reflective of what might be found on average for the entire area, but rather is indicative of litter in the highly used areas. Specifically, Table 3-14 summarizes the portions of each recreational area chosen for litter surveying.

Table 3-14 Portions within Recreational Areas Selected for Surveying

Portions	Total
Picnic Areas	15
Courts/Sport Fields	6
Beach	1
Misc. (Paths, Walkways, Fields, Clubhouses)	8
Total	**30**

Survey results showed that there was an average of 105 items per thousand square feet of litter (large and small items combined) at recreational areas. The average recreational area of the sites measured for this study was 5,094 square feet. Figure 3-32 shows the composition of these litter items.

Figure 3-32 Composition of Litter at Recreational Areas

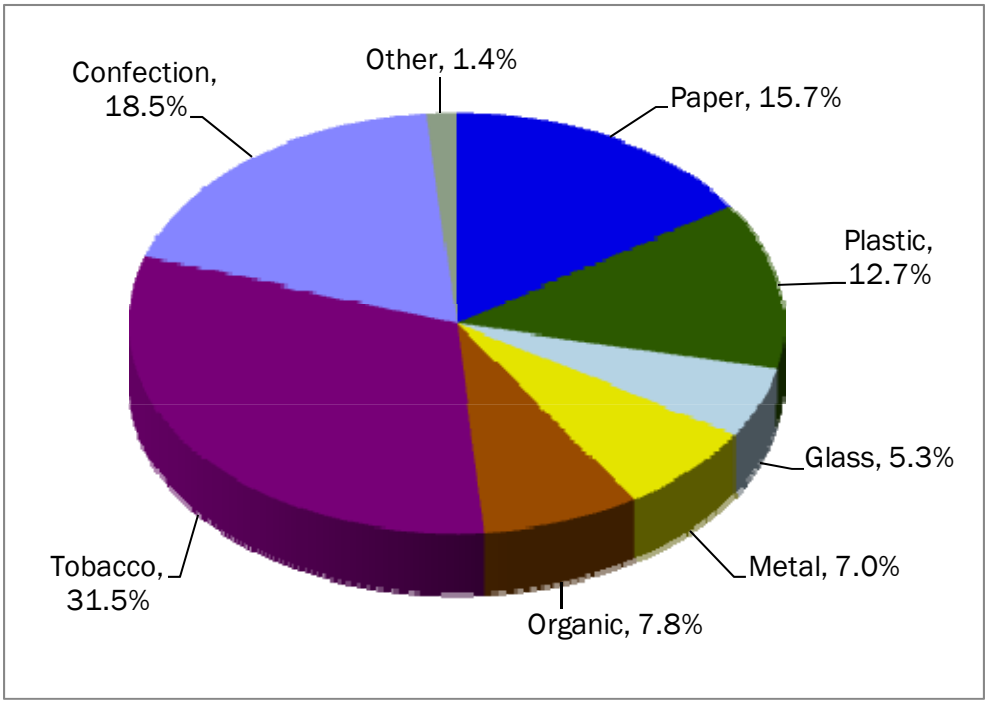
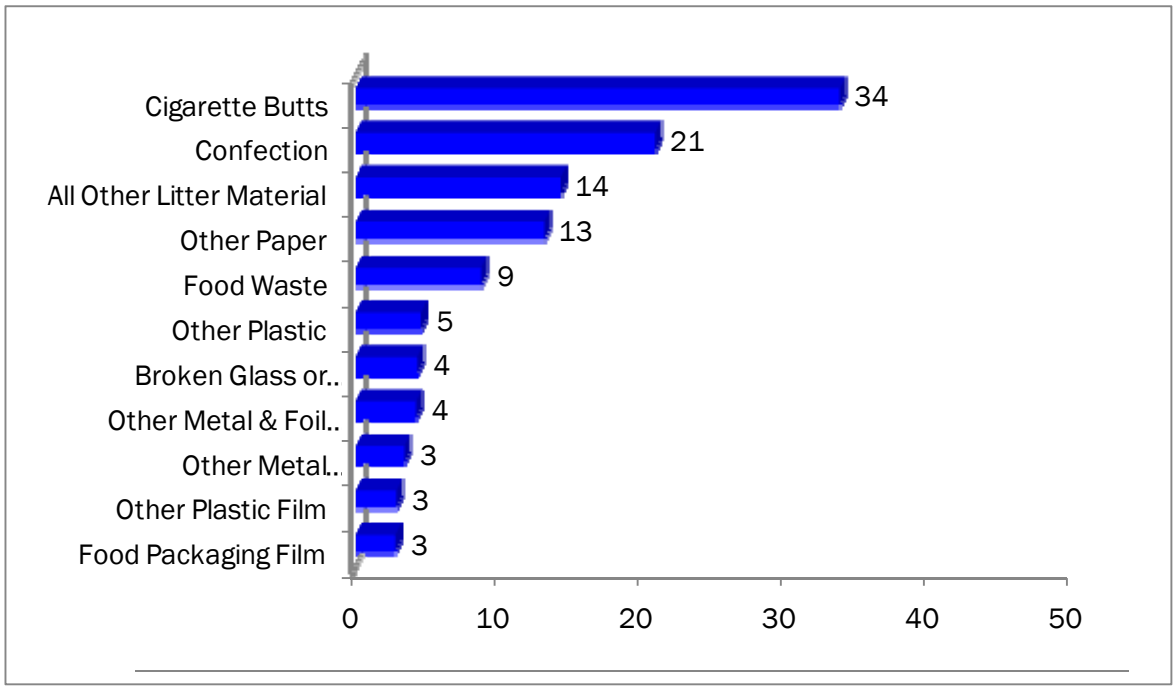


Figure 3-33 breaks down the ten most commonly occurring litter items at recreational areas.

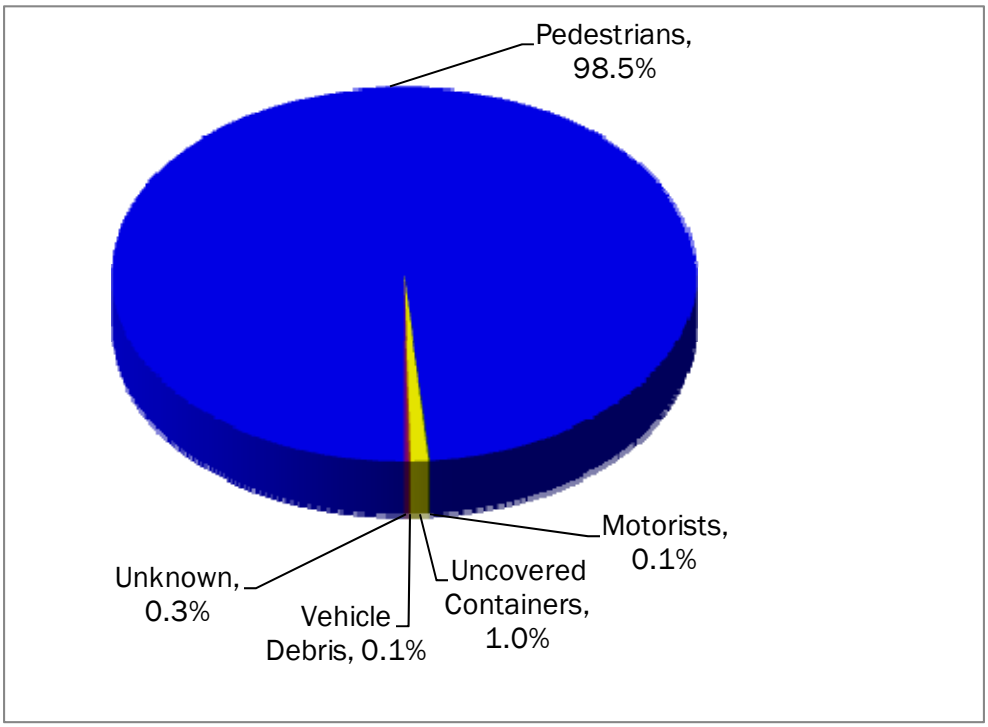
Figure 3-33 Top 10 Most Common Litter Items at Recreational Areas (Items/1,000 sq ft)



Litter in recreational areas was evenly split between large (50 percent) and small (50 percent) items. No other non-roadway category had as much large litter (4 inch-plus) as recreational sites. However, the predominant items were still cigarette butts and confection litter. Most of the large litter was food-related.

Figure 3-34 shows the breakdown of recreational area litter by source. As most of the recreational areas surveyed were not accessible for vehicles, virtually all litter was attributable to pedestrians.

Figure 3-34 Sources of Litter at Recreational Areas



3.4.6 CONSTRUCTION SITES

Survey results showed that there was an average of 101 items per thousand square feet of litter (large and small items combined) at construction sites. The average area of the sites measured for this study was 4,174 square feet. Figure 3-35 shows the composition of these litter items.

Figure 3-35 Composition of Litter at Construction Sites

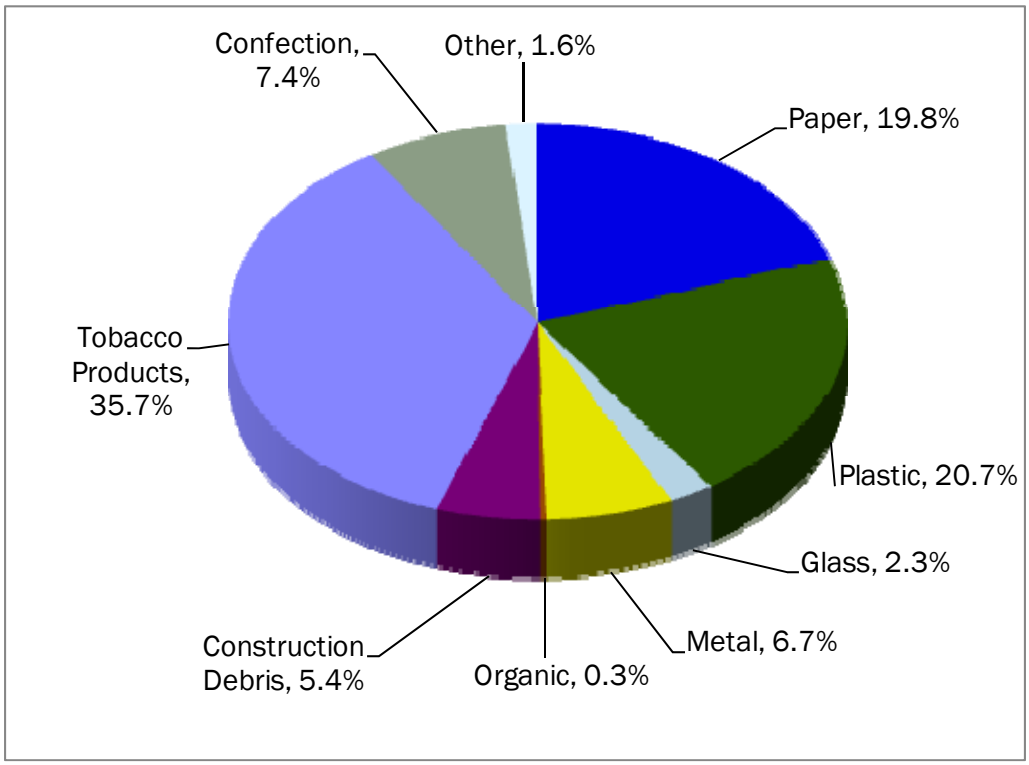
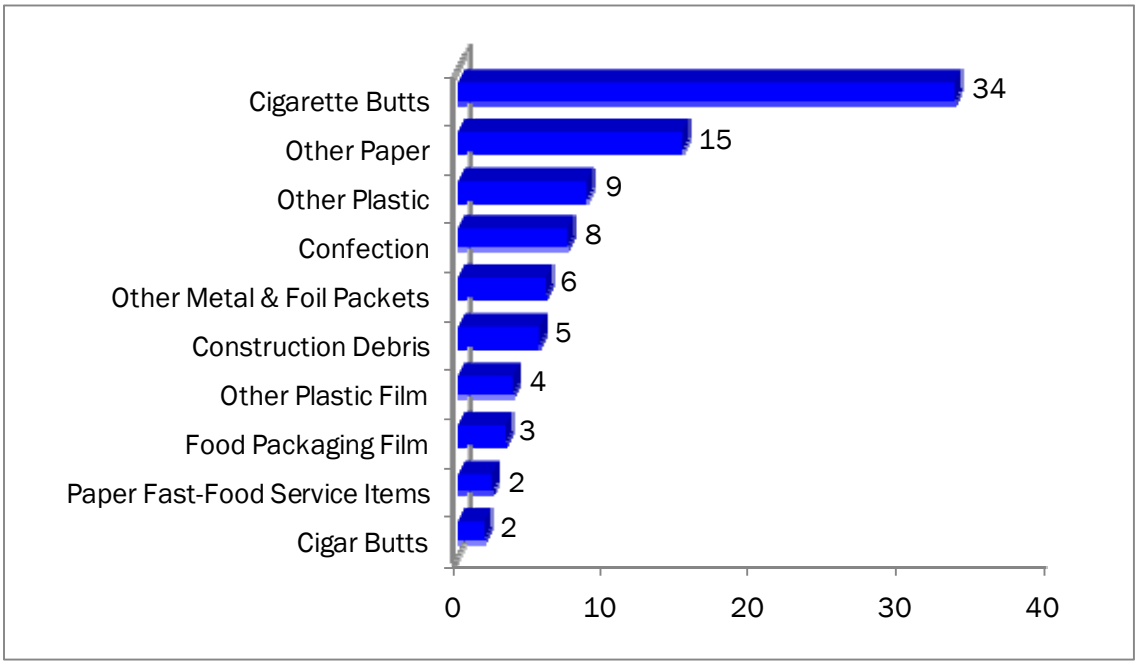


Figure 3-36 breaks down the ten most commonly occurring litter items at construction sites.

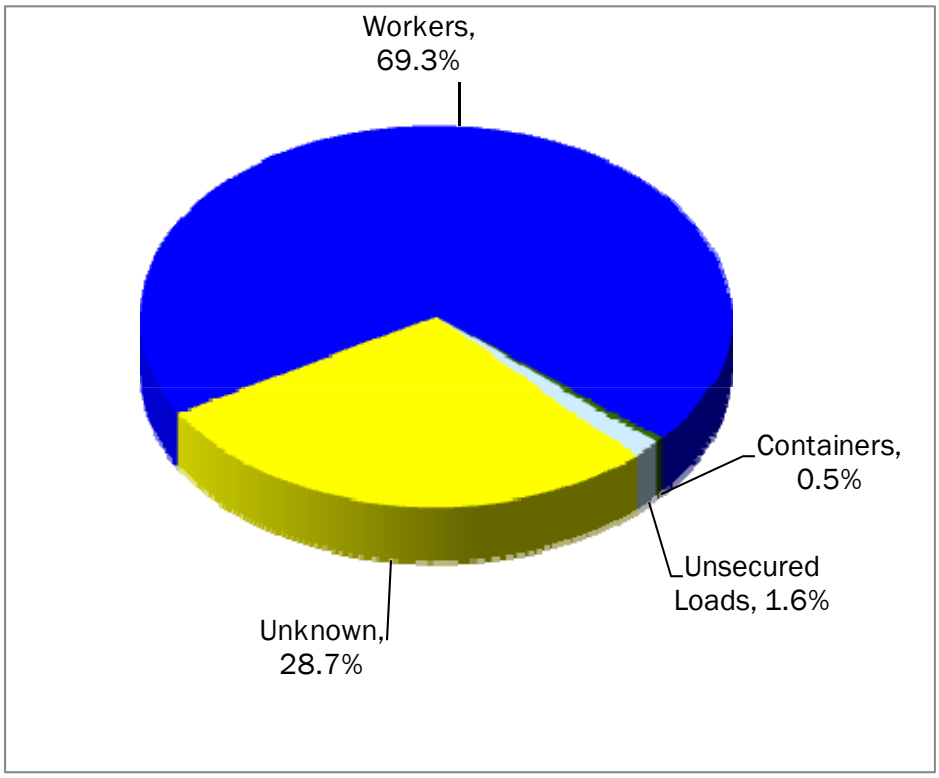
Figure 3-36 Top 10 Most Common Litter Items at Construction Sites (Items/1,000 sq ft)



Most of the litter found at construction sites was smaller items (93 percent) and consisted mostly of cigarette butts and small pieces of paper and plastic as well as confection litter. This site type referred to areas in the process of construction, which is a known source of litter, mostly by workers (69 percent) on site (see Figure 3-32) throwing their trash from snacks, meals, smoking, etc. in areas immediately outside of the fenced area or that have blown past the fencing. Although confection litter was the number four item, the actual number of all litter items, including confections, was generally low. The unknown portion was deemed attributable equally to either pedestrians or motorists.

Figure 3-37 shows the sources of litter at construction sites.

Figure 3-37 Sources of Litter at Construction Sites

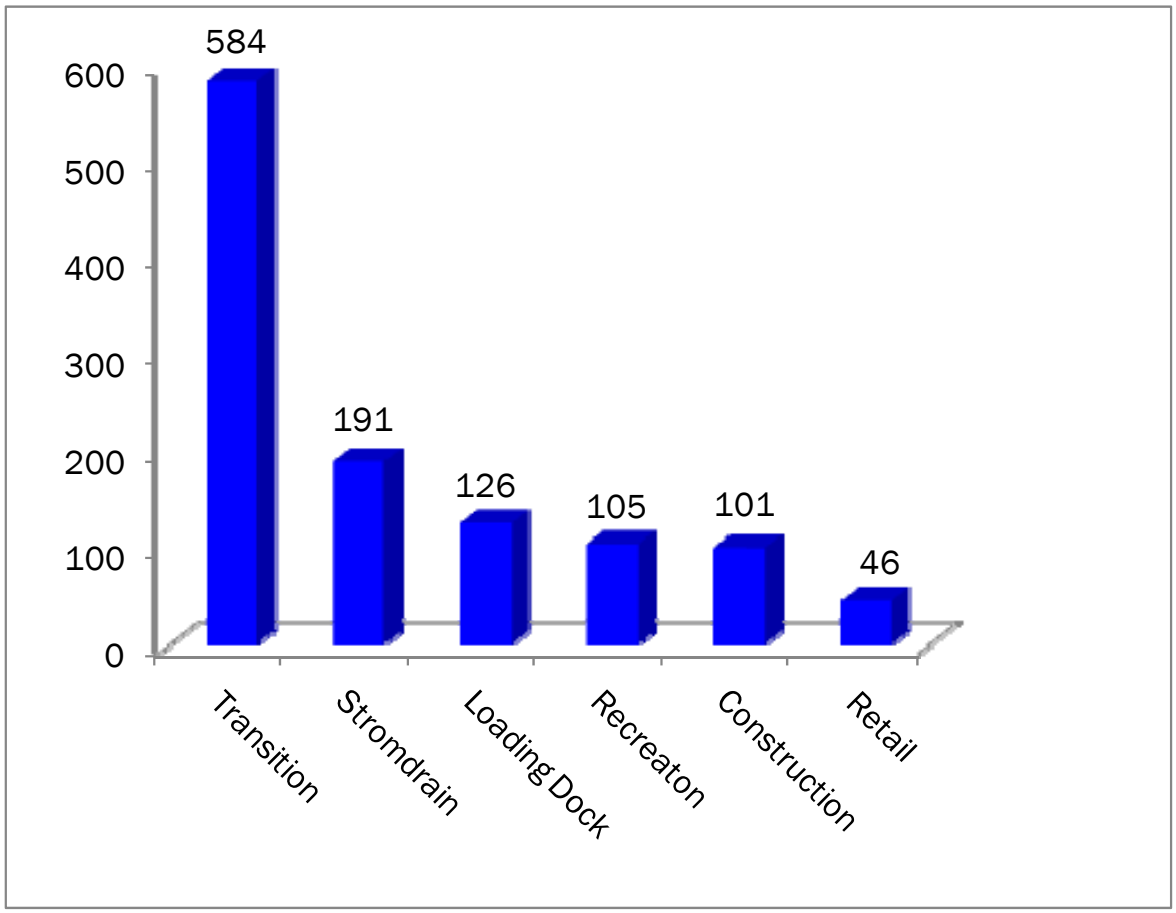


3.4.7 COMPARISON OF NON-ROADWAY LITTER

It is informative to evaluate the litter results of the six non-roadway areas in comparison to one another. A range of comparisons are shown here.

Figure 3-38 compares the relative number of litter items per 1,000 square feet (large and small combined) at non-roadway sites targeted in this project.

Figure 3-38 Comparison of Litter Incidence by Non-roadway Area (items per 1,000 sq.ft.)



As shown, on a per 1,000 square foot basis, transition areas are significantly more littered than any other non-roadway type, at more than twice the litter as the second closest litter rate. Retail areas harbor the least litter.

The size of littered items was also compared among the non-roadway areas. Table 3-15 below shows clearly that most litter found on non-roadway sites consists of smaller items. The one exception is recreational sites, at which there were equal counts of 4-inch-plus and 4-inch-minus litter items.

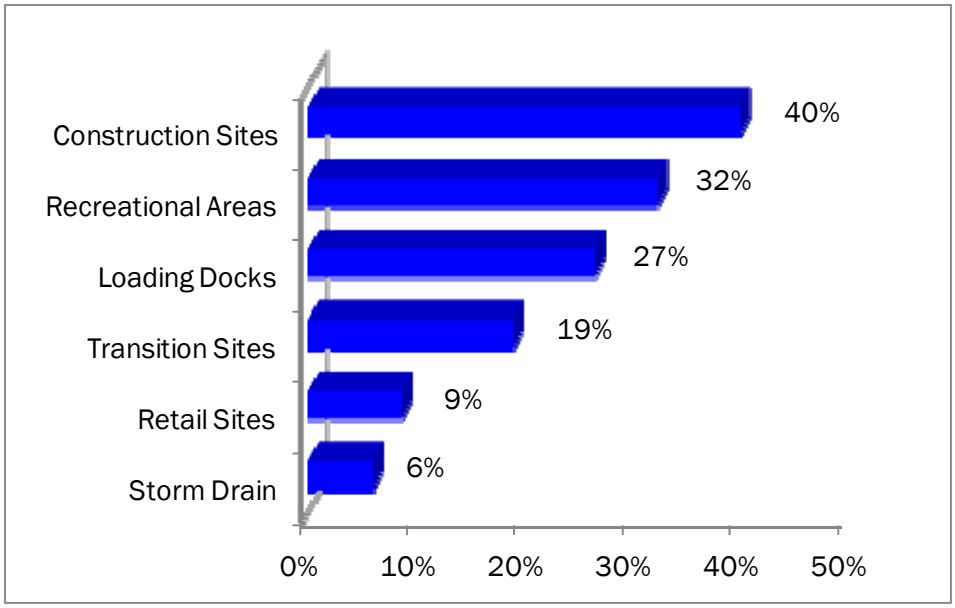
Table 3-15 Comparisons of Litter Items/1,000 Sq Ft. at Non-Roadway Sites

Site Type	Large Items	Small Items	All Litter
Transition Areas	23	561	584
Storm Drains	34	158	191
Loading Docks	17	108	126
Recreation Areas	52	52	105
Construction Sites	7	94	101
Retail Sites	8	38	46

The size of littered items was also compared among the non-roadway areas. Table 3-13 below shows clearly that most litter found on non-roadway sites consists of smaller items. The one exception is recreational sites, at which there were equal counts of 4-inch-plus and 4-inch-minus litter items.

Figure 3-39 plots the incidence of tobacco-related litter at each non-roadway site.

Figure 3-39 Comparison of Tobacco as a Percent of All Litter on Non-roadway Areas



Tobacco found in non-roadways consisted primarily of cigarette butts. However the percentage of tobacco litter varied greatly. Construction sites exhibited the highest fraction of tobacco litter, followed by recreational sites, loading docks and transition points. Storm drains and retail sites contained much less tobacco litter. While it was beyond the scope of this study to determine the reasons for the variances in tobacco litter among non-roadway sites, it is hypothesized that retail sites are cleaned up more often and more thoroughly than other sites, storm drains may not trap cigarette butts (which rather may wash down the drain).

3. VISIBLE LITTER SURVEY RESULTS

3.5. CORRELATION OF CONDITIONS TO LITTER RATES

3.5.1 OVERVIEW – ECONOMETRIC ANALYSIS

Once the litter management database was complete, data from the database was exported for analysis into a statistical package. Econometric Views software was used for the statistical modeling of litter quantification and characterization data.

The econometric modeling approach has been utilized by the solid waste industry for more than 15 years and has become a powerful tool, allowing concurrent testing and analysis of the relationships of a number of complex economic and demographic conditions. In the case of litter, it allows a correlation between observed litter quantities and composition and specific site conditions such as proximity to known or suspected sources of litter generation.

Multi-linear regression was used to test for relationships between a broad range of conditions including solid waste facility proximity, roadway maintenance levels, and beautification.

This approach resulted in determining which of these conditions were key drivers of litter rates overall, and by specific source, across the U.S., providing a broad range of data that noted differences in such drivers in rural and urban areas, specifying the different drivers of litter on municipal, county, state roads and national highways. This modeling tool also numerically defines the significance of these relationships – whether they are strongly or weakly correlated.

The result was a series of tables, showing which conditions exhibit strong relationships to litter rates and which ones will be useful in developing policies and educational programs to address specific drivers of litter roadways and non-roadways.

3.5.2 CORRELATION OF NON-ROADWAY LITTER TO CERTAIN CONDITIONS

As with the roadway samples, non-roadway samples were tested to determine if certain conditions correlated to litter generation.

The preliminary analysis took two paths. First all non-roadway sites were examined to the extent allowed by the data. Second, the six non-roadway types were examined separately. This was done to study the potential for location-specific relationships that might be obscured when evaluating the entire dataset.

For the analysis examining all non-roadway sites, 148 observations were able to be used. Construction site observations were ultimately excluded because they were, by our observations, not in the process of being maintained. Prior experience suggests that construction sites are not always cleaned on a regular basis. In fact, at certain residential and commercial construction sites surveyed, litter was left behind after construction had been completed.

Table 3-16 summarizes the conditions that correlate to littering at non-roadway sites. The values in the table show how many additional litter items (per 1,000 square feet) can be expected to be found given the external condition noted. Analysis of the proximity of residential areas and convenience stores did not result in the presence of more or less litter, thus those variables are not included in the table below.

Table 3-16 Non-Roadway Variable Impacts

Condition Tested	Impact on Litter Items per Site
The non-roadway site was close to a commercial area	- 56
How each improvement in the level of maintenance (from poor to average to good to perfect) will impact litter	-27
There were one or more fast food restaurants in close proximity	+43
There was a Public Area in close proximity to the survey site	+54
There was Landscaping in close proximity to the survey site	+60

The table shows the incremental number of litter items that would be expected to be observed at non-roadway sites exhibiting the conditions shown. For example, if the area is near a Fast Food restaurant, it was found that there were 44 more litter items per site than would otherwise be at that particular site.

All but one of the conditions that correlated with litter generation exhibited positive reinforcement of litter accumulation. The only condition that correlated to lower litter at non-roadway sites was the level of maintenance. Notable observations are:

- **Maintenance**: For the variable "Maintained," each level of maintenance will reduce the number of litter items found by 26. For example, improving the level of maintenance from 2 to 5 would reduce the number of litter items by 3 x 26, or 78 fewer items.
- **Landscaping**: Roadway sites that included landscaping tended to be result in 60 additional items of litter compared with sites that did not have landscaping. This was attributable to the landscaping (hedges, flowers, the edge of planting beds, etc.) harboring litter items that might otherwise have been more dispersed.
- **Commercial establishments**: Sites near businesses other than convenience stores or fast food establishments tended to have 56 fewer items of litter compared with other sites.
- **Fast food restaurants**: Sites near fast food establishments tended to have 43 additional items of litter compared with other sites.
- **Public areas**: Sites near public areas tended to have 54 additional items of litter compared with other sites.

Of the results obtained, those shown for Fast Food, Public Areas, and Maintained are each intuitive: locations near fast food restaurants, locations that are public areas, and the level of maintenance would all be expected to influence the number of litter items found. The remaining two results are somewhat counterintuitive.

In addition to the analysis of all non-roadway data, survey data for each non-roadway type were independently analyzed for correlations. The following correlations were found for individual non-roadway types:

- **Retail**: Results showed that Fast Food establishments again correlated with more litter (+37), while Convenience stores (-45), Receptacles (-66), Maintenance (-18 per level) correlated with less litter. The convenience store result may be counterintuitive, although perhaps convenience stores provide some measure of litter removal as a part of their employee duties.
- **Storm Drains**: Results showed that Maintenance correlated with reduced litter (-23 per level), while close proximity of Convenience stores (+127), Residential areas (+85), Landscaping (+159), Receptacles (+113), and Public areas (+92) each correlated with more litter.
- **Loading Docks**: Results again showed that Maintenance correlated with less litter (-30 per level), as did the proximity of Public Areas (-123). Other commercial establishments correlated with more litter (+101).
- **Construction Sites**: Construction sites, by nature, would not yield meaningful Maintenance data, so this external variable was not considered for this portion of the analysis. Interestingly, the presence of Landscaping (-84), Convenience stores (-78), and Loading Docks (-113) each correlated with less litter. Other commercial establishments (+74) and Receptacles (+136) each correlated with more litter.
- **Transition Points**: Other commercial establishments (-309) and Maintenance (-118 per level) correlated with less litter, while Fast food restaurants (+235) and Landscaping (+229) correlated with more litter.
- **Recreational Areas**: These results were the strongest, statistically speaking, and (not surprisingly) were therefore fairly intuitive. Landscaping (-57) and Residential areas (-98) each correlated with less litter, while Loading Docks (+192) and Receptacles (+85) each correlated with more litter. Interestingly, Maintenance did not correlate to the level of litter in this specific category.

In conclusion, better maintained sites generally yield less litter, as one would expect. However, the presence of certain types of landscaping and litter receptacles each appear to increase litter. While this may seem counter-intuitive at first glance, some qualitative reasons can be offered. Certain landscaping may act as a trap for litter, either against fencing or caught in the spacing of several inches between the ground level and the point at which bushes or flowers and leaves grew. Qualitatively, field observations of landscaping that did not have such spacing showed less trapped litter. Litter receptacles that were not maintained enough to keep up with the trash deposited in them tended to result in overflow, and thus were producers of litter.

4. LITTER COST SURVEY RESULTS

4.1. INTRODUCTION

Litter is known to financially impact a wide range of entities and organizations in a variety of ways. For example, many entities (local government, institutions, and businesses) incur direct costs by expending resources (personnel, equipment, disposal fees, etc.) for collecting litter. Indirect costs may also be incurred if litter reduces the value of a parcel of real estate or deters a customer from entering the premises of a business because of a negative perception about the cleanliness outside of the building. There is a great breadth of litter abatement efforts that are ongoing in our economy on a regular basis.

Despite the intuitive awareness that a great deal is expended on litter abatement, there are few means of quickly and accurately measuring the costs associated with these abatement efforts. Therefore, a critical part of this project was to develop a far-reaching research protocol that spanned a wide range of entities involved in litter abatement.

4.2. METHODOLOGY

4.2.1 DEFINING SURVEY POPULATIONS

To investigate the estimated direct costs of litter borne by a wide range of public and private entities in the U.S., this project utilized a series of surveys of national databases of governments, institutions, and businesses. In many cases, the universe of entities to be surveyed was stratified to better enable meaningful comparison of responses, as well as to improve the similarity of responses for extrapolation of results. The following entities were ultimately researched as part of this project:

- **State Agencies**: MSW Consultants contacted state agencies responsible for litter education, enforcement and abatement in all 50 states and the District of Columbia.
- **Counties**: There are 3,141 counties (including related entities such as parishes in Louisiana and Boroughs in Alaska) in the U.S. according to the U.S. Census Bureau. These entities are typically responsible for litter management in their unincorporated areas, and at times may provide litter abatement to some or all of the incorporated areas within their boundaries. For purposes of this study, counties were stratified by population to separately research, large, medium, and small counties.
- **Cities**: Also according to the U.S. Census Bureau, there are over 27,000 incorporated cities, towns, boroughs, townships, villages, and related entities in the U.S. These entities frequently provide their own litter abatement efforts. For purposes of this study, cities were stratified by population to separately research, large, medium, and small counties.
- **School Districts**: There are thousands of school districts in the U.S., and tens of thousands of school buildings housing kindergarten through 12th grade students. This study targeted the 500 largest school districts based on a database from the National Center for Education Statistics which is part of the U.S. Department of Education.
- **Colleges and Universities**: There are almost 2,000 colleges and universities in the U.S., according to a list by the National Center for Education Statistics.

- **Businesses**: While there are multiple business and market data providers offering proprietary lists of businesses, MSW Consultants opted to rely on a database of businesses' physical locations provided by third party data provider *InfoUSA*. This list of businesses was ultimately selected because it clearly defined the universe of businesses and their actual locations. For purposes of this study, businesses were stratified into four groups based on total employment indicated to be at each physical location.
- **Organizations that Combat Litter**: In addition to the universe of public and private organizations that deal with litter as a necessary part of their existence, there has grown in the U.S. a network of organizations that exist in whole or in part to educate, inform, and otherwise attempt to eradicate litter. Keep America Beautiful and its affiliates, as well as the International Adopt A Highway Association (IAAHA) are two of the main organizations involved in the enterprise of reducing litter, through local and state affiliates and from thousands of volunteers.

With the exception of the KAB and IAAHA organizational data, data for the remaining groups required acquisition and definition of the survey population, followed by random sampling and direct surveying. Table 4-1 summarizes the universe of entities targeted for survey-based litter cost research.

Table 4-1 Definition of Entities to be Surveyed

Entity Type	Stratification	Number of Organizations	Population of Organization
Cities	<30k pop	26,090	86.9 million people
	30k to 100k pop	952	53.0 million people
	>100k pop	247	82.1 million people
Counties	<30k pop	1,717	15.0 million people
	30k to 100k pop	894	32.3 million people
	>100k pop	530	127.6 million people
States	All 50 states and DC	51	305.0 million people
Educational Institutions	School Districts	500 largest	48.7 million students[1]
	Universities	1,994	17.5 million students
Businesses	0-19 employees	4,504,763	21.2 million employees
	20-99 employees	692,677	20.1 million employees
	100-1,000 employees	438,587	22.5 million employees
	1,000+ employees	948,342	50.7 million employees

[1] Although the 500 largest school districts were sampled, the extrapolations presented in subsequent sections were for the entire universe of students in all school districts.

A second objective of the litter cost survey was to explore the indirect costs of litter. An indirect cost is defined as a cost that is not attributable to actively managing and removing litter. Examples of indirect costs include: the degree to which litter increases the perception of a less desirable neighborhood or business district, thereby diminishing property values; or the influence litter may have on the decision of a consumer to patronize a business

establishment. Little prior research has been performed on the indirect costs of litter, primarily because there are many other neighborhood characteristics that also influence property values and/or business visitation.

This study sought to explore perceptions of litter on homeowners, realtors, and business development officials who are generally aware of the factors that influence real estate purchasing, neighborhood attractiveness, and development. Specifically, this study included less rigorous surveying of homeowners, realty companies, and business development entities to investigate the potential indirect impact of litter.

4.2.2 SURVEY PREPARATION

There were two basic steps to conducting the survey of direct litter costs. In the first step, MSW Consultants randomly selected entities from each of the strata to be contacted. This was performed using randomization functions and selecting several hundred entities from each stratum to serve as the contact list. In some cases, such as for the businesses, contact information was contained in the database acquired for the study. For other entities, especially the cities and counties, it was necessary to research appropriate contact numbers on the internet.

The second step involved development of separate survey instruments and survey response mechanisms. A list of survey questions was developed for each entity type, and ultimately approved by KAB.

4.2.3 CONDUCTING THE SURVEY

Given the extent of surveying that was required to obtain a meaningful number of responses, the MSW Team utilized a combination of professional and temporary office staff to conduct litter surveys. Such effort required survey staff to be trained prior to conducting survey phone calls. Surveyor training included the following topics:

- Litter basics;
- An introduction to KAB, its mission, and this project's overall objectives;
- An overview of the type of entity (e.g., cities) along with strategies for identifying the individual(s) within the entity organizational structure who might be knowledgeable about litter;
- Survey processes, including the provision of official e-mail and fax communications, as well as an internet-based survey response site developed for the project; and
- An overview of the cost components involved in litter clean-up, including estimation of the volume of litter and estimation of the labor or other resources applied to litter clean-up.

Table 4-2 summarizes the targeted number of survey responses from each of the survey populations, as well as the number of responses ultimately obtained.

Table 4-2 Summary of Direct Litter Cost Survey Responses

Entity Type	Descriptor	Initial Random Selection	Targeted Responses	Actual Responses
Cities	<30k pop	120	30	39
	30k to 100k pop	120	30	36
	>100k pop	120	30	33
Counties	<30k pop	120	30	38
	30k to 100k pop	120	30	38
	>100k pop	120	30	29
States	All 50 states and DC	51	51	51
Educational Institutions	School Districts	125	20	19
	Universities	1,994	20	18
Businesses	0-19 employees	300	30	42
	20-99 employees	300	30	32
	100-1,000 employees	300	30	37
	1,000+ employees	303	30	0 [1]
Total		**4,093**	**391**	**412**

[1] Significant obstacles were encountered in obtaining responses from large businesses. These are discussed below.

As shown in Table 4-2, approximately 30 responses were targeted from each entity stratum. In most cases, the target number of responses was achieved (although not all responders may have provided complete data for all sets of questions). However, a notable exception involved businesses with 1,000 or more employees. As noted in the methodology section, the universe of businesses was based on a database provided by a third party market data aggregator. This database was selected precisely because it contained the universe of U.S. businesses, which in theory would allow results of a random survey to be projected to a national total.

In practice, these large businesses immediately emerged as those that were the least likely to provide meaningful responses. In brief, large businesses were much more likely to defer surveyors to a corporate office. Not only were corporate offices less likely to respond to surveys, but in every case the responses that may have been provided by the corporate office would not apply to the specific location surveyed. By disassociating responses from the underlying entities targeted for surveying, there would have been no way to apply survey results to the universe and project national totals.

If large companies are to be surveyed in the future, it is recommended that a different approach be taken to first compile a known universe of companies (e.g., all companies in the S&P 500 list of publicly traded companies), and then to work more closely with KAB to approach the corporate offices of these businesses to solicit participation in litter cost research.

The second set of surveys reflected less statistically rigorous questioning of entities that may have insight on indirect litter costs. Table 4-3 summarizes the survey research applied to these entities.

Table 4-3 Summary of Indirect Litter Cost Survey Responses

Organization Type	Random Selection	Targeted Responses	Actual Responses
Real Estate Brokers	40	10	10
Business Development Officers	40	10	10
Property Appraisers	40	10	10
Homeowners	30	30	30
Total	**150**	**60**	**60**

As shown, the targeted response rates were achieved.

4.2.4 DATA ANALYSIS

Given that each target population was to be evaluated separately, survey responses were tabulated in a simple spreadsheet format. Responses from entities surveyed for direct litter costs were aggregated and extrapolated to the universe of each entity, providing a national estimate of litter costs and estimated quantities. Responses from entities surveyed for indirect costs were aggregated, but no extrapolation was possible.

Given the inherent challenges associated with surveying such a wide range of entities, the completeness of survey responses varies by entity type. While the MSW Team made efforts to complete each survey, and applied our Team's logic and past experience to validate the reasonableness of responses, the prospect for some inaccuracies must be acknowledged. However, because of the relatively narrow range of responses to many questions, the MSW Team believes that the responses received for the range of entity types was reasonable for use in projecting the order of magnitude of national litter costs.

4.3. LITTER COST SURVEY RESULTS

4.3.1 STATES

All fifty states and the District of Columbia were contacted and benchmarked for the Litter Costs portion of the study. State agencies that responded include department of transportation, department of environmental protection, state Adopt-a-Highway, and state Keep America Beautiful coordinators. As was to be expected, some States were able to provide complete data, while others could only answer select questions.

4. LITTER COST SURVEY RESULTS

Table 4-4 below summarizes the cost and quantities of litter managed at the state level.

Table 4-4 Results of Litter Cost Survey of U.S. States

	Result
Annual Litter Cost	$362.5 million
Litter Costs $/Capita	$1.19
Tons of Litter	171,164 tons
Annual Lbs/Capita	1.12 pounds
Litter Grant Funding Received	$21.0 million
Grant Funding/Capita	$0.07

In most instances, cost data in this and subsequent tables reflect FY07 or FY08 dollars. Where no recent data exists, some entities may have provided earlier data. No attempts were made to normalize or standardize for inflation. It should be noted that some states did not track their litter-related costs, and consequently it is believed that the state-wide totals may be understated. Tracking of litter related costs is frequently, if not always, obscured because such costs are not typically accounted for separately in the budgeting or expense tracking process. Litter abatement costs are usually grouped with other programs. In addition, litter abatement costs at the state level were potentially incurred by more than one department or agency.

4.3.2 COUNTIES

One hundred and five county responses were obtained in response to litter cost inquiries. County contacts that provided the necessary data to MSW Consultants ranged from highway/road departments, public works departments, solid waste/recycling departments, and KAB county affiliates. Some counties were able to provide reasonably complete data, while others only answered select questions for which they had data available. Results are shown in Table 4-5.

Table 4-5 Results of Litter Cost Survey of U.S. Counties

Entity Type	Annual Litter Cost (million $)	Litter Costs $/Capita	Litter & Illegal Dumps (Tons)	Annual Lbs. per Capita	Litter Grant Funding Received (million $)	Grant Funding $/Capita
Counties < 30k Pop	$24.8	$1.66	56,022	7.49	$4.9	$0.33
Counties 30k-100k Pop	$97.9	$3.03	249,746	15.47	$25.6	$0.79
Counties > 100k Pop	$62.4	$0.49	529,035	8.30	$16.6	$0.13
Total	**$185.1**	**$1.06**	**834,803**	**9.54**	**$47.1**	**$0.27**

Similar to the experience with state-level research, county departments did not accurately separate or track litter clean-up costs, and it is believed that litter abatement costs may be understated.

4.3.3 CITIES

One hundred and eight city responses were obtained in response to litter costs surveys. The city contacts that provided the necessary data to MSW Consultants included streets, landscaping, public works, sanitation, and local KAB coordinators. Some cities were able to provide complete data, while others could only answer select questions. Table 4-6 below details the estimated cost for litter collection and prevention efforts

Table 4-6 Results of Litter Cost Survey of U.S. Cities

Entity Type	Annual Litter Cost (million $)	Litter Costs $/Capita	Litter & Illegal Dumps (Tons)	Annual Lbs. per Capita	Litter Grant Funding Received (million $)	Grant Funding $/Capita
Cities < 30k Pop	$462.6	$5.32	482,489	11.1	$98.3	$1.13
Cities 30k-100k Pop	$96.0	$1.81	153,537	5.8	$4.0	$0.08
Cities > 100k Pop	$238.7	$2.91	955,817	23.3	$1.6	$0.02
Total:	**$797.3**	**$3.59**	**1,591,843**	**14.34**	**$103.9**	**$0.47**

As was the case with counties, city departments were not typically able to provide complete litter cost and quantity data, and as such, their costs may be underrepresented. In discussions with various departments, it was learned that litter collection and remediation costs are grouped with other programs and extrapolating those costs was not possible without significant review of programs.

It should be noted that the number of cities willing or able to provide usable data for this study was almost double that of the counties. This possibly suggests that counties do not track litter costs as thoroughly as cities do.

4.3.4 BUSINESSES

One hundred and eleven businesses, representing three different business size strata, ultimately responded to litter cost surveys. Business contacts responding to the survey included company owners/officers, office managers, accountants, operations staff, and custodial management.

Unlike states, cities and counties, which at least are aware of litter as an issue and may have a litter abatement strategy in place, to many if not most businesses litter is not an issue that is being consciously addressed. Business surveys were generally more challenging to complete because nobody at most businesses had "litter abatement" in their job description. Yet, as our surveys found, a great many businesses do in fact devote resources to removal of litter.

While successful strategies varies slightly, almost all business surveys were more free-form questions aimed at understanding the grounds maintenance responsibilities and resources in use. In many cases, it took respondents several questions to become aware that in fact the business was expending resources on litter. Surveyors then proceeded to construct estimates of the volume of litter and the labor and resource commitments made by the business, which were subsequently used to estimate total costs. Table 4-7 summarize the estimated cost of litter among businesses.

Table 4-7 Results of Litter Cost Survey of U.S. Businesses

Entity Type	Annual Litter Cost (billion $)	Litter Costs $/Employee	Litter & Illegal Dumps (Tons)	Annual Lbs. per Employee
Businesses 0-19 emp.	$2.8	$131.80	473,481	44.67
Businesses 20-99 emp.	$2.0	$97.76	191,978	18.60
Businesses 100-1,000 emp.	$1.3	$58.90	513,206	45.54
Businesses 1,000 + emp. [1]	$3.0	$58.90	813,039	32.07
Total	**$9.1**	**$79.48**	**1,991,704**	**34.79**

[1] The very largest businesses were unable to provide location-specific responses and therefore it would not have been possible to project national results for this stratum. Results for businesses with 1,000 or more employees were therefore calculated based on responses from businesses with 100 to 1,000 employees.

It must be reiterated that the largest businesses were found to be unable to provide litter cost data at individual locations. For this reason, the costs shown in Table 4-7 for businesses with greater than 1,000 employees are based on the litter costs per employee and litter generation per employee that was calculated for the businesses with 100 to 1,000 employees.

Other observations include:

- Businesses spend an order of magnitude more on litter abatement than cities, counties, or states. Where litter abatement costs for these municipal entities are stated in the hundreds of *millions*, the cost of litter abatement for U.S. businesses is almost $10 *billion*. At a minimum this number should give pause to companies in many industries who may be devoting meaningful time and resources to a problem they may not know existed.
- The litter cost per employee diminished as the size of the business increased. This would seem to be a logical relationship, as a smaller fraction of employees would be expected to provide litter abatement for the entire business location as the size of the business increases.

4.3.5 EDUCATIONAL INSTITUTIONS (SCHOOL DISTRICTS AND UNIVERSITIES)

The MSW Team obtained responses from nineteen school districts and eighteen colleges and universities across the country. In most instances the contacts within these educational institutions that provided the necessary data headed the maintenance, facilities, or janitorial

departments. Similar to the other entities surveyed, in most cases only partial data was available. Table 4-8 summarizes the direct costs of litter at educational institutions.

Table 4-8 Results of Litter Cost Survey of U.S. Educational Institutions

Entity Type	Annual Litter Cost (million $)	Litter Costs $/Student	Litter & Illegal Dumps (Tons)	Annual Lbs. per Student
School Districts	$172.6	$3.54	7,415	0.30
Universities	$68.0	$3.89	64,001	7.32
Total:	**$240.6**	**$3.63**	**71,416**	**2.16**

Of interest, the direct cost of litter abatement per student was comparable for both school districts and colleges/universities. Yet, colleges and universities reported over 20 times the quantity of litter and illegal dumps removed. This appears to have been driven by the fact that k-12 schools are unoccupied other than during the school day, while colleges and university students reside on campus and generate much more litter. Also, colleges and universities reported that beginning and end of semester move-in and move-outs create extensive amounts of illegal dumping whose costs are reflected in these results.

4.3.6 LITTER ORGANIZATION COSTS

In addition to public and private organization above, there are non-profit organization and volunteer resources devoted to litter remediation as well. Non-profit organization operating costs, such as Keep America Beautiful, and volunteer groups such as Adopt-a-Highway programs represent another form of direct cost. A breakout of direct costs incurred by litter organizations and their affiliates and volunteers has been factored in to the total cost estimates.

It is well known that placing a dollar value to volunteer time has been a challenge for nonprofit organizations. Neglecting to account for the value of volunteered services, however, results in discounting the value of volunteer services provided. Thus, the Financial Accounting Standards Board issued rules requiring nonprofits to report volunteer services provided.

When estimating the dollar value of volunteers, it is important not to fall into the trap of using minimum wage as the only basis for computing the value of time provided since the majority of volunteer assignments are worth more than minimum wage. The value of volunteer assignments should be based on the cost of that type of work in the marketplace. Volunteers are not free, rather they allow organizations to extend their allocated budget and accomplish more through the use of volunteers.

The costs shown below in Table 4-9 represent the estimated number of volunteers and the average amount of time spent annually on litter-related activities. Costs are calculated based on minimum wage, the national value of volunteer time and an average of those two costs. As shown, the estimated real value of volunteer time associated with litter abatement ranges from $340 million to just over $1.0 billion depending on the assumed hourly wage level.

Table 4-9 Estimated Annual Volunteer Hours and Costs Spent on Litter Clean-ups

Volunteer Group	Volunteers (millions)	Hours per Year	Total Hours (millions)	Minimum Wage Value of Time (millions)[1]	True Value of Time (millions)[2]	Average Value of Time (millions)
AaH	1.1	16	18	$117.9	$351.2	$234.5
KAB – Affiliates[3]	1.0	16	16	$104.8	$312.2	$208.5
KAB – Additional[4]	2.0	8	16	$104.8	$312.2	$208.5
Ocean Conservancy[5]	0.5	4	2	$13.1	$39.0	$26.1
Total	4.6	44	52	$340.6	$1,014.6	$677.6

[1] Based on the federal minimum wage of $6.55 per hour, effective July 2008.
[2] Based on the national value of volunteer time is estimated to be $19.51 per hour for 2008 (www.independentsector.org/programs/research/volunteer_time.html).
[3] Represents the volunteer costs for the state and local affiliates themselves.
[4] Represents the additional value of volunteer time for KAB's annual Great American Cleanup.
[5] Estimated portion of Ocean Conservancy budget allocated to issues related to litter and marine debris.

The direct costs shown in Table 4-10 below represent KAB's estimated costs for office expenditures, educational materials, and media events and specifically exclude the value of volunteer time noted in Table 4-9 above. This adds another $92 million to the cost of litter.

Table 4-10 Direct Litter Costs to Various Organizational Entities

Organization Level	Direct Costs (millions) [1]
Affiliates Reporting	$69
Non-Affiliates (KAB est.)	$13
KAB – National	$10
Total	**$92**

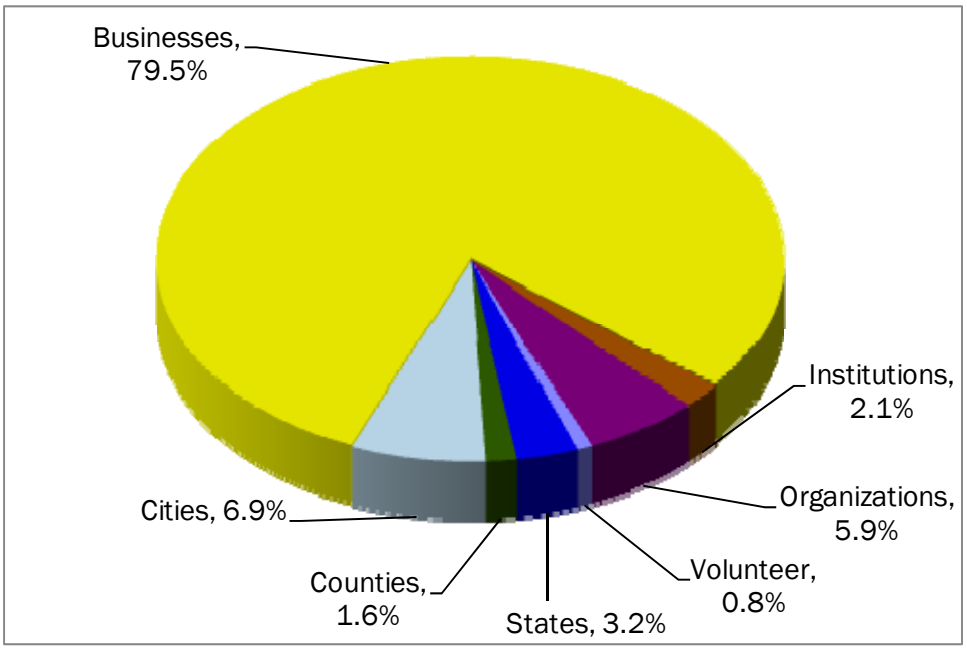
[1] Includes office costs, educational materials and media.

Assuming the combined $769 million dollars in volunteer and organizations costs shown in this section are included with the $10.7 billion already described in Section 4.3, then it could be legitimately argued that the true annual litter collection and prevention costs to the varies entities within the United States approaches $11.5 billion dollars.

4.3.7 COMPARATIVE DATA

Litter costs for each of the targeted entity types discussed in the above sections are combined to estimate a national cost of litter collection and prevention in the United States on an annual basis. In summary, the research performed in this project suggests that a conservative estimate for the direct costs of litter to governments, educational institutions, businesses, volunteer and litter organization costs in the U.S. is $11.5 billion. The percent breakdown of litter costs from each entity type is shown in Figure 4-1.

Figure 4-1 Breakdown of Direct Litter Costs in the U.S.



These data are also summarized in Table 4-11.

Table 4-11 Estimated Annual U.S. Costs for Litter Clean-up and Prevention

Entity Type	Estimated Litter Cost (million $)	Percent of Total	$ per Capita, Employee, or Student
States	$362.6	3.2%	$1.19/capita
Counties	$185.1	1.6%	$1.06/capita
Cities	$797.3	6.9%	$3.59/capita
Businesses	$9,127.5	79.5%	$79.48/employee
Ed. Institutions	$240.6	2.1%	$3.63/student
Organizations	$677.6	5.9%	N/A
Volunteer	$92.0	0.8%	N/A
Total:	**$11,482.7**	**100.0%**	**N/A**

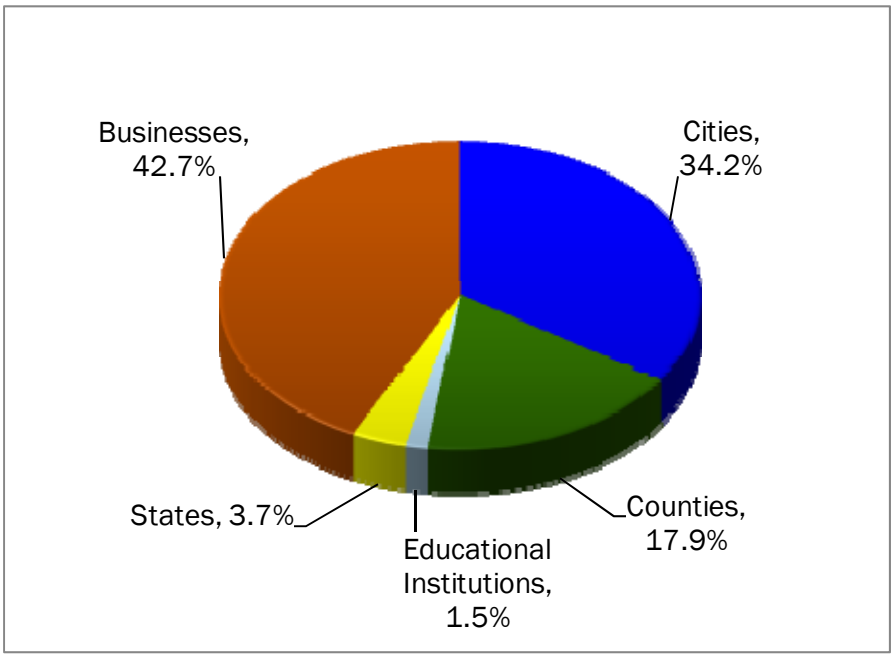
As shown, U.S. businesses pay an unwittingly large fraction of the total cost of litter (80 percent). States, cities and counties together expend another $1.3 billion dollars on litter abatement. This equates to $4.41 for every man, woman and child in the country on an annual basis. Educational institutions, an area not frequently thought off when addressing

litter issues, expend approximately $241 million dollars combined, which equates to approximately $3.71 per student annually.

Given the estimates shown above, it appears that litter costs are a legitimate issue and that many entities, especially in the commercial sector, may benefit from programs that reduce litter around their workplaces and elsewhere.

Figure 4-2 compares the quantity of litter and illegal dumping that was found to have been collected and removed by entities in the U.S.

Figure 4-2 Breakdown of Litter and Illegal Dumping Quantities in the U.S.



These data are also summarized in Table 4-12.

Table 4-12 Estimated Annual Tons of Litter Collected

Entity Type	Tons Collected	Percent	Lbs per capita, student or employee
States	171,164	3.7%	1.12
Counties	834,803	17.9%	9.54
Cities	1,591,843	34.2%	14.34
Businesses	1,991,703	42.7%	34.79
Ed. Institutions	71,416	1.5%	2.16
TOTAL:	**4,660,930**	**100%**	**N/A**

As Table 4-12 shows, an estimated 4.6 million tons of litter is collected by public and private organizations on an annual basis. For perspective, this is more than the total residential waste generated in the five boroughs of New York City in a one year time frame.

As a final topic of research, surveys of governmental entities explored litter-related grants that were received. The amount of litter grants available to and from the various states and local governments can, in most instances, be tied to economic and/or political factors. During difficult economic times, budgets for environmental programs, such as litter collection and prevention programs, can be cut or eliminated altogether. It should be noted that none of the businesses and educational institutions that were surveyed reported receiving grant money for litter. Further research into whether or not these entities receive grant funding should be considered in future studies.

Results of the survey suggest that $172 million of grant funding was received by cities, counties and states. These results are shown in Figure 4-3 and Table 4-13.

Figure 4-3 Breakdown of Annual Litter Grant Funding in the U.S.

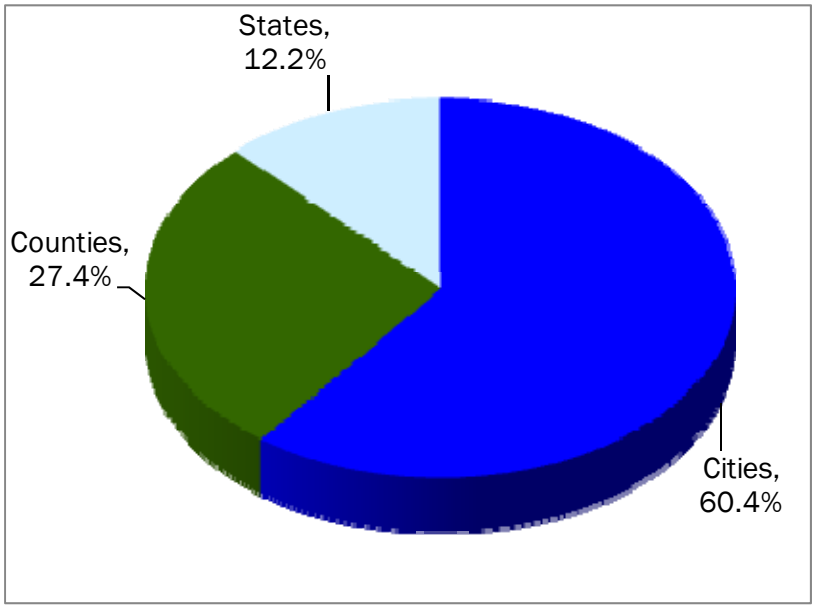


Table 4-13 Estimated Annual Grant Funding Received by Entity Type

Entity Type	Estimated Litter Grants (million $)	Percent	Estimated Grants received per capita ($)
States	$21.0	12.3	$0.07
Counties	$47.1	27.4	$0.27
Cities	$103.8	60.3	$0.47
Total	**$172.0**	**100%**	**N/A**

As shown, cities obtained the greatest proportion of litter grants, almost doubling that of counties on a per capita basis. This seems to suggest either that cities do a better job than counties in requesting litter collection and education grants from the state and local government entities or that the available funding mechanisms are targeting cities and ground-level operations. One key component that could be studied for future calculations is funding mechanisms for county wide KAB affiliates. Consideration of this data might in theory increase the estimated litter grants to county programs and thus increase the estimated grants received on a per capita basis.

4.4. INDIRECT COSTS OF LITTER

There are many factors that improve the attractiveness of a neighborhood or area that are documented to contribute to higher property values and housing prices. Such factors include a good public school system, a safe neighborhood, close access to open spaces, walking trails and public transportation, to name but a few. Conversely, other factors reduce the attractiveness and corresponding property values of a neighborhood. These include proximity to undesirable commercial or industrial facilities, roads in disrepair, abandoned properties, poor schools, and lack of safety.

To explore these factors, both positive and negative, the National Association of Home Builders (NAHB) built a hedonic pricing model[1] based on data from a large survey conducted by the U.S. Census Bureau. This model is one where the component variables were directly related to the quality of a home that one might consider purchasing. The NAHB model deconstructed the price of a home into selected components, so that estimated factors were developed for each price-influencing variable while addressing problems of nonlinearity.

Based on this model, NAHB determined that the presence of litter tended to reduce the value of property in that neighborhood by about 7.4 percent. Due to the functional form used in the NAHB model, the percentage varied and was actually higher in certain cases.

A study of Philadelphia neighborhoods found that the presence of an abandoned house on a block reduced the average value of other adjacent properties by $6,720. It went on to suggest that property abandonment could become a self-sustaining contagion. It is possible that litter is subject to a similar dynamic and that early intervention could produce positive results much quicker than when litter rates become high and neighborhoods began to fall into a negative feedback loop of decay.

With these dynamics in mind, surveys of property appraisers, realtors, business development officials and homeowners were conducted to further research into the relationship of litter to healthy communities. As opposed to the entities surveyed to investigate direct costs, the list of questions presented to homeowners, business development officials, and realty officials were more qualitative in nature, and no attempt was made to project national results. The results of this study are presented in subsequent sections below.

[1] NAHB House Price Estimator (www.nahb.org)

4.4.1 HOMEOWNERS

Thirty home owners from twenty states were randomly selected and surveyed over the phone during the month of July 2008. Each home owner was asked four questions about their impressions of litter and its affect on home values. Responses are shown below.

Question 1: How much of an issue/problem is litter in your neighborhood?

7% Litter is not a problem in my neighborhood

57% Litter is a slight problem in my neighborhood

30% Litter is a moderate problem in my neighborhood

7% Litter is a heavy problem in my neighborhood

0% Litter is an extreme problem in my neighborhood

Question 2: Would an unkempt neighborhood influence your decision in purchasing a property?

93% Yes

7% No

Respondents overwhelmingly said that an unkempt neighborhood would indeed influence home buying decisions. Some went on to say, "I would not be interested if it was littered" or "I absolutely wouldn't buy if it was littered."

Question 3: Would a littered neighborhood decrease your assessment of a home's value?

93% Yes

7% No

Home owners surveyed overwhelmingly thought a littered neighborhood would decrease their assessment of a home's value. One respondent who said "yes" commented on the bigger picture and said "litter can bring rats and other problems to a neighborhood." Others said they "can't stand litter" or that they "wouldn't want to move to an area that is dirty." Interestingly enough, one respondent who said "no" went on to elaborate that while he thought litter "should" affect the value of a home, in reality he did "not believe it is an important enough factor to actually affect the value of a home."

Question 4: By what percent do you think a littered area would reduce property values?

17% 0-9% reduction in property values

40% 10-24% reduction in property values

20% 25-50 % reduction in property values

3% 51-75% reduction in property values

13% 76-100% reduction in property values

7% Uncertain/Unknown

The majority of respondents said they felt they were not in a position to predict an accurate reduction in property values and at first abstained from answering the question. However, when further encouraged to give their "best estimate," 93% of respondents were willing to answer and only 7% continued to abstain.

4.4.2 BUSINESS DEVELOPMENT OFFICIALS

Eleven officials from business and economic development agencies across eleven states were randomly selected and surveyed over the phone during the month of July 2008. Each business development officer was asked the following four questions regarding their impressions of litter and its affect on businesses relocating to a particular city or region.

Question 1: What do you think are the major factors that influence a business to locate in your community?

- 45% Taxes
- 45% Workforce
- 36% Infrastructure/accessibility
- 36% Incentives
- 27% Location
- 27% Economy/ business climate
- 27% Upkeep/cleanliness
- 27% Cost of Living/affordability of housing
- 9% Ratings/public image of town
- 9% Density
- 9% Disposable income of community
- 9% Available land/properties
- 9% Cost of labor
- 9% Foot traffic
- 9% Price charged per square foot
- 9% Weather
- 9% Educational systems

Question 2: From your discussions with prospective businesses, (how) do littered areas that they observe affect decisions to move or relocate?

- 36% Litter has an impact/the area must be clean before showing
- 18% Litter is often associated with blight and presents a negative picture of local government
- 9% Litter can speak about the type of people who use the retail corridor
- 9% Litter would affect most prospective businesses if they were looking for somewhere cheap

9% Litter can have a substantial effect on whether a company considers a community serious about the location

9% Litter can affect the quality of life of employees

9% Litter is not an issue in our clean community

Question 3: Do you keep any data regarding litter that you could share with us?

No development officials knew of any litter studies or sources of data, but two offered additional information via the following websites:

- http://www.nctcog.org - The North Texas Council of Governments has little brochures available for download.
- http://www.cleanslatechicago.org - Clean Slate, a job training program, is a neighborhood beautification business cleaning sidewalks, parkways, public gardens and vacant lots in Chicago.

Question 4: Anything else we should know?

- Story from Ft. Collins, CO - Anheuser Busch sponsors a summer youth program in their town and generally gives grant funding for litter clean ups. However, Ft. Collins was so clean that Anheuser Busch was able to get permission from corporate to do a new project beyond litter. They now build houses, work on trails, repaint houses for elderly, and run a Youth Corps program in the summer.
- Comment from Texarkana, AR - The director of tourism joined the call to inform about volunteers in her city with the local affiliate of KAB and thinks it's very important to have a nice looking community.
- Comment from South Bend, IN – The town has "ambassadors" who clean litter, plant flowers, provide security, and offer tourist information for visitors.
- Comment from Seattle, WA – The President/CEO of Enterprise Seattle felt very strongly that litter is "a quality of life issue. If you're not a clean city, it doesn't communicate the right image."

4.4.3 REAL ESTATE AGENTS

Ten real estate agents from ten states were randomly selected and surveyed over the phone during the month of July 2008. Each real estate agent was asked the following six questions about their impressions of litter and it's affect on a home's value.

Question 1: Does an unkempt neighborhood influence your decision to show a home to prospective buyers?

50% Yes

20% No

30% Not Applicable

Multiple agents said that "yes," litter can influence them but that litter would not deter them for showing a home if it is a home the client wanted to see it. Agents made comments about their role in the home buying process, noting that the real estate agent isn't responsible for deciding which properties to show and that instead it is the buyers who make decisions about which homes to look at. One agent noted that the decision would be influenced "if the whole

neighborhood is littered or if a specific house is just unkempt. The status of neighborhood would be less of a problem if buyer were an investor. However, if an entire block looks bad then buyers are less likely to want to see the house." Another agent noted that "some clients might not care about litter because price is their main concern."

Question 2: What criteria do you use to evaluate the value of a home in a neighborhood?

- 73% Comparable prices in neighborhood
- 18% Overall appearance of neighborhood
- 9% Crime Rate
- 9% Previous sales
- 9% Assessor's office information
- 9% Multiple listing service
- 9% Features
- 9% Number of rooms
- 9% Yard
- 9% Location
- 9% Condition

The majority of real estate agents determined values of homes by looking at the prices of comparable homes in the same neighborhood.

Question 3: How would a littered neighborhood influence your assessment of a home's value?

- 55% Litter would decrease value
- 9% Litter does not look good, however it is not a big deal
- 9% It is up to the client to evaluate if litter is important to them
- 9% Agent would feel obligated to describe the look of the neighborhood and how it might influence the value of the home
- 9% Litter can be cleaned up; it's not a problem
- 9% Litter in a neighborhood affects a city's reputation

While many agents thought litter would decrease a home's value, it was noted that the value of a home is determined by the desire of the client, not by a price set by real estate agents. One agent discussed litter and said "If people don't take care of litter in their yards, they probably don't take care of their homes." Another said if she was giving her opinion to a buyer she would "feel obligated to describe the look of the neighborhood and how it might influence the value of the home." Another said if "litter is a problem in an entire neighborhood, it would effect their reputation in the city and even the county."

Question 4: Do you think a littered area would reduce property values? If yes, by what percent?

55% Yes (Average decrease 9%)

0% No

36% Not Certain

Agents hypothesized an average expected decrease of approximately 9%. One agent commented that the "percent can really vary depending on how much litter there is. For example, whether there are old cars in yard or just some trash on street." Another agent said that they have "never had to deal with a litter problem."

Question 5: Are you aware of any studies that show whether or not litter reduces property values?

No agents knew of any studies regarding litter and home values. One agent suggested perhaps the National Association of Realtors might have some information.

Question 6: Is there anything else we should know?

Comments from real estate agents included:

- "Litter is a problem. You can't control this problem by putting signs up or fining people. Parents have to teach children not to litter."
- "This is an interesting topic. I would like to see a study on litter and property values."
- "There is way too much litter in my community and no one has the time to clean up litter. There is only time for an annual clean up. This is not enough."

4.4.4 PROPERTY APPRAISERS

Ten property appraisers from ten states were randomly selected and surveyed over the phone during the month of July 2008. Each property appraiser was asked the following six questions about their impressions of litter and it's affect on home values. Numbers and averages are rounded to the nearest whole number. Due to this rounding, the percentages presented in this report, when added together, may not exactly match the totals shown.

Question 1: Does an unkempt neighborhood influence the decision to purchase a home?

100% Yes

0% No

All respondents answered "Yes, an unkempt neighborhood would influence their decision to purchase a home."

Question 2: What criteria do you use to evaluate the value of a home in a neighborhood?

50% Condition

40% Location

30% Size

20% Comparable prices in neighborhood

10% Appeal

10% Conformity

10% Updates/renovations

The two most common criteria for property appraisers placing values on homes were the condition and location of the home.

Question 3: Would a littered neighborhood decrease your assessment of a home's value?

60% Yes

10% No

30% Possibly

One property appraiser thought litter probably would not influence the first time home buyers market since they often can't afford nicer areas, therefore litter wouldn't make much of a difference.

Question 4: If yes, by what percent do you think a littered area would reduce property values?

Multiple agents reported having a hard time estimating an appropriate percentage. One appraiser thought that location was a "bigger issue than litter" and another said it "differs by neighborhood." Two agents commented on the volume of litter, saying "a small amount of litter wouldn't decrease the value much" and that "reduced values would depend on the amount of litter."

Question 5: Are you aware of any studies that show whether or not litter reduces property values?

No property appraisers knew of any studies regarding litter and home values.

One appraiser suggested calling the Appraisal Institute in Chicago, home of the Lum Library, to find out if they had any similar studies in their collection. Another appraiser suggested that, while he didn't know of any studies, perhaps there is a study published somewhere by a graduate student for their dissertation.

Question 6: Is there anything else we should know?

All respondents answered "No."

4.5. SUMMARY AND CONCLUSION

MSW Consultants estimates that on an annual basis it costs states, counties, cities, businesses, educational institutions, and litter abatement organizations approximately $11.5 billion per year for litter clean-up, education and/or disposal programs. While this amount is sure to be a surprise to the average citizen, and even to the various entities that were benchmarked, this amount is most likely lower than the true costs. This is a result of many of the entities either not properly tracking their true costs, or not being able to properly identify and benchmark all departments that are involved with litter clean up and prevention efforts.

In addition to the cost of litter to the various entities, MSW Consultants estimates that 4,660,930 tons of litter and illegal dumps are collected and remediated each year while

approximately $172 million of grant funding is received by governmental and state entities on an annual basis.

It should be noted that in 2007, the average U.S. employee was paid approximately $17.00 per hour. In addition, the average disposal fee for regular garbage and trash (in which category most types of litter would fall) in 2004 was $34.30/ton. With both the average hourly rate and disposal fee shown above, it is no wonder that the cost of litter, both for collection prevention and disposal efforts, is so high. Ensuring that local governments, businesses, states and politicians understand these costs is instrumental in furthering KAB's goal of reducing litter across the U.S.

The intent of the litter cost research undertaken for this study was to make a systematic and comprehensive effort to estimate the national cost of litter and the quantities of litter being abated by public, private and institutional organizations in the U.S. The results from this study can ideally be used as a benchmark for further studies to determine if costs are increasing or decreasing, while also providing KAB with a key tool in informing private citizens, businesses, and governments of the rate and extent of the litter problem within the United States. It should be noted, however, that the survey efforts undertaken represent a starting point, and suggest that more detailed investigation, especially among certain strata of businesses and/or particular industries that may experience "hidden" costs of litter clean-up (e.g., fast food restaurants) will provide additional insight into litter costs.

With the cost of litter in the United States detailed, it is of interest to gain insight on the perception of litter among homeowners, realtors and property appraisers. The more qualitative surveys performed on these subjects suggest that litter is not, at the outset, an issue that is cited as being meaningful and relevant to property values and neighborhood attractiveness. Yet, when litter is raised as a discrete issue, most agree that it has a negative impact on neighborhood attractiveness, and possibly even on property values. While it is not possible to draw strong quantitative conclusions from this effort, it appears that educational efforts aimed at separating litter as a meaningful issue warrants consideration.

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5. CONCLUSIONS AND RECOMMENDATIONS

5.1. SUMMARY AND CONCLUSIONS

This study represents the most comprehensive effort to date to measure the quantity, composition, sources, and costs of litter incurred by public, private, and institutional organizations. This study yielded extensive data that can be the basis for more in-depth analysis. The key findings of the study are as follows:

Quantity

- There are over 51 billion pieces of litter on our nation's roadways, 4.6 billion of which are large items more than four inches in size.
- Based on available data about visible litter on rural interstates and primary roads in 1969, large litter items have decreased 61 percent in the past 40 years.
- The decrease in large litter items since 1969 is reflected in a dramatic reduction in the amount of paper (79 percent), metal (88 percent) and glass (86 percent) litter found on rural interstates and primary roads since 1969, offset, in part by an increase in plastic litter of 165 percent.

Composition

- Tobacco products – predominantly cigarette butts - continue to be the most prevalent litter item, comprising roughly 38 percent of all litter.
- Paper and plastic items make up 22 percent and 19 percent, respectively, of litter. However, excluding the impact of tobacco products, approximately 66 percent of litter consists of paper (35 percent) and plastic (31 percent) material.
- The number of plastic items per mile on rural interstate and primary roads has increased between 114 and 313 percent since the 1969 Study. While paper, glass and metal items have decreased since 1969, the dramatic increase in plastic litter is troubling because more than other materials, plastic has the ability to cause significant harm to marine life.
- Packaging litter is significant. Packaging material comprises 16.9 percent of all litter; two-thirds of which is made of plastic. In addition, packaging comprises 40.7 percent of litter items 4 inches and greater. This is important as items greater than 4 inches are most visible to both pedestrians and passing motorists.
- Beverage Containers comprise 3 percent of all litter. The majority of beverage containers found was either beer (30 percent) or soft drink (25 percent) containers. Beverage container litter has decreased by 74.4 percent since the 1969 Study.

Sources

- As might be expected, the vast majority of litter – 76 percent – appears to originate from motorists and pedestrians.
- Another goal of the 2009 Study was to more accurately determine the actual source of items of litter based on context clues. At the outset of the study, the Project Team, working with KAB, developed and refined this set of rules to use as a guide to help

determine the likely source of litter items on both roadway and non-roadway locations. The rationale for making these determinations may be subject to refinement for future studies.

Roadway Comparison

- Litter density is highest on national and state roads, less so on county and city roads. This is understandable given the relative vehicle density. More litter can be found on county and city roads simply because there are more such roadway miles.
- Litter density is comparable on urban and rural roads.

Direct Costs

- The total direct cost of litter in the U.S. is estimated to be at least 11.5 billion annually. At $9.1 billion, businesses bear the brunt of this cost.
- The true cost of litter remains largely hidden among our governments, institutions, and businesses. Most of the organizations surveyed were not able to compile the full costs, especially among the business community.

Indirect Cost:

- When asked about the effect on property values and business development, litter was uniformly cited as being a notable, negative issue by real estate agents, property appraisers and business development officials.

These key findings suggest the following broad conclusions:

- Litter is a pervasive issue. The true extent of litter is likely obscured because litter clean-ups along our nation's highways have become so commonplace in many jurisdictions. It may become necessary in future studies to consider an analysis of litter accumulation to better understand the role that frequent clean-ups play in minimizing the presence of litter.
- Litter near storm drains can play a major role in the contamination of waterways - especially plastics. Results showed that plastic material was the third most littered item at storm drains accounting for 25 items per 1,000 square feet.
- The cost to clean up litter for all entities is significant. Based on the data gathered during this study, the costs for litter cleanups and educational efforts runs into the billions for diverse entities such as cities, counties, states, businesses, schools and universities. This cost is likely understated as there were entities that this project did not thoroughly address, such as litter cleanups after sports events, concerts and festivals. One entity noted that the cleanup after each sporting event costs $25,000 for each event.
- Many entities have no idea of the costs they incur to clean up litter. As the project team surveyed entities of various types across the U.S., it became clear that most of them had no idea what litter cleanups cost them. This was particularly true for businesses.
- Many entities (e.g. DOT's) depend on volunteers to clean up litter, a trend that will likely grow due to the current economic climate, which has spurred budget cutting for public and private organizations alike. A number of survey respondents noted their dependence on volunteer cleanup crews such as Adopt-a-Highway.

- Litter consists of a matrix of different problems. Some of the more persistent problems observed were: (1) fast food and snack packaging, (2) tobacco products, (3) improperly securing vehicles and (4) solid waste facility policies. Addressing these four key problem areas will likely result in the largest reduction of litter in America.
- The current population growth of about 3.5 million/year will continue to put pressure on litter abatement efforts. The population in the U.S. has grown from about 200 million in 1968 to 305 million in 2008. This represents a growth factor of more than 50 percent in just 40 years. A continuation of this growth rate could result in additional litter along roadways and community areas even if littering on a per capita basis remains constant.

5.2. RECOMMENDATIONS FOR FUTURE STUDY

Improved understanding of litter related issues gained through this study will inform policy makers, political and business leaders, community activists, and the public at large about litter as a critical issue. With these ideas in mind, the following recommendations are suggested for future study.

- **Continue Tracking National Litter Rates**: A key to reducing litter is consistent, measured indicators of the extent of the problem. Policy making and political action are geared towards having a measurable impact. This national study should optimally be repeated every 10 years to provide trend data that can defensibly document changes in litter rates and inform leaders and the public at large.
- **Improve Access to Litter-related Data**: While state-wide litter studies have been performed in multiple states, litter data remains relatively inaccessible and static. In today's electronic age, affiliates could benefit greatly from relevant and useful data to the general public on litter behavior habits and the quantity and types of litter along our nations roadways on KAB's website. The availability of such data would help students, governmental entities, and the public alike understand the true social and economic impact of litter within the United States.
- **Enlist Industry Participation for Litter Cost Research**: This study took a broad-based approach to determining litter costs. Specifically, it surveyed a wide swath of businesses in all industries, based on a national database. Yet, this research demonstrated that litter impacts all businesses differently. Of equal importance, there was a different learning curve to adequately capture the costs of litter with each type and size of business. It would be beneficial to recruit a single large company (e.g., McDonalds) and enlist assistance at the corporate level to study the hard and soft costs of litter throughout the organization. This strategy is appealing for two reasons. First, it starts with a corporate commitment at the top level, which provides greater chance of success. Second, it will provide KAB with a reason to approach a wider range of corporations to explore the problem of litter in a way that may ultimately broaden support.
- **Develop a Cost Effective Litter Study Methodology for Municipal-level "Rapid Litter Assessment":** Although visible litter survey methods are well developed, they are too costly for application at the county or municipal level. Yet, the statistics of litter suggest that it may very well be possible to develop much lower-cost strategies for gauging litter quantities within a single city or county to help politicians and senior managers

understand the extent of litter and determine remediation commitments. A pilot test of a municipal-level litter assessment could identify an alternative, lower-cost strategy.

- **Advanced Sampling Protocol for Non-Roadway Sites:** Visible, volume and weight based litter studies have been conducted on various types of roadways within the United States over the last 30 plus years. To obtain a holistic picture of the amount and cost of litter in the United States, methods should be developed to representatively sample non-roadway locations known to harbor litter. A basic methodology for this could entail field surveying of randomly selected parcels with the goal of measuring (a) the incidence of litter per unit area covered by the parcel, and (b) the range of characteristics (such as number of storm drains, transition points, retail areas, litter and ash receptacles, etc.) contained in the parcel. This idea would require significant effort to expand into a workable study methodology, but the results could significantly improve the understanding of litter on non-roadway sites.

APPENDIX A

Material Types and Definitions

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APPENDIX A – MATERIAL DEFINITIONS

Group	Material	Description
Paper	OCC	Uncoated Corrugated Cardboard usually has three layers. The center wavy layer is sandwiched between the two outer layers. It may have a 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
Paper	Kraft bags	Paper bags and sheets made from Kraft paper. Examples include paper grocery bags, fast food bags, department store bags, and heavyweight sheets of Kraft packing paper.
Paper	Office paper/junk mail	Paper used in offices. Examples include manila folders, manila envelopes, index cards, white envelopes, white window envelopes, white or colored notebook paper, carbonless forms, and junk mail.
Paper	Newspaper/ inserts	Printed groundwood newsprint, including glossy ads, inserts, and Sunday edition magazines that were delivered with the newspaper.
Paper	Magazines/ books	Magazines, catalogs and similar products with glossy paper, as well as paperback and hardback books.
Paper	Advertising/ signs/cards	Glossy or matte cardboard and cardstock used for advertising, signs, and cards. Examples include political yard signs and business advertising signs.
Paper	Receipts	Paper items showing purchases or receipt of items or goods.
Paper	Paper fast-food service items	Paper items used to serve one-time or fast-food service items originating from restaurants, taverns, drive-ins, concessions, the fast-food section of a grocery store, and other such establishments. Examples include paper cups, plates, bowls, wrappings, individual serving condiment packages, cup and beverage holders, napkins or towels, pizza boxes, and paper bags known to be from such establishments.
Paper	Aseptic and gable-top containers	Gable-top containers such as milk cartons and orange juice cartons and aseptic containers, such as for soy milk.
Paper	Beverage carriers and cartons	Paperboard boxes used to hold 6 or more individual soft drinks or beer bottles or cans.
Paper	Paper home food packaging	Low-grade recyclable papers used in food packaging, including chipboard and other solid boxboard (not polycoated) such as for cereal, egg cartons (molded pulp), and other boxes. Also includes ice cream cartons and other frozen food boxes.
Paper	Other Paper	Items made mostly of paper that do not fit into any of the above types and may be combined with minor amounts of other materials such as wax or glues.
Plastic	Soda	Plastic bottle or container of any size (excluding plastic cups) designed to contain soft drinks.

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Group	Material	Description
Plastic	Wine & liquor	Plastic bottles or containers of any size (excluding plastic cups) designed to contain alcoholic beverages, wine, wine coolers, vodka, gin, rum, and liqueurs.
Plastic	Sports & health drinks	Plastic bottle or container of any size (excluding plastic cups) designed to contain sports and health drinks.
Plastic	Juice	Plastic bottle or container of any size (excluding plastic cups) designed to contain juice.
Plastic	Tea	Plastic bottle or container of any size (excluding plastic cups) designed to contain tea.
Plastic	Water	Polyethylene Terephthalate (PET) (#1) plastic bottle or container of any size (excluding plastic cups) designed to contain water.
Plastic	Plastic jugs	Translucent high-density translucent polyethylene (HDPE) (#2) bottles and jars. Examples include milk, juice, beverage, oil, vinegar, and distilled water.
Plastic	Other	Plastic bottle or container of any size (excluding plastic cups) that is not distinguishable by type of beverage.
Plastic	Plastic bags	Plastic trash bags, and plastic grocery, and other merchandise shopping bags used to contain merchandise to transport from the place of purchase, given out by the store with the purchase (including dry cleaning bags). This category includes full bags; bags will not be opened for the study.
Plastic	Food packaging film	Wrappings or bags used to package candy, gum, chips, or other food items.
Plastic	Other film	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.
Plastic	Plastic fast food service items	Plastic items (excluding Styrofoam) used to serve one-time or fast-food service items originating from restaurants, taverns, drive-ins, concessions, the fast-food section of a grocery store, and other such establishments. Examples include plastic cups, lids, straws, utensils, plates, bowls, wrappings, individual serving condiment packages, cup and beverage holders, and plastic bags known to be from such establishments.
Plastic	Expanded polystyrene fast food service items	Polystyrene items used to serve one-time or fast-food service items originating from restaurants, taverns, drive-ins, concessions, the fast-food section of a grocery store, and other such establishments. Examples include Styrofoam platters, plates, bowls, cups, beverage holders, and clamshells.
Plastic	Other expanded polystyrene	Non-food packaging and finished products made of expanded polystyrene. The SPI code for polystyrene (PS) is 6.
Plastic	Other beverage packaging	Plastic 6-pack rings to hold soft drinks or beer cans, pull tabs, bottle caps, lids, and seals, made of plastic, used in the packaging/sealing of beverage containers.

Group	Material	Description
Plastic	Plastic home food packaging	All other non-film packaging that does not fit into the above categories including cookie tray inserts and plastic frozen food trays.
Plastic	Other plastic	Items that are predominantly made of plastic, but are combined with other material, and/or do not fit into the above categories. Includes durable plastic products other than toys, games, and furniture, such as durable water bottles.
Glass	Beer	Glass bottles or containers of any size designed to contain beer or other malt beverages.
Glass	Soda	Glass bottle or container of any size designed to contain soft drinks.
Glass	Water	Glass bottle or container of any size designed to contain water.
Glass	Wine & liquor	Glass bottle or container of any size designed to contain alcoholic beverages, wine, wine coolers, vodka, gin, rum, and liqueurs.
Glass	Sports & health drinks	Glass bottle or container of any size designed to contain sports and health drinks.
Glass	Juice	Glass bottle or container of any size designed to contain juice.
Glass	Tea	Glass bottle or container of any size designed to contain tea.
Glass	Other Container	Glass bottle or container of any size that is not distinguishable by type of beverage.
Glass	Broken glass or ceramic	Broken glass pieces and ceramic products that do not fit into another category. Examples include broken glass beverage bottles, ceramic dishware, porcelain, china, garden pottery, and used toilets and sinks. Does not include automotive window glass.
Glass	Other glass	Items that are predominantly made of glass, but are combined with other material, and/or do not fit into the above categories. Does not include automotive window glass.
Metal	Beer	Aluminum cans of any size designed to contain beer or other malt beverages.
Metal	Soda	Aluminum cans of any size designed to contain soft drinks.
Metal	Sports & health drinks	Aluminum cans of any size designed to contain sports and health drinks.
Metal	Juice	Aluminum cans of any size designed to contain juice.
Metal	Tea	Aluminum cans of any size designed to contain tea.
Metal	Other	Metal bottle or container of any size that is not distinguishable by type of beverage.
Metal	Other beverage packaging	Pull tabs, bottle caps, lids, and seals, made of metal, used in the packaging/sealing of beverage containers.
Metal	Metal home food packaging	Includes steel/tin cans made mainly of steel, such as canned food containers, bimetal containers with steel sides and aluminum ends and aluminum foil.
Metal	Other metal	Products made entirely from metal or predominantly metal products. Includes ferrous metal (iron or steel) that is magnetic or any stainless steel item, such as metal clothes hangers, metal pipes, small appliances comprised mainly of metal, and scrap ferrous items.

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Group	Material	Description
Organic	Human waste (trucker bottles & diapers)	Containers of any size or shape that contain human feces or urine. Examples include disposable baby diapers, protective undergarments for adults, and plastic beverage bottles filled with urine.
Other	Other hazardous (includes medical, vehicle fluids, paint)	Latex water-based paints, oil-based paints (including varnishes and stains), motor oil and other vehicle fluids, and medical wastes (needles, syringes, I.V. tubing, medications, ointments, creams, etc. used to heal persons or animals, but does not include their packaging unless negligible by weight).
Other	Vehicle debris and packaging	Vehicle hubcaps, tailpipes, tires of all types (including bicycle tires), and tire rims if attached. Car, motorcycle, and other lead-acid batteries used for motorized vehicles. HDPE motor oil bottles. Molding, exterior light covers, rearview mirrors, lights, or window glass known to be from an automobile or other motorized vehicle. Special waste that cannot be put in any other type including asbestos-containing materials such as certain types of auto fluff, auto-bodies, trucks, trailers, and truck cabs.
Other	Construction material and debris	Construction and demolition includes rocks and brick, concrete, soil, fines, dirt, non-distinct fines, gypsum board, fiberglass insulation, other fiberglass, roofing waste, asphalt paving, asphalt roofing, lumber (non-treated), treated wood waste, pallets, and other C&D materials that did not fit into one of the above categories.
Other	Textiles/Rugs (includes bathroom rugs)	Items made of thread, yarn, fabric, or cloth. Examples include clothes, fabric trimmings, draperies, and bathroom rugs (flooring applications consisting of various natural or synthetic fibers bonded to some type of backing material). This type does not include cloth-covered furniture, mattresses, or leather.
Other	Bulky items (furniture, mattresses, appliances, area rugs)	Mixed material furniture, mattresses, box springs, appliances, refrigerators, and area rugs (flooring applications consisting of various natural or synthetic fibers bonded to some type of backing material).
Other	Confection	Any type of candy, chocolate, gum or other sweet preparation containing sugar or artificial sweetener as its principal ingredient.
Tobacco	Cigarette butts	The discarded ends, pieces or filters of fully or partially smoked cigarettes.
Tobacco	Cigar tips	The discarded ends, pieces or plastic filters of fully or partially smoked cigars.
Tobacco	Other Tobacco-related Products and Packaging	All other tobacco-related products other than discarded cigarette ends (butts). This includes unsmoked cigarettes, cigars, chewing tobacco, pipe tobacco, matches, matchbooks and packaging for tobacco products such as paper boxes, plastic or foil wrappings, or other materials used to package cigarettes, cigars, chewing or pipe tobacco, including individual cigarette packages and unused cigarette papers. Spent smokeless tobacco is included.
Other	Toiletries/drug bottles/ personal hygiene products	Bottles and containers of health care products such as cosmetics, shampoo, hair care styling products, lotion, personal hygiene products, make-up sponges, gloves, and condoms. Drug bottles include containers for vitamins, over the counter medicines, and prescription drugs.

Group	Material	Description
Other	Entertainment items	Games, music cassettes, CDs, golf balls, Frisbees, small cars, and other toys.
Organic	Food	Any item of food, excluding packaging.
Other	Other items	Any other material not otherwise described.

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APPENDIX B

Visible Litter Survey Field Form

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VLS & Sources Field Log

Site#	ID #	Weather [1]	Walk: Direction Facing	Street or Highway Name	Meander Distance (pa/ft)	Sub-Sort Distance (pa/ft)	Site/Source Location From: (Starting Point) To: (End Point)	GPS Coord.	Mowing Notes[2]	Median[3]	County City/Parish/Town	Roadway AAH, etc.	KAB Y/N Index Num.[4]
1													
2													
3													
4													
5													
6													
7													
8													

Day of Week:

Date:

Daily Start Time:

Daily End Time:

Additional Notes about the sites:

[1] S = Sunny; PC = Partly Cloundy; C = Cloudy; R = Rain; W = Wind

[2] "M" = Recently Mowed

[3] M1

[4] KAB Litter Index Number: 1 = No Litter; 2 = Slightly Littered; 3 = Littered; 4 = Extremely Littered

KAB Nationwide Litter Survey: Roadways Only Litter Tally Sheet (SUB SAMPLE)

Site #:	ID #:	City, State:	Dimensions of site: _____ ft x _____ ft (attempt 15' x 15')
Site Notes:			State of the area: 1 (poorly maint.) 2 3 4 5 (well-maint.)

Additional Site Notes:

Material Category	Material Type	Pedestrians	Motorists	Unsecured/ Overflowing Containers	Unsecured Loads	Vehicle Debris	Unknown
Paper Items	OCC						
	Kraft bags						
	Office paper/junk mail						
	Newspaper/inserts						
	Magazines/books						
	Advertising/signs/cards						
	Receipts						
	Paper fast-food serv. Items						
	Aseptic/gable-top containers						
	Beverage carriers/cartons						
	Paper home food packaging						
	Other Paper						
Plastic Beverage Containers	Soda						
	Wine & liquor						
	Sports & health drinks						
	Juice						
	Tea						
	Water						
	Plastic jugs						
	Other						
	Other beverage packaging						
Other Plastic Items	Plastic bags						
	Food packaging film						
	Other film						

KAB Nationwide Litter Survey: Roadways Only Litter Tally Sheet (SUB SAMPLE)

Site #:	ID #:		City, State:				
Material Category	Material Type	Pedestrians	Motorists	Unsecured/ Overflowing Containers	Unsecured Loads	Vehicle Debris	Unknown
Other Plastic Items	Plastic fast food serv. items						
	EPS fast food service items						
	Other exp. polystyrene						
	Plastic home food packaging						
	Other plastic						
Glass Beverage Containers	Beer						
	Soda						
	Water						
	Wine & liquor						
	Sports & health drinks						
	Juice						
	Tea						
	Other						
Other Glass Items	Broken glass or ceramic						
	Other glass						
Metal Beverage Containers	Beer						
	Soda						
	Sports & health drinks						
	Juice						
	Tea						
	Other						
Other Metal Items	Other beverage packaging						
	Metal home food packaging						
	Other metal and foil pkts						
Household Waste	Human waste						
	Food Waste						
	Other hazardous						
Other Items	CIGARETTE Butts						
	Construction debris						
	Vehicle debris						
	Road Debris						
	Gum						
	Bulky items						
	CIGAR Butts						
	All Other Tobacco-Related Products & Packaging						
	Textiles/Small Rugs						
	Toiletries/drug bottles/pers.hyg. products						
	Entertainment items						
	Other items						

KAB Nationwide Litter Survey: Roadways Only Litter Tally Sheet (FULL SAMPLE)

Site #:	ID #:	City, State:	Dimensions of site: _____ ft x _____ ft (attempt 300' x 15')
Site Notes:			State of the area: 1 (poorly maint.) 2 3 4 5 (well-maint.)

Sampling Area — Roadways: (Circle one) Urban interstate / Rural interstate / Urban state roads / Rural state roads / Urban county Roads / Rural county roads / Urban city roads / Rural city roads

Check all found on or within 1 block of site:

[ ] Residential [ ] Conv. Stores # _____ [ ] Fast food # _____ [ ] Other comm. [ ] Loading docks

[ ] Litter Receptacles # _____ [ ] Public Areas - _____ [ ] Beautification: _____

Additional Site Notes:

Material Category	Material Type	Pedestrians	Motorists	Unsecured/ Overflowing Containers	Unsecured Loads	Vehicle Debris	Unknown
Paper Items	OCC						
	Kraft bags						
	Office paper/junk mail						
	Newspaper/inserts						
	Magazines/books						
	Advertising/signs/cards						
	Receipts						
	Paper fast-food serv. Items						
	Aseptic/gable-top containers						
	Beverage carriers/cartons						
	Paper home food packaging						
	Other Paper						
Plastic Beverage Containers	Soda						
	Wine & liquor						
	Sports & health drinks						
	Juice						
	Tea						
	Water						
	Plastic jugs						
	Other						
	Other beverage packaging						
Other Plastic Items	Plastic bags						
	Food packaging film						
	Other film						

KAB Nationwide Litter Survey: Roadways Only Litter Tally Sheet (FULL SAMPLE)

Site #:	ID #:		City, State:				
Material Category	Material Type	Pedestrians	Motorists	Unsecured/ Overflowing Containers	Unsecured Loads	Vehicle Debris	Unknown
Other Plastic Items	Plastic fast food serv. items						
	EPS fast food service items						
	Other exp. polystyrene						
	Plastic home food packaging						
	Other plastic						
Glass Beverage Containers	Beer						
	Soda						
	Water						
	Wine & liquor						
	Sports & health drinks						
	Juice						
	Tea						
	Other						
Other Glass Items	Broken glass or ceramic						
	Other glass						
Metal Beverage Containers	Beer						
	Soda						
	Sports & health drinks						
	Juice						
	Tea						
	Other						
Other Metal Items	Other beverage packaging						
	Metal home food packaging						
	Other metal and foil pkts						
Household Waste	Human waste						
	Food Waste						
	Other hazardous						
Other Items	Construction debris						
	Vehicle debris						
	Road Debris						
	Bulky items						
	CIGAR Butts						
	All Other Tobacco-Related						
	Textiles/Small Rugs						
	Toiletries/drug bottles/pers.hyg. products						
	Entertainment items						
	Other items						

APPENDIX C

Rules for Determining Sources of Litter

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APPENDIX C – DETERMINING SOURCES OF LITTER

This appendix summarizes the logical considerations that were applied to attempt to determine the sources of litter by field data collection personnel.

It should be noted that field data collection personnel for this project were MSW Consultants professional staff with significant prior experience in the fields of litter, solid waste, and/or recycling. In addition to being provided with written field data collection instructions that included the list of rules in this appendix, these staff underwent a full day training session to observe and collectively discuss approaches to determining the source of litter. Based on the professional experience of the field data collection staff, and based on the intent of this research effort, the management decision was made for field staff to make an aggressive attempt to assign each item of litter to a source. It is acknowledged that attempting to aggressively assign litter to sources has almost certainly introduced some potential for error into the results. However, the alternative to aggressively determining sources would be to have a large fraction of litter items categorized as having an "unknown" source. Ultimately, it was decided that a large percentage of litter items being classified as "unknown" would be uninformative, and so discretion was given to field data collectors to use their judgment.

Broadly speaking, the determination of the source of litter at each roadway and non-roadway sampling site was based first and foremost on obvious characteristics in the immediate surroundings, and on the type of litter item. Some obvious indicators that factored into the determination included identification of litter or trash receptacles nearby, certain types of commercial establishments in the vicinity, observations of the mix of vehicle traffic on the roadway, and an assessment of "what part of town" was the selected site located in. Further, certain litter items could always be assumed to be from a particular source, such as cigarette butts on an interstate road – these would almost certainly always be attributed to motorists flicking them out their vehicle windows.

In the planning stages of this project, MSW Consultants staff and KAB also spent time in the field working through the determination of litter sources. This process resulted in a compilation of more nuanced context clues that further informed the field data collectors in the efforts to determine sources.

The long table in this appendix contains the list of context clues that were considered, along with the basic observations about each sample site. This list of clues is not intended to be comprehensive, but rather meant to provide examples of how to reason through the most likely litter source for various litter items. Others attempting to perform a similar study to determine the sources may have different interpretations, or may not choose to apply these rationales as aggressively as was performed in this project.

Source	Material Category	Material Type	Rule for Determining Source for Litter
Pedestrians	Paper Items	OCC	*not likely to be from pedestrians*
		Kraft bags	*not compacted, holding beverage or other items*

APPENDIX C

Source	Material Category	Material Type	Rule for Determining Source for Litter
		Paper fast-food service items	*several items near each other*
		Beverage carriers and cartons	*with beverage containers*
		Paper home food packaging	*not likely*
	Plastic items	Other film	*not likely*
		Plastic fast food service items	*several items near each other*
		Expanded polystyrene fast food service items	*several items near each other*
		Other expanded polystyrene	*not likely to be from pedestrians*
	Plastic Beverage Containers	Water	*intact*
	Glass Beverage Containers	Beer	*intact, in a six-pack ring or carton*
	Metal Beverage Containers	Beer	*intact, in a six-pack ring or carton*
	Household Waste	Human waste (trucker bottles & diapers)	*N/A*
	Other Items	Vehicle debris and packaging	N/A
		Construction material and debris	near construction sites
		Bulky items (furniture, mattresses, appliances, area rugs)	not likely
		Cigarette packs, matches, cigars, tobacco	most likely
		Toiletries/drug bottles/personal hygiene products	less likely
		Entertainment items	small toys likely here
		Other items	depends on sample area and material
Motorists	Paper items	OCC	smaller but not likely
		Kraft bags	not compacted, holding beverage or other item
		Office paper/junk mail	crumpled receipts, alone
		Paper fast food service items	several items near each other
		Paper home food packaging	not likely
		Other paper	depends on sample area and material
	Plastic items	Plastic bags	loose/empty
		Other film	N/A

Source	Material Category	Material Type	Rule for Determining Source for Litter
		Plastic fast food service items	several items near each other
		Expanded polystyrene fast food service items	several items near each other
		Other expanded polystyrene	N/A
	Plastic Beverage Containers	Water	intact
	Glass Beverage Containers	Beer	shattered but still together
	Metal Beverage Containers	Beer	intact or crushed
	Other Items	Vehicle debris and packaging	N/A
		Construction material and debris	not likely
		Bulky items (furniture, mattresses, appliances, area rugs)	most likely
		Cigarette packs, matches, cigars, tobacco	most likely
		Toiletries/drug bottles/personal hygiene products	less likely
		Entertainment items	likely
		Other items	depends on sample area and material
Unsecured/ Overflowing Containers	Paper items	Kraft bags	dirty, next to container
		Newspaper/inserts	next to container
	Plastic items	Plastic bags	next to container
		Other film	N/A
		Other expanded polystyrene	next to container
	Plastic Beverage Containers	Water	next to container
	Glass Beverage Containers	Beer	next to container
	Household Waste	Human waste (trucker bottles & diapers)	N/A
	Other Items	Vehicle debris and packaging	N/A
		Construction material and debris	near construction sites
		Bulky items (furniture, mattresses, appliances, area rugs)	next to container
		Cigarette packs, matches, cigars, tobacco	unlikely

Source	Material Category	Material Type	Rule for Determining Source for Litter
		Other items	depends on sample area and material
Unsecured Loads	Paper Items	OCC	compacted, dirty
		Kraft bags	dirty, crumpled
		Office paper/junk mail	dirty, office paper here
		Paper fast food service items	crushed, dirty
		Beverage carriers and cartons	dirty, crushed
		Paper home food packaging	almost always from unsecured loads
	Plastic Items	Plastic bags	dirty, crushed
		Plastic fast food service items	crushed, dirty
		Expanded polystyrene fast food service items	crushed, dirty
		Other expanded polystyrene	likely
	Plastic Beverage Containers	Water	crushed, slightly crushed, dirty
	Glass Items	Broken glass or ceramic	Likely
	Metal Beverage Containers	Beer	compacted
	Household Waste	Human waste (trucker bottles & diapers)	N/A
	Other Items	Vehicle debris and packaging	N/A
		Construction material and debris	likely
		Bulky items (furniture, mattresses, appliances, area rugs)	likely
		Cigarette packs, matches, cigars, tobacco	unlikely
		Toiletries/drug bottles/personal hygiene products	most likely
		Entertainment items	likely
		Other items	depends on sample area and material

APPENDIX D

Roadway Sampling Sites

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Appendix D
Roadway Sampling Sites

#	Latitude	Longitude	Physical Address (if applicable)	City	State
1	33.084880	-87.559550		Tuscaloosa	AL
2	33.159750	-87.533170		Tuscaloosa	AL
3	33.199660	-87.506070		Tuscaloosa	AL
4	33.194300	-87.597950		Tuscaloosa	AL
5	33.422700	-94.030110	4571 East Street (after bridge)	Texarkana	AR
6	33.430730	-94.012570	US HWY 82 & N. Oats St	Texarkana	AR
7	33.474060	-93.924760	SR 296 Dooley Ferry Road near County Road 25	Texarkana	AR
8	33.524000	-93.970610	State Road 108	Texarkana	AR
9	33.417920	-93.908670	Meadows Road	Texarkana	AR
10	31.467317	-110.274217	E Ramsey Canyon	Sierra Vista	AZ
11	32.129950	-110.882167	I-10	Sierra Vista	AZ
12	37.752667	-122.209200	Oakport St	Oakland	CA
13	37.797517	-122.264933	Oak Street	Oakland	CA
14	37.807900	-122.270133	Telegraph Ave	Oakland	CA
15	46.183550	-122.259450	Alcatraz Ave	Oakland	CA
16	37.745200	-122.261500	Doolittle St	Oakland	CA
17	37.759550	-122.212700	Hwy 880	Oakland	CA
18	37.874983	-122.305917	Hwy 80	Oakland	CA
19	37.881433	-122.248967	Olympus Ave	Oakland	CA
20	37.854050	-122.285383	Matthews St	Oakland	CA
21	40.602770	-105.076740	N College Ave	Fort Collins	CO
22	40.601441	-105.115127	N Taft Road	Fort Collins	CO
23	40.664933	-105.197483		Fort Collins	CO
24	40.573317	-105.076583	N College Ave	Fort Collins	CO
25	41.801390	-72.815950		Avon	CT
26	41.815890	-72.865660		Avon	CT
27	41.746610	-72.827960		Farmington	CT
28	28.056910	-82.531900	Gunn HWY & Nixon Rd	Tampa Bay	FL
29	28.026260	-82.579900	Waters & River Oaks	Tampa Bay	FL
30	27.998700	-82.583600	Sheldon & Memorial HWY	Tampa Bay	FL
31	28.025220	-82.463500	W Waters & Nola Ave	Tampa Bay	FL
32	28.039550	-82.467400	Linebaugh & N. Boulevard	Tampa Bay	FL
33	28.080500	-82.432500	Bears Ave	Tampa Bay	FL
34	28.031450	-82.415900	140th & E Humphrey St	Tampa Bay	FL
35	27.921940	-82.517720	Manhattan Ave & W. Bacelona	Tampa Bay	FL
36	27.871260	-82.506190	S. Dale Mabry HWY & County Road 573	Tampa Bay	FL
37	27.922750	-82.340800	Causeway Blvd E	Tampa Bay	FL
38	27.868270	-82.343390	Riverview & Dean	Tampa Bay	FL
39	27.877560	-82.331670	Kankakee	Tampa Bay	FL
40	27.831630	-82.350500	I-75 South	Tampa Bay	FL
41	27.916440	-82.401700	HWY 41S & 36th Ave	Tampa Bay	FL
42	27.959900	-82.295820	Windforest Rd & Terrace View Dr	Tampa Bay	FL
43	27.955580	-82.435800	21st Street & Adomo Dr	Tampa Bay	FL
44	34.233230	-85.159860		Rome	GA
45	34.218310	-85.127700		Rome	GA
46	34.268590	-85.171740	Rivermont Drive	Rome	GA
47	34.265160	-85.148040		Rome	GA
48	34.305700	-85.103530	Calhoun Rd (GA State Road 53)	Rome	GA
49	34.272030	-85.236190		Rome	GA
50	34.980920	-85.244510	Corner of Page Road & Kelsey Road	Rome	GA
51	34.976980	-85.265030		Rome	GA

#	Latitude	Longitude	Physical Address (if applicable)	City	State
52	34.984220	-85.177170	Magnolia Street	Rome	GA
53	41.972500	-93.570400		Ames	IA
54	42.048560	-93.815590		Boone	IA
55	42.550083	-114.451400	2nd Ave & Sycamore	Twin Falls	ID
56	42.563667	-114.546333	Highway 30	Twin Falls	ID
57	42.548033	-114.358650	State 50 E	Twin Falls	ID
58	42.571967	-114.296183	State 50 E	Twin Falls	ID
59	42.641933	-114.438367	I-84 @ 93	Twin Falls	ID
60	42.635017	-114.499217	State 79	Twin Falls	ID
61	42.681533	-114.518200	Golf Course Rd & 300	Twin Falls	ID
62	41.826520	-87.794850		Berwyn	IL
63	41.884450	-87.614360		Chicago	IL
64	41.891910	-87.613110		Chicago	IL
65	41.890620	-87.611350		Chicago	IL
66	41.866240	-87.614270		Chicago	IL
67	41.888320	-87.614190		Chicago	IL
68	41.883410	-87.789770		Oak Park	IL
69	41.685340	-87.871930		Palos Park	IL
70	41.908740	-87.808580		River Forest	IL
71	41.652230	-86.060870		Elkhart	IN
72	41.751020	-86.133840		Granger	IN
73	41.753080	-86.060870		Granger	IN
74	41.754250	-86.125420		Granger	IN
75	41.661000	-86.215070		Mishawaka	IN
76	41.680070	-86.187120		Mishawaka	IN
77	41.640850	-86.392380		N.Liberty	IN
78	41.665260	-86.237000		South Bend	IN
79	41.630250	-86.280230		South Bend	IN
80	37.606640	-97.201130		Kechi	KS
81	37.780870	-97.464050		Maize	KS
82	38.198800	-85.859540	SS16 Campground Rd (SR2051)	Luisville	KY
83	38.149430	-85.693110	SR61	Luisville	KY
84	38.313340	-85.565570	Brownsboro Road (SR22)	Luisville	KY
85	32.464860	-93.756090	I-495	Sherevport	LA
86	32.536490	-93.769530	Corner of Jewella & Judson Street	Sherevport	LA
87	32.536490	-93.769530	HWY 715 & N. Hearn St.	Sherevport	LA
88	32.580390	-93.812690	Pine Hill Road near McDaniel Drive	Sherevport	LA
89	32.491480	-93.724760	Youree Drive & E. College	Sherevport	LA
90	42.354540	-73.280820		Lenox	MA
91	42.351030	-73.280940		Lenox	MA
92	42.732780	-73.195780		Williamsport	MA
93	42.733390	-73.193150		Williamstown	MA
94	42.734400	-73.201850		Williamstown	MA
95	42.734570	-73.204390		Williamstown	MA
96	39.521210	-77.668330		Boonsboro	MD
97	39.670680	-77.915990		Clear Springs	MD
98	39.605900	-77.745200		Hagerstown	MD
99	39.430670	-77.743220		Sharpsburg	MD
100	44.815340	-68.929420		Banger	ME
101	42.271680	-85.151440		Battle Creek	MI
102	42.274060	-85.080980		Battle Creek	MI
103	42.314280	-85.180700		Battle Creek	MI
104	42.299210	-85.085440		Battle Creek	MI
105	42.297370	-85.257700		Battle Creek	MI

#	Latitude	Longitude	Physical Address (if applicable)	City	State
106	42.325110	-85.140380		Battle Creek	MI
107	42.332290	-85.139340		Battle Creek	MI
108	42.281200	-85.156500		Battle Creek	MI
109	42.301300	-85.189470		Battle Creek	MI
110	42.298250	-85.189980		Battle Creek	MI
111	45.589860	-94.340330		Avon	MN
112	45.589100	-93.961360		Foley	MN
113	45.499350	-94.281680		Pleasant Lake	MN
114	45.518450	-94.132730		St Cloud	MN
115	45.517260	-94.163260		St Cloud	MN
116	45.500830	-94.195440		St Cloud	MN
117	45.498430	-94.240130		St Cloud	MN
118	45.559110	-94.157180		St Cloud	MN
119	45.498970	-94.122310		St Cloud	MN
120	45.572200	-94.144250		St Cloud	MN
121	39.108640	-94.567430		Kansas City	MO
122	39.104480	-94.606820		Kansas City	MO
123	38.996360	-94.503180		Kansas City	MO
124	39.118520	-94.580600		Kansas City	MO
125	39.145760	-94.417250		Sugar Creek	MO
126	32.383520	-88.724650	US Highway N 11	Meridian	MS
127	32.383520	-88.699480		Meridian	MS
128	45.773317	-108.513800	2nd Ave	Billings	MT
129	45.741600	-108.584083	Hwy 90 W	Billings	MT
130	45.801617	-108.413700	Johnson Ln & Ford St	Billings	MT
131	35.088270	-80.826440	5919 Woodleigh Oaks	Charlotte	NC
132	35.196840	-80.933740	West Paul Bosewn Rd (Hmy 160)	Charlotte	NC
133	35.216310	-80.772600	West Blvd	Charlotte	NC
134	35.216710	-80.892930	Tyrons & Winona	Charlotte	NC
135	35.245600	-80.892930	Freedom Dr. & Ashleu	Charlotte	NC
136	35.254820	-80.983210	Mt Holly Rd & Spring Hill Rd (I-85)	Charlotte	NC
137	35.287680	-80.962120	Mt Holly Rd & Spring Hill Rd	Charlotte	NC
138	35.309480	-80.925720	Brookshire & Pleasant Gr.	Charlotte	NC
139	35.342600	-80.824470	Old Statesville SR115	Charlotte	NC
140	46.826333	-100.716667	Hwy 94	Bismarck	ND
141	46.835333	-100.570333	Hwy 94	Bismarck	ND
142	46.838167	-100.670000	80th St (gravel road)	Bismarck	ND
143	46.806667	-100.670833	W Bristol	Bismarck	ND
144	46.790000	-100.709667	Old Hwy 10 (Old Apple Creek)	Bismarck	ND
145	40.710370	-96.558790		Bennet	NE
146	40.799880	-96.706900		Lincoln	NE
147	40.857240	-96.651360		Lincoln	NE
148	40.868910	-96.624700		Lincoln	NE
149	39.876430	-75.102680	Roosevelt Blvd	Bellmawr	NJ
150	39.951441	-75.112031		Camden	NJ
151	39.911590	-75.058590		Collinwood	NJ
152	39.939100	-75.021910		Mt. Holly Cherry Tree	NJ
153	34.962180	-106.657200	I-25	Albuquerque	NM
154	35.132010	-106.610670	I-25	Albuquerque	NM
155	35.101380	-106.631060	I-25	Albuquerque	NM
156	35.099580	-106.719740	I-40	Albuquerque	NM
157	39.459900	-118.782850	Sheckler	FallonV	NV
158	42.641960	-73.572590		Averill Park	NY
159	42.555290	-73.707880		Castleton	NY

#	Latitude	Longitude	Physical Address (if applicable)	City	State
160	42.547860	-73.671260		Castleton	NY
161	42.594510	-73.855670		Delmar	NY
162	42.598980	-73.688040		East Greenbush	NY
163	42.728340	-73.795590		Latham	NY
164	42.741240	-73.738990		Latham	NY
165	42.705690	-73.644450		Troy	NY
166	42.739360	-73.657550		Troy	NY
167	41.107300	-81.348410		Brimfield	OH
168	41.006960	-81.674900		Norton	OH
169	40.993950	-81.667350		Norton	OH
170	41.175480	-81.462130		Stow	OH
171	36.140260	-96.093790		Sand Spring	OK
172	36.155200	-96.001310		Tulsa	OK
173	45.562433	-122.743967	US 30	Portland	OR
174	45.599550	-122.683850	I-5	Portland	OR
175	45.886917	-122.731150	I-5	Portland	OR
176	39.962220	-75.309270	Us HWY 1& N Edwards	Drexel Hill	PA
177	39.922560	-75.338440		Drexel Hill	PA
178	40.067830	-75.147130	W Cheltenham Ave 19th	Melrose Park	PA
179	40.076510	-75.144160	Spring Ave & Lynnewood	Melrose Park	PA
180	40.069220	-75.145140	Rayrose & Willow Ave	Melrose Park	PA
181	39.962430	-75.183370		Philadelphia	PA
182	39.962430	-75.183370	Roosevelt Blvd 200th Block	Philadelphia	PA
183	39.977380	-75.135580	W Montgomery Ave & Waterloo Street	Philadelphia	PA
184	39.981040	-75.157370		Philadelphia	PA
185	39.999900	-75.153270	Broad Street 611	Philadelphia	PA
186	39.974080	-75.204770	Gilaid Ave, near 41st	Philadelphia	PA
187	39.984070	-75.260550	US HWY 1 & City Ave	Philadelphia	PA
188	39.838920	-75.410700	I 95 S at Exit 322	Ridely Park	PA
189	39.871220	-75.322790		Ridley Park	PA
190	34.992650	-82.031210	2621 New Cut Road	Spartenburg	SC
191	34.960310	-81.986160	Haynes HWY	Spartenburg	SC
192	34.965920	-81.934970	299 Pearl Street	Spartenburg	SC
193	34.908700	-81.959200	Southport Rd	Spartenburg	SC
194	44.364617	-100.358500	Island View Dr	Pierre	SD
195	44.416133	-100.256350	Sage Pl & Redwood	Pierre	SD
196	44.409750	-100.299783	Sussex & Karen	Pierre	SD
197	44.360450	-100.375950	7th & Deadwood	Pierre	SD
198	44.369933	-100.381017	US 14	Pierre	SD
199	44.400667	-100.395033	Hwy 1806	Pierre	SD
200	35.059370	-85.323950		Chattanooga	TN
201	35.099830	-85.327140		Chattanooga	TN
202	35.036720	-85.270900		Chattanooga	TN
203	35.342600	-80.824470	Dodson (Str 17) & Daisy to Taylor Road	Chattanooga	TN
204	35.053370	-85.185950		Chattanooga	TN
205	32.695970	-97.480760	I-20	Fort Worth	TX
206	32.724590	-97.490700	SR-580	Fort Worth	TX
207	32.724490	-97.485330	SR-580	Fort Worth	TX
208	32.766060	-97.474270		Fort Worth	TX
209	32.623310	-97.384490		Fort Worth	TX
210	32.746830	-97.328710	Lancaster & Throckmortogist	Fort Worth	TX
211	32.731320	-97.268570	E. Rosedale &Haynes State Road 303	Fort Worth	TX
212	32.755580	-97.205480	Muse Street Muse turns into Merry	Fort Worth	TX
213	32.716750	-97.267120	Fitzhugh & Donalee St	Fort Worth	TX

#	Latitude	Longitude	Physical Address (if applicable)	City	State
214	32.765290	-97.287830	N. Beach Circle & First St.	Fort Worth	TX
215	32.721660	-97.434560	SR 80 & Lackland Rd	Fort Worth	TX
216	32.627400	-97.394520		Fort Worth	TX
217	32.737870	-97.456690	I30 East	Fort Worth	TX
218	32.741010	-97.440500		Fort Worth	TX
219	32.821740	-97.456960		Fort Worth	TX
220	33.091240	-97.141740		Fort Worth	TX
221	32.543940	-97.211320		Fort Worth	TX
222	32.574570	-97.214540	SR 1187	Fort Worth	TX
223	40.768750	-111.939050	State 68 & S Folsom	Bountiful	UT
224	40.836617	-111.934383	State 68 & N Pointe Circle	Bountiful	UT
225	38.835480	-77.182910		Annandale	VA
226	38.869660	-77.271710	Circle Woods Drive	Fairfax	VA
227	38.870620	-77.269460	St HWY 237at Fauille Dr	Fairfax	VA
228	38.854540	-77.307420	St HWY 123 at Providence Way	Fairfax	VA
229	38.847010	-77.268920		Fairfax	VA
230	42.867120	-73.187340		Bennington	VT
231	42.833490	-73.200150		Bennington	VT
232	47.549890	-122.160850	Lakehurst & 106th Ave SE	Seattle	WA
233	47.522600	-122.160850	Coal Creek Pkwy & 89th Ave	Seattle	WA
234	47.589500	-122.393700	Beach St & W Seattle	Seattle	WA
235	44.719830	-91.526230		Eau Claire	WI
236	44.793110	-91.504440		Eau Claire	WI
237	44.756320	-91.472480		Eau Claire	WI
238	44.785140	-91.635590		Eau Claire	WI
239	39.453750	-77.964920		Martinsburg	WV
240	39.489140	-77.958400		Martinsburg	WV
241	44.276800	-105.468850	Boxelder Rd	Gillette	WY
242	44.292900	-105.493950	Douglas Hwy	Gillette	WY
243	44.290467	-105.361067	I-90 E & Wodak Rd	Gillette	WY

APPENDIX E

Results by Roadway Type

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Combined Large and Small Litter Tables and Figures by Roadway Type

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Summary Data for Urban Roadways - Large + Small Items

Sources of Litter	Pieces	Percent of Total	Urban Total (1,000)
Pedestrians	3,117	40%	6,184,148
Motorists	2,919	37%	5,790,423
Containers	50	1%	98,839
Untarped Loads	1,461	19%	2,899,212
Vehicle Debris	86	1%	170,621
Unknown	151	2%	298,957
Total	**7,784**	**100%**	**15,442,200**

Tobacco-related Litter	
Pieces	2,759
Percent of Total	35%
Urban	**5,474,455**

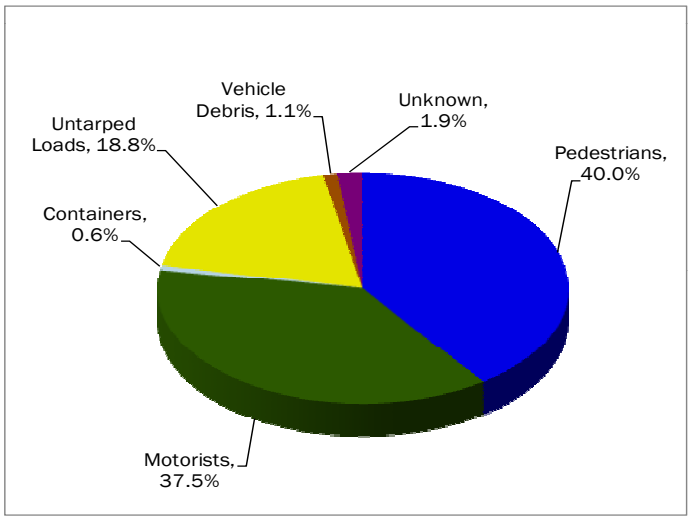
Litter by Material Group	Pieces	Percent of Total	Urban Total (1,000)
Paper	1,627	21%	3,227,060
Plastic	1,364	18%	2,705,625
Glass	435	6%	863,068
Metal	311	4%	616,960
Organic	730	9%	1,448,008
Tobacco Products	2,759	35%	5,474,455
Construction Debris	302	4%	599,941
Vehicle Debris	69	1%	136,349
Other	187	2%	370,734
Total	**7,784**	**100%**	**15,442,200**

Packaging Summary	Pieces	Percent of Total	Percent of Packaging	Urban Total (1,000)
By Material				
Paper	348	4%	27%	690,475
Plastic	796	10%	62%	1,579,250
Other	148	2%	11%	294,215
Subtotal	**1,292**	**17%**	**100%**	**2,563,940**
By Type				
Snack	234	3%	18%	465,210
Fast Food	500	6%	39%	991,225
Home Use	257	3%	20%	509,388
Commercial	301	4%	23%	598,116
Subtotal	**1,292**	**17%**	**100%**	**2,563,940**

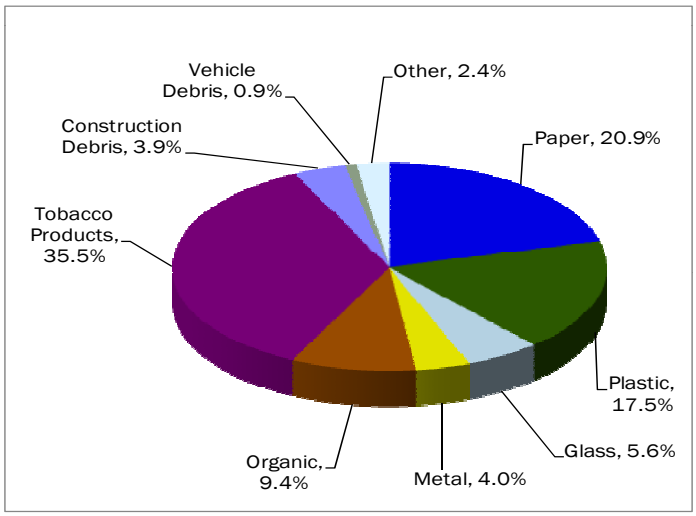
Beverage Container Summary	Pieces	Percent of Total	Percent of Beverage	Urban Total (1,000)
Beer	47	1%	33%	92,831
Soft Drinks	26	0%	18%	50,702
Water	12	0%	9%	24,143
Wine & liquor	3	0%	2%	6,065
Sports & Health Drinks	5	0%	4%	10,156
Juice	2	0%	2%	4,802
Tea	1	0%	1%	1,656
Unrecognizable	46	1%	32%	90,990
Total	**142**	**2%**	**100%**	**281,345**

Summary Data for Urban Roadways - Large + Small Items

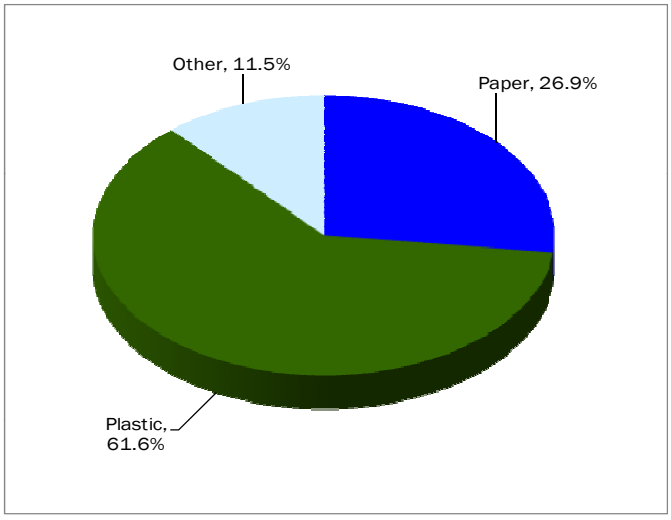
Litter by Source



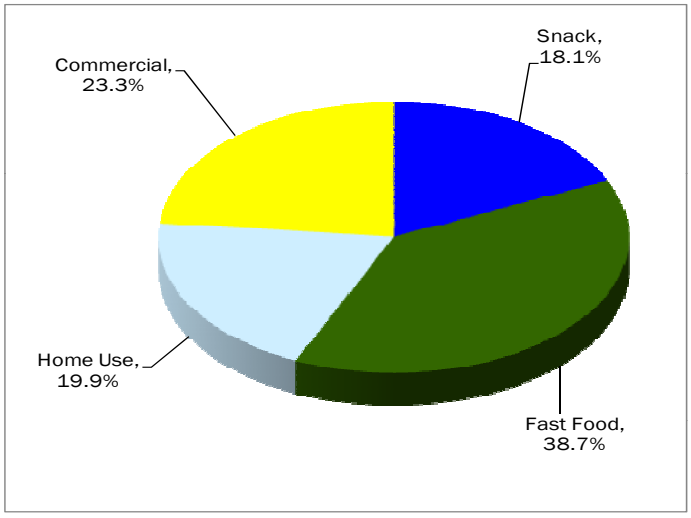
Litter by Material Group



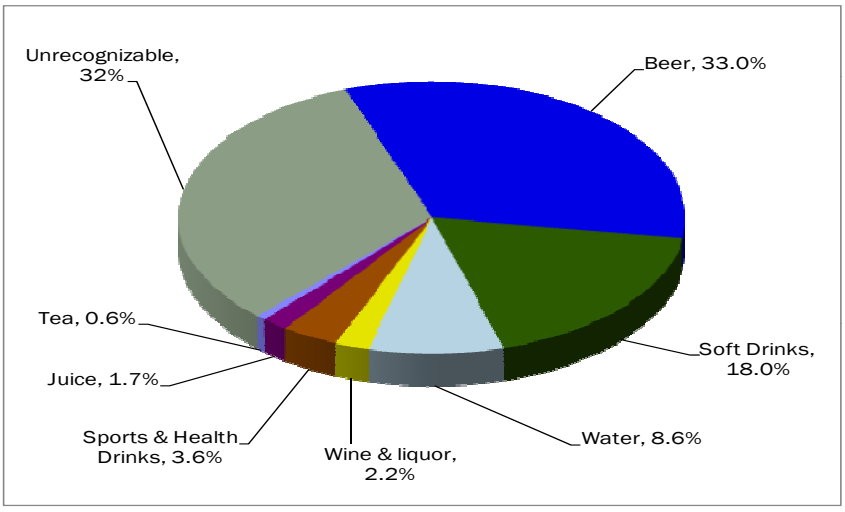
Packaging Summary by Material



Packaging Summary by Type



Beverage Containers



Summary Data for Rural Roadways - Large + Small Items

Sources of Litter	Pieces	Percent of Total	Rural Total (1,000)
Pedestrians	975	15%	5,483,139
Motorists	3,777	59%	21,232,801
Containers	122	2%	687,049
Untarped Loads	981	15%	5,516,419
Vehicle Debris	179	3%	1,006,056
Unknown	322	5%	1,808,226
Total	**6,357**	**100%**	**35,733,690**

Tobacco-related Litter	
Pieces	2,457
Percent of Total	39%
Rural	**13,808,786**

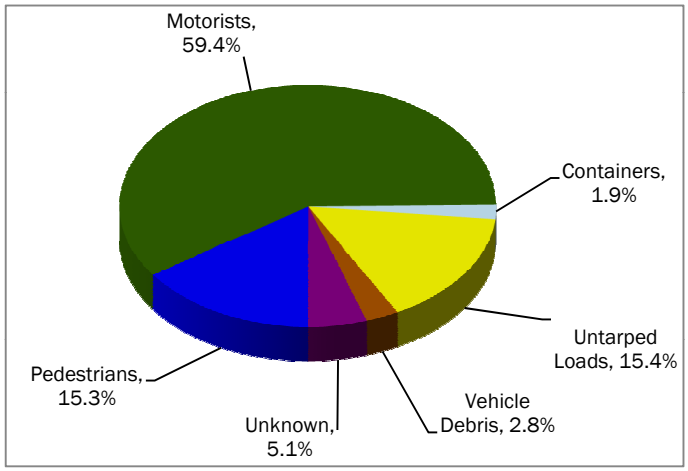
Litter by Material Group	Pieces	Percent of Total	Rural Total (1,000)
Paper	1,418	22%	7,969,547
Plastic	1,274	20%	7,160,946
Glass	260	4%	1,463,327
Metal	417	7%	2,346,176
Organic	128	2%	717,076
Tobacco Products	2,457	39%	13,808,786
Construction Debris	130	2%	730,517
Vehicle Debris	115	2%	646,082
Other	159	2%	891,234
Total	**6,357**	**100%**	**35,733,690**

Packaging Summary	Pieces	Percent of Total	Percent of Packaging	Rural Total (1,000)
By Material				
Paper	261	4%	22%	1,466,719
Plastic	812	13%	69%	4,562,738
Other	112	2%	9%	627,888
Subtotal	**1,184**	**19%**	**100%**	**6,657,345**
By Type				
Snack	84	1%	7%	471,236
Fast Food	302	5%	25%	1,696,696
Home Use	355	6%	30%	1,996,695
Commercial	443	7%	37%	2,492,718
Subtotal	**1,184**	**19%**	**100%**	**6,657,345**

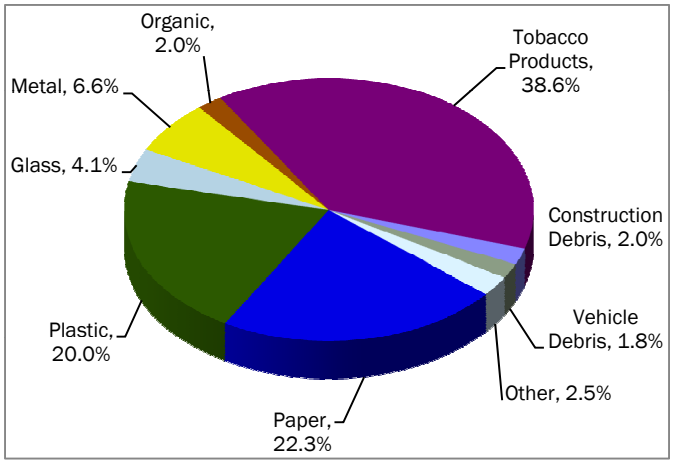
Beverage Container Summary	Pieces	Percent of Total	Percent of Beverage	Rural Total (1,000)
Beer	57	1%	30%	321,930
Soft Drinks	51	1%	26%	284,003
Water	10	0%	5%	56,479
Wine & liquor	4	0%	2%	24,811
Sports & health drinks	6	0%	3%	31,604
Juice	2	0%	1%	13,675
Tea	1	0%	1%	6,598
Unrecognized	61	1%	32%	341,633
Total	**192**	**3%**	**100%**	**1,080,734**

Summary Data for Rural Roadways - Large + Small Items

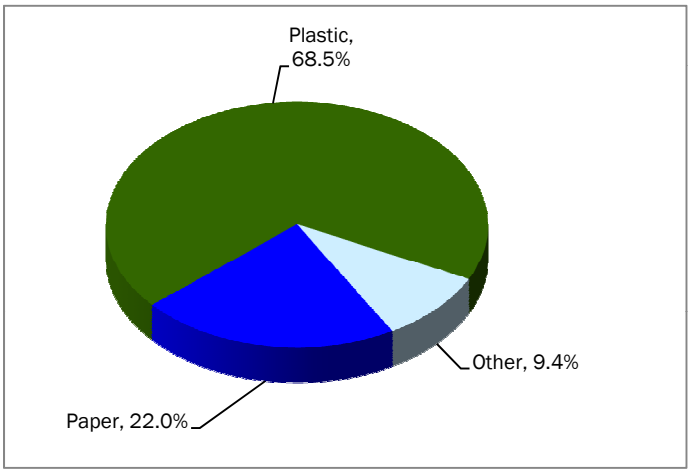
Litter by Source



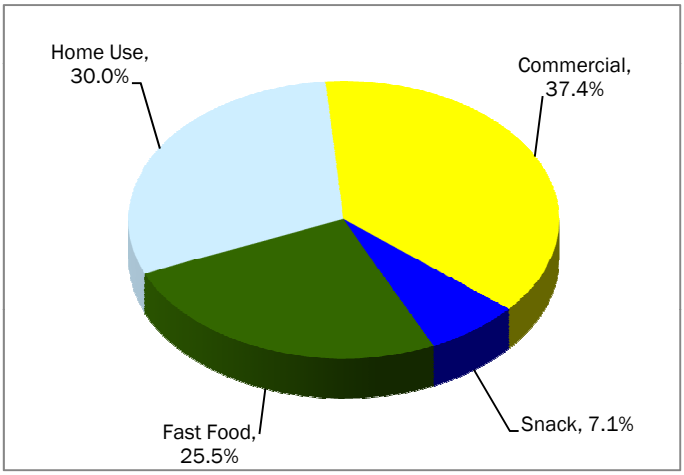
Litter by Material Group



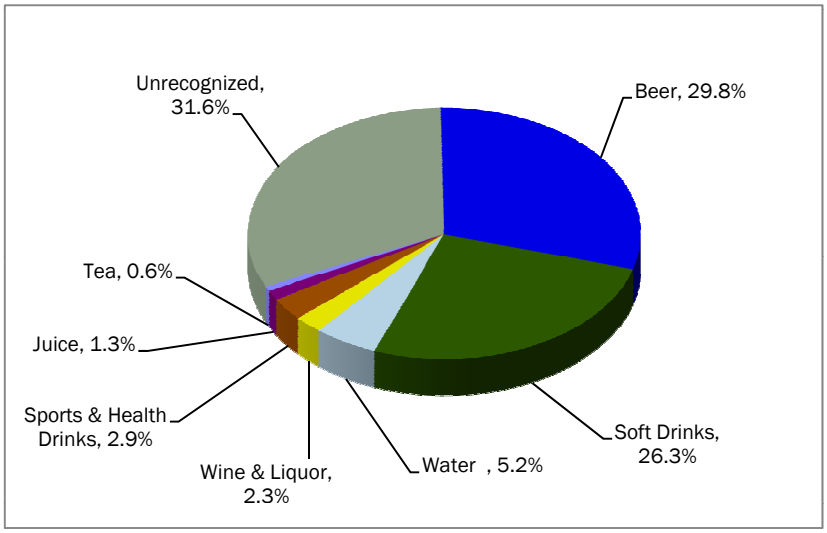
Summary of Packaging by Material



Summary of Packaging by Type



Beverage Containers



Summary Data for National Roadways - Large + Small Items

Sources of Litter	Pieces	Percent of Total	National Total (1,000)
Pedestrians	859	4%	80,076
Motorists	13,691	71%	1,276,261
Containers	82	0.4%	7,623
Untarped Loads	2,820	15%	262,862
Vehicle Debris	1,581	8%	147,368
Unknown	153	1%	14,248
Total	**19,186**	**100%**	**1,788,438**

Tobacco-related Litter	
Pieces	9,084
Percent of Total	47%
National	**846,768**

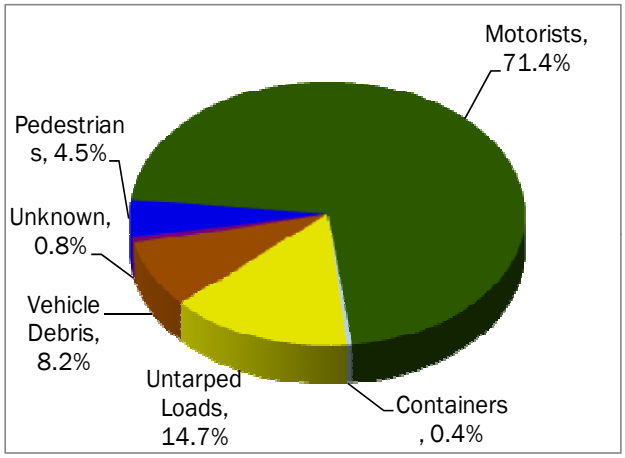
Litter by Material Group	Pieces	Percent of Total	National Total (1,000)
Paper	2,396	12%	223,340
Plastic	3,158	16%	294,404
Glass	804	4%	74,992
Metal	1,041	5%	97,009
Organic	106	1%	9,905
Tobacco	9,084	47%	846,768
Construction Debris	724	4%	67,462
Vehicle Debris	1,529	8%	142,517
Other	344	2%	32,043
Total	**19,186**	**100%**	**1,788,438**

Packaging Summary	Pieces	Percent of Total	Percent of Packaging	National Total (1,000)
By Material				
Paper	580	3%	22%	54,063
Plastic	1,868	10%	70%	174,161
Other	215	1%	8%	20,011
Subtotal	**2,663**	**14%**	**100%**	**248,235**
By Type				
Snack	209	1%	8%	19,514
Fast Food	752	4%	28%	70,123
Home Use	571	3%	21%	53,200
Commercial	1,131	6%	42%	105,398
Subtotal	**2,663**	**14%**	**100%**	**248,235**

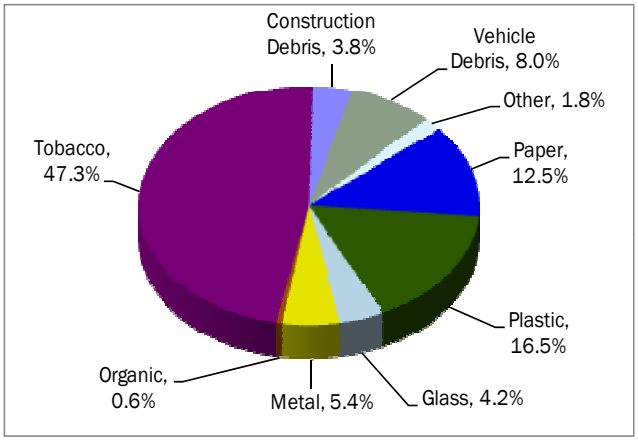
Beverage Container Summary	Pieces	Percent of Total	Percent of Beverage	National Total (1,000)
Beer	159	1%	41%	14,835
Soft Drinks	46	0%	12%	4,271
Water	19	0%	5%	1,762
Wine & liquor	3	0%	1%	301
Sports & health drinks	19	0%	5%	1,750
Juice	1	0%	0.3%	111
Tea	1	0%	0.3%	102
Unrecognizable	143	1%	37%	13,367
Total	**392**	**2%**	**100%**	**36,498**

Summary Data for National Roadways - Large + Small Items

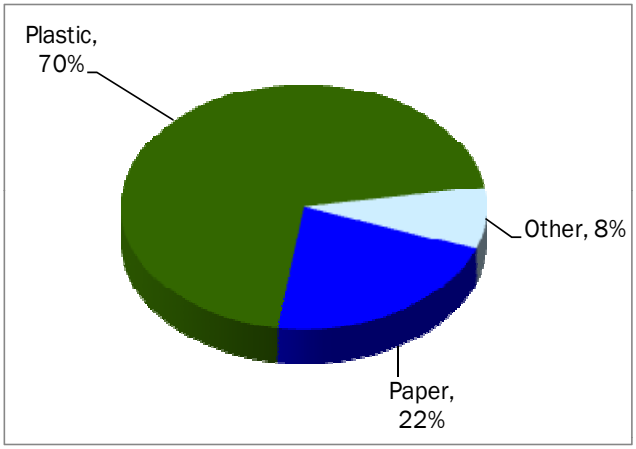
Litter by Source



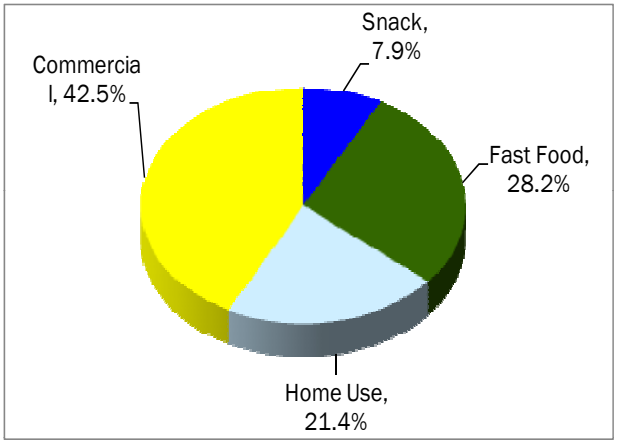
Litter by Material Group



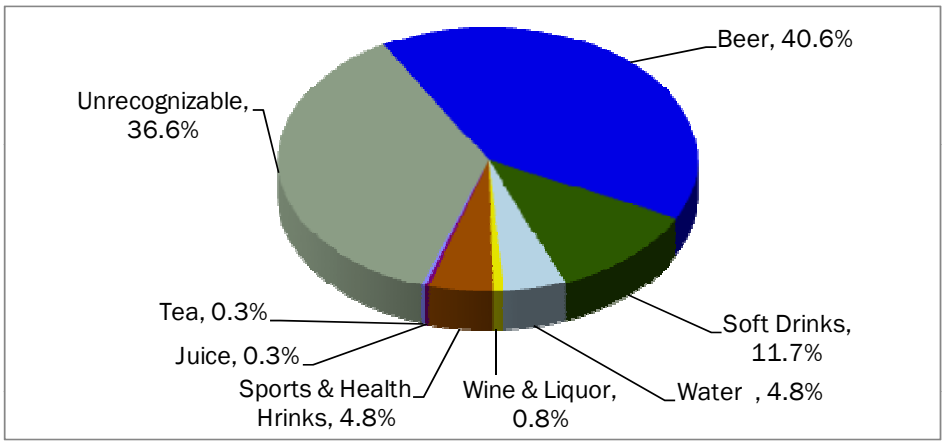
Packaging Summary by Material



Packaging Summary by Type



Beverage Containers



Summary Data for State Roadways - Large + Small Items

Sources of Litter	Pieces	Percent of Total	State Total (1,000)
Pedestrians	2,614	20%	3,820,370
Motorists	5,508	42%	8,049,200
Containers	124	1%	181,209
Untarped Loads	3,204	25%	4,681,583
Vehicle Debris	386	3%	564,097
Unknown	1,174	9%	1,715,885
Total	**13,011**	**100%**	**19,012,344**

Tobacco-related Litter	
Pieces	4,725
Percent of Total	36%
State	**6,904,715**

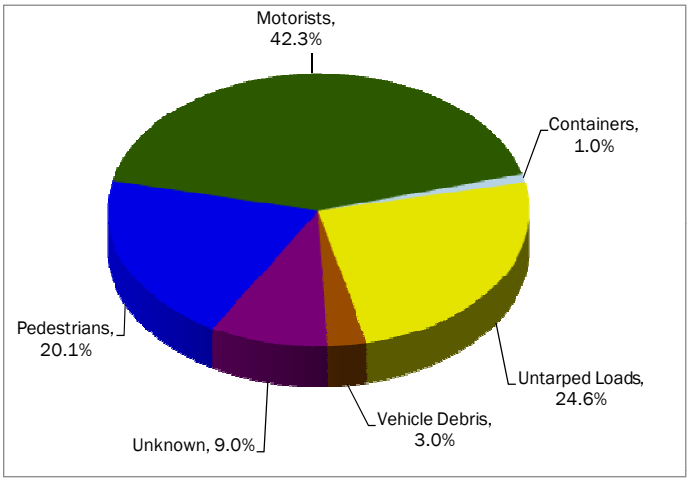
Litter by Material Group	Pieces	Percent of Total	State Total (1,000)
Paper	3,059	24%	4,469,456
Plastic	2,408	19%	3,518,927
Glass	626	5%	914,441
Metal	593	5%	866,810
Organic	707	5%	1,032,985
Tobacco	4,725	36%	6,904,715
Construction Debris	314	2%	458,695
Vehicle Debris	197	2%	288,193
Other	382	3%	558,122
Total	**13,011**	**100%**	**19,012,344**

Packaging Summary	Pieces	Percent of Total	Percent of Packaging	State Total (1,000)
By Material				
Paper	303	2%	15%	442,618
Plastic	1,609	12%	78%	2,350,596
Other	152	1%	7%	221,450
Subtotal	**2,063**	**16%**	**100%**	**3,014,665**
By Type				
Snack	207	2%	10%	302,908
Fast Food	367	3%	18%	535,800
Home Use	361	3%	17%	526,874
Commercial	1,129	9%	55%	1,649,083
Subtotal	**2,063**	**16%**	**100%**	**3,014,665**

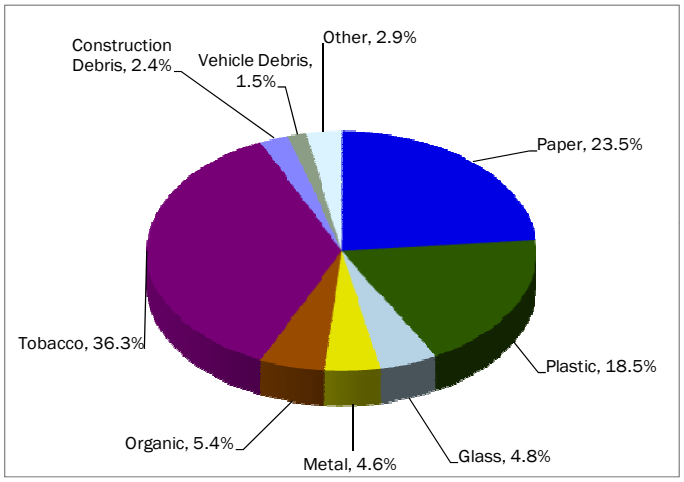
Beverage Container Summary	Pieces	Percent of Total	Percent of Beverage	State Total (1,000)
Beer	72	1%	41%	104,715
Soft Drinks	48	0%	28%	69,743
Water	13	0%	7%	18,583
Wine & liquor	5	0%	3%	6,748
Sports & health drinks	6	0%	4%	9,169
Juice	3	0%	2%	4,273
Tea	3	0%	2%	4,208
Unrecognizable	24	0%	14%	35,549
Total	**173**	**1%**	**100%**	**252,987**

Summary Data for State Roadways - Large + Small Items

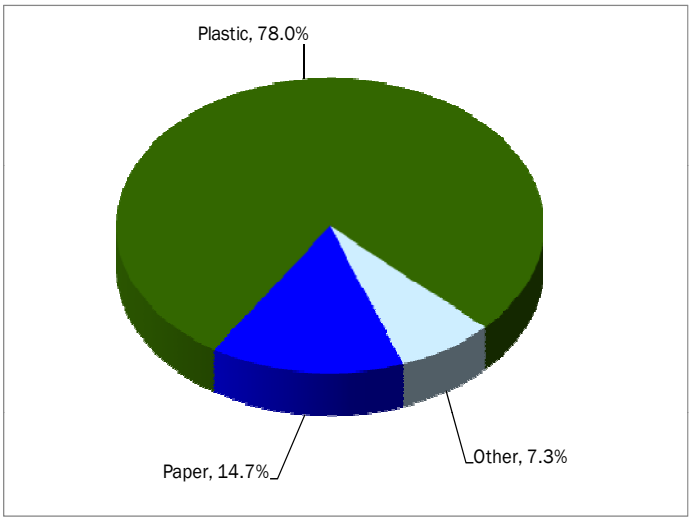
Litter by Source



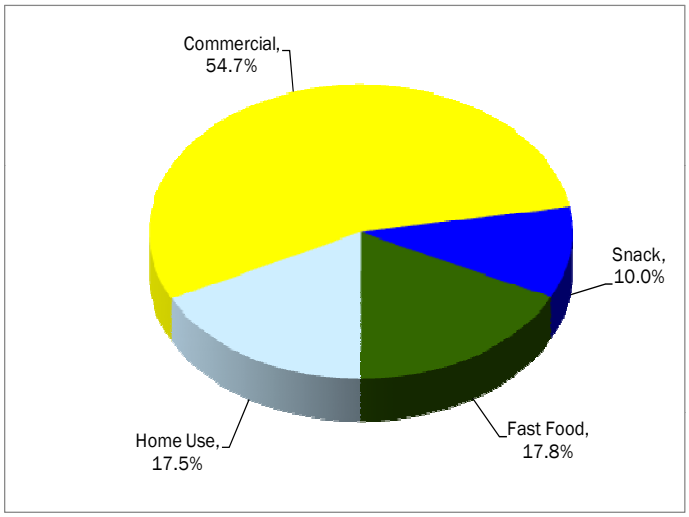
Litter by Material Group



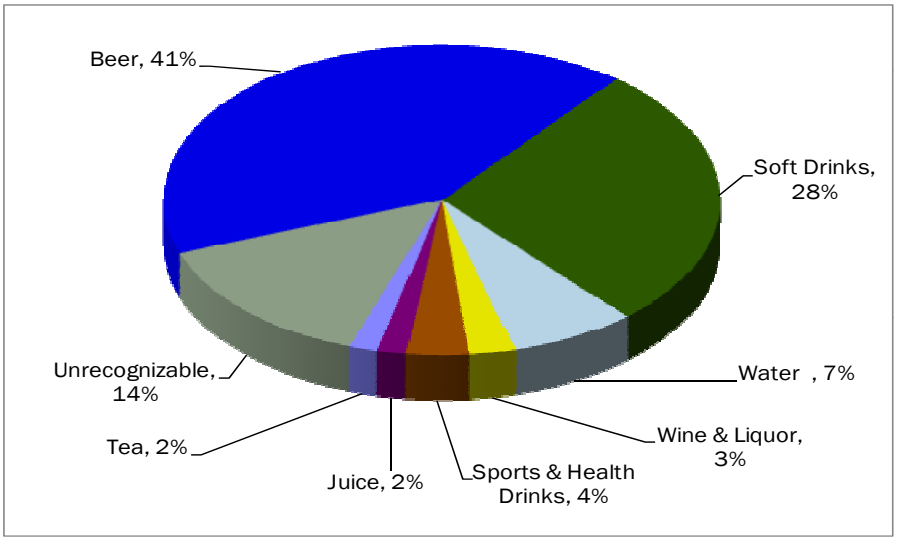
Packaging Summary by Material



Packaging Summary by Type



Beverage Containers



Summary Data for County Roadways - Large + Small Items

Sources of Litter	Pieces	Percent of Total	County Total (1,000)
Pedestrians	884	16%	3,149,805
Motorists	3,768	68%	13,424,853
Containers	56	1%	201,203
Untarped Loads	681	12%	2,426,041
Vehicle Debris	92	2%	326,767
Unknown	58	1%	206,078
Total	**5,539**	**100%**	**19,734,747**

Tobacco-related Litter	
Pieces	2,179
Percent of Total	39%
County	**7,764,815**

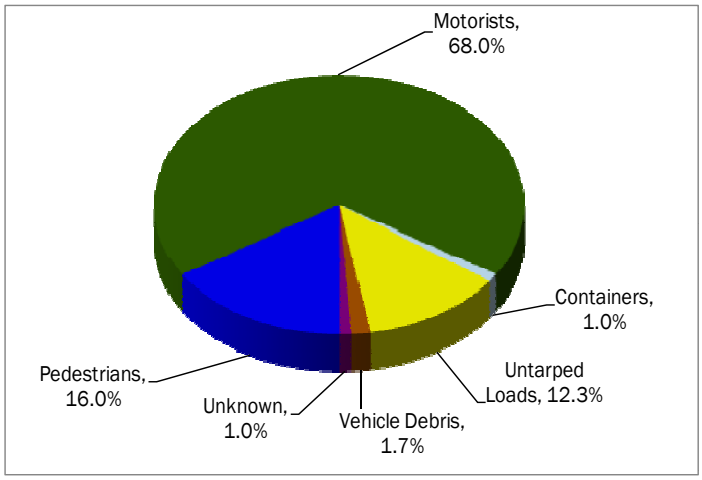
Litter by Material Group	Pieces	Percent of Total	County Total (1,000)
Paper	1,201	22%	4,277,450
Plastic	1,131	20%	4,030,639
Glass	179	3%	636,235
Metal	445	8%	1,586,494
Organic	50	1%	177,408
Tobacco	2,179	39%	7,764,815
Construction Debris	161	3%	572,216
Vehicle Debris	84	2%	300,531
Other	109	2%	388,960
Total	**5,539**	**100%**	**19,734,747**

Packaging Summary	Pieces	Percent of Total	Percent of Packaging	County Total (1,000)
By Material				
Paper	336	6%	28%	1,198,763
Plastic	729	13%	62%	2,598,440
Other	116	2%	10%	413,975
Subtotal	**1,182**	**21%**	**100%**	**4,211,178**
By Type				
Snack	89	2%	8%	317,438
Fast Food	382	7%	32%	1,361,990
Home Use	409	7%	35%	1,456,900
Commercial	302	5%	26%	1,074,849
Subtotal	**1,182**	**21%**	**100%**	**4,211,178**

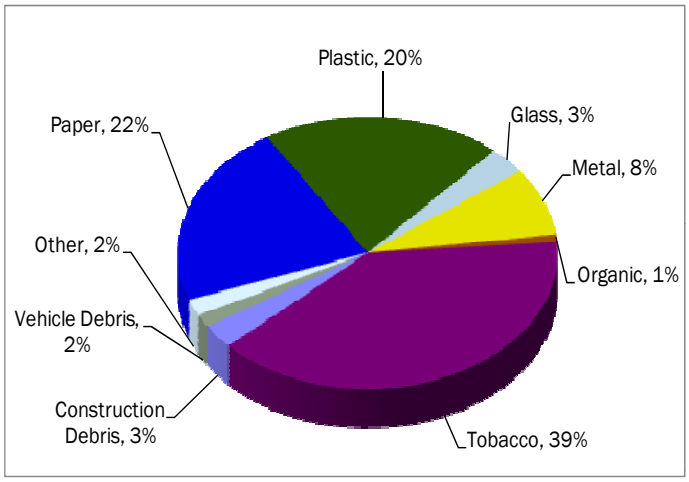
Beverage Container Summary	Pieces	Percent of Total	Percent of Beverage	County Total (1,000)
Beer	61	1%	26%	217,707
Soft Drinks	58	1%	24%	205,188
Water	13	0%	6%	47,189
Wine & liquor	5	0%	2%	19,213
Sports & health drinks	7	0%	3%	25,454
Juice	3	0%	1%	10,434
Tea	1	0%	0.4%	3,160
Unrecognizable	88	2%	37%	312,309
Total	**236**	**4%**	**100%**	**840,655**

Summary Data for County Roadways - Large + Small Items

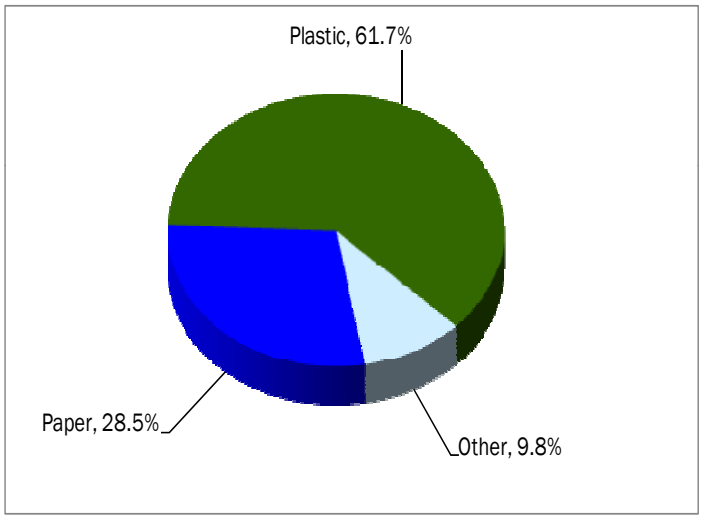
Litter by Source



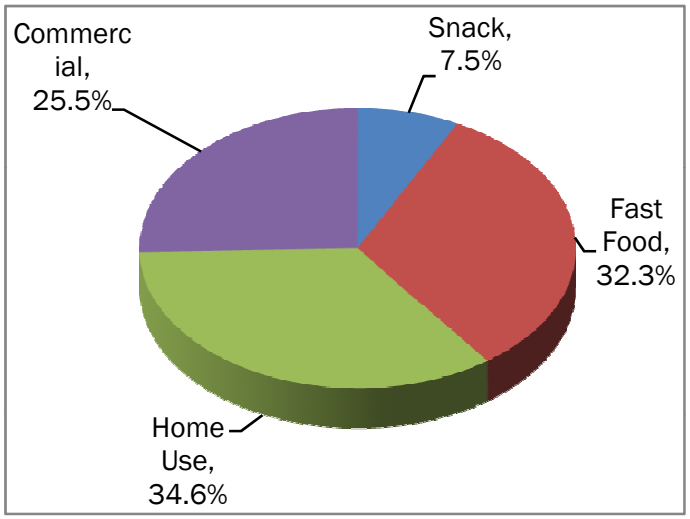
Litter by Group



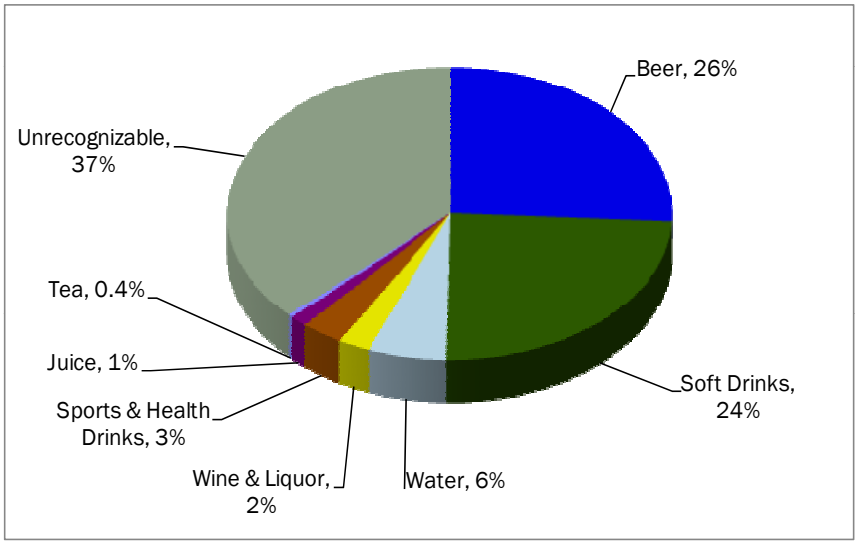
Packaging Summary by Material



Packaging Summary by Type



Beverage Containers



Summary Data for Municipal Roadways - Large + Small Items

Sources of Litter	Pieces	Percent of Total	Municipal Total (1,000)
Pedestrians	1,856	43%	4,617,036
Motorists	1,718	40%	4,272,911
Containers	159	4%	395,854
Untarped Loads	420	10%	1,045,145
Vehicle Debris	56	1%	138,444
Unknown	69	2%	170,972
Total	**4,277**	**100%**	**10,640,361**

Tobacco-related Litter	
Pieces	1,514
Percent of Total	35%
Municipal	**3,766,944**

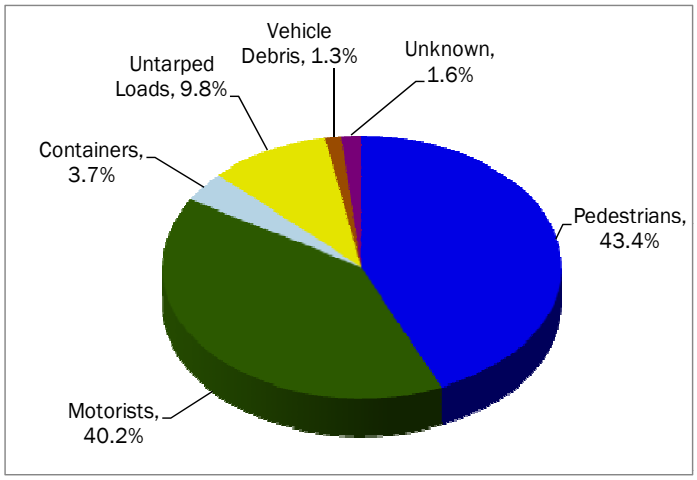
Litter by Material Group	Pieces	Percent of Total	Municipal Total (1,000)
Paper	895	21%	2,226,361
Plastic	813	19%	2,022,601
Glass	282	7%	700,728
Metal	166	4%	412,823
Organic	380	9%	944,787
Tobacco Products	1,514	35%	3,766,944
Construction Debris	93	2%	232,084
Vehicle Debris	21	0.5%	51,190
Unrecognizable	114	3%	282,843
Total	**4,277**	**100%**	**10,640,361**

Packaging Summary	Pieces	Percent of Total	Percent of Packaging	Municipal Total (1,000)
By Material				
Paper	186	4%	26%	461,749
Plastic	410	10%	58%	1,018,790
Other	107	3%	15%	266,667
Subtotal	**702**	**16%**	**100%**	**1,747,207**
By Type				
Snack	119	3%	17%	296,585
Fast Food	289	7%	41%	720,008
Home Use	189	4%	27%	469,108
Commercial	105	2%	15%	261,505
Subtotal	**702**	**16%**	**100%**	**1,747,207**

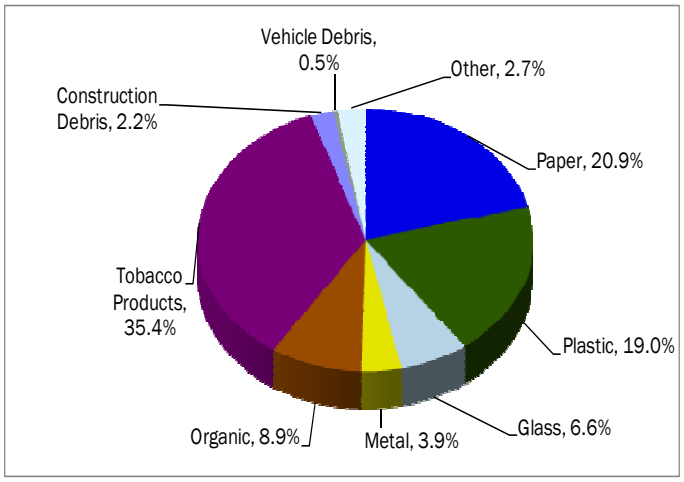
Beverage Container Summary	Pieces	Percent of Total	Percent of Beverage	Municipal Total (1,000)
Beer	31	1%	33%	77,504
Soft Drinks	22	1%	24%	55,503
Water	5	0%	6%	13,089
Wine & liquor	2	0%	2%	4,614
Sports & health drinks	2	0%	2%	5,387
Juice	1	0%	2%	3,660
Tea	0	0%	0.3%	784
Other	29	1%	31%	71,398
Total	**93**	**2%**	**100%**	**231,939**

Summary Data for Municipal Roadways - Large + Small Items

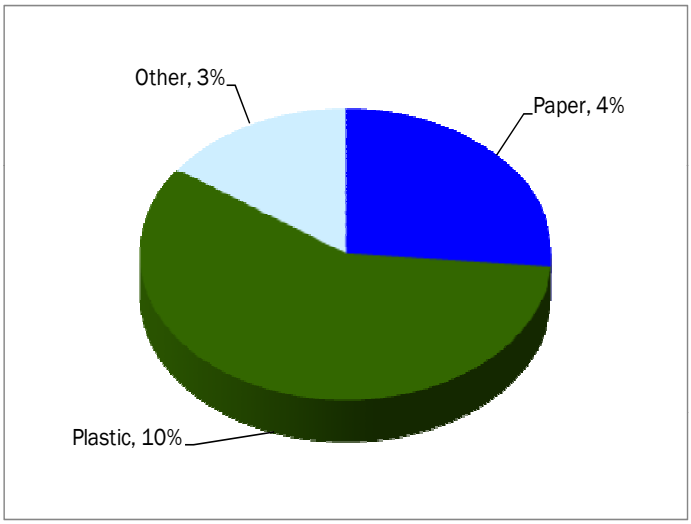
Litter by Source



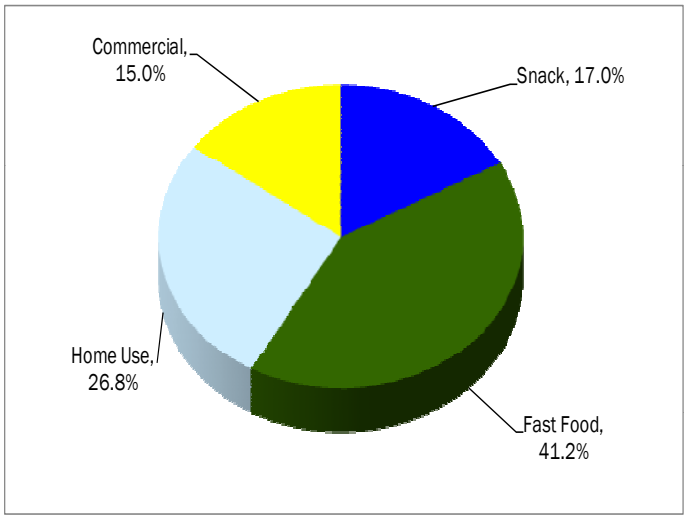
Litter by Material Group



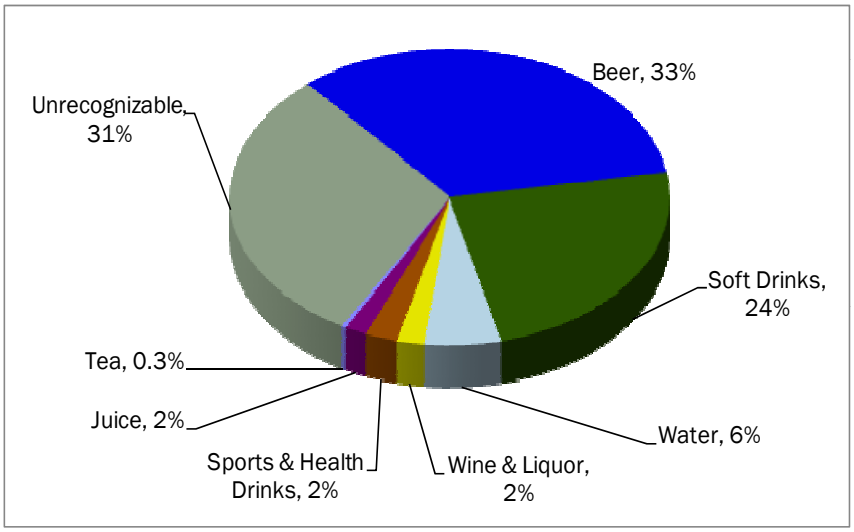
Packaging Summary by Material



Packaging Summary by Type



Beverage Containers



Large Litter Tables and Figures by Roadway Type

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Summary Data for Urban Roadways

Sources of Litter	Pieces	Percent of Total	Urban Total (1,000)
Pedestrians	307	45.6%	608,895
Motorists	186	27.6%	368,545
Containers	8	1.2%	16,668
Untarped Loads	151	22.5%	300,196
Vehicle Debris	14	2.1%	28,363
Unknown	7	1.0%	13,502
Total	**674**	**100.0%**	1,336,169

Tobacco-related Litter	
Pieces	29
Percent of Total	4.3%
Urban	**57,660**

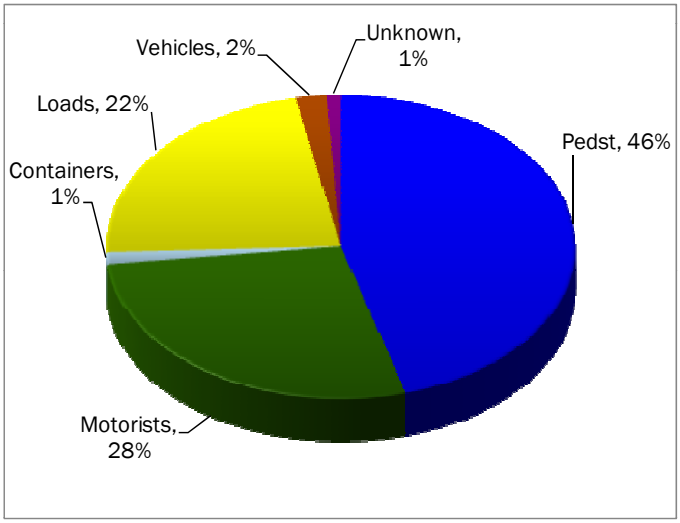
Litter by Material Grou	Pieces	Percent of Total	Urban Total (1,000)
Paper	299	44.4%	593,328
Plastic	233	34.5%	461,325
Glass	19	2.8%	37,506
Metal	28	4.1%	54,668
Organic	4	0.5%	7,291
Tobacco	29	4.3%	57,660
Construction Debris	25	3.7%	49,216
Vehicle Debris	15	2.3%	30,580
Other	22	3.3%	44,594
Total	**674**	**100.0%**	1,336,169

Packaging Summary	Pieces	Percent of Total	Percent of Packaging	Urban Total (1,000)
By Material				
Paper	179	26.6%	48%	354,875
Plastic	161	23.9%	43%	318,865
Other	31	4.6%	8%	61,235
Subtotal	**370**	**55.0%**	**100%**	**734,976**
By Type				
Snack	57	8.4%	15%	112,407
Fast Food	217	32.3%	59%	431,112
Home Use	57	8.5%	16%	113,947
Commercial	39	5.8%	11%	77,510
Subtotal	**370**	**55.0%**	**100%**	**734,976**

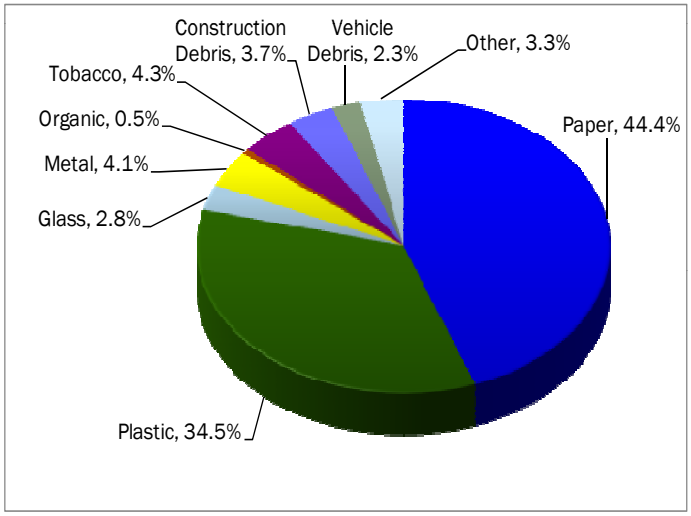
Beverage Container Su	Pieces	Percent of Total	Percent of Beverage	Urban Total (1,000)
Beer	20	3.0%	32%	40,520
Soft Drink	12	1.8%	19%	24,213
Water	10	1.5%	16%	20,390
Wine & liquor	3	0.5%	5%	6,065
Sports & health drinks	3	0.4%	4%	5,666
Juice	2	0.4%	4%	4,802
Tea	1	0.1%	1%	1,656
Unrecognizable	12	1.8%	19%	24,307
Total	**64**	**9.6%**	**100%**	**127,620**

Summary Data for Urban Roadways

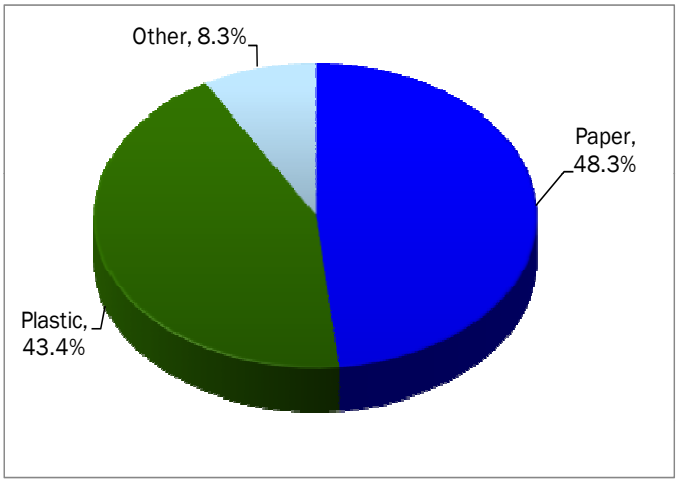
Litter by Source



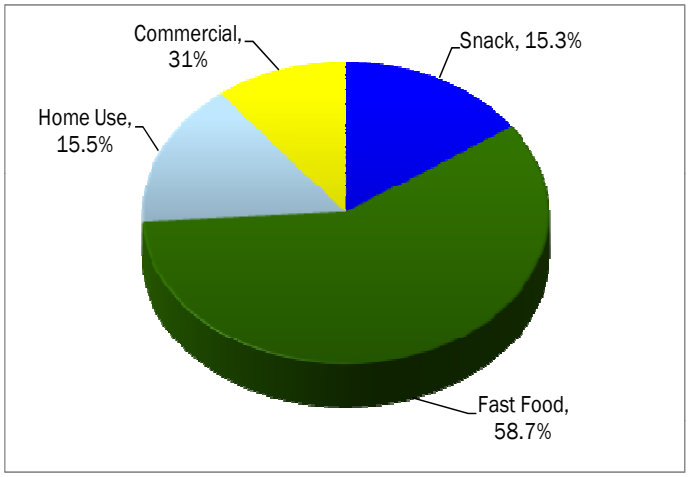
Litter by Material Group



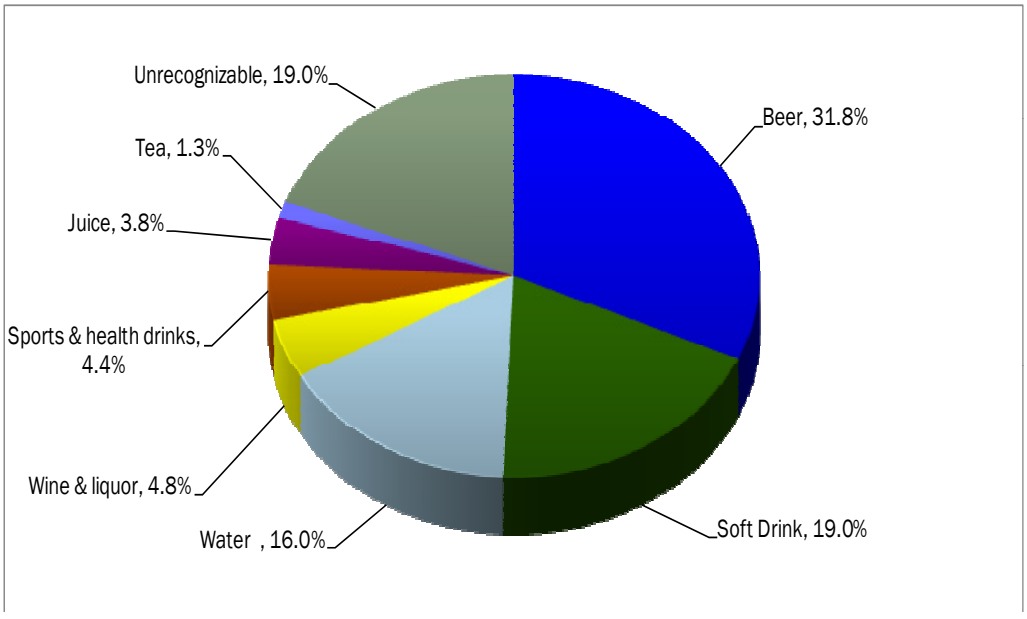
Summary of Packaging by Material



Summary of Packaging by Type



Beverage Breakdown



Summary Data for Rural Roadways

Sources of Litter	Pieces	Percent of Total	Rural Total (1,000)
Pedestrians	36	6.1%	202,338
Motorists	365	62.3%	2,049,333
Containers	22	3.7%	121,112
Untarped Loads	117	20.0%	657,160
Vehicle Debris	37	6.2%	205,551
Unknown	10	1.7%	56,057
Total	**586**	**100.0%**	3,291,550

Tobacco-related Litter	
Pieces	32
Percent of Total	5.4%
Rural	**179,259**

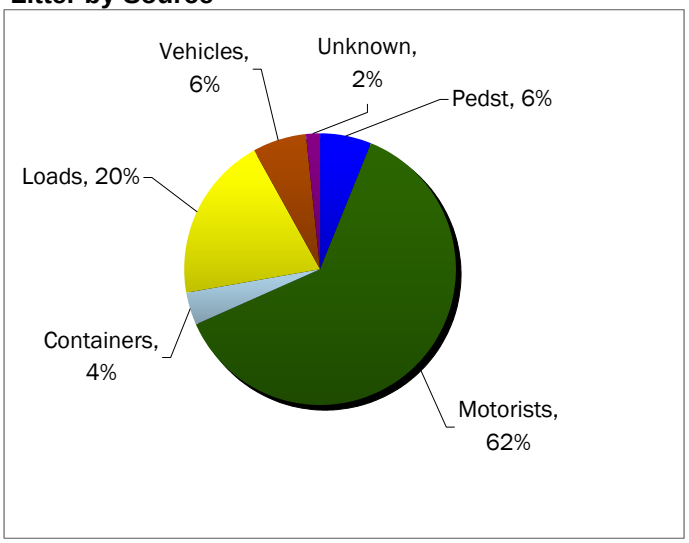
Litter by Material Group	Pieces	Percent of Total	Rural Total (1,000)
Paper	149	25.5%	839,947
Plastic	227	38.8%	1,276,769
Glass	17	2.9%	96,880
Metal	54	9.2%	302,262
Organic	3	0.4%	14,668
Tobacco	32	5.4%	179,259
Construction Debris	34	5.8%	190,937
Vehicle Debris	36	6.2%	205,091
Other	33	5.6%	185,736
Total	**586**	**100.0%**	3,291,550

Packaging Summary	Pieces	Percent of Total	Percent of Packaging	Rural Total (1,000)
By Material				
Paper	57	9.8%	23%	320,974
Plastic	155	26.4%	63%	869,030
Other	35	5.9%	14%	195,325
Subtotal	**246**	**42.1%**	**100%**	**1,385,329**
By Type				
Snack	42	7.3%	17%	238,762
Fast Food	83	14.1%	34%	465,443
Home Use	64	10.9%	26%	359,395
Commercial	57	9.8%	23%	321,729
Subtotal	**246**	**42.1%**	**100%**	**1,385,329**

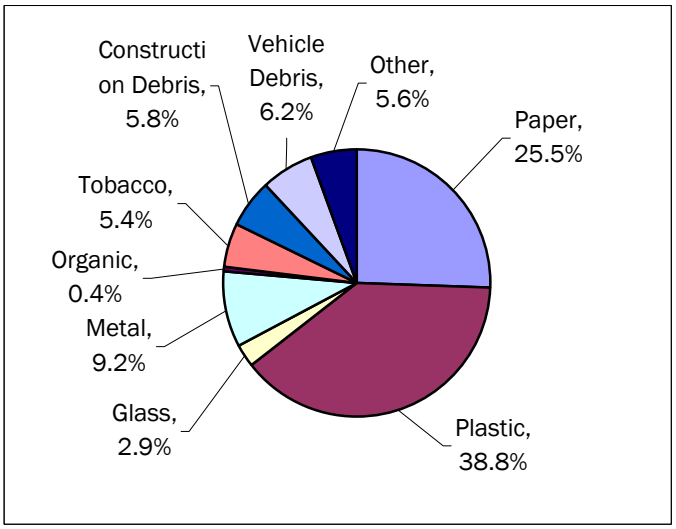
Beverage Container Summ	Pieces	Percent of Total	Percent of Beverage	Rural Total (1,000)
Beer	30	5.1%	31%	168,175
Soft Drink	31	5.4%	32%	176,304
Water	10	1.7%	10%	56,479
Wine & liquor	4	0.8%	5%	24,811
Sports & health drinks	6	1.0%	6%	31,604
Juice	2	0.4%	3%	13,675
Tea	1	0.2%	1%	6,598
Unrecognizable	12	2.0%	12%	65,612
Total	**97**	**16.5%**	**100%**	**543,259**

Summary Data for Rural Roadways

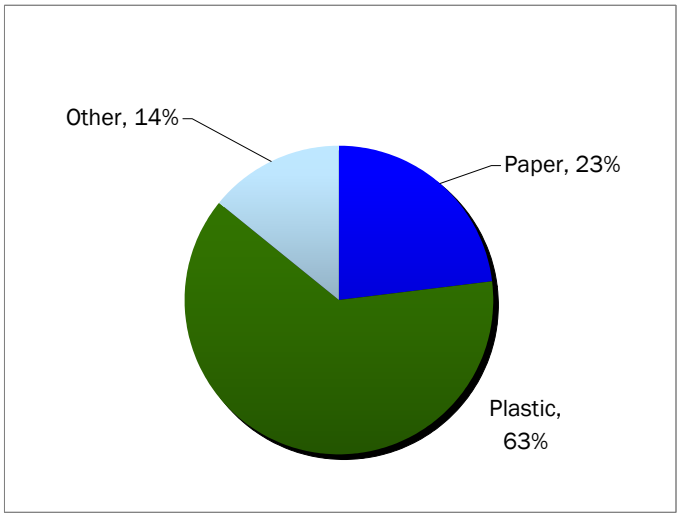
Litter by Source



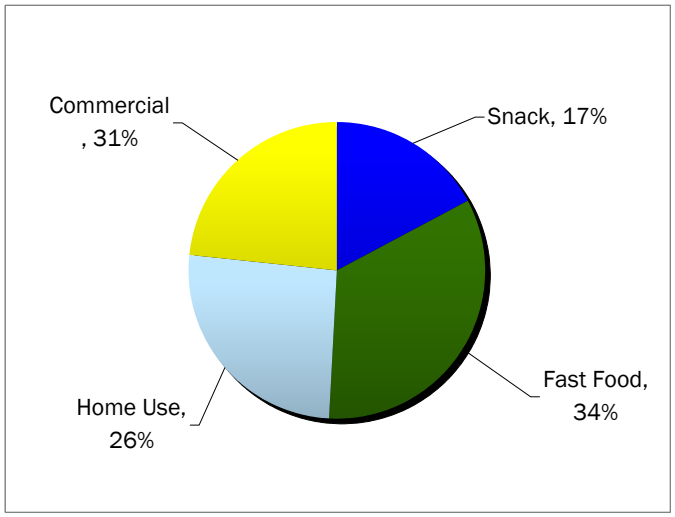
Litter by Material Goup



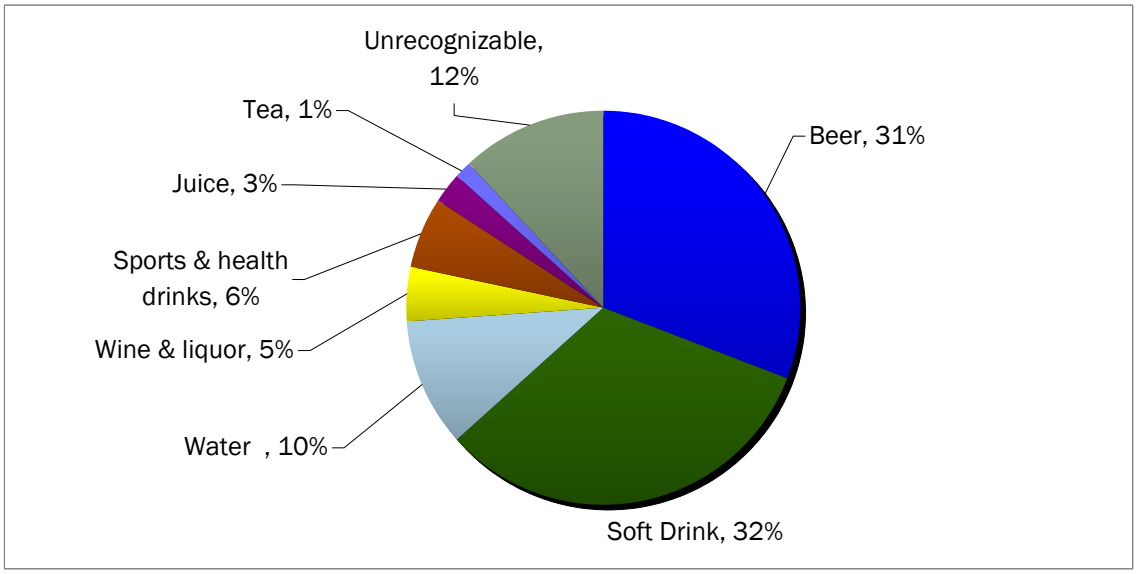
Summary of Packaging by Material



Summary of Packaging by Type



Beverage Breakdown



Summary Data for National Roadways

Sources of Litter	Pieces	Percent of Total	National Total (1,000)
Pedestrians	82	5.5%	7,635
Motorists	615	41.5%	57,353
Containers	15	1.0%	1,397
Untarped Loads	464	31.2%	43,217
Vehicle Debris	292	19.7%	27,202
Unknown	17	1.1%	1,559
Total	**1,484**	**100.0%**	138,362

Tobacco-related Litter	
Pieces	32
Percent of Total	2.2%
National	**2,982**

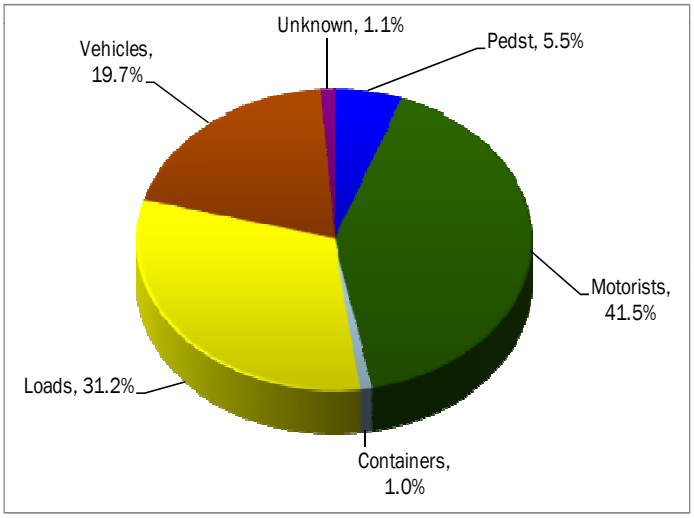
Litter by Material Group	Pieces	Percent of Total	National Total (1,000)
Paper	425	28.6%	39,610
Plastic	399	26.9%	37,174
Glass	11	0.7%	1,003
Metal	113	7.6%	10,493
Organic	5	0.3%	464
Tobacco	32	2.2%	2,982
Construction Debris	129	8.7%	11,996
Vehicle Debris	302	20.4%	28,178
Other	69	4.7%	6,463
Total	**1,484**	**100.0%**	138,362

Packaging Summary	Pieces	Percent of Total	Percent of Packaging	National Total (1,000)
By Material				
Paper	256	17.2%	46%	23,861
Plastic	257	17.3%	47%	23,947
Other	39	2.6%	7%	3,605
Subtotal	**552**	**37.2%**	**100%**	**51,414**
By Type				
Snack	53	3.6%	10%	4,912
Fast Food	315	21.2%	57%	29,335
Home Use	72	4.8%	13%	6,701
Commercial	112	7.6%	20%	10,466
Subtotal	**552**	**37.2%**	**100%**	**51,414**

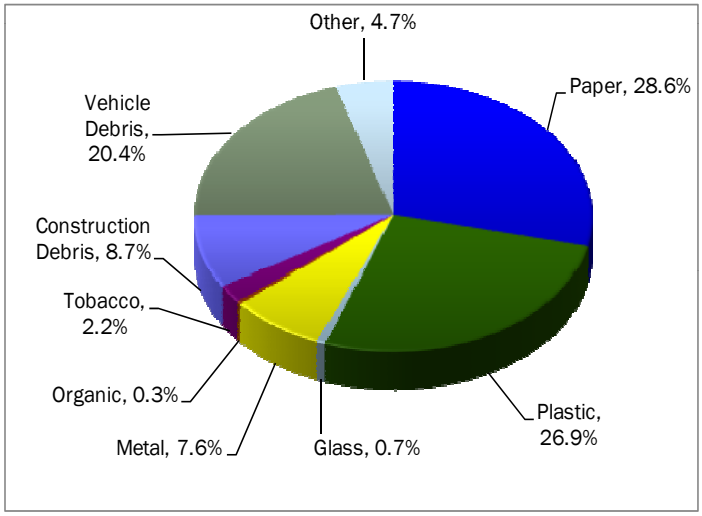
Beverage Container Summ	Pieces	Percent of Total	Percent of Beverage	National Total (1,000)
Beer	38	2.5%	35%	3,519
Soft Drink	33	2.2%	30%	3,065
Water	15	1.0%	14%	1,393
Wine & liquor	3	0.2%	3%	301
Sports & health drinks	7	0.5%	6%	644
Juice	1	0.1%	1%	111
Tea	1	0.1%	1%	102
Unrecognizable	11	0.7%	10%	985
Total	**109**	**7.3%**	**100%**	**10,120**

Summary Data for National Roadways Large Litter

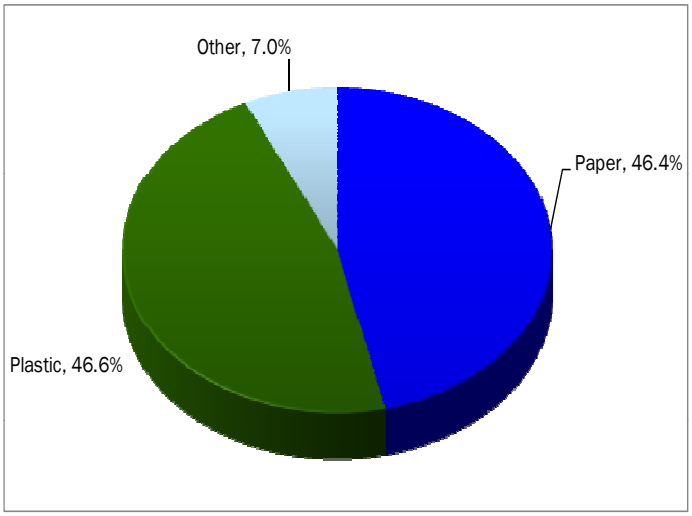
Litter by Source



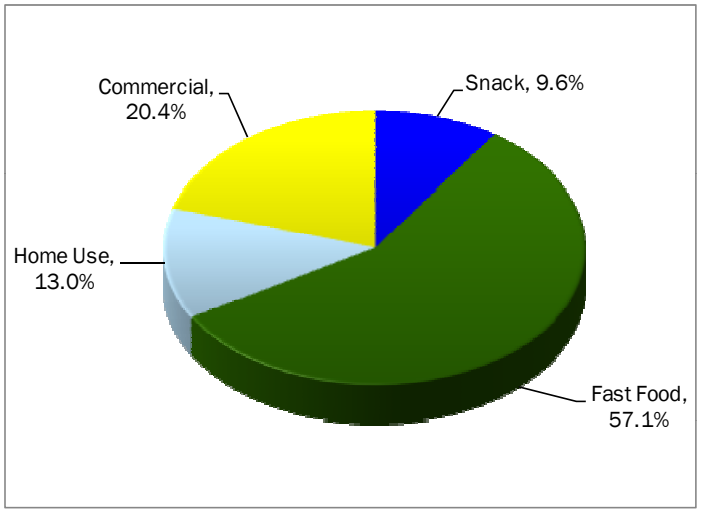
Litter by Material Group



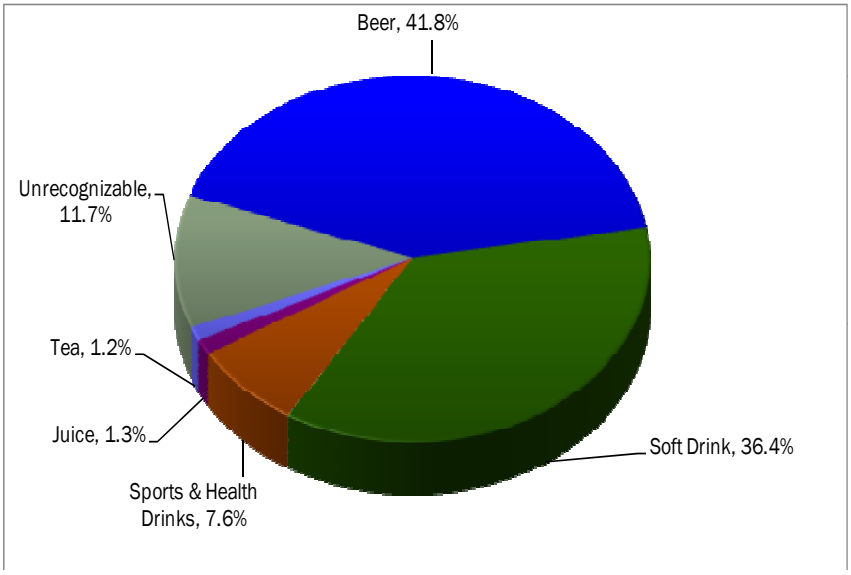
Summary of Packaging by Material



Summary of Packaging by Type



Beverage Breakdown



Summary Data for State Roadways

Sources of Litter	Pieces	Percent of Total	State Total (1,000)
Pedestrians	61	7.0%	88,458
Motorists	415	47.7%	606,368
Containers	14	1.6%	19,934
Untarped Loads	296	34.0%	432,065
Vehicle Debris	74	8.5%	108,520
Unknown	10	1.2%	15,234
Total	**869**	**100.0%**	1,270,579

Tobacco-related Litter	
Pieces	45
Percent of Total	5.2%
State	**65,854**

Litter by Material Group	Pieces	Percent of Total	State Total (1,000)
Paper	241	27.7%	351,760
Plastic	309	35.5%	451,122
Glass	21	2.5%	31,215
Metal	73	8.3%	105,964
Organic	3	0.4%	4,649
Tobacco	45	5.2%	65,854
Construction Debris	78	9.0%	114,436
Vehicle Debris	69	7.9%	100,151
Other	31	3.6%	45,428
Total	**869**	**100.0%**	1,270,579

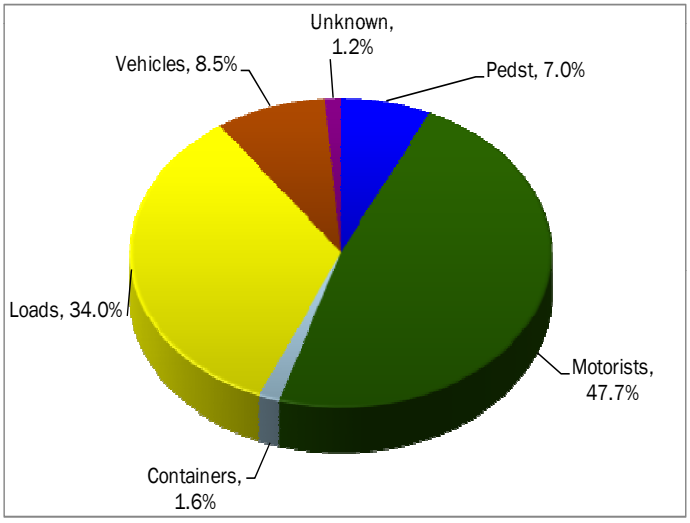
Recycled Paper Summary	
Pieces	44
Percent of Total	5.1%
State	**64,646**

Packaging Summary	Pieces	Percent of Total	Percent of Packaging	State Total (1,000)
By Material				
Paper	90	10.4%	25%	131,609
Plastic	222	25.5%	62%	323,948
Other	47	5.4%	13%	68,078
Subtotal	**358**	**41.2%**	**100%**	**523,635**
By Type				
Snack	62	7.2%	17%	90,905
Fast Food	121	13.9%	34%	176,128
Home Use	80	9.3%	22%	117,608
Commercial	95	10.9%	27%	138,995
Subtotal	**358**	**41.2%**	**100%**	**523,635**

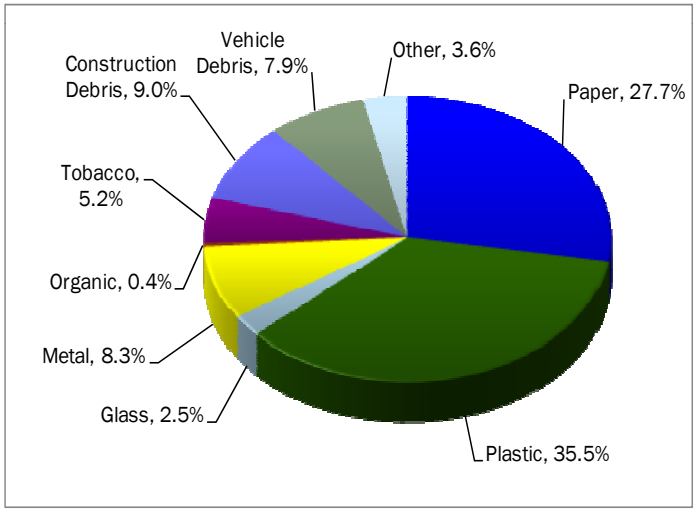
Beverage Container Summ	Pieces	Percent of Total	Percent of Beverage	State Total (1,000)
Beer	40	4.6%	38%	58,636
Soft Drink	27	3.1%	26%	39,652
Water	13	1.5%	12%	18,583
Wine & liquor	5	0.5%	4%	6,748
Sports & health drinks	6	0.7%	6%	9,169
Juice	3	0.3%	3%	4,273
Tea	3	0.3%	3%	4,208
Unrecognizable	8	0.9%	8%	12,043
Total	**105**	**12.1%**	**100%**	**153,311**

Summary Data for State Roadways Large Litter

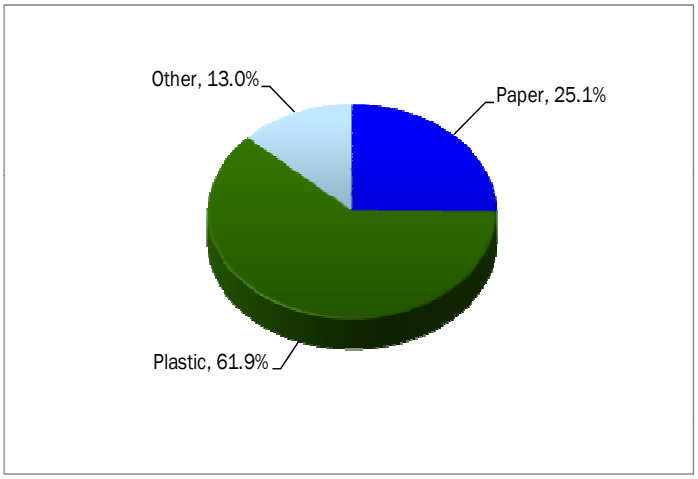
Litter by Source



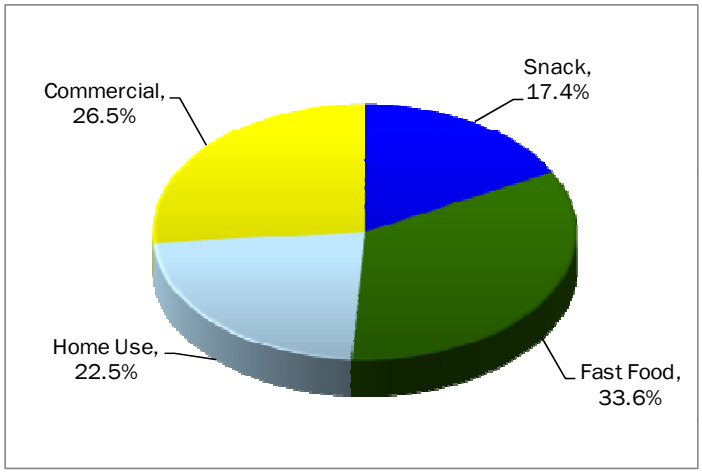
Litter by Material Group



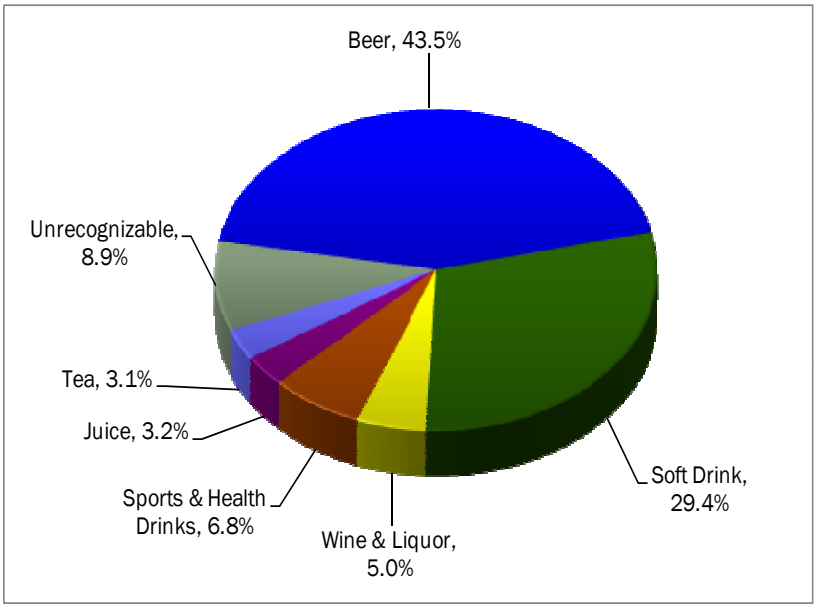
Summary of Packaging by Material



Summary of Packaging by Type



Beverage Breakdown



Summary Data for County Roadways

Sources of Litter	Pieces	Percent of Total	County Total (1,000)
Pedestrians	108	16.6%	386,399
Motorists	400	61.1%	1,423,667
Containers	28	4.2%	98,509
Untarped Loads	84	12.9%	300,271
Vehicle Debris	23	3.5%	81,137
Unknown	11	1.7%	40,564
Total	**654**	**100.0%**	2,330,546

Tobacco-related Litter	
Pieces	32
Percent of Total	4.9%
State	**113,980**

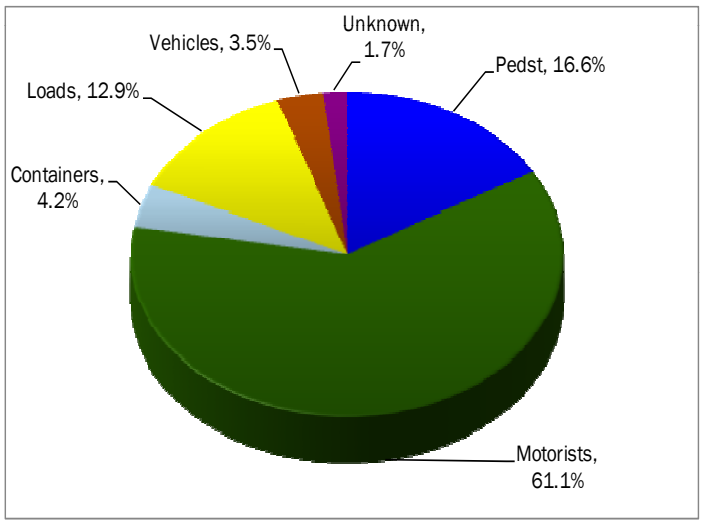
Litter by Material Group	Pieces	Percent of Total	County Total (1,000)
Paper	215	32.9%	765,790
Plastic	243	37.1%	865,178
Glass	20	3.0%	69,716
Metal	54	8.2%	192,027
Organic	2	0.3%	6,423
Tobacco	32	4.9%	113,980
Construction Debris	26	3.9%	91,326
Vehicle Debris	26	3.9%	91,387
Other	38	5.8%	134,719
Total	**654**	**100.0%**	2,330,546

Packaging Summary	Pieces	Percent of Total	Percent of Packaging	County Total (1,000)
By Material				
Paper	108	16.6%	36%	385,839
Plastic	159	24.4%	52%	567,796
Other	36	5.5%	12%	127,899
Subtotal	**304**	**46.4%**	**100%**	**1,081,534**
By Type				
Snack	42	6.5%	14%	150,838
Fast Food	140	21.4%	46%	498,207
Home Use	69	10.6%	23%	246,343
Commercial	52	8.0%	17%	186,146
Subtotal	**304**	**46.4%**	**100%**	**1,081,534**

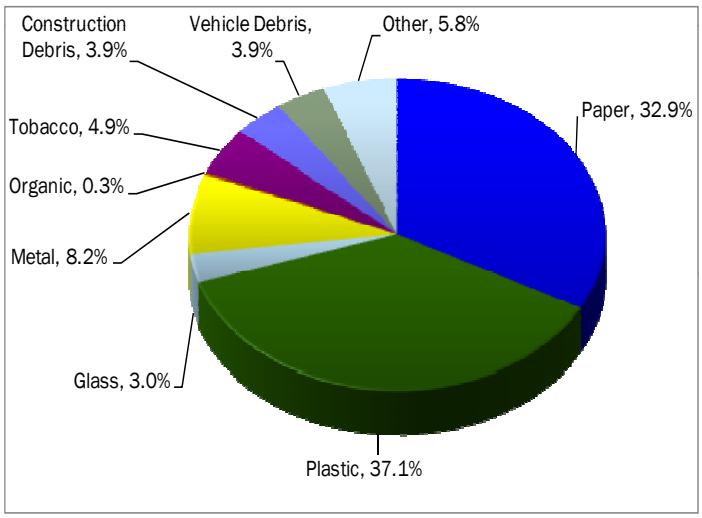
Beverage Container Summary	Pieces	Percent of Total	Percent of Beverage	County Total (1,000)
Beer	30	4.6%	27%	108,245
Soft Drink	38	5.8%	34%	135,598
Water	12	1.9%	11%	43,805
Wine & liquor	5	0.8%	5%	19,213
Sports & health drinks	6	0.9%	6%	22,069
Juice	3	0.4%	3%	10,434
Tea	1	0.1%	1%	3,160
Unrecognizable	16	2.4%	14%	56,413
Total	**112**	**17.1%**	**100%**	**398,936**

Summary Data for County Roadways Large Litter

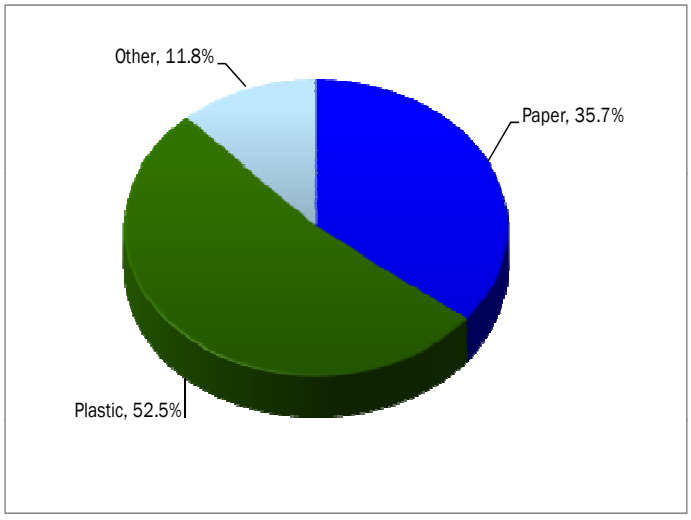
Litter by Source



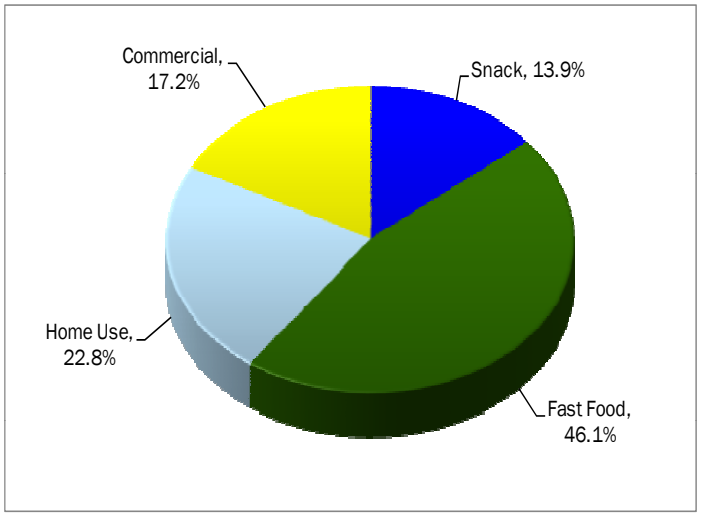
Litter by Material Group



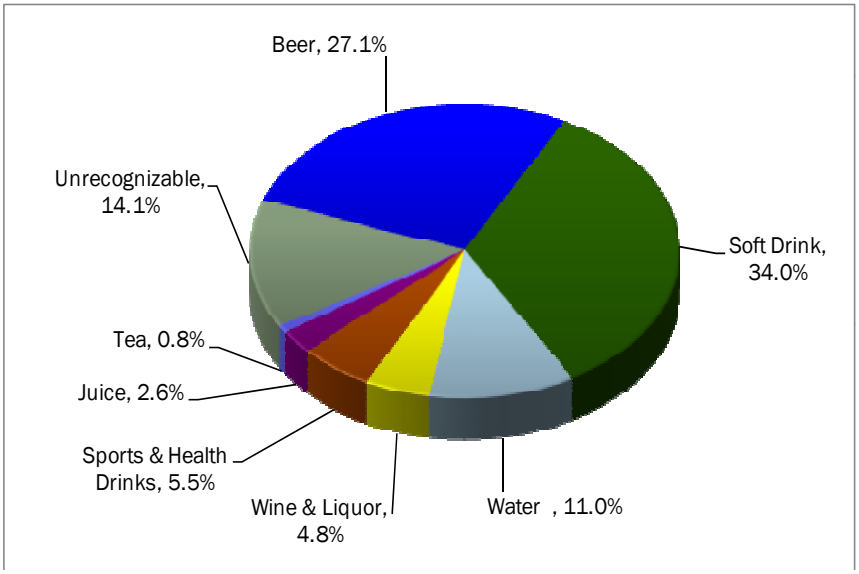
Summary of Packaging by Material



Summary of Packaging by Type



Beverage Breakdown



Summary Data for Municipal Roadways

Sources of Litter	Pieces	Percent of Total	Municipal Total (1,000)
Pedestrians	132	37.0%	328,741
Motorists	133	37.2%	330,490
Containers	7	2.0%	17,939
Untarped Loads	73	20.5%	181,804
Vehicle Debris	7	1.9%	17,056
Unknown	5	1.4%	12,201
Total	**357**	**100.0%**	888,232

Tobacco-related Litter	
Pieces	22
Percent of Total	6.1%
Municipal	**54,103**

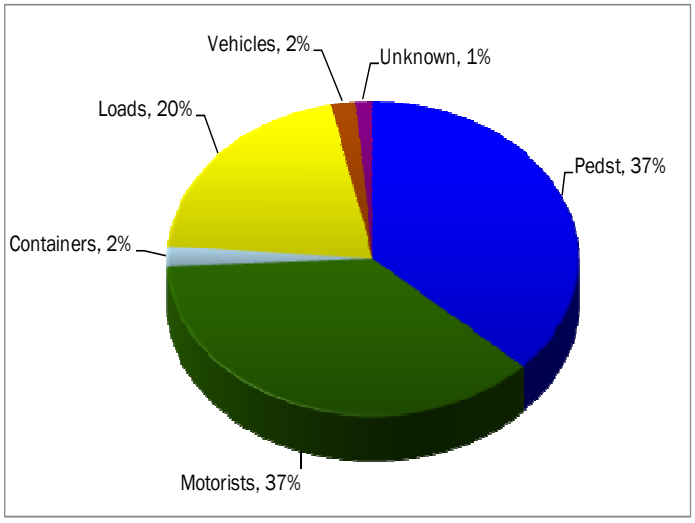
Litter by Material Group	Pieces	Percent of Total	Municipal Total (1,000)
Paper	111	31.1%	276,115
Plastic	155	43.3%	384,620
Glass	13	3.7%	32,453
Metal	19	5.5%	48,445
Organic	4	1.2%	10,424
Tobacco	22	6.1%	54,103
Construction Debris	9	2.5%	22,395
Vehicle Debris	6	1.8%	15,956
Other	18	4.9%	43,721
Total	**357**	**100.0%**	888,232

Packaging Summary	Pieces	Percent of Total	Percent of Packaging	Municipal Total (1,000)
By Material				
Paper	54	15.1%	29%	134,540
Plastic	109	30.6%	59%	272,203
Other	23	6.4%	12%	56,979
Subtotal	**186**	**52.2%**	**100%**	**463,722**
By Type				
Snack	42	11.8%	23%	104,514
Fast Food	78	21.7%	42%	192,886
Home Use	41	11.6%	22%	102,690
Commercial	26	7.2%	14%	63,632
Subtotal	**186**	**52.2%**	**100%**	**463,722**

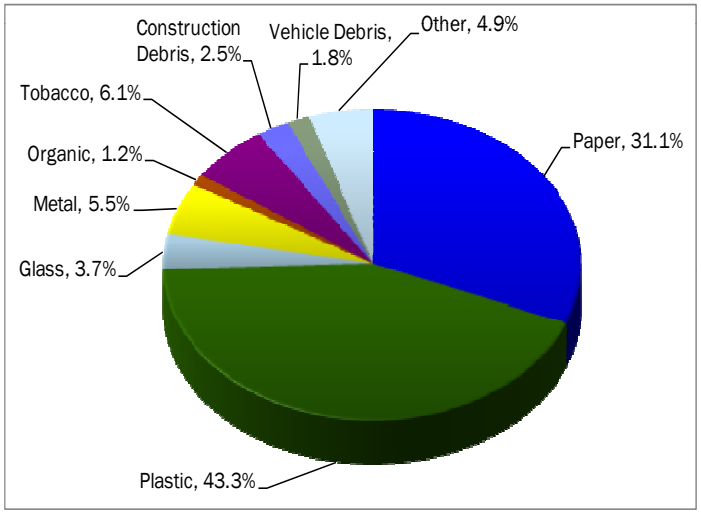
Beverage Container Summary	Pieces	Percent of Total	Percent of Beverage	Municipal Total (1,000)
Beer	15	4.3%	35%	38,295
Soft Drink	9	2.5%	20%	22,202
Water	5	1.5%	12%	13,089
Wine & liquor	2	0.5%	4%	4,614
Sports & health drinks	2	0.6%	5%	5,387
Juice	1	0.4%	3%	3,660
Tea	0	0.1%	1%	784
Unrecognizable	8	2.3%	19%	20,479
Total	**44**	**12.2%**	**100%**	**108,511**

Summary Data for Municipal Roadways Large Litter

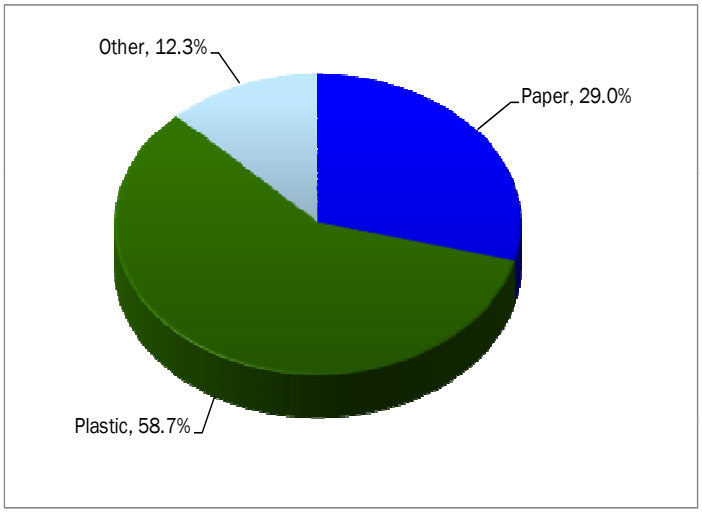
Litter by Source



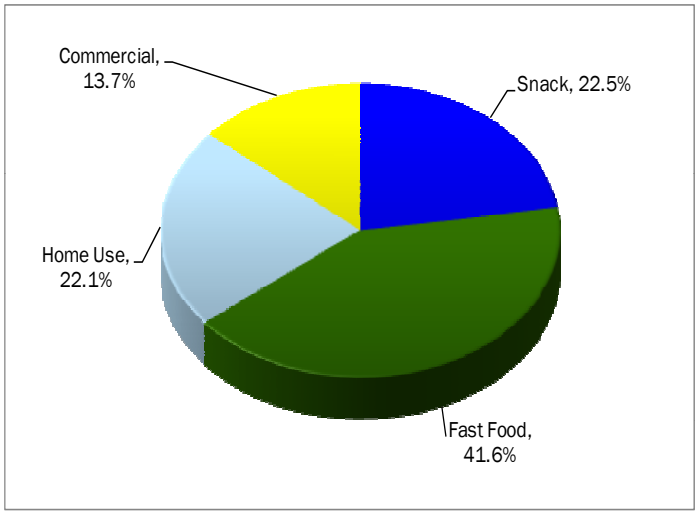
Litter by Material Group



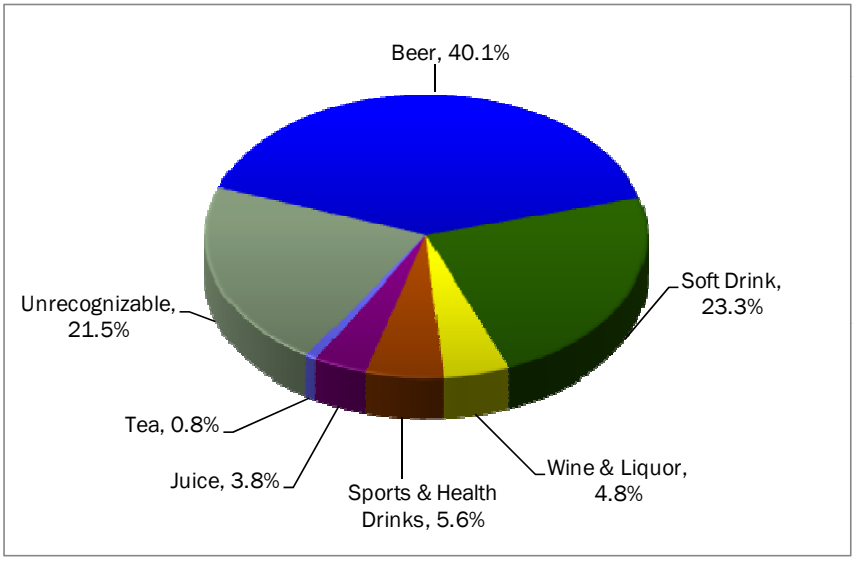
Summary of Packaging by Material



Summary of Packaging by Type



Beverage Breakdown



APPENDIX F

Site Survey Photographs

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APPENDIX F – SITE PHOTOGRAPHS

A total of 243 roadway samples and 180 non-roadway samples were obtained over the course of this study. The digital photographs in this appendix are intended to provide representative examples of each of the roadway and non-roadway types. Street segments were selected within either a 10 mile buffer or a 40 mile buffer of the city's center point and then identified as either "urban" or "rural" based on the U.S. Census listing of urbanized areas.

1.1. NATIONAL ROADS

National roads are defined to include all federal interstates and other federally maintained roadways. National roads were categorized as being urban or rural depending on the population density of the surrounding area. Urban and rural national roads are shown in Figures F-1 and F-2, respectively.

Figure F-1 National Roads: Urban

Albuquerque, NM

Texarkana, AR

Figure F-2 National Roads: Rural

South Bend, IN

Fort Worth, TX

1.2. STATE ROADS

Urban state roads are maintained by state department of transportation officials. Figures F-3 and F-4 shows urban and rural state roads, respectively.

Figure F-3 State Roads: Urban

Chattanooga, TN

Spartanburg, NC

Figure F-4 State Roads: Rural

Fort Worth, TX

Tampa, FL

1.3. COUNTY ROADS

County roads are maintained by county public works and streets personnel. Figures F-5 and F-6 depict urban and rural county roads, respectively.

Figure F-5 County Roads: Urban

Spartanburg, NC

Tampa, Florida

Figure F-6 County Roads: Rural

Fort Worth, TX

Shreveport, LA

1.4. MUNICIPAL ROADS

Municipal roads are maintained by the public works and streets departments of an incorporated city, town, borough, or other entity. These tend to be residential roads. Figures F-7 and F-8 depict urban and rural municipal roads, respectively.

Figure F-7 Municipal Roads: Urban

Chattanooga, TN

Tuscaloosa, AL

Figure F-8 - Municipal Roads: Rural

Louisville, KY

Rome, GA

1.5. TRANSITION POINTS

Transition points are congregating areas beyond which citizens are not allowed to bring certain products such as lit cigarettes, beverages and certain food products into a given area. Transition points may include bus stops or entrances to theaters, shopping malls, libraries and schools.

Figure F-9 - Transition Points

Meridian, MS

Texarkana, AR

1.6. LOADING DOCKS

Loading docks are characterized as an area within an exposition facility where freight is received and shipped. Loading Docks are commonly found in the back of commercial and industrial establishments. In most instances the entire circumference of the ramp leading into or out of the loading dock was sampled.

Figure F-10 – Loading Docks

Rome, GA

Martinsburg, WV

1.7. STORM DRAINS

Storm drains are characterized as an opening leading to an underground pipe or open ditch for carrying surface runoff and which can be separate from the sanitary sewer or wastewater system.

Figure F-11 - Storm Drains

Meridian, MS

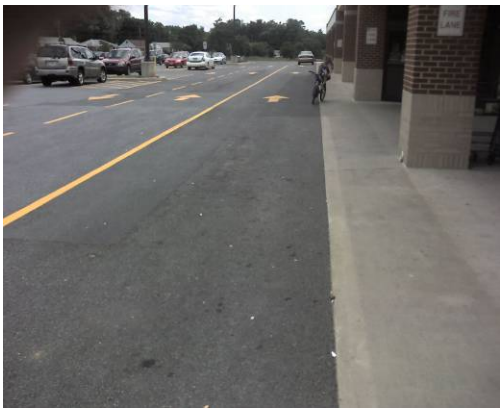
Philadelphia, PA

1.8. RETAIL AREAS

Retail areas are characterized as the walkways immediately outside of stores within a shopping malls and shopping strips. Convenience stores and fast food establishments are not included in this category.

Figure F-12 - Retail Areas

Hagerstown, MD



Annandale, VA

1.9. RECREATIONAL AREAS

Recreational areas included "high-use" areas within state and national parks and forests, beaches, waterways, fairgrounds, and other recreation sites. High use areas are defined as areas where users tend to congregate, and include courts, vending areas, pavilions, playgrounds, docks and parking lots.

Figure F-13 - Recreational Areas

Camden, NJ

Hagerstown, MD

1.10. CONSTRUCTION SITES

Construction sites are characterized as residential, commercial or industrial parcels that are under any phase of construction. Due to safety and legal issues, only the area immediately outside of the construction "border" was sampled. This could include signs, silt run-off fences, roped off areas, and other temporary borders.

Figure F-14 - Construction Sites

Gaithersburg, MD

Drexel Hill, PA

APPENDIX G

Litter Cost Survey Instrument

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APPENDIX G - LITTER COST SURVEY INSTRUMENT

Appendix G contains a summary of the survey questions and types of open-ended interview strategies that were used to obtain the litter cost estimates. The litter cost survey spanned three distinct entity types: 1) Government Agencies (States, Counties and Cities); 2) Educational Institutions (School Districts and Colleges and Universities); and 3) Businesses (by employee size). While the list of questions was similar for many of the entity types, in some cases additional questions and/or interview strategies were utilized to obtain the necessary information. Pertinent content from the various survey instruments has been compiled below.

Keep America Beautiful is conducting a nationwide survey to estimate the total amount spent on litter-related costs including prevention efforts each year. Litter is defined to include trash or recyclables that are abandoned or disposed of improperly. Please answer the following questions to the best of your ability. As you fill out the survey, please use the most recent complete calendar or fiscal year that data is available to draw your answers from. In addition, for your response please include contractor costs if applicable.

Thank you for taking the time to fill out this survey. Your assistance will help facilitate Keep America Beautiful's litter reduction and education goals.

1. Survey ID Number _____

2. What entity type are you filling this survey out for?

Government Agency (check one below)

___ State

___ County

___ City

Educational Institution (check one below)

___ College or University

___ School District

Business (check one below)

___ 0 to 30 employees

___ 30 to 99 employees

___ 100 to 1,000 employees

___ Over 1,000 employees

3. For Government Agencies

During the most recent year that data are available for, how much did your agency expense for litter-related collection and prevention efforts? Please include any costs for contractors who may have performed these services for you.

1. What is the name of your department or agency? _____

2. For which year are you reporting data? _____

3. How much were your agencies direct expenses (capitol spent from agency budget) for each of the following categories? If it is possible to break down your expenses into the categories shown below, please do so. Otherwise please enter the total expenses at the bottom.

    a. Litter Collection and/or Disposal $_____

    b. Illegal Dumping Programs $_____

    c. Public Education and Outreach Program $____

    d. Total $_____

4. How much grant funding did you receive in the last calendar or fiscal year from other government agencies and/or not-for-profits for the following efforts? If it is possible to break down grants provided to other governmental entities or not for profits into the categories shown below, please do so. Otherwise please enter the total grants provided at the bottom.

    a. Litter Collection and/or Disposal $ _____

    b. Illegal Dumping Programs $_____

    c. Public Education and Outreach Program $____

    d. Total $_____

5. If applicable, which entities provided your state, department, or agency with grant funding? (Please choose as many as apply).

    a. States _____
    b. Counties _____
    c. Cities _____
    d. Community Groups _____
    e. Law Enforcement _____
    f. Other (List) _____

6. How much grant funding did you provide in the last calendar or fiscal year to other government agencies and/or to not-for-profits for the following efforts?

a. Litter Collection and/or Disposal $_____

b. Illegal Dumping Programs $_____

c. Public Education and Outreach Program $____

d. Total $_____

7. If applicable, what types of groups did you offer grant funding to? (Please choose as many as apply)

   a. States ___

   b. Counties ___

   c. Cities ___

   d. Community groups ___

   e. Law enforcement ___

   f. Other (list) _____

8. How much litter did your agency or organization collect in the last year for which data exists? This can include both direct litter collection in addition to volunteer community collection events that you sponsored or organized. Please enter "O" if your organization did not engage in litter collection efforts.

   _____ (Tons); or

   _____ (Pounds); or

   _____ (Cubic Yards).

9. How much waste from illegal dump sites did your agency or organization collect in the last year for which data exists? Please enter "O" if your organization did not engage in illegal dump collection or remediation efforts.

   _____ (Tons); or

   _____ (Pounds); or

   _____ (Cubic Yards).

10. Is there other important information about your litter efforts that is not covered in the questions above?

4. For Educational Institutions

During the most recent year that data are available for, how much did your school district or college/university expense for litter-related collection and prevention efforts? Please include any costs for contractors who may have performed these services for you.

1. What is the name of your school district or university? _____

2. For which year are you reporting data? _____

3. What were your expenses related to litter, including contractors who may have performed these services for you? Please itemize expenses if known; otherwise enter a total at the bottom.

    a. Litter Collection and/or Disposal $ _____
    b. Illegal Dumping $ _____
    c. Education and outreach programs on litter $ _____
    d. Total Costs ($) _____

4. Did your school district or college/university receive litter related grants or other outside litter funding?

    a. Yes ____
    b. No _____
    c. If "Yes," enter amount $_____

5. If you answered "Yes," to question 5 above, who were the major sources of the grants?

    a. States __
    b. Counties __
    c. Cities __
    d. Community Groups __

6. Did you award any litter related grants?

    a. Yes ____
    b. No ____
    c. If "Yes," what was the aggregate dollar amount of the awards? $_____

7. How much litter did your school district or college/university collect last year? Please enter "0" if you did not engage in litter collection efforts.

    a. _____(Tons); or

b. _____(Pounds); or
c. _____ (Cubic Yards).

8. How much waste from illegal dumpsites did your school district or college/university collect last year? Please enter "0" if you did not engage in illegal dump remediation efforts.

   a. _____(Tons); or
   b. _____(Pounds); or
   c. _____ (Cubic Yards).

9. What is the size of the total student body at this school district or campus? _____

In the likely event that the educational institutions contacted did not keep records of, nor document the amount of time or costs related to litter collection efforts within or on their property, additional follow-up questions were asked. The response to these additional questions provided MSW Consultants a means to estimate the annual tons and collection and disposal costs ourselves, which were then extrapolated to the universe of educational institutions as a whole.

1. Please estimate how many tons or number of plastic bags (with size as small, medium, or large) that are collected from your educational institution.

   _____ Tons (Circle one - daily, weekly, monthly); or

   _____ Number of bags collected (Circle one – daily, weekly, monthly).

2. Please approximate the number of man-hours per week utilized to collect litter.

   (You can calculate by using, for example, 10% of a person's time 40 hours per week performing his/hers normal work duties taken up by collecting litter)

   ____ Employee number 1: hours per week

   ____ Employee number 2: hours per week

   ____ Employee number 3: hours per week

   ____ Employee number 4: hours per week

   ____ Employee number 5: hours per week

   ____ Employee number 6: hours per week

   ____ Employee number 7: hours per week

   ____ Employee number 8: hours per week

   ____ Employee number 9: hours per week

   ____ Employee number 10: hours per week

3. What is the average pay rate per hour for the personnel who are collecting the litter?

$____ Employee number 1: average hourly pay rate

$____ Employee number 2: average hourly pay rate

$____ Employee number 3: average hourly pay rate

$____ Employee number 4: average hourly pay rate

$____ Employee number 5: average hourly pay rate

$____ Employee number 6: average hourly pay rate

$____ Employee number 7: average hourly pay rate

$____ Employee number 8: average hourly pay rate

$____ Employee number 9: average hourly pay rate

$____ Employee number 10: average hourly pay rate

4. Can you estimate the total percentage of litter disposed with the rest of the trash? (i.e. 3% of the total trash is comprised of litter) _____%

5. How many dumpsters or containers does you school district or college/university utilize? _____

6. What size are the dumpster(s)/container(s)?

____ Dumpster/container number 1 (Circle one – gallons or cubic yards)

____ Dumpster/container number 2 (Circle one – gallons or cubic yards)

____ Dumpster/container number 3 (Circle one – gallons or cubic yards)

____ Dumpster/container number 4 (Circle one – gallons or cubic yards)

____ Dumpster/container number 5 (Circle one – gallons or cubic yards)

____ Dumpster/container number 6 (Circle one – gallons or cubic yards)

____ Dumpster/container number 7 (Circle one – gallons or cubic yards)

____ Dumpster/container number 8 (Circle one – gallons or cubic yards)

____ Dumpster/container number 9 (Circle one – gallons or cubic yards)

____ Dumpster/container number 10 (Circle one – gallons or cubic yards)

7. How often are the dumpster(s)/containers collected? (check one below)

___ One time per week

___ Two times per week

___ Three times per week

___ Four times per week

___ Five times per week

___ Six times per week

8. Please provide or estimate your trash disposal costs (i.e. $800.00 per month)

   $ ____ per week; or

   $ ____ bi-weekly; or

   $ ____ month; or

   $ ____ every three months; or

   $ ____ every four months; or

   $ ____ every six months; or

   $ ____ per year.

9. Within the last year, have you had any illegal dumping on your property that your educational institution had to remove?

   ___ Yes; or

   ___ No.

10. If "Yes" to question 9 above, please estimate how many pounds, tons, or cubic yards were removed.

    ____ pounds; or

    ____ tons; or

    ____ cubic yards.

11. If possible, please estimate the cost ($) and/or time spent removing the waste?

    ____ $ per year

    ____ Hours per year

12. Can you estimate the annual cost to dispose of illegal waste or the percentage of illegal waste of all waste disposed from you normal waste collection?

    $ _____ Annual cost; or

    _____ Percent of illegal waste disposed of in normal waste stream.

5. For Businesses

During the most recent year that data are available for, how much did your business expense for litter-related collection and prevention efforts? Please include any costs for contractors who may have performed these services for you.

1. What is the name of your business? _____

2. For which year are you reporting data? _____

3. What were your expenses related to litter, including contractors who may have performed these services for you? Please itemize expenses if known; otherwise enter a total at the bottom.

    a. Litter Collection and/or Disposal $_____
    b. Illegal Dumping $ _____
    c. Total Costs ($) _____

4. How much litter did your business collect last year? Please enter "0" if you did not engage in litter collection efforts.

    a. _____(Tons); or
    b. _____(Pounds); or
    c. _____ (Cubic Yards).

5. How much waste from illegal dumpsites did your business collect last year? Please enter "0" if you did not engage in illegal dump remediation efforts.

    a. _____(Tons); or
    b. _____(Pounds); or
    c. _____ (Cubic Yards).

6. How many employees work at this location? _____

7. How much land does your business, including any surrounding property, occupy?
    a. Acres ____; or
    b. Square Feet _____.

8. Is there other important information about your litter efforts that is not covered in the questions above? _____.

In the likely event that the businesses contacted did not keep records of, nor document the amount of time or costs related to litter collection efforts within or on their property, an additional 12 follow-up questions were asked. The response to these additional questions provided MSW Consultants a means to estimate the annual tons and collection and disposal costs ourselves, which were then extrapolated to the universe of businesses as a whole.

1. Please estimate how many pounds or number of plastic bags (with size as small, medium, or large) that are collected from your business.

   _____ Pounds (Circle one - daily, weekly, monthly); or

   _____ Number of bags collected (Circle one – daily, weekly, monthly).

2. Please approximate the number of man-hours per week utilized to collect litter.

   (You can calculate by using, for example, 10% of a person's time 40 hours per week performing his/hers normal work duties taken up by collecting litter)

   ____ Employee number 1: hours per week

   ____ Employee number 2: hours per week

   ____ Employee number 3: hours per week

   ____ Employee number 4: hours per week

   ____ Employee number 5: hours per week

3. What is the average pay rate per hour for the personnel who are collecting the litter?

   $____ Employee number 1: average hourly pay rate

   $____ Employee number 2: average hourly pay rate

   $____ Employee number 3: average hourly pay rate

   $____ Employee number 4: average hourly pay rate

   $____ Employee number 5: average hourly pay rate

4. Can you estimate the total percentage of litter disposed with the rest of the trash? (i.e. 3% of the total trash is comprised of litter) _____%

5. How many dumpsters or containers does you company utilize? _____

6. What size are the dumpster(s)/container(s)?

   ____ Dumpster/container number 1(Circle one – gallons or cubic yards)

   ____ Dumpster/container number 2 (Circle one – gallons or cubic yards)

____ Dumpster/container number 3 (Circle one – gallons or cubic yards)

____ Dumpster/container number 4 (Circle one – gallons or cubic yards)

____ Dumpster/container number 5 (Circle one – gallons or cubic yards)

7. How often are the dumpster(s)/containers collected? (check one below)

___ One time per week

___ Two times per week

___ Three times per week

___ Four times per week

___ Five times per week

___ Six times per week

8. Please provide or estimate your trash disposal costs (i.e. $800.00 per month)

$ ____ per week; or

$ ____ bi-weekly; or

$ ____ month; or

$ ____ every three months; or

$ ____ every four months; or

$ ____ every six months; or

$ ____ per year.

9. Within the last year, have you had any illegal dumping on your property that your company had to remove?

___ Yes; or

___ No.

10. If "Yes" to question 9 above, please estimate how many pounds, tons, or cubic yards were removed.

____ pounds; or

____ tons; or

____ cubic yards.

11. If possible, please estimate the cost ($) and/or time spent removing the waste?

____ $ per year

____ Hours per year

12. Can you estimate the annual cost to dispose of illegal waste or the percentage of illegal waste of all waste disposed from you normal waste collection?

    $ _____ Annual cost; or

    _____ Percent of illegal waste disposed of in normal waste stream.

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APPENDIX H

1969 to 2009 Study Comparison

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APPENDIX H – COMPARISON OF THE 1969 AND 2009 NATIONAL LITTER STUDIES

A.1. INTRODUCTION

Keep America Beautiful first commissioned a study of nationwide litter generation in the late 1960s. Published in September 1969, this first study was performed by the Highway Research Board of the National Academy of Sciences – National Academy of Engineering.[1] This report (1969 Study) indicated that it was attempting the first-ever comprehensive analysis of the composition and quantity of litter on the nation's "primary rural highways" in the United States.

Although there have been many state-wide studies conducted in the ensuing decades, no other litter quantification and composition studies that are national in scope have been performed (to the knowledge of the Project Team) since 1969. Consequently, this seminal work represents the only known benchmark to the 2009 National Visible Litter Survey and Litter Cost Study (2009 Study).

It is likely that littering behaviors and the composition of littered items has changed in the almost 40 years between these two national studies. This appendix describes and compares the methodologies used in both the 1969 and 2009 Studies, and subsequently attempts to draw defensible conclusions about the changes in roadside litter that can be drawn from a comparison of the two studies' results.

A.2. OVERVIEW OF 1969 STUDY

The 1969 Study was groundbreaking in several ways. First, it applied statistical sampling techniques to the problem of roadside litter for the purpose of estimating the composition and quantity of litter. Second, it drew samples from 29 states, giving it a legitimate claim to being national in scope. It introduced, or at least tested, a number of concepts that are still relevant to litter analysis today.

The main body of the 1969 Study includes 18 pages of narrative and contains an introduction, a statement of the problem, description of the methodology, presentation of results, and offers summary and conclusion statements. In addition to the main body of the report, the 1969 Study includes eight appendices containing the field forms, sampling procedures, statistical estimation methods, and a list of "special" items noted in the field observations. The last appendix in the 1969 Study contains 86 full-page tables showing statistical results generated by the field data collection effort. This appendix is particularly of interest as it provides statistical tabulations of the study results segregated by:

- **Aggregate weighted results** of all samples (the overall results of the "national" study);
- **State** (29 states participated);
- **Highway Class** (Interstate, Primary, Other, Non-responsive);

[1] "National Study of the Composition of Roadside Litter," a Report from the Highway Engineering Board of the Division of Engineering, National Research Council, National Academy of Sciences – National Academy of Engineering; prepared for Keep America Beautiful; prepared by A. L. Finkner, Director, Statistics Research Division, Research Triangle Institute (Research Triangle Park, NC), September 12, 1969.

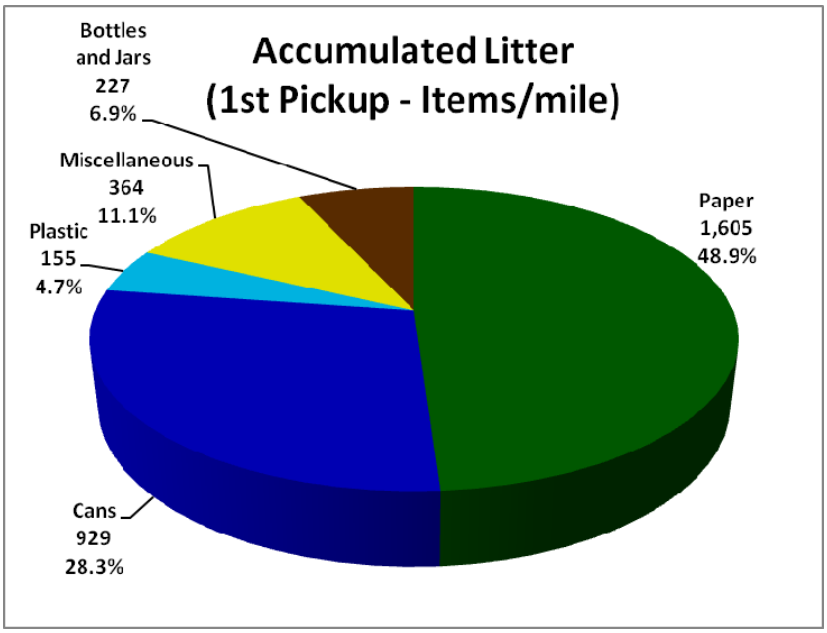
- **Highway Use** (Intercity, Recreational, Local including Farm and Commercial, Cross country, Trunkline, Bypass, Arterial, Other, Non-responsive);
- **Number of Lanes and Median** (Two Lanes, Three Lanes, Four Lanes Not Divided, Four Lanes Divided, Six Lanes Divided, Eight Lanes Divided, Non-responsive);
- **Access Control** (None, Free, Minimum, Partial Limited, Full, Other, Non-responsive);
- **Average Daily Traffic** measured as the number of vehicles traveling over the roadway over a 24 hour period (Less than 400; 400 to 999; 1,000 to 1,999; 2,000 to 2,999; 3,000 to 3,999; 4,000 to 4,999; 5,000 to 9,999; 10,000 to 14,999; 15,000 to 19,999; 20,000 and Over; Non-responsive);
- **Average Width of Right-of-Way** measured in feet from the road's edge to the end of the right-of-way (Avg. Width of Right a Way (< 30, 30 to 49, 50 to 69, 70 to 99, 100 to 149, 150 to 199, 200 to 299, 300 to 499, 500 and Over, Non-responsive);
- **Variability of Width of Right-of-Way** (Constant, Variable, Non-responsive);
- **Roadside Cover** (Grass Alone; Grass with Trees, Shrubs, Vines, etc.; Trees, Shrubs, etc. Mentioned Separately; Sagebrush, Weeds, Etc. with Grass or Alone; Dead Grass, and Grass with Snow; No Cover, Free Shoulders, etc.; Water; Seeded and Strawed; Non-responsive);

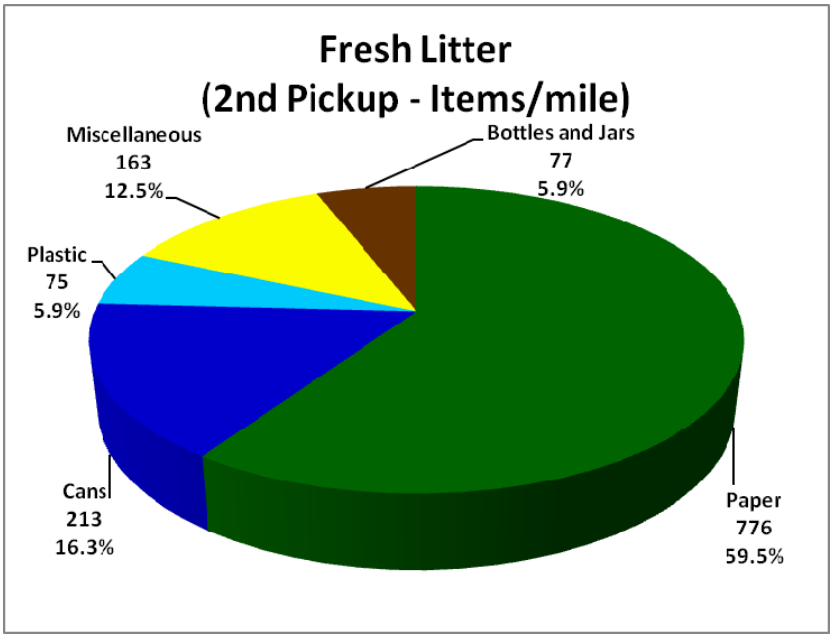
As shown above, the presentation of statistics is extensive. The 1969 Study authors devote some discussion to the limitations that exist in making detailed analysis of the results subsets, stating "this report can examine only a few of the large number of comparisons and relationships that could be studied with the given data. The full tables are presented, however, to allow the reader to examine those aspects which interest him most (p. 6)."

The 1969 Study makes a number of interesting observations, and offers a range of results and conclusions that are of interest. These are itemized below.

- **Accumulated Versus Fresh Litter**: Accumulated litter includes any and all litter that is found the first time a roadway segment is observed. Accumulated litter may have been in situ for one day, or for one year or even longer. No attempt is made to discern or correct for the length of time litter has been on the ground. Accumulated litter is measured the first time field data collection is performed at any given roadway segment. Alternatively, fresh litter is measured on roadway segments where a first visit has been performed to remove accumulated litter, such that any subsequent litter occurs on a clean roadway segment (and therefore that litter is "fresh"). The 1969 Study reports both the accumulated litter data (i.e., the first time the roadway segments were observed and the litter picked up) and the fresh litter (i.e., the second time the same roadway segment was observed and the litter picked up). Interestingly, the 1969 Study authors indicate that analysis and interpretations of the 1969 Study should be based primarily on the fresh litter results (p. 11). Both the accumulated and fresh litter results are equally informative, although only the accumulated litter results are comparable to the 2009 Study.
- **Litter Composition**: The 1969 Study's primary objective was to determine the composition of roadside litter. Figure H-1 shows pie charts that break down litter composition by the five material groups defined in the Study. As shown, paper items comprised the majority of fresh litter (almost 60 percent), but less than 50 percent of accumulated litter. This reduction in paper magnifies the apparent percentage increases in the other litter types. The 1969 Study authors offer the theory that paper contributes more highly to fresh litter than accumulated litter because it deteriorates faster than other items and is also more subject to being windblown out of the roadside right-of-way, both diminishing the contribution of paper to accumulated litter counts.

Figure H-1 Composition of Litter as Reported in 1969 Study





- **Total Litter Generation**: Figure H-1 above also shows the observed pieces of litter per mile. Specifically, the 1969 Study found that there were 3,279 pieces of accumulated litter per mile, and 1,304 pieces of fresh litter per mile. This was found to equate to three cubic yards (82 cubic feet) of accumulated litter per mile and one cubic yard (29 cubic feet) of fresh litter per mile, respectively. The confidence intervals reported in the 1969 Study confirm that these estimates

are within 8 to 12 percent at a 95 percent level of confidence. Table H-2 shows the accumulated and fresh litter generation reported in the 1969 Study for the aggregate, national results.

Table H-1 1969 Study Results – Roadside Litter Composition

Litter Type	Accumulated Litter		Fresh Litter	
	Pieces/Mile	Percent	Pieces/Mile	Percent
Newspapers or Magazines	58	1.77%	25	1.89%
Paper Packages or Containers	352	10.73%	150	11.52%
Other Paper Items	1,195	36.43%	601	46.08%
Subtotal Paper Items	*1,605*	*48.93%*	*776*	*59.49%*
Beer Cans	710	21.65%	153	11.75%
Soft Drink Cans	143	4.36%	40	3.11%
Food Cans	33	1.01%	8	0.64%
Other Cans	43	1.31%	11	0.82%
Subtotal Cans	*929*	*28.32%*	*213*	*16.32%*
Plastic Packages or Containers	63	1.92%	34	2.57%
Other Plastic Items	92	2.80%	42	3.20%
Subtotal Plastic Items	*155*	*4.73%*	*75*	*5.77%*
Auto Parts and Accessories (Not tires)	27	0.82%	11	0.83%
Tires (or tire pieces)	99	3.02%	39	3.00%
Lumber or Construction Items	87	2.65%	52	3.97%
Unclassified Items	151	4.60%	62	4.73%
Subtotal Miscellaneous Items	*364*	*11.10%*	*163*	*12.53%*
Returnable Beer Bottles	13	0.40%	5	0.41%
Non Returnable Beer Bottles	90	2.74%	30	2.31%
Returnable Soft Drink Bottles	53	1.62%	21	1.62%
Non Returnable Soft Drink Bottles	26	0.79%	7	0.51%
Wine or Liquor Bottles	25	0.76%	8	0.64%
Food Bottles or Jars	8	0.24%	3	0.22%
Other Bottles or Jars	12	0.37%	2	0.17%
Subtotal Bottles and Jars	*227*	*6.92%*	*77*	*5.88%*
Total	**3,279**	**100%**	**1,304**	**100%**

Source: Appendix VII, Table A-01. Totals may not sum precisely due to rounding.

- **Paper is Predominant**: As shown above, paper was the most commonly littered item in 1969, whether accumulated or fresh litter was observed. Within the Paper material group, 36 to 46 percent of all litter was labeled as "Other Miscellaneous Paper." This is one of the reasons that paper categories have been greatly expanded in subsequent studies, and the 2009 Study contained 12 paper categories.
- **Bottles, Jars and Cans:** Over 35 percent of observed litter items per mile were found to be bottles, jars and cans, with over 20 percent being beer cans. This data point suggests that the 1969 Study focused primarily on larger items of litter, rather than on every scrap of material that may have been visible. Had smaller items of litter been tabulated in the study, it is unlikely that over one-third of all litter items would have been bottles jars and cans.
- **Cigarette Butts**: Notably absent from the 1969 Study results are cigarette butts. Field forms contained in Appendix IV explicitly indicate that "pieces of the size of cigarette or gum wrappers should not be counted." Recent visible litter studies that have counted cigarette butts show that cigarette butts tend to be the predominant item in roadside litter. From the available evidence in the 1969 Study, including the absence of cigarette butts and the exclusion of paper items similar to or smaller than "cigarette or gum wrappers" in the 1969 study, the focus of the study was primarily on larger items of litter that would have been clearly visible to a pedestrian surveyor.
- **Variability of State Results**: The 1969 Study comments that most of the state-specific results mirrored the aggregate results of the study, although variability from state to state was much wider. This is to be expected given the relatively small sample sizes within each state (from 5 to 15 samples per state).
- **Comparison of Results by Roadway Type**: The 1969 Study points out that litter volume was greater on interstate roads compared to primary highways. Detailed results by road type are shown in Table H-2. As shown, there was 60 percent more accumulated litter on interstate roads, and over one and one half times more fresh litter on interstate roads. It is also noteworthy that five times as many samples were obtained from primary roads compared to interstates. At a minimum, this suggests that the national aggregate results reported in the 1969 Study are weighted towards litter on primary roads rather than interstates, which appropriately reflects the distribution of roadways.

Table H-2 1969 Study Results – Litter Comparison by Road Type

Road Type	Number of Samples	Accumulated Pieces/Mile	Fresh Pieces/Mile
Interstate	39	5,344	2,844
Primary	205	3,298	1,082
Other	33	1,818	1,395
Non-Responsive	11	3,180	1,566
Totals	**290**	**3,279**	**1,304**

Source: Appendix VII, Tables C-01 through C-04.

- **Comparison of Results by Highway Use**: The 1969 Study authors also comment on the differences in litter by roadway usage. These data are summarized in Table H-3. It was

reasoned in the 1969 Study that recreational roads were found to have less litter primarily because litter surveying took place predominantly in the fall and winter. Low sample sizes limit the ability to compare some of the road uses.

Table H-3 1969 Study Results – Litter Comparison by Road Use

Road Use	Number of Samples	Accumulated Pieces/Mile	Fresh Pieces/Mile
Intercity	49	4,062	1,205
Recreational	47	2,168	548
Local including Farm & Commercial	58	2,586	1,543
Cross Country	95	4,035	1,348
Trunkline	3	1,916	800
Bypass	2	5,382	2,754
Arterial	8	3,206	2,171
Intercity	1	985	580
Other	27	3,237	1,400
Non-Responsive	49	4,062	1,205
Totals	**290**	**3,279**	**1,304**

Source: Appendix VII, Tables D-01 through D-09.

- **Comparison of Results by Lanes and Median**: The 1969 Study also comments on the differences in litter volume by roadway usage. Not surprisingly, the 1969 Study found that the quantity of litter increases as the number of lanes increases, although there were very small sample sizes for several of these strata. It was also noted that the composition of litter did not vary dramatically based on lanes. Of particular relevance to the 2009 Study, it should be noted that the vast majority of samples in the 1969 Study were taken on two lane highways. This highlights the rural focus of the 1969 Study. These data are summarized in Table H-4.

Table H-4 1969 Study Results – Litter Comparison by Lane Characteristics

Lanes and Median	Number of Samples	Accumulated Pieces/Mile	Fresh Pieces/Mile
Two Lanes	224	2,607	943
Three Lanes	5	4,279	815
Four Lanes - Not Divided	2	4,305	1,315
Four Lanes - Divided	54	5,509	2,606
Six Lanes - Divided	2	3,297	2,378
Eight Lanes - Divided	1	21,675	8,560
Non Response	2	2,060	865
Totals	**290**	**3,279**	**1,304**

Source: Appendix VII, Tables E-01 through E-07.

- **Comparison of Results by Road Access Control**: Access control refers to roadway segments with access restricted to a limited number of entrance and exits. As shown, the majority of samples were obtained from non-access controlled roads. These data are summarized in Table H-5.

Table H-5 1969 Study Results – Litter Comparison by Road Access Control

Access Control	Number of Samples	Accumulated Pieces/Mile	Fresh Pieces/Mile
None, Free, Minimum	210	2,738	959
Partial Limited	16	4,527	1,742
Full	50	5,623	2,759
Other	1	0	325
Non Response	13	2,604	1,536
Totals	**290**	**3,279**	**1,304**

Source: Appendix VII, Tables F-01 through F-05.

- **Comparison of Results by Average Daily Traffic Volume**: Daily traffic volume refers to the number of vehicles that pass the section of roadway in a 24 hours period. The 1969 Study found a positive relationship between average daily traffic volume and litter volume. These data are summarized in Table H-6.

Table H-6 1969 Study Results – Litter Comparison by Daily Traffic Volume

Daily Traffic Volume (vehicles per 24 hours)	Number of Samples	Accumulated Pieces/Mile	Fresh Pieces/Mile
Less than 400	19	1,429	326
400 to 999	43	1,972	568
1,000 to 1,999	57	2,212	900
2,000 to 2,999	45	3,096	941
3,000 to 3,999	19	3,029	1,225
4,000 to 4,999	18	3,867	1,299
5,000 to 9,999	26	6,347	2,886
10,000 to 14,999	17	5,346	2,266
15,000 to 19,999	6	7,436	3,465
20,000 and Over	9	9,070	10,368
Non Response	33	3,790	1,205
Totals	**290**	**3,279**	**1,304**

Source: Appendix VII, Tables G-01 through G-11.

- **Comparison of Results by Width of Right-of-Way**: Most of the visible litter studies performed in the past decade have focused on a relatively narrow band of the right-of-way (ROW) directly adjacent to the roadway edge. The 1969 Study did not limit the width of the right-of-way to be measured, and consequently has tabulated litter volume and composition in some samples more than 500 feet from the road's edge. The 1969 Study found a positive relationship between the width of the ROW and the volume of litter. Given that the 2009 Study measured only the first 15 feet of ROW, this difference is one of the most critical to consider when comparing the 1969 and 2009 Study results. Litter counts by width of right-of-way are summarized in Table H-7.

Table H-7 1969 Study Results – Litter Comparison by Width of Right-of-Way

Average Width of Right-of-Way (feet)	Number of Samples	Accumulated Pieces/Mile	Fresh Pieces/Mile
< 30	3	3,241	263
30 to 49	11	1,571	624
50 to 69	54	2,005	949
70 to 99	43	2,476	769
100 to 149	70	2,890	1,065
150 to 199	27	3,471	1,011
200 to 299	36	3,544	1,178
300 to 499	36	6,968	3,573
500 and Over	5	6,857	1,668
Non Response	5	4,471	1,384
Totals	**290**	**3,279**	**1,304**

Source: Appendix VII, Tables H-01 through H-10.

- **Comparison of Results by Variability of Right-of-Way**: The 1969 Study also compared litter volume and composition on roadway segments with even and variable right-of-way widths. No significant differences were noted. These data are summarized in Table H-8.

Table H-8 1969 Study Results – Litter Comparison by Variability of Right-of-Way

Variability of Right-of-Way (feet)	Number of Samples	Accumulated Pieces/Mile	Fresh Pieces/Mile
Constant	210	3,182	1,050
Variable	35	4,969	2,635
Non Response	45	2,763	1,248
Totals	**290**	**3,279**	**1,304**

Source: Appendix VII, Tables I-01 through I-03.

- **Comparison of Results by Roadside Cover**: The 1969 Study recorded characteristics about the roadside cover, paying particular attention to woody versus grass right-or-ways. These data reflect a wide range of roadside cover areas, comparable to the 2009 Study, and are summarized in Table H-9.

Table H-9 1969 Study Results – Litter Comparison by Roadside Cover Type

Average Width of Right-of-Way (feet)	Number of Samples	Accumulated Pieces/Mile	Fresh Pieces/Mile
Grass Alone	152	3,097	1,163
Grass with Trees, Shrubs, Vines, etc.	67	3,331	1,171
Trees, Shrubs, etc. Mentioned Separately	6	3,690	1,182
Sagebrush, Weeds, Etc. with Grass or Alone	37	3,698	1,079
Dead Grass, and Grass with Snow	9	1,148	1,500
No Cover, Free Shoulders, etc.	9	4,153	868
Water	1	2,695	920
Seeded and Strawed	1	0	325
Non Response	8	9,303	12,451
Totals	**290**	**3,279**	**1,304**

Source: Appendix VII, Tables J-01 through J-09.

- **Special Interest Items**: The 1969 Study contains a two page appendix that lists roughly 150 items that were labeled "special interest" items. The special interest items range in size from extremely large (telephone pole, washing machine) to very small (2 coins, 4 pens, 1 nut/bolt, 1 dice), and span all material types. Dead animals, both domestic and wild, are listed. No specific definition of "special interest" is provided, and it appears that these items were listed primarily because of their novelty, not because of any particular contribution made to the overall study and analysis.

Because of the length of the 1969 Study, it is not feasible to include the entire study as an appendix to the 2009 Study. However, detailed data for each of the results summarized in the bullets and tables above are included in this appendix in Exhibit H-1.

A.3. COMPARISON OF METHODOLOGIES USED

There are numerous differences in the study used for the 1969 and 2009 Studies. Some of these differences are minor, but others materially impact one's ability to compare the results of the two studies. The columns below intend to compare and contrast the two studies. Page numbers from the 1969 Study are referenced parenthetically for certain assumptions that were not clearly stated.

Table H-10 Comparison of 1969 and 2009 Study Methodologies

Study Parameter	1969 Study	2009 Study
Participating States	29	46 states sampled based on roadway miles
Roadway Types	Interstate highways and Primary roads (p. 4)	All roads representatively sampled
Roadways Type Defined by	Each participating state defined the roadways to the best of their ability (p. 4)	FHWA, U.S. Census Bureau MAF/TIGER GIS database
Demographic Areas	Rural Roads (see Foreword)	Both Urban and Rural Roads
Seasonal Representation	Most samples obtained in October or November; some samples obtained the following spring (p. 3)	All samples obtained in the summer months of July and August
Type of Litter Measured	Accumulated and Fresh	Accumulated
Random Sampling of Roadside Segments	Yes	Yes
Total Samples Taken	290	240
Length of Roadway Segment	2/10ths of a mile or 1,056 feet	300 feet
Width of Right-of-Way (ROW) Measured	Entire ROW to depths up to and beyond 500 feet	15 feet from edge of road
Litter Particle Size	Not clearly stated; available evidence suggests a focus on larger, intact items of litter	Two strata to capture all litter: 4 inches and larger; and less than 4 inches
Data Collection Staff	State Department of Transportation employees (multiple data collectors from each participating state)	Dedicated professional field survey team
Litter Metrics Used	Litter volume per mile; Pieces of litter per mile	Pieces of litter per mile
Sampling Error Provided in Study Results	Yes	No
Individual Material Categories	20	64
Definition of Glass	Includes only container glass	Includes container glass and all other glass
Definition of Metal	Includes only metal cans	Includes metal cans and all other metal

Many of these differences do not materially impact the ability to compare the results, and both studies provide subsets of the collected data such that it is possible to match up comparable data to

a significant extent. The following differences between the studies, however, require particular attention and/or adjustment to enable a reasonable comparison:

- **Urban/Rural Focus**: The 1969 Study clearly focuses on rural roads, while the 2009 Study attempts to capture both urban and rural roads representatively. When comparing the two studies, it is appropriate to compare results from rural areas.
- **Road Type**: The 1969 Study focuses on roadway types defined as being either interstate or primary. The 2009 Study attempts to segregate roadway types based on the entity responsible for litter removal on the roads, and therefore roads are classified as national, state, county and municipal. Mapping for the road types was based on data provided by FHWA. Interstate roads (1969 Study) are a subset of national roads (2009 Study), while primary roads (1969 Study) map to either national or state roads (2009 Study). As shown below, regardless of how the data are mapped, the conclusions do not change.
- **Accumulated Litter**: The 2009 Study focused strictly on accumulated litter, and consequently all comparative data reflects only the accumulated litter data from the 1969 Study.
- **Litter Particle Size**: The 2009 Study sought to measure all litter, and provides data on both large (greater than 4 inches) and total litter items. Category descriptions in the 1969 Study suggest that it sought to quantify primarily "large" items that were intact and readily visible to field surveyors. Consequently, all comparative data reflects only larger litter items.
- **Width of Right-of-Way**: A major difference in the two studies is the width of right-of-way measured. The 1969 Study provides data for right-of-way widths up to and beyond 500 feet from the road's edge. Clearly, this is not comparable to the 2009 Study, which only measured litter in the first 15 feet. Fortunately, the 1969 Study provided data separately for nine bands of ROW width. As there is a linear relationship between the width of the right-of-way and the number of litter pieces per mile, a linear regression analysis of these data was conducted in order to estimate the expected pieces per mile at a ROW width of 15 feet. The results of the regression analysis are shown in Table H-11. This analysis suggests that the number of litter items within 15 feet of the ROW amounts to between 39 and 61 percent of all litter items for the entire ROW width. Therefore, reported results from the 1969 Study should be reduced by 39 to 61 percent, or an average of 50 percent, to reflect only the first 15 feet of the ROW.

Table H-11 1969 Study Results – Correlation of ROW Width to Litter Items per Mile

ROW Width			No. of Samples	Pieces/ Mile	Estimated Pieces/Mile, All Data [1]	Estimated Pieces/ Mile, Adjusted [2]
Min	Max	Average				
0	30	15	3	3,241	2,293	1,285
30	49	39.5	11	1,571	2,461	1,618
50	69	59.5	54	2,005	2,598	1,889
70	99	84.5	43	2,476	2,769	2,229
100	149	124.5	70	2,890	3,042	2,772
150	199	174.5	27	3,471	3,385	3,451
200	299	249.5	36	3,554	3,898	4,470
300	499	399.5	36	6,969	4,924	6,507
500	unknown [3]	800 [3]	5	6,857	7,665	9,231

[1] Results of a linear regression of the pieces per mile and average ROW width for all ROW strata.

[2] Results of a linear regression of the pieces per mile and average ROW for all ROW strata for which more than 10 samples were obtained in the 1969 Study.

[3] The maximum width of ROWs varies from state to state, and may have evolved over time since the 1969 Study was performed. The average number shown is intended to reflect a reasonable estimate for the five samples that were classified as having more than 500 foot width of ROW.

A.4. CONCLUSION

Comparing the 1969 and 2009 Studies required detailed analysis and adjustments to the 1969 Study data to align the results. It is possible to draw defensible conclusions about changes in overall litter quantities per mile, as well as changes to the number of items per mile of five major material groups as well as beverage containers.

Table H-12 shows the raw data reported by both studies for large litter items on rural roadways. While a precise comparison is difficult to establish – due to complex changes such as population growth, roadway expansion and packaging changes – the unadjusted data show that litter has declined significantly since 1969. Based on the unadjusted results, there are close to 80 percent fewer items of litter per mile on our nation's rural roadways. Despite the overall decrease in the unadjusted litter items per mile, plastic litter items per mile increased by 49 to 91 percent (unadjusted).

Table H-12 Comparison of Unadjusted Results, 1969 and 2009 Study

	1969 Study, Items/Mile		2009 Study, Items/Mile		Change	
Material	Interstate	Primary	National	State	Interstate/ National	Primary/ State
Paper	2,621	1,635	259	255	-90.1%	-84.4%
Metal	1,197	983	121	77	-89.9%	-92.1%
Plastic	220	165	328	316	49.0%	91.4%
Misc	1,067	291	506	246	-52.6%	-15.4%
Glass	239	224	12	23	-95.2%	-89.7%
Total	**5,344**	**3,298**	**1,226**	**918**	**-77.1%**	**-72.2%**
Beverage Containers [1]	1,308	1,110	405	170	-69.0%	-84.7%
Samples	*39*	*205*	*30*	*30*		

[1] Beverage containers were segregated in both the 1969 and 2009 Studies and are shown separately. Data from the 2009 Study includes all beverage containers, regardless of size.

A more accurate comparison requires adjusting the 1969 Study results to reflect only the first 15 feet of ROW. This adjustment reduces the 1969 Study raw data by an average of 46 percent. Table H-13 shows the comparison of 1969 Study results, adjusted for ROW width, to the 2009 Study. Of particular interest, this comparison draws similar conclusions to the comparison of raw data. The ROW-adjusted data show that litter has declined between 40 and 51 percent since 1969, but plastic litter has increased 221 to 313 percent.[2] Whether the raw or adjusted data are used, the overall trends of "less overall litter" and "more plastic litter" remain the same.

[2] Note that average adjustments are utilized in this analysis. Arguments could be made to rely on minimum or maximum threshold assumptions in some cases. Such changes to the underlying assumptions change the magnitude of the increase or decrease, but do not materially change the macro level comparison.

Table H-13 Comparison of 1969 and 2009 Study Results, Adjusted for ROW Width

	1969 Study, Adjusted Items/Mile [1]		2009 Study, Items/Mile		Change	
Material	Interstate	Primary	National	State	Interstate/ National	Primary/ State
Paper	1,216	758	259	255	-78.7%	-66.3%
Metal	555	456	121	77	-78.2%	-83.0%
Plastic	102	77	328	316	221.1%	312.7%
Misc	495	135	506	246	2.3%	82.4%
Glass	111	104	12	23	-89.6%	-77.7%
Total	**2,479**	**1,530**	**1,226**	**918**	**-50.5%**	**-40.0%**
Beverage Containers [2]	607	515	405	170	-33.2%	-67.0%

[1] Results of a linear regression of the pieces per mile and average ROW width for all ROW strata.

[2] Beverage containers were segregated in both the 1969 and 2009 Studies and are shown separately. Data from the 2009 Study includes all beverage containers, regardless of size.

As a final consideration, the U.S. population has increased by 50 percent since 1969, from 200 million people to 300 million people. All else being equal, it would be expected that the number of litter items per mile would increase by roughly the same percentage as the overall population. However, this is not the case. As litter education, removal efforts and expenditures have changed, so has the quantity and composition of litter observed along roadways.

A final adjustment to normalize for population growth since the 1969 Study data in effect escalates the results by 50 percent to capture the impact of increasing the population to 2008 levels. Table H-14 shows the comparison of population-normalized and ROW-adjusted 1969 Study results to the 2009 Study. Once again, this comparison reflects less overall litter (declines of 60 to 67 percent) and more plastic litter (114 to 175 percent increase).

Table H-14 Comparison of 1969 and 2009 Study Results, Adjusted for ROW Width and Normalized for U.S. Population Growth

	1969 Study, Adjusted Items/Mile [1]		2009 Study, Items/Mile		Change	
Material	Interstate	Primary	National	State	Interstate/ National	Primary/ State
Paper	1,823	1,138	259	255	-85.8%	-77.6%
Metal	833	684	121	77	-85.4%	-88.7%
Plastic	153	115	328	316	114.1%	175.1%
Misc	742	202	506	246	-31.8%	21.6%
Glass	166	156	12	23	-93.1%	-85.1%
Total	**3,718**	**2,294**	**1,226**	**918**	**-67.0%**	**-60.0%**
Beverage Containers [1]	910	772	405	170	-55.5%	-78.0%

[1] Beverage containers were segregated in both the 1969 and 2009 Studies and are shown separately. Data from the 2009 Study includes all beverage containers, regardless of size.

In order to concisely report results of this comparative analysis, a weighted estimate of the changes to roadside visible litter since 1969 was developed. The 1969 Study reported a total of 39 samples (16.0 percent) from interstates, and 205 samples (84.0 percent) from primary roads. These sample counts represent the weighting factors used for combining the interstate and primary roads, to arrive at a weighted estimate of the changes to litter since 1969. Table H-15 provides the weighted average changes in visible litter on rural roads from the 1969 Study to the 2009 Study.

Table H-15 Comparison of 1969 and 2009 Study Results: Visible Litter on Rural Interstates and Primary Roads

Material	Change in Litter
Paper	-78.9%
Metal	-88.2%
Plastic	165.4%
Misc	13.1%
Glass	-86.4%
Total	**-61.1%**
Beverage Containers [1]	-74.4%

[1] Beverage containers were segregated in both the 1969 and 2009 Studies and are shown separately.

Several significant conclusions can be drawn when comparing the 1969 and 2009 litter surveys:

- The actual count of overall litter is down by 61% since 1969.

- This decrease, a result of successful education, ongoing cleanup efforts and changes in packaging, is reflected in dramatic reductions of paper, metal and glass litter since 1969.
- Plastic litter has increased by 165% since 1969.

These results also indicate a slight increase in miscellaneous litter, which includes automotive parts and accessories, tires and retread, lumber and other construction/demolition/renovation materials, and non-container metals and glass items. Readers should bear in mind that it was not possible to precisely align the materials captured under miscellaneous litter between the 1969 and 2009 Studies, and some of the apparent increase to miscellaneous litter may be the result of a more comprehensive material list used in the 2008 Study.

All of the data that were used to develop this comparison are available elsewhere in the 2009 Study report, and interested parties are encouraged to evaluate the evidence and available data for themselves.

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