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Thank you!

Executive Summary

1. Overview of 2004 Litter Study

The 1998 Litter Act[1] directed the Washington State Department of Ecology (Ecology) to conduct a statewide litter survey to guide litter prevention and cleanup efforts, building upon previous studies.[2] Shortly thereafter, Ecology's Solid Waste and Financial Assistance Program worked with other state agencies and Cascadia Consulting Group to initiate a litter survey using a new, more extensive study methodology. As specified in the 1998 Litter Act, the 1999 study established baseline information about the distribution, types, and amount of litter in the state, and described citizens' litter attitudes and behaviors. Methodology and results were published in May 2000 and can be viewed on Ecology's Litter Web page.[3]

In the spring of 2002, Ecology launched a targeted advertising effort to reduce litter generation in Washington, using the results of the1999 Litter Study. The new slogan, "Litter and it will hurt," focused on the demographic group most likely to litter: males and young adults.

Ecology contracted with Cascadia Consulting Group for the 2004 Litter Study. The purpose of the 2004 Study was to characterize Washington's litter so Ecology could evaluate littering trends, gauge the effectiveness of cleanup efforts and its advertising campaign and adapt future efforts as needed.

The 2004 Litter Study was as similar as possible to the 1999 Litter Study, with two important exceptions:

- The 2004 Litter Study focused on litter generation and composition on roadways and interchanges, where changes in litter behaviors were most likely to be detected, and did not examine public areas such as parks and recreation areas.[4]
- The method of weighting composite data was changed to a per-pound basis rather than a per-mile basis to increase the accuracy of the overall litter picture.[5]

The results of this 2004 Litter Study and comparisons with the 1999 study are presented in this report.

To the extent feasible, the 2004 sampling plan specified the same survey sites used in the 1999 study. These sites had been randomly selected from urban and non-urban

[1] Second Substitute House Bill 3058, now part of Chapter 70.93 Revised Code of Washington (RCW).

[2] The State had conducted litter surveys in 1982, 1983, 1985, 1987, and 1990.

[3] http://www.ecy.wa.gov/programs/swfa/litter/public.html

[4] The telephone and focus group survey of attitudes done in 1998-99 was also postponed, due to cost and the probability that significant change would not be detectible in such a short period of time.

[5] See the main report and Appendix H for rationale and results of the new weighting on the 1999 data.

designations statewide within the roadways and interchanges categories. Each of the 115 sites were verified, marked, and initially cleaned in the fall of 2003. Samples were taken in the spring and fall of 2004 by a total of 24 Ecology Youth Corps crews and three sessions of the Clallam County Litter Crew. All crews used the collection protocol specified in the 1999 study.

Cascadia and its partners sorted and characterized the 230 litter samples[6], compiled and analyzed the resulting data using statistically appropriate methods, and then compared the 2004 data with the 1999 data. This report includes these statistical comparisons, as well as detailed information on the quantity and composition of litter in 2004.

2. KEY FINDINGS

Litter generation and composition results are summarized below. Notable findings within the roadway and interchange categories are discussed in Sections 2.1 and 2.2, respectively. Section 2.3 lists key findings from the comparison of litter generation in 1999 and 2004.

2.1 ROADWAYS

- The total amount of litter generated annually on county roads in Washington is greater than the amount generated on state routes and interstates. We can expect to see this because there are considerably more miles of county roads in Washington than any other type. More than 4,000 tons of litter accumulated on county roads in 2004, and more than 1,200 tons accumulated on state routes. Total generation was least on interstates, at 682 tons.
- The total amount of litter generated per mile of roadway is found on Interstates. Interstates accumulate about 2,372 pounds – or slightly less than one and a quarter tons – of litter per mile per year. State routes accumulate 404 pounds of litter per mile per year, and county roads 217 pounds.
- Per mile driven, state routes receive more litter than interstates. In 2004, state routes averaged 0.15 pounds per 1,000 miles driven, while interstates averaged 0.09 pounds.
- In general, the amount of litter generated per mile on urban roads is greater than on non-urban:
    - On urban interstates, almost twice as much litter is generated per mile as on non-urban interstates: 3,762 versus 1,920 pounds per mile.
    - Nearly five times as much litter (1,298 pounds per mile) collects on urban state routes as on non-urban state routes (282 pounds per mile).
    - On urban county roads, over 600 pounds per mile is littered, compared with only about 160 pounds per mile on non-urban county roads.

[6] Although a total of 230 samples were characterized, only 222 were included in the analysis because eight samples were discarded due to site interference. Please see Appendix C: Site Directory for information about specific sites.

- *Glass beverage containers*, at 11.9%, constitute the largest single litter item by weight along roadways. Among road types, county roads had the highest percentage of glass beverage containers, at 13.6%, and interstates had the lowest percentage at 2.9%.
- *Other organics*, including yard debris, stumps, firewood, branches, and pruning debris, were 9.8% of roadside litter, by weight, in 2004. These materials constituted over a third of litter on interstates overall and nearly 50% of litter on non-urban interstates.
- *Wood/lumber/particleboard* was common on all three road types. On interstates this material made up nearly 9% of litter, on state routes, about 12%, and on county roads, about 7%.

2.2 INTERCHANGES

- Approximately 443 tons of litter was generated on interchanges in 2004.
- The average weight of material littered per interchange in Washington per year is 1,801 pounds, or nearly one ton.
- Because urban interchanges outnumber non-urban interchanges, and have a higher litter generation rate (1,950 pounds per year compared to 1,491 pounds per year), the amount of litter generated on urban interchanges was estimated to be almost three times as much as on their non-urban counterparts.
- Other organics – such as yard debris, stumps, firewood, branches, and pruning debris – and *tires/auto rubber products* were the top two components of litter found on interchanges in 2004, accounting for about 10% each.

2.3 COMPARISON OF 1999 AND 2004 LITTER STUDIES

2.3.1 CHANGES IN ESTIMATED QUANTITIES OF LITTER

- The estimated amount of litter on Washington roadways decreased from 8,322 tons in 1999 to 6,315 tons in 2004.
- The estimated amount of litter on interchanges in Washington decreased from 617 tons in 1999 to 443 tons in 2004.

2.3.2 STATISTICALLY TESTED CHANGES IN GENERATION RATES

- Statistical tests indicated a strong downward trend in overall litter generation between 1999 and 2004 on county roads and on interchanges, especially in the winter. The tests did not detect a statistically significant decrease in overall litter generation on other road types or on all roadways combined.
- Individual components of litter showed statistically significant decreases between 1999 and 2004. The component *all beverage containers combined* decreased significantly on both interchanges and all roadways combined during this time period.

- *Glass beverage containers* also showed a statistically significant decrease on both interchanges and all roadways combined between 1999 and 2004.
- The decrease in *CDL* (construction and demolition debris, also known as C&D[7])on interchanges was statistically significant. On all road types, CDL showed a strong downward trend.
- The accumulation of *tires/auto rubber products* exhibited a strong downward trend on all road types, except interchanges, between 1999 and 2004.
- The decrease in accumulation of *fast-food containers* on interchanges was statistically significant. On all road types, littering of these containers showed a strong downward trend.
- *All alcoholic beverage containers combined* showed a statistically significant decrease on all road types combined.
- *Glass alcoholic beverage containers* showed a statistically significant decrease on roads, and a strong downward trend on interchanges.
- *Metal alcoholic beverage containers* showed a strong downward trend on all road types in winter, but not for the year as a whole.
- The number of alcoholic beverage containers, as measured in Bottle Equivalents, showed a statistically significant decrease in winter on all road types combined, and a strong downward trend on all roads year-round.
- The number of all beverage containers combined, as measured in Bottle Equivalents, exhibited a strong downward trend on all road types combined in winter, but not for the year as a whole.
- Although not tested statistically, litter generation on interstates seems to have increased since 1999.
- Similarly, *plastic beverage containers* and *plastic alcoholic beverage containers* showed an apparent increase over 1999 generation.

2.3.3 CHANGES IN ESTIMATED COMPOSITION OF LITTER

- For all roadways combined, the portion of litter that is glass decreased from 21% in 1999 to 13% in 2004.
- Several material classes comprised smaller portions of litter found on interchanges in 2004 than in 1999:
  - The portion of litter that is glass decreased from 14% in 1999 to 7% in 2004.
  - The CDL portion decreased from 21% to 13%.
  - The percentage of organics decreased from 16% to about 14%.

[7] For the purposes of this study, CDL is used to refer to construction and demolition debris only. Land-clearing debris was not included.

Litter Generation & Composition Report

1. *Overview of the 2004 Litter Study*

The 1998 Litter Act[8] directed the Washington State Department of Ecology (Ecology) to conduct a statewide litter survey to guide litter prevention and cleanup efforts, building upon previous studies.[9] Shortly thereafter, Ecology's Solid Waste and Financial Assistance Program worked with other state agencies and Cascadia Consulting Group to initiate a litter survey using a new, more extensive study methodology. As specified in the 1998 Litter Act, the 1999 study established baseline information about the distribution, types, and amount of litter in the state, and described citizens' litter attitudes and behaviors. Methodology and results were published in May 2000 and can be viewed on Ecology's Litter Web page.[10]

In the spring of 2002, Ecology launched a targeted advertising effort to reduce litter generation in Washington, using the results of the 1999 Litter Study. The new slogan, "Litter and it will hurt," was aimed at the demographic group most likely to litter: males and young adults. The slogan appeared statewide on billboards, freeway signs, and litterbags. Thirty-second TV and radio spots were aired statewide during Mariners professional baseball games. In 2004 the target expanded to include the two most frequent littering behaviors, cigarette butt disposal and unsecured loads. A brief description of the campaign appears in Appendix G, and more information can be found at Ecology's Litter Web page.[11]

Although Chapter 70.93 RCW states that Ecology shall "...conduct a biennial statewide litter survey...," Ecology negotiated with the state legislature to lengthen the time between surveys to five years. This change increased the probability that a new study would detect changes in litter generation and composition, and saved the state a sizable amount of money.

Ecology contracted with Cascadia Consulting Group for the 2004 Litter Study. The purpose of the 2004 Study was to characterize Washington's litter so that Ecology could evaluate littering trends, gauge the effectiveness of cleanup efforts and its advertising campaign and adapt future efforts as needed.

The 2004 Litter Study was as similar as possible to the 1999 Litter Study with two important exceptions:

- The 2004 Litter Study focused on litter generation and composition on roadways and interchanges, where changes in litter behaviors were most likely to be detected, and did not examine public areas such as parks and recreation areas.[12]

[8] Second Substitute House Bill 3058, now part of Chapter 70.93, Revised Code of Washington (RCW).

[9] The State had conducted litter surveys in 1982, 1983, 1985, 1987, and 1990.

[10] http://www.ecy.wa.gov/programs/swfa/litter/campaign.html

[11] http://www.ecy.wa.gov/programs/swfa/litter/campaign.html

[12] The telephone and focus group survey of attitudes done in 1998-99 was also postponed, due to cost and the probability that significant change would not be detectible in such a short period of time.

- The method of weighting composite data was changed to a per-pound basis rather than a per-mile basis to increase the accuracy of the overall litter picture.[13]

The results of this 2004 Litter Study and comparisons with the 1999 study are presented in this report.

To the extent feasible, the 2004 sampling plan specified the same survey sites used in the 1999 study. These sites had been randomly selected from urban and non-urban designations statewide within the roadways and interchanges categories. Each of these 115 sites were verified, marked, and initially cleaned in the fall of 2003. Samples were taken in the spring and fall of 2004 by a total of 24 Department of Ecology Youth Corps (EYC) crews and three sessions of the Clallam County Chain Gang. All crews used the collection protocol specified in the 1999 study.

Cascadia and its partners sorted and characterized 230 litter samples, using the same methodology and material categories that were used in the 1999 study.[14] They then compiled and analyzed the resulting data using statistically appropriate methods. Data from 2004 were compared with the 1999 data. The main body of this report includes these statistical comparisons, as well as the results of the 2004 sampling in detail. Supplemental information, including litter component categories and definitions, the sampling methodology, the site directory, calculations, composition results by subcategory, field forms, and information about the litter campaign is appended.

Chapter 70.93 of the Revised Code of Washington defines litter as "...*all waste material including but not limited to disposable packages or containers thrown or deposited as herein prohibited and solid waste that is illegally dumped, but not including the wastes of the primary process of mining, logging, sawmilling, farming or manufacturing...*" This definition is applied throughout the study. It is important to note that illegally dumped materials are included in the State's definition of litter. While illegal dumps themselves were not a focus of the study, they were included in the composition analysis, if found within the study area.[15]

This report presents the results of this 2004 Litter Study and comparisons with the 1999 study. Section 2 describes the methodology used to collect and analyze the data contained in this report. Sections 3 and 4 present detailed litter generation and composition results, respectively. Comparisons with the previous study are described in Section 5. Section 6 presents a summary of results.

[13] See Section 5.3 of the main report and Appendix H for rationale and results of the new weighting on the 1999 data.

[14] Although a total of 230 samples were characterized, only 222 were included in the analysis because eight samples were discarded due to site interference. Please see Appendix C for the specific information about each site.

[15] Some interchange sites attract the homeless, and their encampments often resemble illegal dumps. When encountered, crews collected the litter, leaving any bedding, usable clothing, and canned food.

2. SUMMARY OF METHODOLOGY

In 1998, Ecology and the consultant team devoted time and attention to developing a comprehensive sampling methodology that could be replicated in future studies. The 2004 sampling plan was therefore identical to the 1999 sampling plan[16] with the following exceptions:

- Public areas, such as parks, were not included in the 2004 study, which focused on roadways and interchanges. This decision allowed limited budget dollars to be spent on increasing the number of samples from roadways and interchanges in an effort to improve the statistical power of the study.
- The method of weighting composite data was changed to tonnage rather than mileage to increase accuracy of the overall litter picture.
- Some of the sites sampled in 1999 were not sampled in 2004 because they were inaccessible due to construction or snow. Appendix C lists the sites not sampled in 2004, and the new sites chosen to replace them.
- The telephone and focus group survey of attitudes done in 1998-99 was also postponed, due to cost and the probability that significant change would not be detectible in such a short period of time.

2.1 SAMPLING PLAN

Using the 1999 template, Cascadia Consulting Group developed a sampling plan in association with staff from the Department of Ecology's Solid Waste and Financial Assistance Program. A complete description of the 2004 Sampling Plan is in Appendix B.

As in 1999, the sampling strategy was designed to collect and analyze litter samples from representative areas across the state. Two principal site categories were selected for the 2004 study, since they were most likely to show change: roadways and highway interchanges (also known as on- and off-ramps). [17] Roadways were further subdivided into interstates, state routes, and county roads, and both roadways and interchanges were separated into urban and non-urban categories. The 2000 Census data were used to define "urban" in this study, whereas data from the 1990 Census was used in 1999. Table 2-1 provides a summary of the site categories and their respective subcategories.

[16] For a complete description of the 1999 Sampling Plan, please see Appendix B of the 2000 *Washington State Litter Study Volume II -- Generation and Composition Report*, available at http://www.ecy.wa.gov/programs/swfa/litter/public.html#a1.

[17] In early 2003, Ecology contracted with Cascadia Consulting Group to perform power analyses in support of an updated litter study. That report determined how great a reduction (measured as relative percent decrease) in litter generation could be detected by replicating the methodology of the 1999 litter study. Among the conclusions was that "… [t]he power to detect a 10% decrease in overall litter generation on all of Washington's roads…is estimated to be approximately 82%...."

Table 2-1 Site Category and Subcategory Descriptions

Primary Site Category	Subcategory	Further Subcategories
Roadways	Interstates	Urban interstates
		Non-urban interstates
	State routes	Urban state routes
		Non-urban state routes
	County roads	Urban county roads
		Non-urban county roads
Interchanges	Interchanges	Urban interchanges
		Non-urban interchanges

To the extent possible, the 2004 sampling plan specified the same sites and sample areas as the 1999 plan, except as noted above. The sample areas were defined as follows:

- ***Roadways:*** All roadway sample areas were cross-sections, including both shoulders and the median if present. To ensure an adequate sample size, urban interstate, urban state route, and urban county road sample areas were one-tenth of a mile in length. Non-urban interstate sample areas were one-half mile long. Non-urban state route and county road sample areas were one mile long.
- ***Interchanges:*** Interchange sites were also cross-sections, usually including an on-ramp, an off-ramp, and a portion of the median.

After an initial cleanup of each site in the fall of 2003, litter was collected from each sampling area twice – once in the spring and once in the fall of 2004 – to account for seasonal variations. This collection schedule is comparable to the 1999 plan. Ecology Youth Corps median crews cleaned the majority of the sites.[18]

Table 2-2 shows the planned versus actual number of samples sorted for each subcategory in 2004. Although all 230 samples were collected, eight samples were discarded due to *site interference*, as defined in Section 2.3. This decrease in the number of actual samples sorted does not have an appreciable effect on the statistical power or validity of the study.

[18] A few fall samples were collected by EYC youth crews and the three remote sites on the Olympic Peninsula were cleaned and sampled by the Clallam County Litter Crew.

Table 2-2 Planned Versus Actual Sampling by Subcategory

Site Type	Planned Samples	Actual Samples	Difference
Spring			
Interstate Highway	30	29	-1
State Route	29	26	-3
County Road	29	28	-1
Interchange	27	27	0
Fall			
Interstate Highway	30	30	0
State Route	29	27	-2
County Road	29	28	-1
Interchange	27	27	0
TOTAL	**230**	**222**	**-8**

2.2 COLLECTION AND SORTING OF SAMPLES

The spring litter samples were collected between March and May 2004, and the fall samples between August and October 2004. Crews transported the samples to regional storage locations.[19]

Once each collection period was completed, all the samples were transported to central sorting locations in Tacoma and Spokane. There, Sky Valley Associates, a professional waste characterization company, sorted, weighed, and tabulated the litter into component categories, such as *paper beverage containers*, *metal automotive parts*, and *cigarettes*. A complete description of the component categories can be found in Appendix A. In the 2004 study, 230 samples weighing a total of 23.9 tons were collected. For details, please see Appendix B.

2.3 DATA ANALYSIS

With one important exception, the 2004 data analysis methodology was identical to the 1999 analysis. To improve the accuracy of the analysis, the data was *weighted* using a different method in 2004 than in 1999.[20] As a result, the weighted composition estimates presented in Section 4 of this report for all roadways, each roadway category, and interchanges are not directly comparable to those appearing in the 1999 report. The method for weighting the data in 2004 is described in detail in Appendix D. For purposes of comparison, the weighted tables from the 1999 report were recalculated using the 2004 weighting system and appear in Appendix H.

As in 1999, the 2004 roadway subcategories surveyed represent the majority of roadways with high traffic volume and high speeds in the state. The combined data

[19] The litter samples were stored at landfills and transfer stations across the state.

[20] Tonnage, rather than miles, was used to weight the data in the 2004 report, because it is a more accurate indicator of litter on roadways and interchanges.

from the sampled roadway sites provide a general picture of overall litter on roadways statewide. Likewise, the surveyed interchanges represent all interchanges in the state.

As noted above, litter crews collected all litter at each sample site, and all of it was sorted. Exceptions to this rule included the following:

- *Site interference*
  While the Department of Ecology attempted to communicate with all groups that routinely or voluntarily collect litter around the state, some of the groups may have removed litter from selected sites during the course of the study. As a result, litter accumulation rates may have been underestimated. In twenty cases at eighteen sites, Ecology learned that site interference had occurred. Ecology was able to recover the bags of litter in twelve of these cases, thereby restoring the sample so it could be included in the analysis. In eight cases, however, Ecology was unable to recover the bags, so these samples were eliminated from the analysis.
- *Items not recorded*
  For safety reasons, collection crews were instructed to leave certain littered items on site or dispose of them separately. Examples include hazardous materials, explosives, urine-filled bottles, knives, firearms, tissues containing human waste, and extra large or heavy objects. These items were documented, but were not included in the composition data. Table B-5 in Appendix B lists these items.
- *Subsampling*
  When the site sample exceeded 200 pounds, all the material was weighed in bulk and a representative subsample of the combined material was taken, wherein each item was sorted. The result was then extrapolated to the sample as a whole.

As in 1999, litter generation rates were calculated for each subcategory by unit (mile, interchange, or acre) and for the total site category statewide (the "universe").[21] The average per-unit calculation was based on the total weights of the samples collected and sorted. The average total generation statewide was calculated using weighted averages, explained in detail in Appendix B.

Composition estimates were calculated by net weight (tons) and are presented as a percentage of the whole. It is important to note that items with a higher unit weight, such as glass and wood, typically constitute a larger percentage of the overall composition; yet the *volume* of these materials may be less than other litter components that have a lower unit weight, such as aluminum cans and plastic beverage containers.

All composition and generation estimates were calculated using a 90% confidence interval. This means that there is a 90% certainty that the actual quantity is within the calculated range, between the low and high estimates.

[21] The subcategories are urban interstates, non-urban interstates, urban state routes, non-urban state routes, urban county roads, non-urban county roads, urban interchanges, and non-urban interchanges.

3. DETAILED GENERATION RESULTS

The term *litter generation* refers to the quantity of litter that has accumulated over a specific time within a defined area. The quantity of litter generated per year was estimated for each site subcategory, both on a per-unit basis and as a statewide total.

The generation results for roadways and interchanges are presented separately below.[22] Each section contains two tables: the quantity of litter generated per unit in pounds per year, and the total quantity of litter generated in tons per year. The information in these tables was calculated as follows:

- The amount of litter generated per unit in each of the subcategories was calculated using the total weights of the samples collected and sorted. Weighted averages based on the number of road miles or interchanges defined in the universe of sites were used to determine the average litter generation for all roadways, interstates, state routes, county roads, and interchanges.[23] Appendix B contains additional information on weighted averages and a description of the universe of sites.
- To calculate the total tons of litter generated per year for each category, the estimated per-unit generation was multiplied by the number of road miles or interchanges included in the universe.

For interstates and state routes, Cascadia also calculated the amount of litter generated *per mile driven per year*. This calculation provides Ecology with a sense of the amount of litter each automobile generates on these road types and accounts for the differences in traffic counts between urban and non-urban routes. To perform this calculation, the total amount of litter generated per year was divided by the total number of miles driven on interstate or state highways per year.

In 1999, Cascadia calculated the average annual litter generation *per acre* for each category to compare generation of litter on roadways and interchanges with generation in public areas, which were also studied that year. We present this metric again to facilitate comparisons with the 1999 study and to provide another way of considering litter generation on Washington's roadways and interchanges. Table 3-1 presents the average quantity of litter generated within an acre of roadside, including the median, for each roadway and interchange category.[24]

---

[22] Interchanges are not part of the roadway categories, because they represent "a unique sector of the population". Interchanges often *combine* roadway categories, some of which are not included in the sample design. For instance, litter deposited on an interchange on Interstate 90 could be coming from both the interstate and a city street (and city streets were not included in this study).

[23] For example, litter generation on urban interstates is estimated to be 3,762 pounds per mile while the generation on non-urban interstates is estimated to be 1,920 pounds per mile. Since there are more non-urban interstate miles than urban, a weighted average must be used to calculate the average generation of litter per mile for interstates overall to avoid overestimating it. Among the interstate miles included in this study, approximately 25% of the interstate miles are in urban areas while 75% are in non-urban areas. Thus the average generation rate for interstates overall is equal to:
(25% x 3,762) + (75% x 1,920), or roughly 2,372 pounds per mile per year.

[24] The rate of litter generation per acre for each roadway subcategory was calculated by dividing the total amount of litter generated per year by the total acreage of roadside shoulders and medians in the

Table 3-1 Quantity of Litter Generated per Acre, in Pounds per Year

	(Pounds per Acre per Year)		
	Total	**Urban**	**Non-Urban**
ROADS (Interstates, State Routes, & County Roads)	**48**		
Interstates	108	187	83
State Routes	51	92	45
County Roads	47	118	37
INTERCHANGES	**99**	**115**	**65**

3.1 ROADWAYS

Roadway litter consists primarily of waste originating from moving vehicles. It includes litter that drivers or passengers toss from vehicles, parts that have fallen off vehicles, and debris from unsecured loads. To a much lesser extent, it reflects litter from pedestrians.[25] Roadway litter generation was analyzed in three ways: total generation statewide, generation per mile, and generation per mile driven. Each of these analyses is described below.

3.1.1 TOTAL GENERATION

Table 3-2 shows the total amount of litter generated per year on roads statewide, based on an extrapolation of the 2004 sampling results.[26] The total number of miles in each category greatly influences these figures. For example, the total estimated amount of litter generated in tons per year is larger for county roads, because there are approximately 40,500 miles of county roads within Washington State, compared to 575 miles of interstates and 6,200 miles of state routes. Non-urban county roads have the most litter (an estimated 2,806 tons of litter per year), while urban interstates have the least (an estimated 266 tons per year). Overall, an estimated 6,315 tons of material are littered on interstates, state routes, and county roads annually.

universe. The total acreage of roadside shoulders and medians is equal to the average acreage of roadside shoulders and medians per mile (from the site measurements) multiplied by the number of miles in the universe of each category. The area of interchanges was calculated in the same fashion. For more information on the total number of miles and the total number of interchanges in the universe of sites, please see Appendix B.

[25] Pedestrian traffic is prohibited from many of the interstate and state route miles in the state. There may be some pedestrian traffic on the county roads sampled as part of this study. Crews did find litter associated with road construction workers and the homeless.

[26] The total number of tons statewide is calculated by multiplying the average pounds per mile, listed in Table 3-3, by the total number of miles in the universe, and dividing by 2000.

As stated earlier, generation estimates detailed in the following tables were calculated using a 90% confidence interval. This statistical method assures that there is a 90% certainty that the actual quantity is within the calculated range, between the low and high estimates. For example, an estimated 682 tons of litter are generated on interstates per year, plus or minus 139 tons. In this case, the "calculated range" is between 543 and 821 tons, with the most probable value – the mean – being 682 tons per year.

Table 3-2 Total Quantity of Litter Generated on Roadways (Interstates, State Routes, and County Roads), in Tons per Year

Calculated at 90% confidence interval

	(Tons per Year)		
	Mean	**Low**	**High**
Interstates	**682**	**543**	**821**
Urban Interstates	266	204	328
Non-Urban Interstates	416	151	681
State Routes	**1,244**	**1,121**	**1,367**
Urban State Routes	481	241	721
Non-Urban State Routes	763	549	977
County Roads	**4,389**	**3,686**	**5,092**
Urban County Roads	1,582	764	2,401
Non-Urban County Roads	2,806	1,671	3,941
ROADS (Interstates, State Routes, & County Roads)	**6,315**	**6,018**	**6,611**

3.1.2 PER-MILE GENERATION RATES

Table 3-3 shows the number of pounds of litter per mile that accumulate each year in the roadway categories. The greatest amount of litter accumulates on interstates; over one ton of litter collects each year along a typical interstate mile. Each year about a fifth of a ton of litter is discarded along each mile of state routes. Non-urban county roads have the lowest accumulation rate per mile, at an estimated 159 pounds per mile per year.

Table 3-3 Quantity of Litter Generated per Mile on Roadways (Interstates, State Routes, and County Roads), in Pounds per Year

Calculated at 90% confidence interval

	(Pounds per Mile per Year)		
	Mean	**Low**	**High**
Interstates	**2,372**	**1,716**	**3,028**
Urban Interstates	3,762	2,882	4,642
Non-Urban Interstates	1,920	698	3,141
State Routes	**404**	**333**	**475**
Urban State Routes	1,298	650	1,946
Non-Urban State Routes	282	203	361
County Roads	**217**	**169**	**264**
Urban County Roads	606	292	919
Non-Urban County Roads	159	95	223
ROADS (Interstates, State Routes, & County Roads)	**267**	**246**	**288**

3.1.3 GENERATION PER MILE DRIVEN

The total number of road miles in urban areas is less than that of non-urban areas (see Appendix B); however, traffic counts in urban areas are higher than in non-urban areas. To account for the different volumes of traffic using urban and non-urban roads, litter generation rates *per mile driven* were calculated for interstates and state routes.[27] Traffic counts were obtained from the *Washington State Department of Transportation 2003 Annual Traffic Report*.[28]

As Table 3-4 shows, non-urban state routes had approximately 50% more litter per mile driven than urban state routes. The difference between urban and non-urban interstates was more pronounced: 0.05 pounds of litter were generated per 1,000 miles driven on urban interstates, while 0.17 pounds were generated per 1,000 miles driven on non-urban interstates, compared to an average of 0.15 pounds for state routes. Overall, an average of 0.09 pounds of litter per 1,000 miles driven collects on interstates.

Table 3-4 Quantity of Litter Generated per Mile Driven, in Pounds per 1000 Miles Driven

	Litter Generated per Year (lbs)	Miles Driven per Year (in thousands)	Litter Generated per Mile Driven (lbs/1000 miles)
Interstates	**1,364,371**	**15,397,629**	**0.09**
Urban Interstates	531,695	10,433,036	0.05
Non-Urban Interstates	832,676	4,964,593	0.17
State Routes	**2,487,622**	**16,266,079**	**0.15**
Urban State Routes	961,316	8,330,344	0.12
Non-Urban State Routes	1,526,306	7,935,736	0.19

3.2 INTERCHANGES

Litter on interchanges originates primarily from vehicles that are entering or exiting roadways. It also may represent litter discarded on overpasses or blown from the road shoulders. Two analyses were performed on interchange generation data: total generation, and per-interchange generation rates. The results of these analyses are presented below.

3.2.1 TOTAL GENERATION

Table 3-5 indicates that almost three times as much litter is deposited on urban interchanges (324 tons) than on non-urban interchanges (119 tons) per year. Combined, an estimated 443 tons are littered on interchanges overall.

[27] The amount of litter generated per mile driven was calculated for each site category by dividing the total amount of litter generated per year by the total number of miles driven on interstate or state highways per year.

[28] These reports can be found online at http://www.wsdot.wa.gov/mapsdata/tdo/annualtrafficreport.htm.

Table 3-5 Total Quantity of Litter Generated on Interchanges, in Tons per Year

Calculated at a 90% confidence interval

	(Tons per Year)		
	Mean	**Low**	**High**
Interchanges	**443**	**381**	**505**
Urban Interchanges	324	193	455
Non-Urban Interchanges	119	84	154

3.2.2 PER-INTERCHANGE GENERATION RATES

The average weight of litter generated per interchange per year was greater in urban areas than in non-urban areas. As illustrated in Table 3-6, urban interchanges accumulated an average of 1,950 pounds of litter per year, while non-urban interchanges accumulate an average of 1,491 pounds of litter per year.

Table 3-6 Quantity of Litter Generated per Interchange, in Pounds per Year

Calculated at a 90% confidence interval

	(Pounds per Interchange per Year)		
	Mean	**Low**	**High**
Interchanges	**1,801**	**1,419**	**2,183**
Urban Interchanges	1,950	1,160	2,741
Non-Urban Interchanges	1,491	1,052	1,931

4. DETAILED COMPOSITION RESULTS

Litter composition refers to the types of materials found in the litter, such as paper, fast-food waste, or glass beverage containers. Litter was sorted into one of eight broad material classes: **paper**, **plastic**, **glass**, **metal**, **organics**, **CDL** (construction and demolition debris, also known as C&D[29]), **hazardous materials**, and **other materials**.[30] Within these broad material classes, the litter was further sorted into various components, such as *fast-food wastes*, *beverage containers*, *tires/auto rubber products*, etc. A total of 57 component categories of litter were used in this study, each selected to gather information about different types of litter, their sources, and littering behavior. The list of components within the broad material classes, and their definitions, appear in Appendix A.[31]

[29] For the purposes of this study, CDL is used to refer to construction and demolition debris only. Land-clearing debris was not included.

[30] Throughout this report, material classes are designated by bold type to distinguish them from their components, which appear in italics. Items in quotes are groupings of components from different material classes.

[31] The material classes and components are the same as those used in the 1999 study, with one exception. In 1999, pieces of rubber from tires were classified as *tires*. In 2004, these pieces were classified as *automotive rubber*, a change which is more consistent with the component definitions. For this reason, the materials *tires* and *auto rubber products* have been combined for this report.

Collection crews were instructed to leave certain items on site or dispose of them separately to ensure their safety and that of the sorting crews. Examples include hazardous materials, explosives, urine-filled bottles, knives, firearms, hypodermic needles, tissues containing human waste, and extra large or heavy objects. These items were documented, but were not included in the composition data. A tally of these items appears in Table B-5 of Appendix B. Of these materials, urine-filled bottles or other human wastes, items too bulky or heavy to be carried safely, and "other materials" were the most common. The *other materials* component category included dead animals, pet waste, homeless encampment bedding & food, ten pounds of mail (which was turned in to the authorities), and money and toys, which field crews recorded, but kept for reuse.

The composition of litter was estimated for each broad material class and component category based on weight, as is customary in solid waste studies. This practice means that items with a higher weight per unit, such as *glass beverage containers*, often constitute a higher percentage of litter than items with a low weight per unit, such as aluminum cans. For example, a cubic yard of glass bottles weighs from 600 to 1000 pounds, while a cubic yard of aluminum cans weighs just 50 to 75 pounds. Consequently, *glass beverage containers* may be a larger component by weight than aluminum cans, but the cans often have a greater volume. Table 4-1 lists volume-to-weight conversion factors and is included to allow readers to make these comparisons.

Table 4-1 Estimated Litter Volume and Count to Weight Conversion Factors[32]

Material	Volume/Count	Weight in Pounds
Cigarette butts	2,000	1
Cardboard	1 cubic yard	100
One-time fast-food service item*	1	0.2
Mixed plastic containers	1 cubic yard	32-38
Glass bottles	1 cubic yard	600-1,000
Aluminum cans	1 cubic yard	50-75
Auto battery	1	36
Tire, passenger car	1	20
Tire, light truck	1	35
Tire, semi truck	1	105
Wood chips	1 cubic yard	500
Grass clippings	1 cubic yard	400

*One-time fast-food service item include typical fast-food "to-go" items, including paper bags, paper cup with plastic straws, wrappers, napkins, condiment packets, and french fry containers.

As with the generation estimates, each composition estimate was calculated at a 90% confidence interval. Also, weighted averages based on the universe of road miles or interchanges were used to calculate composition estimates for each site category.

[32] Conversions between weight and volume were calculated by Ecology and Cascadia Consulting Group using data from the National Recycling Coalition and the U.S. Environmental Protection Agency.

Detailed composition results for all site subcategories are presented in tables in Appendix E.

Section 4.1 summarizes the overall composition results, and sections 4.2 and 4.3 present the detailed composition results for roadways and interchanges respectively. In each section, a pie chart shows the percent composition of each of the eight broad material classes. A table lists the ten component categories that were the highest percentages of litter composition by weight for each site category. The tables also include the estimated total amount of each component littered annually, presented in tons. A second, more comprehensive table in each section lists the composition percentages of all 57 components.

4.1 OVERALL COMPOSITION

The components listed in Table 4-2 were selected because they represent typical litter or littering behaviors. Of these, *beverage containers*, *other organics*, *wood*, *tires/auto rubber products*, and *automotive products* comprised the larger percentages of litter by weight in each site category. *Other organics* – including yard debris, stumps, firewood, branches, and pruning debris – was the largest component by weight on interstates and interchanges, while *beverage containers* were the top component on state routes and county roads.

Components in Table 4-2 that the average citizen considers litter include "beverage containers", "one-time fast-food service items", "other food and beverage packaging," and *cigarette and other tobacco*. As Table 4-2 shows, "beverage containers" ranged from 3.8% to 17.6% of roadside litter. "One-time fast-food service items" comprised only 1.3% to 2.8% of the litter, while "other food and beverage packaging" accounted for 1.3% to 4.3%. *Cigarettes and other tobacco* comprised 1.1% to 2.8% of littered items. The other components – *wood*, *tires/auto rubber products*, *other organics*, and "automotive" – are not considered "litter" by most people, even though they meet the State's definition of litter, since these items are more likely the result of tire blow-outs, automobile accidents or failures, and improperly secured loads than willful littering.

Table 4-2 Composition by Weight, All Site Categories, Selected Litter Components Combined[33]

	Roads			Interchanges
	Interstates	*State Routes*	*County Roads*	*Interchanges*
Beverage Containers	3.8%	12.8%	17.6%	7.9%
One-time Fast Food Service Items	1.3%	2.2%	2.8%	2.4%
Other Food and Beverage Packaging	1.3%	2.9%	4.3%	2.4%
Non-food Packaging	0.2%	0.7%	0.5%	0.3%
Automotive	7.7%	5.8%	8.9%	8.1%
Tires/Auto Rubber Products	14.7%	9.7%	4.2%	9.9%
Wood/Lumber/Particle Board	8.8%	11.8%	7.2%	9.4%
Food (Human and Pet)	0.6%	1.4%	1.7%	1.4%
Cigarettes and Other Tobacco	1.1%	2.8%	1.8%	1.8%
Other Organics	33.6%	7.8%	6.7%	10.5%

4.2 ROADWAYS

Data from interstates, state routes, and county roads were analyzed separately and then combined to provide an overall picture of roadway litter. Section 4.2.1 presents an overall picture of road litter composition, including a summary of the largest components. Following the composite assessment, each road subcategory is analyzed separately in greater detail.

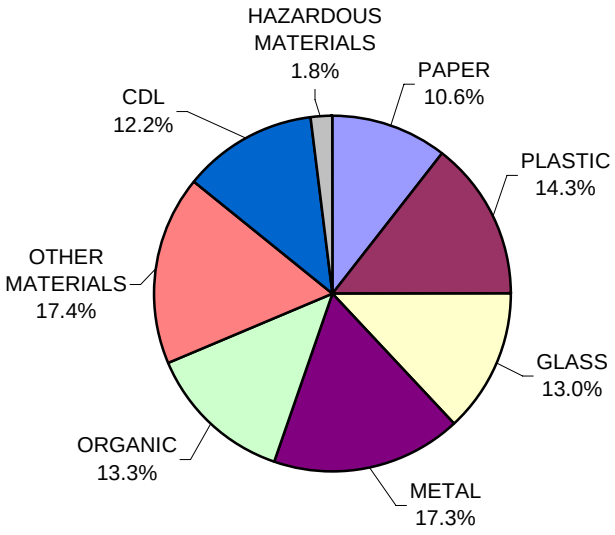
4.2.1 ALL ROADWAYS (INTERSTATES, STATE ROUTES, AND COUNTY ROADS)

Figure 4-1 illustrates the composition of litter on roadways (interstates, state routes, and county roads) by broad material class. **Other materials** and **metal** each accounted for about 17% of total roadway litter.[34] **Hazardous materials** comprised the smallest amount (1.8%) and the other broad material classes each made up about 10% to 14% of the litter deposited on the roadways studied.

[33] "Beverage containers" includes *glass*, *plastic*, *paper*, and *metal beverage containers*. "One-time fast-food service items" includes the components *glass*, *plastic*, *paper*, and *metal one-time fast-food service items*. "Other food & beverage packaging" includes the components *glass*, *plastic*, *paper*, and *metal other food and beverage packaging*. "Non-food packaging" includes the components *glass*, *plastic*, *paper*, and *metal non-food packaging*. "Automotive" includes the components *glass*, *plastic*, and *metal automotive parts*.

[34] **Other materials** includes *tires/auto rubber products*, *rubber and latex toiletries*, *other rubber and latex products*, *disposable diapers*, *textiles and leather*, *carpet*, *furniture/mattresses/appliances*, *ceramics and porcelain*, *toys and sporting goods*, and *other miscellaneous items*.

Figure 4-1 Composition Summary All Roadways (Interstates, State Routes, County Roads)



4.2.1.1 LARGEST COMPONENTS

Table 4-3 lists the composition percentages of the ten largest components of litter found on roadways and the estimated tons generated in one year. The cumulative percentage column is the sum of each component's composition percentage and those that come before it in the table. The composition percentage for all 57 components is shown in the next section

The ten largest litter components accounted for about two-thirds of the litter found on roadways. Consequently, litter classified in the other 47 component categories comprised only about one-third of the litter deposited annually on roadways. *Glass beverage containers* (11.9%), *other organics* (9.8%), and *wood/lumber/particleboard* (8.2%) were the top three components of roadside litter in 2004 by weight. As noted above, the beverage containers are commonly considered "litter," while the other items are not. *Other metals/composite materials* includes such items as toasters, bicycles, and insulated wire. Examples of *other plastics/composite materials* are disposable razors, pens, lighters, toys, and 3-ring binders.

Table 4-3 Top 10 Largest Components by Weight on All Roadways (Interstates, State Routes and County Roads)

Component	Composition Percent	Estimated Tons	Cumulative Percent
Glass Beverage Containers	11.9%	749	11.9%
Other Organics	9.8%	620	21.7%
Wood/Lumber/Particleboard	8.2%	521	29.9%
Other Metals/Composite Materials	7.4%	470	37.4%
Other Plastics/Composite Materials	6.9%	436	44.3%
Tires/Auto Rubber Products	6.4%	403	50.7%
Metal Automotive Parts	6.3%	396	56.9%
Furniture/Mattresses/Appliances	5.2%	331	62.2%
Metal Beverage Containers	3.0%	189	65.2%
Plastic Bags and Film	2.9%	183	68.1%

Table 4-4 presents the detailed composition results of the litter collected along roadways. This table includes both the composition percentage and the estimated amount littered per year for each of the broad material categories and each of their component subcategories. The individual component categories are defined in Appendix A

Table 4-4 Composition by Weight, All Roadways (Interstates, State Routes, and County Roads)

Calculated at a 90% confidence interval

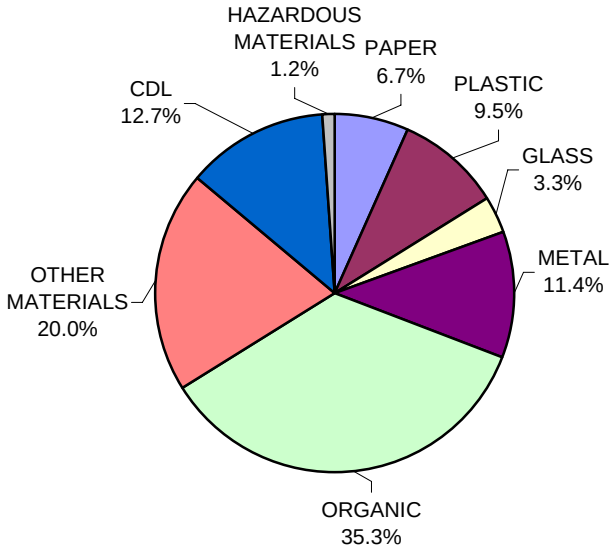
	Tons	Mean %	Low %	High %		Tons	Mean %	Low %	High %
PAPER	**671**	**10.6%**			**ORGANIC**	**840**	**13.3%**		
Beverage Containers	5	0.1%	0.0%	0.1%	Food (Human And Pet)	99	1.6%	1.1%	2.0%
One-Time Fast Food Service Items	102	1.6%	1.3%	1.9%	Cigarettes and Other Tobacco	122	1.9%	1.3%	2.6%
Other Food and Beverage Packaging	94	1.5%	1.1%	1.9%	Other Organics	620	9.8%	7.3%	12.3%
Non-food Packaging	24	0.4%	0.3%	0.5%	**CDL**	**773**	**12.2%**		
Other Cardboard/Boxboard	117	1.8%	1.3%	2.4%	Wood/Lumber/Particleboard	521	8.2%	6.4%	10.1%
Paper Bags	104	1.7%	0.9%	2.4%	Mineral Aggregates	149	2.4%	0.2%	4.5%
Newspapers and Magazines	92	1.5%	0.8%	2.1%	Roofing	36	0.6%	0.3%	0.8%
Other Paper/Composite Materials	134	2.1%	1.7%	2.5%	Insulation	5	0.1%	0.0%	0.1%
PLASTIC	**906**	**14.3%**			Drywall	2	0.0%	0.0%	0.1%
Beverage Containers	14	0.2%	0.1%	0.3%	Other Construction/Demolition Debris	60	1.0%	0.0%	1.9%
One-Time Fast Food Service Items	58	0.9%	0.8%	1.1%	**HAZARDOUS MATERIALS**	**114**	**1.8%**		
Other Food and Beverage Packaging	99	1.6%	1.3%	1.9%	Latex paint	0	0.0%	0.0%	0.0%
Non-food Packaging	6	0.1%	0.0%	0.2%	Oil based paints	3	0.0%	0.0%	0.1%
Plastic Bags and Film	183	2.9%	2.3%	3.5%	Oil	79	1.3%	0.7%	1.8%
Automotive Parts	109	1.7%	1.2%	2.2%	Batteries	16	0.3%	0.1%	0.4%
Other Plastics/Composite Materials	436	6.9%	5.2%	8.6%	Flammable gas	0	0.0%	0.0%	0.0%
GLASS	**818**	**13.0%**			Flammable liquids	0	0.0%	0.0%	0.0%
Beverage Containers	749	11.9%	8.0%	15.7%	Explosives	1	0.0%	0.0%	0.0%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.0%	Pesticides/Herbicides	0	0.0%	0.0%	0.0%
Other Food and Beverage Packaging	6	0.1%	0.0%	0.2%	Cleaners (Hazardous)	0	0.0%	0.0%	0.0%
Non-food Packaging	0	0.0%	0.0%	0.0%	Medical waste	2	0.0%	0.0%	0.1%
Automotive Parts	11	0.2%	0.1%	0.3%	Other	13	0.2%	0.1%	0.3%
Other Glass/Composite Materials	51	0.8%	0.2%	1.4%	**OTHER MATERIALS**	**1100**	**17.4%**		
METAL	**1092**	**17.3%**			Tires/Auto Rubber Products	403	6.4%	4.4%	8.4%
Beverage Containers	189	3.0%	2.0%	3.9%	Rubber/Latex toiletries	1	0.0%	0.0%	0.0%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.0%	Other Rubber/Latex products	35	0.6%	0.3%	0.8%
Other Food and Beverage Packaging	36	0.6%	0.3%	0.8%	Disposable diapers	4	0.1%	0.0%	0.1%
Non-food Packaging	1	0.0%	0.0%	0.0%	Textiles/Leather	136	2.2%	1.8%	2.6%
Automotive Parts	396	6.3%	3.3%	9.2%	Carpet	93	1.5%	0.0%	3.4%
Other Metals/Composite Materials	470	7.4%	4.4%	10.5%	Furniture/Mattresses/Appliances	331	5.2%	0.0%	10.5%
					Ceramics/Porcelain	4	0.1%	0.0%	0.1%
					Toys/Sporting goods	11	0.2%	0.1%	0.3%
					Miscellaneous/Other	81	1.3%	0.9%	1.7%

Total Tons **6,315** ***Sample Count*** **168**

4.2.2 INTERSTATE HIGHWAYS

Figure 4-2 illustrates the composition of litter on interstate highways by broad material class. As shown, the **organics** class accounted for the largest percentage of litter found, at 35.3%, while **hazardous materials** made up the lowest percentage (1.2%). Notably, **glass** was only 3.3% of interstate litter by weight. **Other materials**, including tires, made up 20.0% of items littered in this roadway category. The next largest classes of interstate litter were **CDL** (12.7%) and **metal** (11.4%).

Figure 4-2 Composition Summary, Interstate Highways



4.2.2.1 LARGEST COMPONENTS

As shown in Table 4-5, *other organics* (33.6%) and *tires/auto rubber products* (14.7%) accounted for nearly 50% of the litter collected along interstate highways. The *other organics* component category includes yard debris, firewood, branches and pruning debris, and stumps. *Glass beverage containers* made up only 2.9% of interstate litter by weight.

Table 4-5 Top 10 Largest Components by Weight, Interstate Highways

Component	Composition Percent	Estimated Tons	Cumulative Percent
Other Organics	33.6%	229	33.6%
Tires/Auto Rubber Products	14.7%	100	48.3%
Wood/Lumber/Particleboard	8.8%	60	57.1%
Other Metals/Composite Materials	5.3%	36	62.4%
Metal Automotive Parts	5.0%	34	67.4%
Other Plastics/Composite Materials	4.9%	34	72.4%
Glass Beverage Containers	2.9%	19	75.2%
Mineral Aggregates	2.8%	19	78.0%
Plastic Automotive Parts	2.4%	16	80.3%
Textiles/Leather	1.9%	13	82.2%

Table 4-6 presents the full composition results by individual component category. Component definitions are described in Appendix A.

Table 4-6 Composition by Weight, Interstate Highways

Calculated at a 90% confidence interval

	Tons	Mean %	Low %	High %		Tons	Mean %	Low %	High %
PAPER	**46**	**6.7%**			**ORGANIC**	**241**	**35.3%**		
Beverage Containers	0	0.0%	0.0%	0.1%	Food (Human And Pet)	4	0.6%	0.4%	0.9%
One-Time Fast Food Service Items	6	0.9%	0.5%	1.3%	Cigarettes and Other Tobacco	7	1.1%	0.7%	1.4%
Other Food and Beverage Packaging	5	0.7%	0.4%	1.0%	Other Organics	229	33.6%	19.6%	47.6%
Non-food Packaging	1	0.2%	0.1%	0.2%	**CDL**	**86**	**12.7%**		
Other Cardboard/Boxboard	11	1.6%	1.2%	2.1%	Wood/Lumber/Particleboard	60	8.8%	6.7%	10.9%
Paper Bags	9	1.4%	0.6%	2.1%	Mineral Aggregates	19	2.8%	0.9%	4.6%
Newspapers and Magazines	2	0.4%	0.3%	0.5%	Roofing	5	0.7%	0.4%	1.0%
Other Paper/Composite Materials	11	1.6%	1.1%	2.0%	Insulation	1	0.1%	0.0%	0.2%
PLASTIC	**65**	**9.5%**			Drywall	0	0.0%	0.0%	0.0%
Beverage Containers	0	0.0%	0.0%	0.0%	Other Construction/Demolition Debris	2	0.2%	0.1%	0.3%
One-Time Fast Food Service Items	3	0.4%	0.3%	0.5%	**HAZARDOUS MATERIALS**	**8**	**1.2%**		
Other Food and Beverage Packaging	3	0.5%	0.4%	0.6%	Latex paint	0	0.0%	0.0%	0.0%
Non-food Packaging	0	0.0%	0.0%	0.0%	Oil based paints	0	0.0%	0.0%	0.0%
Plastic Bags and Film	8	1.2%	0.9%	1.5%	Oil	3	0.4%	0.2%	0.7%
Automotive Parts	16	2.4%	1.7%	3.0%	Batteries	4	0.6%	0.0%	1.2%
Other Plastics/Composite Materials	34	4.9%	3.0%	6.9%	Flammable gas	0	0.0%	0.0%	0.0%
GLASS	**23**	**3.3%**			Flammable liquids	0	0.0%	0.0%	0.0%
Beverage Containers	19	2.9%	1.4%	4.3%	Explosives	0	0.0%	0.0%	0.0%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.0%	Pesticides/Herbicides	0	0.0%	0.0%	0.0%
Other Food and Beverage Packaging	0	0.0%	0.0%	0.0%	Cleaners (Hazardous)	0	0.0%	0.0%	0.0%
Non-food Packaging	0	0.0%	0.0%	0.0%	Medical waste	0	0.0%	0.0%	0.0%
Automotive Parts	2	0.3%	0.1%	0.5%	Other	1	0.1%	0.0%	0.1%
Other Glass/Composite Materials	1	0.2%	0.1%	0.4%	**OTHER MATERIALS**	**136**	**20.0%**		
METAL	**78**	**11.4%**			Tires/Auto Rubber Products	100	14.7%	8.0%	21.3%
Beverage Containers	6	0.9%	0.5%	1.2%	Rubber/Latex toiletries	0	0.0%	0.0%	0.1%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.0%	Other Rubber/Latex products	7	1.0%	0.5%	1.5%
Other Food and Beverage Packaging	1	0.1%	0.1%	0.2%	Disposable diapers	0	0.1%	0.0%	0.1%
Non-food Packaging	0	0.0%	0.0%	0.0%	Textiles/Leather	13	1.9%	1.4%	2.4%
Automotive Parts	34	5.0%	2.4%	7.6%	Carpet	3	0.4%	0.1%	0.7%
Other Metals/Composite Materials	36	5.3%	4.1%	6.5%	Furniture/Mattresses/Appliances	3	0.4%	0.0%	1.0%
					Ceramics/Porcelain	0	0.0%	0.0%	0.0%
					Toys/Sporting goods	2	0.2%	0.0%	0.5%
					Miscellaneous/Other	9	1.4%	0.9%	1.9%
Total Tons	**682**	***Sample Count***		**59**					

A breakdown of urban/non-urban composition for the interstate site category can be found in Appendix E. Relevant findings from this comparison are as follows:

- The organics class was a much larger percentage of litter by weight on non-urban interstates (48.5%) than on urban interstates (14.6%). On both types of interstates, other organics were the largest component by weight (47.4% non-urban, 12% urban). Unsecured loads of produce, hay, and bark chips are common origins of quantities of organic litter.
- Conversely, CDL materials were a much larger percentage of the urban interstate litter, at 20.5%, than of non-urban litter, at 7.7%. Wood/lumber/particleboard was the largest

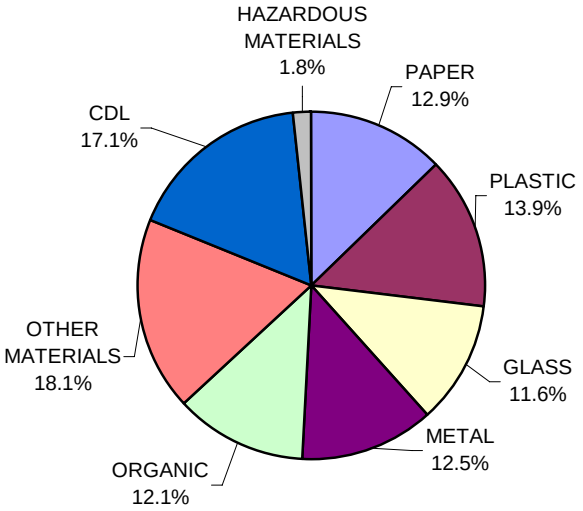
component by weight of both categories, at 13.4% on urban interstates and 5.9% on non-urban interstates.

- Metal constituted about 15.6% of litter on urban interstates and 8.6% of litter on non-urban interstates. Metal automotive parts was the largest component by weight on urban interstates at 7.9%. Other metals/composite materials was the largest metal component at 4.8% for non-urban interstates.

4.2.3 STATE ROUTES

Along state routes, **other materials** (18.1%) and **CDL** (17.1%) were the two largest classes by weight. With the exception of **hazardous materials** (1.8%), the other categories ranged between 11% and 14%.

Figure 4-3 Composition Summary, State Routes



4.2.3.1 LARGEST COMPONENTS

As Table 4-7 shows, *wood/lumber/particleboard* was the largest single component at 11.8% of the litter on state routes. *Glass beverage containers* and *tires/auto rubber products* each accounted for about 10% of this litter. *Other organics* made up 7.8% of litter in the state route sub-category.

Table 4-7 Top 10 Largest Components by Weight, State Routes

Component	Composition Percent	Estimated Tons	Cumulative Percent
Wood/Lumber/Particleboard	11.8%	146	11.8%
Glass Beverage Containers	10.5%	131	22.3%
Tires/Auto Rubber Products	9.7%	121	32.0%
Other Organics	7.8%	97	39.8%
Other Plastics/Composite Materials	6.7%	83	46.5%
Other Metals/Composite Materials	6.3%	78	52.8%
Metal Automotive Parts	3.8%	47	56.6%
Other Cardboard/Boxboard	3.2%	40	59.8%
Plastic Bags and Film	3.1%	39	62.9%
Furniture/Mattresses/Appliances	3.0%	37	65.9%

Table 4-8 presents the full composition results of each component category for state routes.

Table 4-8 Composition by Weight, State Routes

Calculated at a 90% confidence interval

	Tons	Mean %	Low %	High %		Tons	Mean %	Low %	High %
PAPER	**160**	**12.9%**			**ORGANIC**	**150**	**12.1%**		
Beverage Containers	1	0.1%	0.0%	0.2%	Food (Human And Pet)	18	1.4%	0.9%	2.0%
One-Time Fast Food Service Items	16	1.3%	1.1%	1.5%	Cigarettes and Other Tobacco	35	2.8%	1.6%	4.1%
Other Food and Beverage Packaging	15	1.2%	0.9%	1.5%	Other Organics	97	7.8%	5.4%	10.3%
Non-food Packaging	4	0.3%	0.3%	0.4%	**CDL**	**213**	**17.1%**		
Other Cardboard/Boxboard	40	3.2%	1.9%	4.6%	Wood/Lumber/Particleboard	146	11.8%	8.5%	15.0%
Paper Bags	31	2.5%	1.1%	3.9%	Mineral Aggregates	29	2.3%	0.0%	5.2%
Newspapers and Magazines	16	1.3%	0.8%	1.8%	Roofing	12	0.9%	0.5%	1.4%
Other Paper/Composite Materials	36	2.9%	2.0%	3.8%	Insulation	0	0.0%	0.0%	0.0%
PLASTIC	**174**	**13.9%**			Drywall	2	0.1%	0.0%	0.3%
Beverage Containers	1	0.1%	0.1%	0.1%	Other Construction/Demolition Debris	24	1.9%	0.0%	3.8%
One-Time Fast Food Service Items	11	0.8%	0.7%	1.0%	**HAZARDOUS MATERIALS**	**22**	**1.8%**		
Other Food and Beverage Packaging	16	1.3%	1.0%	1.6%	Latex paint	0	0.0%	0.0%	0.0%
Non-food Packaging	4	0.3%	0.0%	0.7%	Oil based paints	0	0.0%	0.0%	0.1%
Plastic Bags and Film	39	3.1%	2.2%	4.1%	Oil	12	1.0%	0.5%	1.4%
Automotive Parts	20	1.6%	1.1%	2.0%	Batteries	5	0.4%	0.1%	0.7%
Other Plastics/Composite Materials	83	6.7%	4.8%	8.5%	Flammable gas	0	0.0%	0.0%	0.0%
GLASS	**144**	**11.6%**			Flammable liquids	0	0.0%	0.0%	0.0%
Beverage Containers	131	10.5%	6.6%	14.4%	Explosives	0	0.0%	0.0%	0.1%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.1%	Pesticides/Herbicides	0	0.0%	0.0%	0.0%
Other Food and Beverage Packaging	1	0.0%	0.0%	0.1%	Cleaners (Hazardous)	0	0.0%	0.0%	0.0%
Non-food Packaging	0	0.0%	0.0%	0.0%	Medical waste	0	0.0%	0.0%	0.0%
Automotive Parts	6	0.5%	0.2%	0.8%	Other	4	0.3%	0.2%	0.5%
Other Glass/Composite Materials	7	0.5%	0.3%	0.8%	**OTHER MATERIALS**	**225**	**18.1%**		
METAL	**155**	**12.5%**			Tires/Auto Rubber Products	121	9.7%	5.4%	13.9%
Beverage Containers	25	2.0%	1.4%	2.7%	Rubber/Latex toiletries	0	0.0%	0.0%	0.1%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.0%	Other Rubber/Latex products	11	0.9%	0.5%	1.3%
Other Food and Beverage Packaging	4	0.3%	0.2%	0.5%	Disposable diapers	1	0.1%	0.0%	0.2%
Non-food Packaging	0	0.0%	0.0%	0.0%	Textiles/Leather	26	2.1%	1.6%	2.5%
Automotive Parts	47	3.8%	2.1%	5.5%	Carpet	3	0.2%	0.0%	0.5%
Other Metals/Composite Materials	78	6.3%	4.6%	8.0%	Furniture/Mattresses/Appliances	37	3.0%	0.0%	6.4%
					Ceramics/Porcelain	2	0.1%	0.0%	0.3%
					Toys/Sporting goods	1	0.1%	0.0%	0.1%
					Miscellaneous/Other	24	1.9%	1.0%	2.8%
Total Tons	**1,244**	***Sample Count***	**53**						

A breakdown of urban/non-urban composition for the state route site subcategory can be found in Appendix E. Notable findings from this analysis include the following:

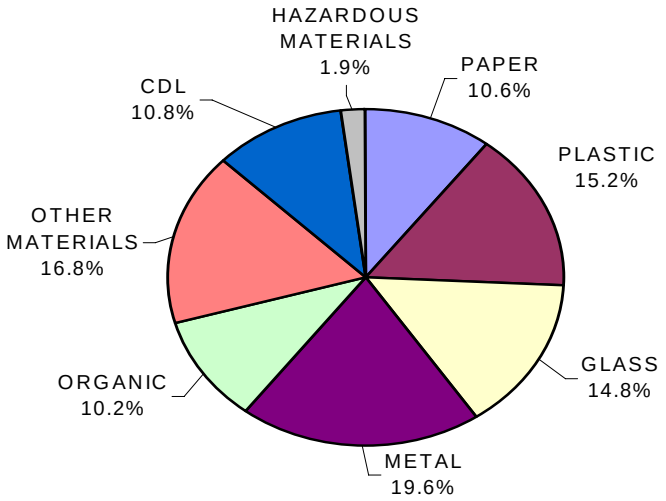
- CDL and other materials were the top two broad material classes of litter on both urban and non-urban state routes, but their positions were reversed: CDL was the top broad material class on urban state routes at 21.9%, and other materials was second at 16.3%, which included tires/auto rubber products at 5.2%. Other materials was the top broad material class on non-urban state routes at 19.2%, which included tires/auto rubber products at 12.5%, while CDL was second at 14.1%. Wood/lumber/particleboard was the largest component of both non-urban and urban CDL litter, at roughly 12% in each.

- On urban state routes, plastic (16.3%) and metal (12.2%) were the third and fourth largest classes. Other metal/composite products (8.1%) and other plastic/composite products (7.2%) were the largest components in these two classes.
- On non-urban state routes, paper (13.8%) and glass (13.8%) were tied for the third largest class. Glass beverage containers (12.4%) and other cardboard/boxboard were the largest components in these two classes.

4.2.4 COUNTY ROADS

Metal comprised the largest percentage of litter on county roads among the broad material classes (19.6%). **Other materials** followed at 16.8%. With the exception of **hazardous materials**, all other categories were distributed fairly evenly, ranging from roughly 10% to 15%.

Figure 4-4 Composition Summary, County Roads



4.2.4.1 LARGEST COMPONENTS

As shown in Table 4-9, *glass beverage containers* comprised the largest percentage of litter deposited on county roads, at 13.6%. *Other metals/composite materials* were 8.1% of the litter, while *other plastics/composite materials*, *wood/lumber/particleboard*, *metal automotive products*, *other organics*, and *furniture/mattresses/appliances* were each more than 6%.

Table 4-9 Top 10 Largest Components by Weight, County Roads

Component	Composition Percent	Estimated Tons	Cumulative Percent
Glass Beverage Containers	13.6%	599	13.6%
Other Metals/Composite Materials	8.1%	356	21.8%
Other Plastics/Composite Materials	7.3%	319	29.0%
Wood/Lumber/Particleboard	7.2%	315	36.2%
Metal Automotive Parts	7.2%	314	43.4%
Other Organics	6.7%	293	50.0%
Furniture/Mattresses/Appliances	6.6%	291	56.7%
Tires/Auto Rubber Products	4.2%	183	60.8%
Metal Beverage Containers	3.6%	158	64.4%
Plastic Bags and Film	3.1%	136	67.5%

Table 4-10 presents the full composition results by component for county roads.

Table 4-10 Composition by Weight, County Roads

Calculated at a 90% confidence interval

	Tons	Mean %	Low %	High %		Tons	Mean %	Low %	High %
PAPER	**465**	**10.6%**			**ORGANIC**	**449**	**10.2%**		
Beverage Containers	3	0.1%	0.0%	0.1%	Food (Human And Pet)	77	1.7%	1.2%	2.3%
One-Time Fast Food Service Items	79	1.8%	1.4%	2.3%	Cigarettes and Other Tobacco	79	1.8%	0.9%	2.7%
Other Food and Beverage Packaging	75	1.7%	1.2%	2.2%	Other Organics	293	6.7%	3.8%	9.5%
Non-food Packaging	19	0.4%	0.3%	0.6%	**CDL**	**474**	**10.8%**		
Other Cardboard/Boxboard	65	1.5%	0.9%	2.1%	Wood/Lumber/Particleboard	315	7.2%	4.7%	9.7%
Paper Bags	64	1.5%	0.5%	2.4%	Mineral Aggregates	101	2.3%	0.0%	5.3%
Newspapers and Magazines	73	1.7%	0.8%	2.5%	Roofing	19	0.4%	0.1%	0.7%
Other Paper/Composite Materials	87	2.0%	1.5%	2.5%	Insulation	4	0.1%	0.0%	0.2%
PLASTIC	**668**	**15.2%**			Drywall	0	0.0%	0.0%	0.0%
Beverage Containers	13	0.3%	0.1%	0.5%	Other Construction/Demolition Debris	35	0.8%	0.0%	2.0%
One-Time Fast Food Service Items	45	1.0%	0.8%	1.2%	**HAZARDOUS MATERIALS**	**84**	**1.9%**		
Other Food and Beverage Packaging	79	1.8%	1.4%	2.2%	Latex paint	0	0.0%	0.0%	0.0%
Non-food Packaging	2	0.0%	0.0%	0.1%	Oil based paints	2	0.1%	0.0%	0.1%
Plastic Bags and Film	136	3.1%	2.2%	4.0%	Oil	64	1.5%	0.7%	2.2%
Automotive Parts	73	1.7%	0.9%	2.4%	Batteries	7	0.2%	0.0%	0.3%
Other Plastics/Composite Materials	319	7.3%	5.0%	9.6%	Flammable gas	0	0.0%	0.0%	0.0%
GLASS	**651**	**14.8%**			Flammable liquids	0	0.0%	0.0%	0.0%
Beverage Containers	599	13.6%	8.2%	19.0%	Explosives	0	0.0%	0.0%	0.0%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.0%	Pesticides/Herbicides	0	0.0%	0.0%	0.0%
Other Food and Beverage Packaging	6	0.1%	0.0%	0.2%	Cleaners (Hazardous)	0	0.0%	0.0%	0.0%
Non-food Packaging	0	0.0%	0.0%	0.0%	Medical waste	1	0.0%	0.0%	0.1%
Automotive Parts	3	0.1%	0.0%	0.1%	Other	9	0.2%	0.1%	0.3%
Other Glass/Composite Materials	43	1.0%	0.1%	1.8%	**OTHER MATERIALS**	**738**	**16.8%**		
METAL	**860**	**19.6%**			Tires/Auto Rubber Products	183	4.2%	1.8%	6.6%
Beverage Containers	158	3.6%	2.2%	4.9%	Rubber/Latex toiletries	0	0.0%	0.0%	0.0%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.0%	Other Rubber/Latex products	17	0.4%	0.1%	0.7%
Other Food and Beverage Packaging	31	0.7%	0.4%	1.0%	Disposable diapers	2	0.1%	0.0%	0.1%
Non-food Packaging	1	0.0%	0.0%	0.0%	Textiles/Leather	98	2.2%	1.7%	2.8%
Automotive Parts	314	7.2%	2.9%	11.4%	Carpet	87	2.0%	0.0%	4.7%
Other Metals/Composite Materials	356	8.1%	3.8%	12.4%	Furniture/Mattresses/Appliances	291	6.6%	0.0%	14.1%
					Ceramics/Porcelain	2	0.0%	0.0%	0.1%
					Toys/Sporting goods	9	0.2%	0.1%	0.3%
					Miscellaneous/Other	48	1.1%	0.6%	1.6%
Total Tons	**4,389**	***Sample Count***	**56**						

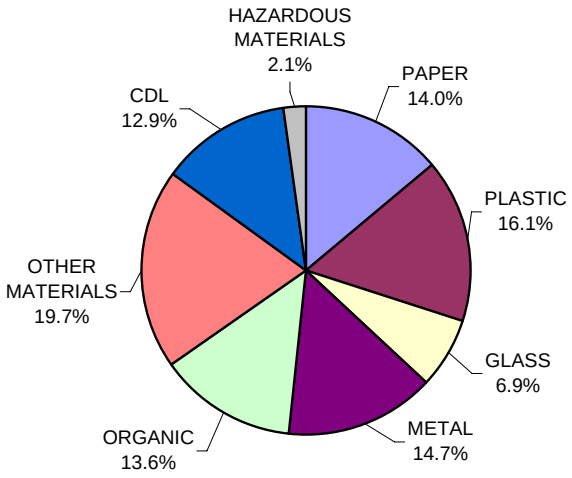
A breakdown of urban/non-urban composition for the county road site subcategory can be found in Appendix E. Findings from that analysis include the following:

- Other materials (23.8%), plastic (17.9%), and metal (17.2%) were the top broad material classes on urban county roads. Within the other materials class, furniture/mattresses/appliances accounted for 18.4% of litter found on urban county roads.
- On non-urban county roads, metal (21%), glass (17.6%), and plastic (13.7%) constituted the top three classes.
- On both urban and non-urban county roads, automotive parts, beverage containers, and other metals/composite products were the top three components in the metal broad material class.
- Glass beverage containers made up 16.6% of litter on non-urban county roads but only 8.4% of litter on urban county roads.

4.3 INTERCHANGES

Other materials (19.7%) and **plastic** (16.1%) were the two largest classes of litter on interchanges, as Figure 4-5 shows. The classes **CDL**, **organic**, **paper**, and **metal** ranged from 12.9% to 14.7%.

Figure 4-5 Composition Summary, Interchanges



4.3.1.1 LARGEST COMPONENTS

Table 4-11 shows that other *other organics* (10.5%), *tires/auto rubber products* (9.9%), and *wood/lumber/particleboard* (9.4%) are the top three components of litter on interchanges, and accounted for about 30% of interchange litter. None of these components are traditionally considered "litter" by the public.

Table 4-11 Top 10 Largest Components by Weight, Interchanges

Component	Composition Percent	Estimated Tons	Cumulative Percent
Other Organics	10.5%	46	10.5%
Tires/Auto Rubber Products	9.9%	44	20.3%
Wood/Lumber/Particleboard	9.4%	41	29.7%
Other Plastics/Composite Materials	8.5%	38	38.2%
Other Metals/Composite Materials	7.0%	31	45.2%
Glass Beverage Containers	5.8%	26	51.0%
Metal Automotive Parts	5.5%	24	56.5%
Textiles/Leather	5.4%	24	61.9%
Other Cardboard/Boxboard	4.6%	20	66.5%
Other Paper/Composite Materials	3.3%	15	69.8%

Table 4-12 presents the full composition results by component category for interchanges.

Table 4-12 Composition by Weight, Interchanges

Calculated at a 90% confidence interval

	Tons	Mean %	Low %	High %		Tons	Mean %	Low %	High %
PAPER	**62**	**14.0%**			**ORGANIC**	**60**	**13.6%**		
Beverage Containers	0	0.1%	0.0%	0.1%	Food (Human And Pet)	6	1.4%	0.7%	2.0%
One-Time Fast Food Service Items	6	1.4%	1.1%	1.6%	Cigarettes and Other Tobacco	8	1.8%	1.3%	2.2%
Other Food and Beverage Packaging	5	1.1%	0.8%	1.4%	Other Organics	46	10.5%	7.3%	13.7%
Non-food Packaging	1	0.2%	0.2%	0.3%	**CDL**	**57**	**12.9%**		
Other Cardboard/Boxboard	20	4.6%	3.0%	6.2%	Wood/Lumber/Particleboard	41	9.4%	6.5%	12.3%
Paper Bags	7	1.7%	0.8%	2.6%	Mineral Aggregates	10	2.2%	1.0%	3.4%
Newspapers and Magazines	8	1.7%	1.2%	2.3%	Roofing	4	0.9%	0.1%	1.8%
Other Paper/Composite Materials	15	3.3%	2.7%	3.9%	Insulation	1	0.1%	0.0%	0.2%
PLASTIC	**71**	**16.1%**			Drywall	0	0.0%	0.0%	0.0%
Beverage Containers	0	0.1%	0.1%	0.1%	Other Construction/Demolition Debris	1	0.2%	0.1%	0.3%
One-Time Fast Food Service Items	4	0.9%	0.7%	1.2%	**HAZARDOUS MATERIALS**	**9**	**2.1%**		
Other Food and Beverage Packaging	5	1.1%	0.9%	1.3%	Latex paint	0	0.0%	0.0%	0.0%
Non-food Packaging	0	0.0%	0.0%	0.0%	Oil based paints	0	0.0%	0.0%	0.0%
Plastic Bags and Film	14	3.1%	2.7%	3.6%	Oil	3	0.8%	0.4%	1.1%
Automotive Parts	10	2.2%	1.6%	2.9%	Batteries	4	0.8%	0.0%	1.7%
Other Plastics/Composite Materials	38	8.5%	6.0%	11.0%	Flammable gas	0	0.0%	0.0%	0.0%
GLASS	**30**	**6.9%**			Flammable liquids	0	0.0%	0.0%	0.0%
Beverage Containers	26	5.8%	3.3%	8.4%	Explosives	0	0.0%	0.0%	0.1%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.0%	Pesticides/Herbicides	0	0.0%	0.0%	0.0%
Other Food and Beverage Packaging	0	0.0%	0.0%	0.0%	Cleaners (Hazardous)	0	0.0%	0.0%	0.0%
Non-food Packaging	0	0.0%	0.0%	0.0%	Medical waste	0	0.0%	0.0%	0.0%
Automotive Parts	1	0.3%	0.1%	0.6%	Other	2	0.4%	0.2%	0.6%
Other Glass/Composite Materials	3	0.7%	0.3%	1.1%	**OTHER MATERIALS**	**88**	**19.7%**		
METAL	**65**	**14.7%**			Tires/Auto Rubber Products	44	9.9%	6.9%	12.8%
Beverage Containers	8	1.9%	1.1%	2.7%	Rubber/Latex toiletries	0	0.0%	0.0%	0.0%
One-Time Fast Food Service Items	0	0.1%	0.0%	0.1%	Other Rubber/Latex products	2	0.4%	0.3%	0.5%
Other Food and Beverage Packaging	1	0.2%	0.1%	0.3%	Disposable diapers	0	0.1%	0.0%	0.1%
Non-food Packaging	0	0.0%	0.0%	0.0%	Textiles/Leather	24	5.4%	2.0%	8.7%
Automotive Parts	24	5.5%	3.1%	7.9%	Carpet	3	0.6%	0.1%	1.1%
Other Metals/Composite Materials	31	7.0%	5.0%	8.9%	Furniture/Mattresses/Appliances	5	1.2%	0.0%	2.7%
					Ceramics/Porcelain	0	0.1%	0.0%	0.2%
					Toys/Sporting goods	1	0.1%	0.0%	0.2%
					Miscellaneous/Other	9	2.0%	1.4%	2.6%
Total Tons	**443**	***Sample Count***	**54**						

A breakdown of urban/non-urban composition for the interchange site category can be found in Appendix E. Interesting findings from that analysis include the following:

- The top three broad material classes on urban interchanges were other materials (19.4%), plastic (17.2%), and paper (16.0%). On non-urban interchanges, however, organics comprised about 21%, while on urban interchanges, organics accounted for only 10.9% of litter.
- On both urban and non-urban interchanges, other organics was the top component within the organics class, at 18.7% on non-urban and 7.4% on urban interchanges.
- Tires/auto rubber products were 14.5% of litter on non-urban interchanges, with 8.2% on urban interchanges.

5. COMPARISONS WITH PREVIOUS LITTER STUDY

One of the primary purposes of the 2004 Litter Study was to determine whether litter decreased and litter composition changed between 1999 and 2004. This chapter presents a comparison of litter quantities, generation rates, and composition between the 1999 and 2004 study years.

Section 5.1 highlights differences in the estimated quantities of all litter along Washington's roadways and interchanges in the 1999 and 2004 studies. Section 5.2 presents the results of statistical tests to examine changes in litter generation rates, and Section 5.3 compares litter composition in the two study years.

5.1 CHANGES IN ESTIMATED QUANTITIES OF LITTER

Perhaps the most fundamental result of comparing the two litter studies is that the estimated amount of litter on Washington's roadways and interchanges decreased between 1999 and 2004, as follows:

- The estimated amount of litter on Washington roadways decreased from 8,322 tons to 6,315 tons.
- The estimated amount of litter on interchanges in Washington decreased from 617 tons to 443 tons in 2004.

However, as will be discussed in Section 5.2.2, these decreases were not statistically significant.

5.2 STATISTICALLY TESTED CHANGES IN GENERATION RATES

While it is possible to make observations about the differences between the litter generation in 1999 and 2004 by directly comparing results[35], the consultant team performed statistical tests on the following as a more rigorous measurement of whether differences exist between the two study years:

[35] Composition data were weighted using a different method in 2004 than in 1999. Tonnage, rather than miles, was used to weight these data in the 2004 report, because it is a more appropriate way to aggregate data from different types of roads and interchanges. Because of this change, please refer to Section 5.3 and Appendix H rather than the 1999 report to compare results of the two studies.

- *overall litter generation* on all roadways, expressed as pounds per road mile
- *interstates, state routes,* and *county roads*, expressed as pounds per road mile
- *interchanges*, expressed as pounds per acre
- *beverage containers*, in pounds per road mile
- *CDL, tires/auto rubber products, and fast-food containers* in pounds per road per mile
- *cigarette butts*, expressed as pounds per acre
- *alcoholic beverage containers*, in pounds per mile
- *alcoholic beverage containers* and (separately) *all beverage containers*, in estimated number of containers per road mile

5.2.1 METHODOLOGY

The consultant team used one-sided, paired t-tests to assess the change in total litter generation and in quantities of individual material types between 1999 and 2004. Due to the variability in waste generation among sampling sites, paired t-tests were selected instead of standard t-tests as they can control for differences among sites. One-sided, rather than two-sided, paired t-tests were used since they increased the chances of detecting statistically significant differences. Although one-sided, paired t-tests could have been used to test for increases or decreases, the tests were designed to look for decreases as a means of evaluating the effectiveness of the Litter Campaign. Please refer to Appendix I for more detail about the statistical methodology.

The observed differences in litter generation across all sites sampled in both 1999 and 2004 were compared to the *expected increase* in litter generation from 1999 to 2004. The expected increase was based on Washington State Department of Transportation data showing a relative increase in miles driven in Washington from 1999 to 2004.[36] To apply the tests, the consultant team assumed that littering behavior (or litter generation per mile driven) remained unchanged since 1999, and therefore that there would be an increase in litter accumulation in 2004 due to the increase in miles driven. This expected change was calculated uniquely for each season, for each road type, and for each material type.

If the observed difference was less than the expected difference, then it was possible that litter generation per mile driven in 2004 was less than in 1999. If the difference between the observed and expected litter generation was large enough (and the variability in observed differences between sites was small enough) then the change was labeled as statistically significant. Different values were used as cut-offs for statistical significance depending on how many tests were conducted. Please refer to Appendix I for more information on the p-values used to detect strong trends and statistical significance.

Units of expected change and of observed change are expressed in pounds of litter per mile per year for all waste types except cigarettes.[37] The expected and observed changes in generation

[36] Washington State Department of Transportation annual traffic reports can be found online at http://www.wsdot.wa.gov/mapsdata/tdo/annualtrafficreport.htm.

[37] Since cigarette butts were cleaned from a sub-area of the sample site, the generation rate for cigarette butts was expressed in units of area rather than distance.

rates for cigarettes are expressed in this section in units of pounds per *acre* per year. Expected and observed changes for interchanges are also expressed in terms of pounds per *acre* per year.[38]

To compare beverage containers in 1999 and 2004, the consultant team also examined the number of glass, metal, and plastic beverage containers discarded during each study year. Since the litter samples were weighed, not counted, the data on these containers is bulk weight. To estimate the number of bottles or cans littered in each study year, the consultant team transformed the weight data into Bottle Equivalents by dividing the sample weight by estimated bottle weights.[39] One-sided paired t-tests were then computed for all beverage containers and for alcoholic beverage containers.

A detailed description of these statistical methods can be found in Appendix I.

5.2.2 Results of Statistical Tests on Generation Rates

The following figures illustrate the expected and observed differences in litter generation rates between 1999 and 2004 and indicate whether the observed difference represents a statistically significant change, or a strong downward trend. On the tables that follow, statistically significant decreases in litter generation are indicated with dots, and strong downward trends indicated by the stripes. Because the consultant team based the expected difference on the increase in miles driven, the expected difference is always positive. The observed difference can be either positive or negative. Please note that the scales on the figures below vary to more clearly illustrate the findings.

Within roadways and interchanges, a great deal of variation between sites exists regarding location, size, amounts, and percentages of litter commodities found. In the cases where changes appear large enough to constitute strong trends or statistical significance on the graph – and do not when tested – there is likely to be a large amount of variability among sites.

As the figures show, overall litter generation on interchanges and on county roads exhibited a strong downward trend, but there was no statistically significant decrease in overall litter generation on all roadways combined, or on roadways individually. Several *components* of litter, however, showed statistically significant decreases on all roadways combined, including the following:

- All beverage containers combined
- Glass beverage containers
- All alcoholic beverage containers combined
- Glass alcoholic beverage containers

A number of types of litter showed strong downward trends on all roadways combined, including the following:

[38] Expected and observed changes for cigarettes and interchanges were analyzed using the units pounds per square foot, although the results are presented in this section as pounds per acre so they are more easily understood.

[39] The individual bottle estimates were based on the research of Kevin Dietley of Northbridge Environmental Management Consultants obtained through personal communication. Plastic bottles were estimated to be 0.065 pounds each, glass bottles at 0.53 pounds, and aluminum cans at 0.03 pounds.

- CDL
- Tires/auto rubber products
- Fast-food containers
- The number of alcoholic beverage containers, measured in Bottle Equivalents

There are four possible results for the statistical tests as displayed in the following figures. The possible outcomes are:

1) decreased significantly,

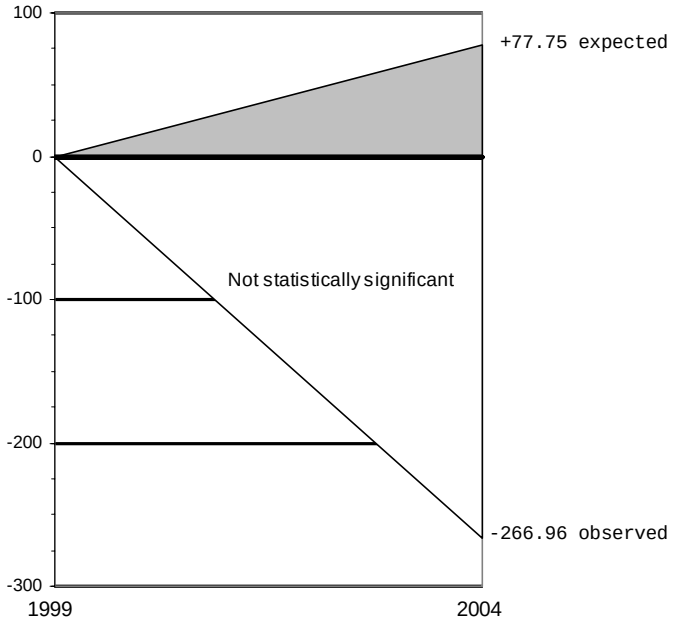
2) exhibited a strong decreasing trend,

3) appeared to decrease (not statistically significant), and

4) appeared to increase (statistical tests did not test for increases).

Figure 5-1 Litter on All Roadway Test Sites

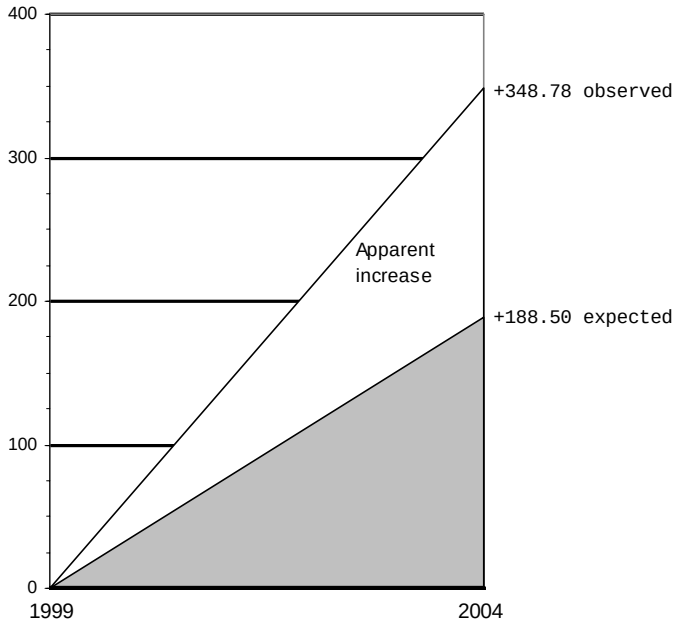
(observed & expected change in pounds per mile per year)



All litter on roadways combined appeared to decrease.

Figure 5-2 Litter on Interstate Test Sites

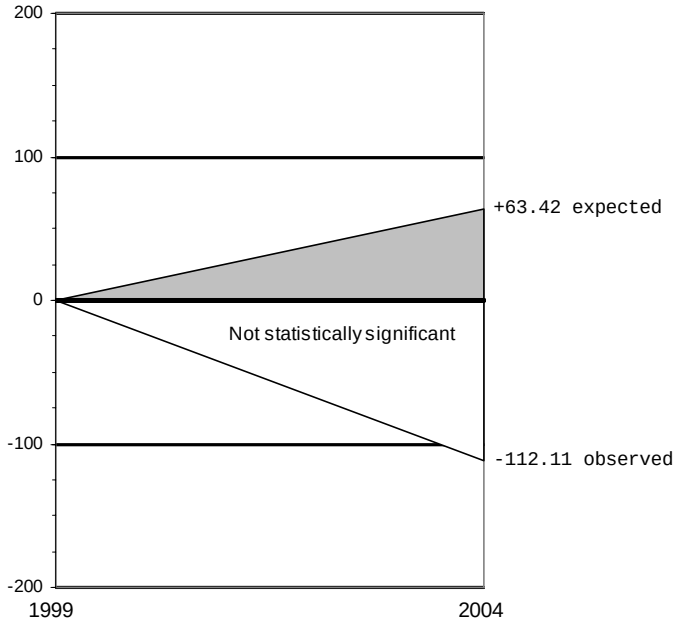
(observed & expected change in pounds per mile per year)



All litter on interstates appeared to increase.

Figure 5-3 All Litter on State Route Test Sites

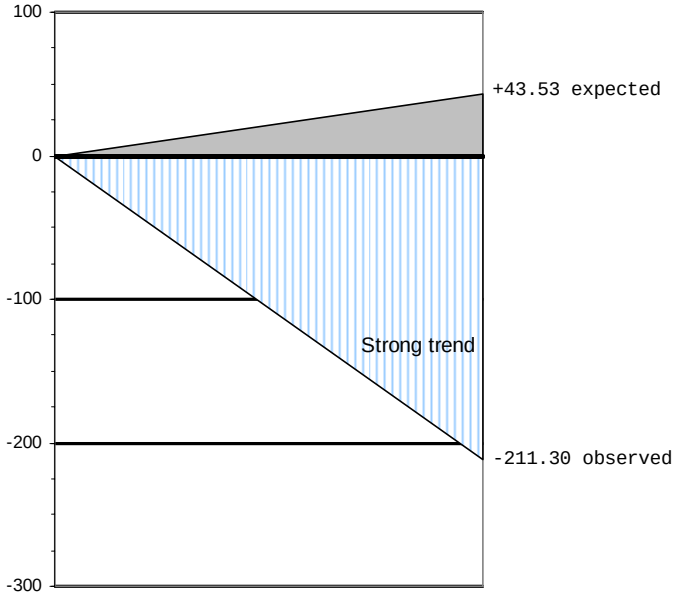
(observed & expected change in pounds per mile per year)



All litter on state routes appeared to decrease.

Figure 5-4 All Litter on County Road Test Sites

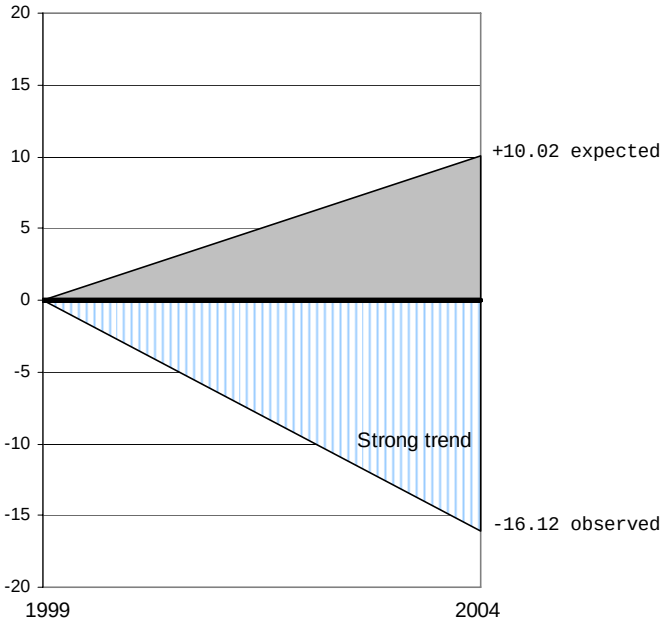
(observed & expected change, in pounds per mile per year)



All litter on county roads exhibited a strong decreasing trend.

Figure 5-5 All Litter at Interchange Test Sites

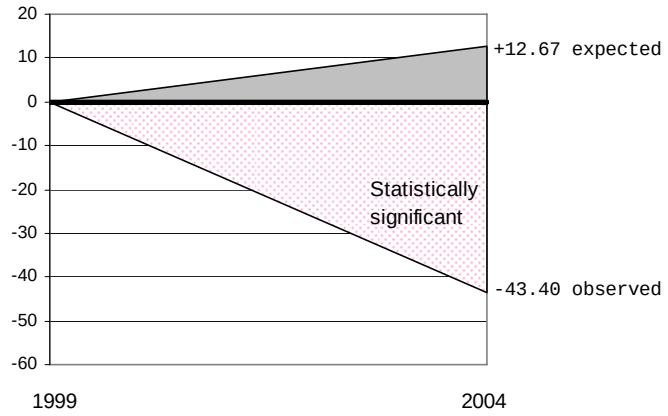
(observed & expected change, in pounds per *acre* per year)



All litter on interchanges exhibited a strong decreasing trend.

Figure 5-6 All Beverage Containers on All Roadway Test Sites

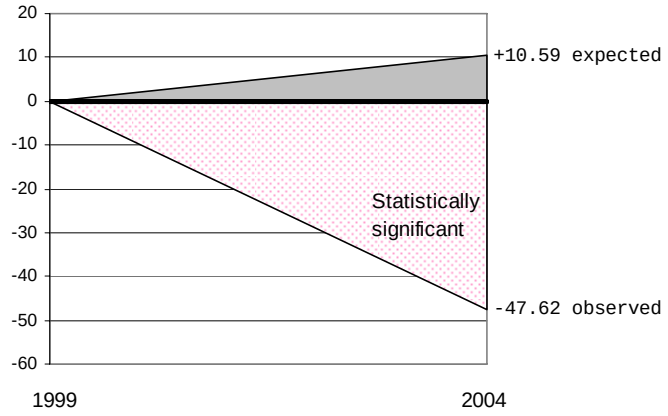
(observed & expected change, in pounds per mile per year)



All beverage containers on all roadways combined decreased significantly.

Figure 5-7 Glass Beverage Containers on All Roadway Test Sites

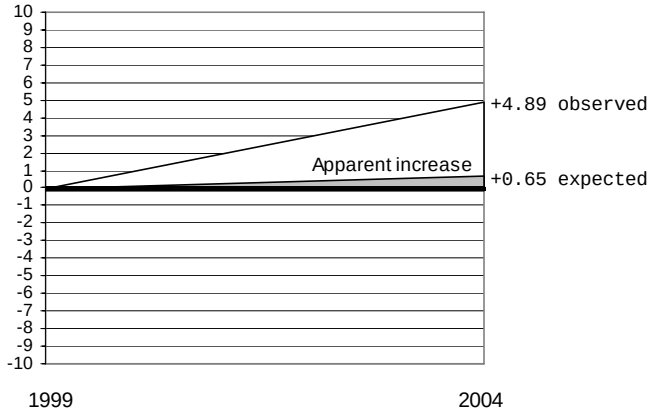
(observed & expected change, in pounds per mile per year)



Glass beverage containers on all roadways combined decreased significantly.

Figure 5-8 Plastic Beverage Containers on All Roadway Test Sites

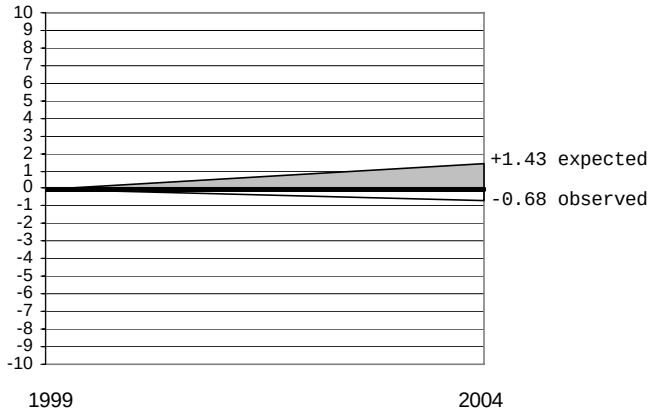
(observed & expected change, in pounds per mile per year)



Plastic beverage containers on all roadways combined appeared to increase.

Figure 5-9 Metal Beverage Containers on All Roadway Test Sites

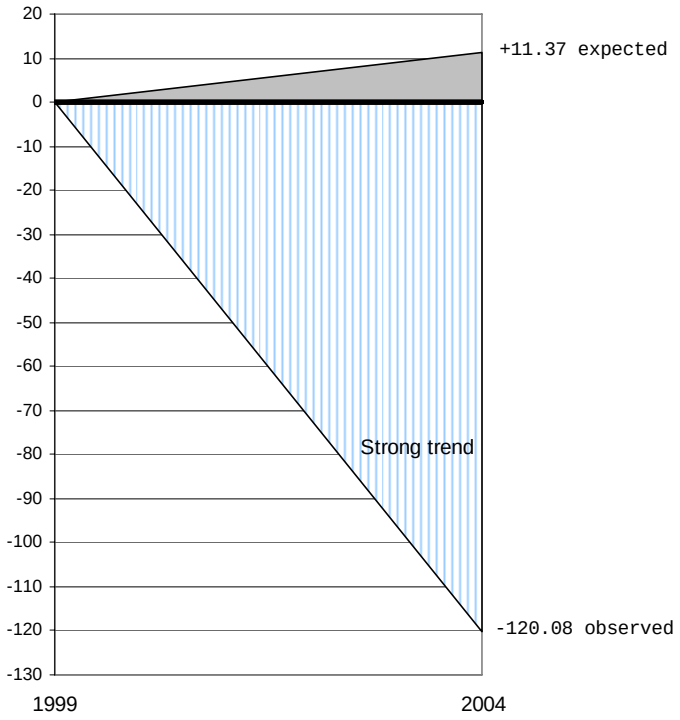
(observed & expected change, in pounds per mile per year)



Metal beverage containers on all roadways combined appeared to decrease.

Figure 5-10 CDL on All Roadway Test Sites

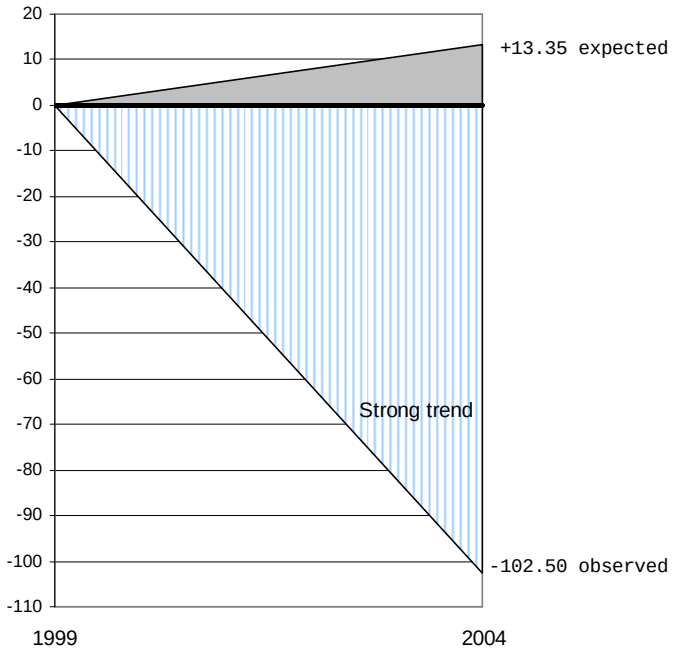
(observed & expected change, in pounds per mile per year)



CDL on all roadways exhibited a strong decreasing trend.

Figure 5-11 Tires/Auto Rubber Products on All Roadway Test Sites

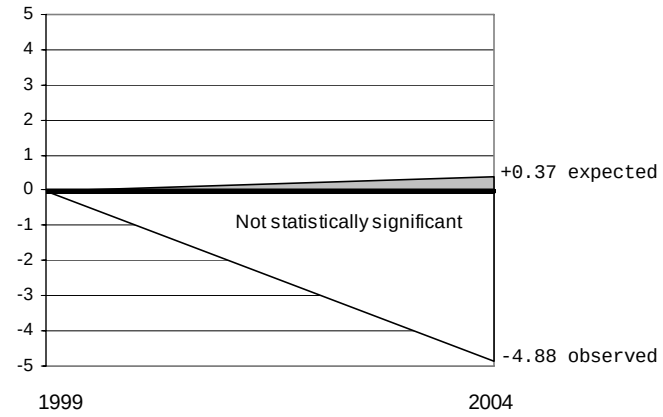
(observed & expected change, in pounds per mile per year)



Tires/auto rubber products on all roadways combined exhibited a strong decreasing trend.

Figure 5-12 Cigarette Butts on All Roadway Test Sites

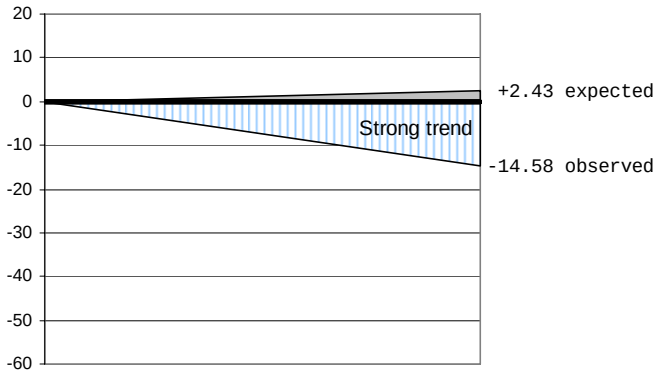
(observed & expected change, in pounds per acre per year)



Cigarette butts for all roadways combined appeared to decrease.

Figure 5-13 Fast-food Containers on All Roadway Test Sites

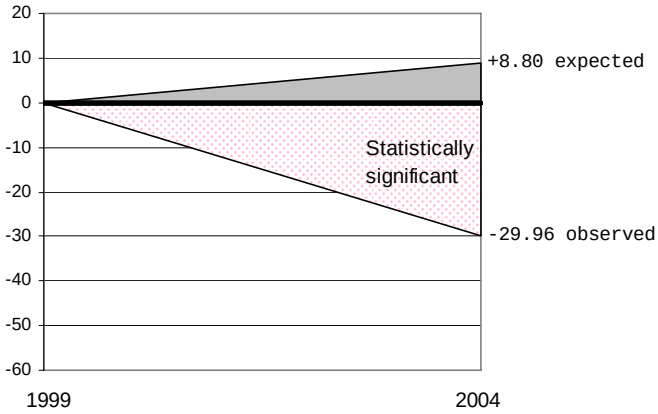
(observed & expected change, in pounds per mile per year)



Fast-food containers on all roadways combined exhibited a strong decreasing trend.

Figure 5-14 All Alcoholic Beverage Containers on All Roadway Test Sites

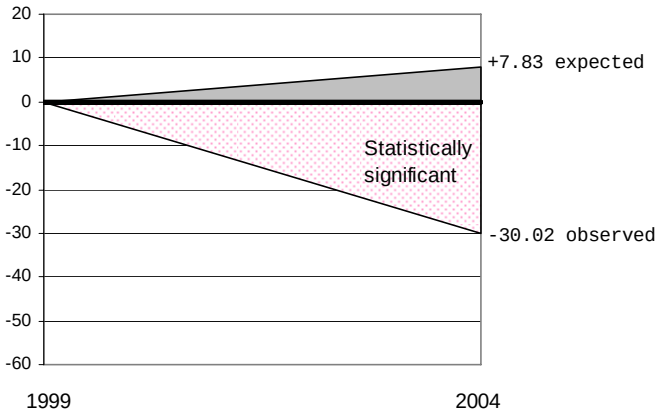
(observed & expected change, in pounds per mile per year)



All alcoholic beverage containers on all roadways combined decreased significantly.

Figure 5-15 Glass Alcoholic Beverage Containers on All Roadway Test Sites

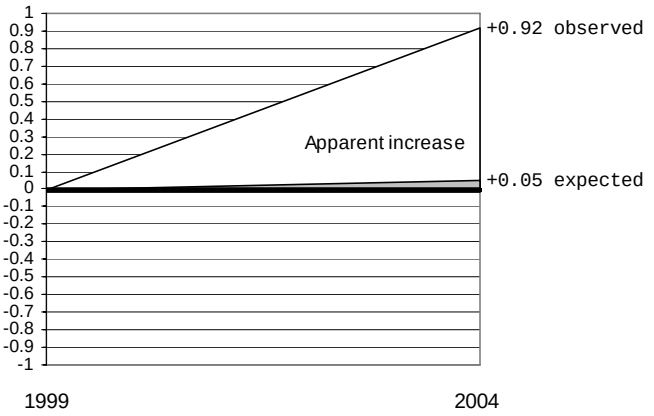
(observed & expected change, in pounds per mile per year)



Glass alcoholic beverage containers on all roadways combined decreased significantly.

Figure 5-16 Plastic Alcoholic Beverage Containers on All Roadway Test Sites

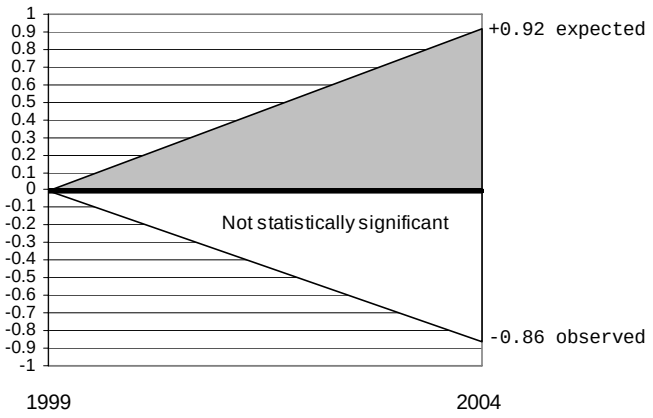
(observed & expected change, in pounds per mile per year)



Plastic alcoholic beverage containers on all roadways combined appeared to increase.

Figure 5-17 Metal Alcoholic Beverage Containers on All Roadway Test Sites

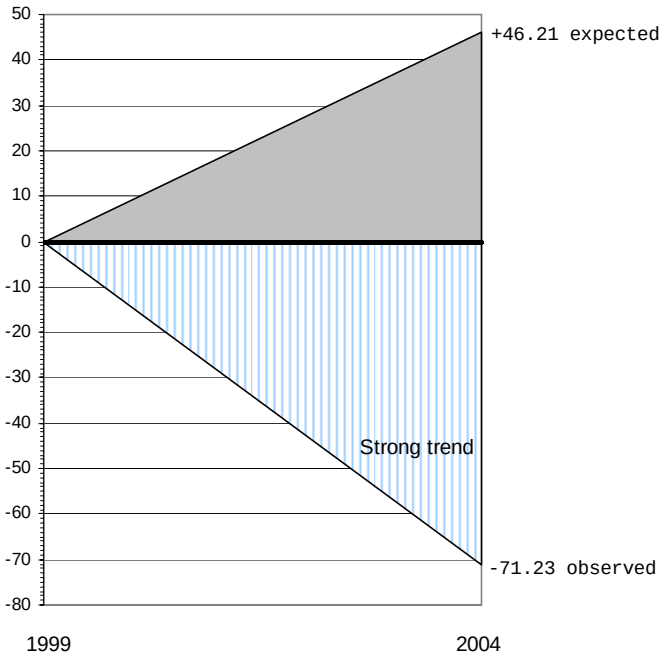
(observed & expected change, in pounds per mile per year)



Metal alcoholic beverage containers on all roadways combined appeared to decrease.

Figure 5-18 Bottle Equivalents, Alcoholic Beverage Containers on All Roadway Test Sites

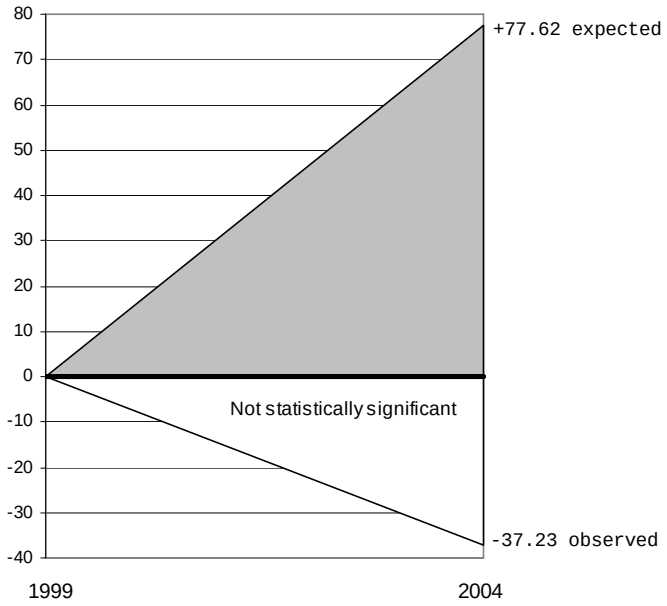
(observed & expected change, in *containers* per mile per year)



Bottle equivalents of alcoholic beverage containers on all roadways combined exhibited a strong decreasing trend.

Figure 5-19 Bottle Equivalents, All Beverage Containers on All Roadway Test Sites

(observed & expected change, in *containers* per mile per year)



Bottle equivalents of all beverage containers on all roadways combined appeared to decrease.

5.3 CHANGES IN ESTIMATED COMPOSITION OF LITTER

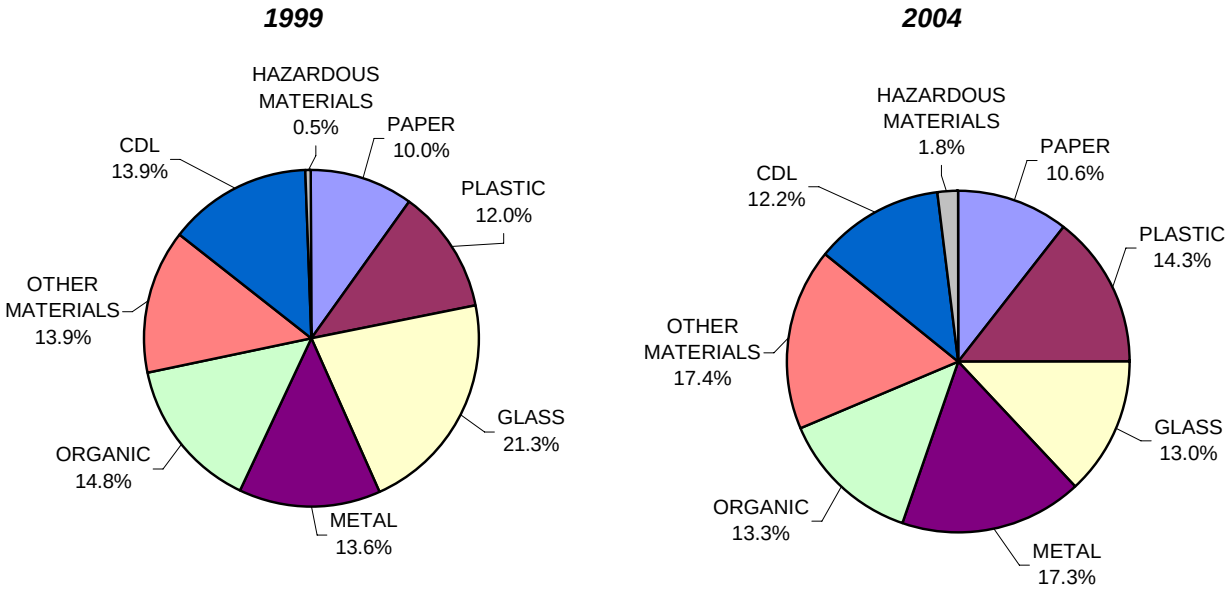
The Department of Ecology and the Cascadia consultant team designed the 2004 Litter Study to be as comparable as possible to the 1999 Litter Study in order to maximize the likelihood of detecting changes in litter composition and generation between 1999 and 2004. While compatibility was a primary objective, the consultant team determined that a change in the weighting method would increase accuracy. Therefore, litter composition findings shown in Section 4 of this report and in the 1999 report are not directly comparable. To allow direct comparisons between the two studies, the consultant team recalculated tables from the 1999 study. Please see Appendix H for tables and a discussion of how these data were weighted to make them directly comparable to the 2004 study results.

This section compares the composition of litter on all roadways combined and on interchanges in 1999 and 2004, using the recalculated 1999 tables. Side-by-side pie charts illustrate the percent of litter in each year by broad material class. A table follows each pie chart set, which lists the top ten individual components of litter in each year, organized by their rank in 2004. The information in Section 5.3 is based on actual data, weighted and extrapolated to the whole, rather than on statistical tests for difference.

5.3.1 ALL ROADWAYS

As Figure 5-20 shows, the portion of litter that is **glass** decreased from 21% in 1999 to 13% in 2004. **Metal**, **other materials**, **hazardous materials**, and **plastic** percentages increased somewhat, while the portions corresponding to **CDL** and **organics** decreased slightly.

Figure 5-20 Changes in Composition Summary, All Roadways



Glass beverage containers were the top component of litter on roadways in both years, but decreased from 19% of litter in 1999 to 12% in 2004, as Table 5-1 shows. *Wood/lumber/particleboard* and *other organics* made up the remainder of the top three components in both years.

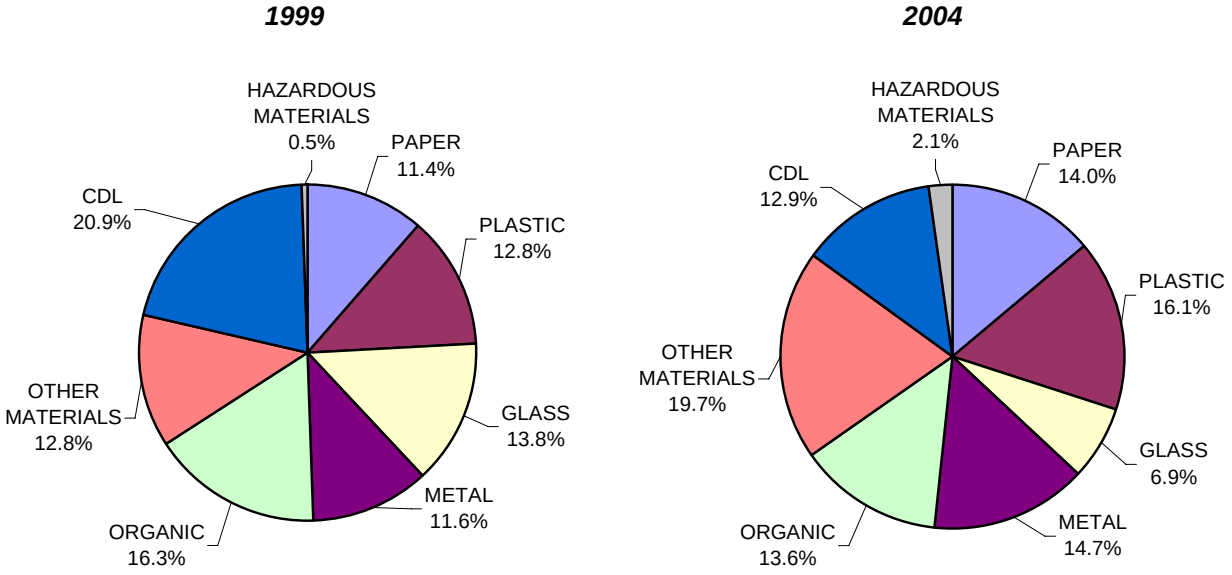
Table 5-1 Changes in Top Ten Largest Components by Weight, All Roadways (Interstates, State Routes and County Roads)

	1999	2004
Glass Beverage Containers	19.4%	11.9%
Other Organics	12.2%	9.8%
Wood/Lumber/Particleboard	12.4%	8.2%
Other Metals/Composite Materials	5.9%	7.4%
Other Plastics/Composite Materials	2.8%	6.9%
Tires/Auto Rubber Products	8.5%	6.4%
Metal Automotive Parts	3.2%	6.3%
Furniture/Mattresses/Appliances	--	5.2%
Metal Beverage Containers	3.3%	3.0%
Plastic Bags and Film	4.5%	2.9%
Other Cardboard/Boxboard	2.6%	--

5.3.2 *INTERCHANGES*

As Figure 5-21 illustrates, the portion of litter on interchanges that is **glass** decreased from 14% in 1999 to 7% in 2004. The **CDL** portion decreased from 21% to 13%, and the **organics** portion decreased from 16% to about 14%. **Other materials**, **hazardous materials**, **paper**, **plastic**, and **metal** all increased in percent by weight between 1999 and 2004.

Figure 5-21 Changes in Composition Summary, Interchanges



As shown in Table 5-2, the three materials that are most prevalent in litter at interchanges in 2004, *other organics*, *tires/auto rubber products*, and *wood/lumber/particleboard*, were also some of the most prevalent materials at interchanges in 1999. The fourth most common material in 2004, *other plastics/composite materials*, has risen since 1999 in its percentage of litter at interchanges.

Table 5-2 Changes in Top Ten Largest Components by Weight, Interchanges

	1999	2004
Other Organics	14.5%	10.5%
Tires/Auto Rubber Products	7.2%	9.9%
Wood/Lumber/Particleboard	16.7%	9.4%
Other Plastics/Composite Materials	3.5%	8.5%
Other Metals/Composite Materials	4.8%	7.0%
Glass Beverage Containers	12.8%	5.8%
Metal Automotive Parts	4.9%	5.5%
Textiles/Leather	--	5.4%
Other Cardboard/Boxboard	4.8%	4.6%
Plastic Bags and Film	3.9%	--
Other Paper/Composite Materials	--	3.3%
Plastic Automotive Parts	2.4%	--

6. SUMMARY OF RESULTS

Litter generation and composition results are summarized below. Notable findings within the roadway and interchange categories are discussed in Sections 6.1 and 6.2, respectively. Section 6.3 lists key findings from the comparison of litter generation in 1999 and 2004.

6.1 ROADWAYS

- The total amount of litter generated annually on county roads in Washington is greater than the amount generated on state routes and interstates. This difference is due to the fact that there are considerably more miles of county roads in Washington than any other type. More than 4,000 tons of litter accumulated on county roads in 2004, and more than 1,200 tons accumulated on state routes. Total generation was least on interstates, at 682 tons.
- Per mile of roadway, however, the situation is reversed. Interstates accumulate about 2,372 pounds – or slightly less than one and a quarter tons – of litter per mile per year. State routes accumulate 404 pounds of litter per mile per year, and county roads 217 pounds.
- Per mile driven, state routes receive more litter than interstates. In 2004, state routes averaged 0.15 pounds per 1,000 miles driven, while interstates averaged 0.09 pounds.
- In general, the amount of litter generated per mile on urban roads is greater than on non-urban:
  - On urban interstates, almost twice as much litter is generated per mile as on non-urban interstates: 3,762 versus 1,920 pounds per mile.
  - Nearly five times as much litter (1,298 pounds per mile) collects on urban state routes as on non-urban state routes (282 pounds per mile).
  - On urban county roads, over 600 pounds per mile is littered, compared with only about 160 pounds per mile on non-urban county roads.
- *Glass beverage containers*, at 11.9%, constitute the largest single litter item by weight along roadways. Among road types, county roads had the highest percentage of glass beverage containers, at 13.6%, and interstates had the lowest percentage at 2.9%.
- *Other organics*, including yard debris, stumps, firewood, branches, and pruning debris, were 9.8% of roadside litter, by weight, in 2004. These materials constituted over a third of litter on interstates overall and nearly 50% of litter on non-urban interstates.
- *Wood/lumber/particleboard* was common on all three road types. On interstates this material made up nearly 9% of litter, on state routes, about 12%, and on county roads, about 7%.

6.2 INTERCHANGES

- Approximately 443 tons of litter was generated on interchanges in 2004.
- The average weight of material littered per interchange in Washington per year is 1,801 pounds, or nearly one ton.
- Because urban interchanges outnumber non-urban interchanges, and have a higher litter generation rate (1,950 pounds per year compared to 1,491 pounds per year), the amount of litter generated on urban interchanges was estimated to be almost three times as much as on their non-urban counterparts.

- *Other organics* – such as yard debris, stumps, firewood, branches, and pruning debris – and *tires/auto rubber products* were the top two components of litter found on interchanges in 2004, accounting for about 10% each.

6.3 COMPARISON OF 1999 AND 2004 LITTER STUDIES

6.3.1 CHANGES IN ESTIMATED QUANTITIES OF LITTER

- The estimated amount of litter on Washington roadways decreased from 8,322 tons in 1999 to 6,315 tons in 2004.
- The estimated amount of litter on interchanges in Washington decreased from 617 tons in 1999 to 443 tons in 2004.

6.3.2 STATISTICALLY TESTED CHANGES IN GENERATION RATES

- Statistical tests indicated a strong downward trend in overall litter generation between 1999 and 2004 on county roads and on interchanges, especially in the winter. The tests did not detect a statistically significant decrease in overall litter generation on other road types or on all roadways combined.
- Individual components of litter showed statistically significant decreases between 1999 and 2004. The component *all beverage containers combined* decreased significantly on both interchanges and all roadways combined during this time period.
- *Glass beverage containers* also showed a statistically significant decrease on both interchanges and all roadways combined between 1999 and 2004.
- The decrease in *CDL* on interchanges was statistically significant. On all road types, CDL showed a strong downward trend.
- The accumulation of *tires/auto rubber products* exhibited a strong downward trend on all road types, except interchanges, between 1999 and 2004.
- The decrease in accumulation of *fast-food containers* on interchanges was statistically significant. On all road types, littering of these containers showed a strong downward trend.
- *All alcoholic beverage containers combined* showed a statistically significant decrease on all road types combined.
- *Glass alcoholic beverage containers* showed a statistically significant decrease on roads, and a strong downward trend on interchanges.
- *Metal alcoholic beverage containers* showed a strong downward trend on all road types in winter, but not for the year as a whole.
- The number of alcoholic beverage containers, as measured in Bottle Equivalents, showed a statistically significant decrease in winter on all road types combined, and a strong downward trend on all roads year-round.
- The number of all beverage containers combined, as measured in Bottle Equivalents, exhibited a strong downward trend on all road types combined in winter, but not for the year as a whole.
- Although not tested statistically, litter generation on interstates seems to have increased since 1999.
- Similarly, *plastic beverage containers* and *plastic alcoholic beverage containers* showed an apparent increase over 1999 generation.

6.3.3 CHANGES IN ESTIMATED COMPOSITION OF LITTER

- For all roadways combined, the portion of litter that is glass decreased from 21% in 1999 to 13% in 2004.
- Several material classes comprised smaller portions of litter found on interchanges in 2004 than in 1999:
  - The portion of litter that is glass decreased from 14% in 1999 to 7% in 2004.
  - The CDL portion decreased from 21% to 13%.
  - The percentage of organics decreased from 16% to about 14%.

Appendix A: Litter Component Categories

Litter samples were sorted by hand into 77 component categories.[40] Some of the 77 material types were "folded up" into a condensed list used for presenting results in this report that includes 57 types. The condensed list of 57 materials appears below followed by the list of 77 materials with corresponding definitions.

Paper

1 Beverage Containers - One-Time Fast-food Service
2 Items Other Food and Beverage
3 Packaging
4 Non-food Packaging
5 Other Cardboard/Boxboard
6 Paper Bags
7 Newspapers and Magazines
Other Paper/Composite
8 Materials

Plastic

9 Beverage Containers One-Time Fast-food Service
10 Items Other Food and Beverage
11 Packaging
12 Non-food Packaging
13 Plastic Bags and Film
14 Automotive Parts
Other Plastics/Composite
15 Materials

Glass

16 Beverage Containers One-Time Fast-food Service
17 Items Other Food and Beverage
18 Packaging
19 Non-food Packaging
20 Automotive Parts
Other Glass/Composite
21 Materials

Metal

[40] The material classes and components are the same as those used in the 1999 study, with one exception. In 1999, pieces of rubber from tires were classified as tires. In 2004, these pieces were classified as automotive rubber, a change which is more consistent with the component definitions. For this reason, the materials tires and auto rubber products have been combined for this report.

22 Beverage Containers
One-Time Fast-food Service
23 Items
Other Food and Beverage
24 Packaging
25 Non-food Packaging
26 Automotive Parts
Other Metals/Composite
27 Materials

Organics

28 Food (Human And Pet)
29 Cigarettes and Other Tobacco
30 Other Organics

CDL

31 Wood/Lumber/Particleboard
32 Mineral Aggregates
33 Roofing
34 Insulation
35 Drywall
Other Construction/Demolition
36 Debris

Hazardous Material and Packaging

37 Oil
38 Oil based paints
39 Flammable liquids
40 Latex paint
41 Flammable gas
42 Batteries
43 Medical waste
44 Pesticides/Herbicides
45 Explosives
46 Cleaners (Hazardous)
47 Other

Other Materials

48 Textiles/Leather
49 Carpet
50 Furniture/Mattresses/Appliances
51 Tires/Auto Rubber Products
52 Rubber/Latex toiletries
53 Other Rubber/Latex products
54 Disposable diapers
55 Ceramics/Porcelain
56 Toys/Sporting goods
57 Miscellaneous/Other

COMPLETE LIST OF MATERIAL COMPONENTS

PAPER

BEVERAGE CONTAINERS

1. **Alcoholic:** Any paperboard carton or other container of any size (excluding paper cups and packaging materials) designed to contain wine or wine cooler beverages.
2. **Nonalcoholic:** Any paperboard carton or other container of any size (excluding paper cups) designed to contain nonalcoholic beverages. This includes such items as juice boxes and milk cartons, but excludes paper used as packaging material.
3. **Unknown:** Any paperboard carton or other container of any size (excluding paper cups and packaging material) designed to contain beverages, but whose previous contents are unknown.
4. **One-time/fast-food service items:** All 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, and paper bags known to be from such establishments.
5. **Other food and beverage packaging:** Any paperboard boxes or cartons, wrappings, or other papers designed to hold food or beverages not originating from fast-food service establishments. This includes, but is not limited to, paperboard boxes used to hold 12 or more individual soda pop or beer cans, and wrappings, bags, or boxes used to package gum, chips, crackers or other snack items.

NON-FOOD PACKAGING

6. **Tobacco products:** Paper boxes, wrappings, bags, or other papers used to package cigarettes, cigars, chewing or pipe tobacco, and other tobacco products. Includes individual cigarette packages.
7. **Cleaning agents (nonhazardous):** Paper boxes, wrappings, bags, or other papers that contained cleaning agents such as soaps, shampoos, or detergents, that are primarily used for cleaning buildings, places, persons, animals, or things.
8. **Hazardous material packaging:** Paper boxes, wrappers, bags, or other papers that contained hazardous items such as pesticide.
9. **Other packaging:** Paper boxes, wrappings, bags, or other papers used to package items that are not food, tobacco, cleaning agents, or hazardous; or whose previous contents are unknown.
10. **Other cardboard/boxboard:** Any other corrugated or paper boxes either not used for packaging or whose purpose is unknown.

11. **Paper bags:** All other paper bags (brown, bleached, or colored) not known to be used as packaging materials or serving fast-food items. Examples are hardware store bags and grocery bags.

12. **Newspapers and magazines:** Printed newsprint, including "glossy" ad slicks and bound or individual pages of magazines.

13. **Other paper/composite materials:** Products made entirely of paper that are not elsewhere described, such as computer paper, envelopes, and paperback books. Products made predominantly of paper, but also including other materials, such as hardback books and photographs.

PLASTIC

BEVERAGE CONTAINERS

14. **Alcoholic:** Plastic bottles or containers of any size designed to contain beer or other malt beverages, wine, wine coolers, vodka, gin, rum, and liqueurs.

15. **Nonalcoholic:** Any plastic bottle or container of any size (excluding plastic cups) designed to contain nonalcoholic beverages, such as soda pop, juice, and sports drinks.

16. **Unknown:** Any plastic bottle or other container of any size (excluding plastic cups and packaging materials) designed to contain beverages, but whose previous contents are unknown.

17. **One-time/fast-food service items:** All plastic items (including 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.

18. **Other food and beverage packaging:** Any plastic containers (including Styrofoam) or film wrappings designed to hold food or beverage items not originating from fast-food service establishments. This includes, but is not limited to, 6-ringed beverage holders, yogurt cups, and wrappings or bags used to package candy, chips, or other snack items.

NON-FOOD PACKAGING

19. **Tobacco products:** Plastic wrappings, bags, or other plastic packaging materials used to package cigarettes, cigars, chewing or pipe tobacco, or other tobacco products.

20. **Cleaning agents (nonhazardous):** Plastic boxes, wrappings, bags, or other plastic packaging materials that contained cleaning agents such as soaps, shampoos, or detergents, that are primarily used for cleaning buildings, places, persons, animals, or things.

21. **Hazardous material packaging:** Plastic bottles, boxes or bags that contained hazardous products, such as motor oil bottles.

22. **Other packaging:** Plastic boxes, wrappings, bags, or other plastics used to package items that are not food, tobacco, cleaning agents; or hazardous materials, or whose previous contents are unknown.
23. **Plastic bags and film:** Plastic films not known to be used for packaging materials or serving fast-food service items. Examples include plastic grocery bags, plastic garbage bags, and tarps.
24. **Automotive parts:** Plastic molding, exterior light covers, and any other plastic part known to be from an automobile.
25. **Other plastic/composite materials:** Products made entirely of plastic that are not elsewhere described, such as multiple-use water bottles. Products made predominantly of plastic, but that also include other materials. Examples include small appliances comprised mainly of plastic.

GLASS

BEVERAGE CONTAINERS

26. **Alcoholic:** Any glass bottle or other container of any size designed to contain beer or other malt beverages, wine or wine coolers, vodka, gin, rum, and other liqueurs.
27. **Nonalcoholic:** Any glass bottle or other container of any size designed to contain nonalcoholic beverages such as juice, milk or soda pop.
28. **Unknown:** Any glass bottle or other container of any size designed to contain a beverage, but whose previous contents is unknown.
29. **One-time/fast-food service items:** All glass items used to serve one-time or fast-food service items originating from restaurants, taverns, drive-ins, concessions, fast-food section of a grocery store and other such establishments.
30. **Other food and beverage packaging:** Any glass containers or other glass designed to hold food items not originating from fast-food service establishments. This includes, but is not limited to, jam jars, condiment bottles (e.g., mustard), and spices.

NON-FOOD PACKAGING

31. **Tobacco products:** Glass containers or other glass used to contain cigarettes, cigars, chewing tobacco, or other tobacco products.
32. **Cleaning agents (nonhazardous):** Glass containers or other glass used to contain cleaning agents such as soaps, shampoos, or detergents that are primarily used for cleaning buildings, places, persons, animals, or things.
33. **Hazardous material packaging:** Glass containers that contained hazardous materials.
34. **Other packaging:** Other glass used to package items that are not food, tobacco, cleaning agents, or hazardous materials, or whose previous contents were unknown.

35. **Automotive parts:** Rearview mirrors, lights, or window glass known to be from an automobile or other motorized vehicle.

36. **Other glass/composite materials:** Glass pieces or products made entirely of glass that are not classified elsewhere, including flat glass such as window glass. Products predominantly made from glass but which also include other materials.

METAL

BEVERAGE CONTAINERS

37. **Alcoholic:** Any metal can or other container of any size designed to contain beer or other malt beverages, wine or wine coolers, vodka, gin, rum, and other liqueurs.

38. **Nonalcoholic:** Any metal can or other container of any size designed to contain nonalcoholic beverages such as juice, milk or soda pop.

39. **Unknown:** Any metal can or other container of any size designed to contain beverages, although the type of beverage is unknown.

40. **One-time/fast-food service items:** All metal containers or foils 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 foil wrappings, aluminum bowls, and condiment packaging known to be from such an establishment.

41. **Other food packaging:** Any metal container or foil designed to hold food items not originating from fast-food service establishments. Examples include canned food containers, chocolate bar wrappings, and soda/beer bottle lids.

NON-FOOD PACKAGING

42. **Tobacco products:** Metal containers or foils used to package cigarettes, cigars, chewing tobacco, or other tobacco products.

43. **Cleaning agents (nonhazardous):** Metal containers or foils used to contain cleaning agents such as soaps, shampoos, or detergents, that are primarily used for cleaning buildings, places, persons, animals, or things.

44. **Hazardous materials packaging:** Metal containers that contained hazardous items, such as oven cleaner.

45. **Other packaging:** Other metal used to package items that are not food, tobacco, cleaning agents, or hazardous materials, or whose previous contents were unknown.

46. **Automotive parts:** Any metals known to originate from automobiles. Examples include hubcaps, tailpipes, and wheels.

47. **Other metal/composite materials:** Products made entirely from metal and are not elsewhere described. Predominantly metal products, but containing other materials as well. Examples include small appliances comprised mainly of metal.

ORGANICS

48. **Food (human or pet):** Food wastes and scraps including bones, rinds, etc., for human or pet consumption. Excludes the weight of food containers, except when the container weight is negligible compared to the food inside.

49. **Cigarettes and other tobacco products:** All tobacco products including used and unused cigarettes, cigars, chewing tobacco, and pipe tobacco, excluding their packaging, except when the weight is negligible when compared to the weight of the tobacco product.

50. **Other organics:** All organic materials, not elsewhere classified. This includes yard debris, stumps, firewood, branches, and prunings.

CDL

51. **Wood/lumber/particleboard:** Milled lumber and wood products, including treated, untreated, and painted wood.

52. **Mineral aggregates:** Concrete, cinder blocks, and brick.

53. **Roofing:** Roofing materials, asphalt roofing, shingles, tarpaper and tiles.

54. **Insulation:** Fiberglass insulation.

55. **Drywall:** Gypsum drywall (new or used).

56. **Other construction/demolition debris:** Other construction/demolition materials not elsewhere classified.

HAZARDOUS MATERIALS

57. **Latex paint:** Water-based paints.

58. **Oil-based paint:** Oil-based paints, varnishes, stains, and similar products.

59. **Oil:** Motor oil and other fuel oils.

60. **Batteries:** Batteries known to be from automobiles.

61. **Flammable gas:** Propane canisters.

62. **Flammable liquids:** Gas, turpentine, and nonchlorinated solvents, including paint strippers and solvents contaminated with other products (such as paints, degreasers and some other cleaners) if the primary ingredient is (or was) the solvent or an alcohol such as methanol or propanol.

63. **Explosives:** Fireworks, firecrackers, or any potentially explosive material other than fireworks, including gunpowder, unspent ammunition, and picric acid.

64. **Pesticides/herbicides:** Variety of poisons whose purpose is to discourage or kill pests, weeds, or microorganisms. Fungicides and wood preservatives are also included.

65. **Cleaners (hazardous):** Cleaning agents such as drain cleaners and mildew removers. This does not include the packaging unless it is negligible by weight.

66. **Medical wastes:** Needles, syringes, I.V. tubing, and other medical waste materials used in connection with treating a patient (or animal). Also includes medications, ointments, creams, etc., used to heal persons or other animals, but does not include their packaging unless negligible by weight.

67. **Other hazardous:** Other hazardous materials that do not fit into the above categories, including unidentifiable materials, such as nonautomotive batteries and adhesives/glue.

OTHER MATERIALS

68. **Textiles and leather:** Fabrics and products made from leather and/or textiles, such as clothing, shoes, and purses.

69. **Carpet:** General category of flooring applications consisting of various natural or synthetic fibers bonded to some type of backing material.

70. **Furniture/mattresses/appliances:** Mixed material furniture, mattresses, box springs, and refrigerators.

71. **Tires/auto rubber products:** Vehicle tires and tire shards of all types and other rubber products that originate from vehicles.

72. **Rubber and latex toiletries:** Rubber or latex products for grooming or health purposes, such as make-up sponges, gloves, and condoms.

73. **Other rubber or latex products:** Finished products and scrap materials made of rubber, such as bath mats, inner tubes for bicycles, rubber hoses, and foam rubber.

74. **Disposable diapers:** Disposable baby diapers and adult protective undergarments.

75. **Ceramics/porcelain:** Finished ceramic or porcelain products such as dishware, toilets, etc.

76. **Toys/sporting goods:** Items such as golf balls, Frisbees, and toy cars.

77. **Miscellaneous materials:** Any other material not otherwise described. Includes dirt, soil, and nondistinct fines.

Appendix B: Sampling Methodology

The purpose of the 2004 Litter Generation and Composition Study was to generate litter data to provide a comprehensive current picture of litter quantities and components, and to compare to the 1999 Litter Generation and Composition Study. This information will help Ecology evaluate its litter reduction efforts; therefore, the sampling methodology used in the 2004 study was as close to the 1999 methodology as possible. This appendix describes the 2004 methodology briefly, focusing on areas where methods or details differed from 1999. The interested reader is directed to Appendix B of the *Washington State Litter Study: Litter Generation and Composition Report* (2000) for a complete description of the sampling methodology designed and used in 1999. This report can be viewed via Ecology's Litter Web page.[41]

Site Category Stratification

The 2004 study focused on areas where litter generation was most likely to have changed since 1999 – roadways and interchanges – and omitted public areas. All subcategories within the two primary site categories remained the same as in 1999. Table B-1 lists the categories and subcategories of sites sampled in 2004.

Table B-1 Site Categories and Subcategories

Primary Site Category	Subcategory	Further Subcategories
Roadways	Interstates	Urban interstates
		Non-urban interstates
	State routes	Urban state routes
		Non-urban state routes
	County roads	Urban county roads
		Non-urban county roads
Interchanges	Interchanges	Urban interchanges
		Non-urban interchanges

Sample Allocation and Schedule

To obtain the desired statistical power, samples were allocated as follows:

- Each subcategory – interstates, state routes, county roads, and interchanges – was allocated approximately 30 sites, or 60 samples, over both seasons for a total of 230 samples.
- Half of the samples, 115 samples, were collected and sorted in the spring, and half in the fall.
- For each subcategory, about half of the samples were collected from urban sites and half from non-urban sites.

[41] http://www.ecy.wa.gov/programs/swfa/litter/public.html#a1

Table B-2 Sample Allocation

Roadway Sampling Locations					
Interstate Highway 30 sites		**State Routes** 29 sites		**County Roads** 29 sites	
Urban 15 sites	*Non-urban* 15 sites	*Urban* 15 sites	*Non-urban* 14 sites	*Urban* 14 sites	*Non-urban* 15 sites

Interchange Sampling Locations	
Interchanges 27 sites	
Urban 14 sites	*Non-urban* 13 sites

To ensure comparability with the 1999 study, the 2004 study used a similar sampling schedule. Ecology Youth Corps (EYC) median crews performed an initial cleanup of each site in September, October or November of 2003. EYC crews also collected the litter samples in the spring and in the fall of 2004, as noted below.[42] The initial cleanup ensured that the length of time over which litter accumulated was known, and provided an opportunity for crews to verify the site boundaries and report any oversized items that might remain on site throughout the accumulation period. The seasonal schedule provided comparable accumulation times for both seasons of approximately five months and minimized complications due to snow. Spring samples were collected between March and May, 2004, while fall samples were collected between August and October, 2004.

SITE SELECTION PROCESS

The 2004 study sampled the same roadway and interchange sites studied in 1999 so that the two studies would be as comparable as possible. Certain sites, however, were unavailable in 2004 due to construction, safety hazards, or snow. Appendix C lists the sites sampled in both 1999 and 2004, and explains which of the 1999 sites were not used in 2004.

A total of eleven sites were new in 2004: seven of these new sites were roads, and four were interchanges. To avoid potential bias, the sites were chosen using a random selection process, where all potential sampling locations within the "universe" had an

[42] A few fall samples were collected by EYC youth crews and the three remote sites on the Olympic Peninsula were cleaned and sampled by the Clallam County Litter Crew. More crews from Department of Corrections participated in the 1998-9 study.

equal chance of being chosen.[43] This selection process was similar to that used in 1998. Sampling areas were also defined in a manner identical to the 1999 study:

- For roadways, the length of the roadway site was determined by moving a specified distance from the starting milepost in the increasing direction of the numbered milepost markers – north on a north/south road, east on an east/west road. To account for traffic variations and wind-blown litter, the width of the roadway site was a cross section of the road, including both shoulders and the median if one existed.
- For interchanges, the litter sampling areas were also cross-sections, commonly including an off-ramp, an on-ramp, and the adjacent median area within a particular interchange.

Next, Ecology Youth Corps (EYC) coordinators inspected the sites located within their regions. Sites could be rejected at this point due to safety hazards, or shifted to avoid "overlapping populations." An ***overlapping population*** area is any interstate or state route site that includes portions of or an entire interchange (overlap of roadway and interchange populations).

"UNIVERSE" OF SITES

In both 1999 and 2004, Cascadia documented the universe of each site category for use in extrapolating the generation and composition results derived from field sampling. The "universe" represents all possible sampling sites and includes the total number of urban and non-urban interchanges, and urban and non-urban interstate, state route and county road miles, minus those miles associated with interchanges.

Although the universe of sites was similar in 2004 and 1999, several changes did occur, as follows:

- In 1999, two interchanges were categorized as being on state routes when in reality they were on interstates. Correcting this error increased the number of interstate interchange miles and decreased the number of state route interchange miles. Because road miles associated with interchanges are subtracted from the total road miles to create the roadways universe, this change decreased the number of interstate miles and increased the number of state route miles in the universe.
- Eleven interchanges were built since the 1999 study, seven of which were urban and 4 of which were non-urban. These new interchanges also increased the number of interchange miles, thus decreasing the universe of road miles as noted above
- Construction and changes in vegetative cover altered the amount of cleanable square feet per mile of roadway or per interchange.

[43] The list of potential sites included all the 1999 sites, although the random selection process did not re-generate any of the 1999 sites.

- The 2004 study used the 2000 Census in identifying urban versus non-urban roadways. Data from the 1990 Census was used in the 1998 site selection process.

The method used to identify the "universe" for each of the sampled categories is outlined below.

ROADWAYS

The number of road miles was obtained from the Washington State Department of Transportation for each of the sampled categories (see Table B-3). Because interchanges were defined as a separate category and no roadway sampling occurred within an interchange, the mileage associated with interchanges had to be subtracted from the total number of roadway miles for all interstate and state route sub-categories. The number of interchange miles was calculated by multiplying the average length of an urban or non-urban interchange (obtained from the maps of all the sample sites) by the total number of interchanges within each road subcategory.[44]

On a per-mile basis, the *area* of the road shoulders and the medians differ between road categories. For example, some sites have wide shoulders or medians, while others may have a narrow shoulder or median (for example, there may be a jersey barrier or a rock wall). In order to compare the relative sizes of the sites, an average cross-sectional area was calculated based on the sites included in the study. This average cross-sectional area, presented in Table B-3, represents the sum of the median and shoulder portions of a stretch of road one mile in length.[45] Since the area per mile is an average, it is representative of road miles both with and without a median.

[44] Based on the maps, the average length of an urban interchange was approximately 0.70 miles and the average length of a non-urban interchange was approximately 0.56 miles. An example of calculating the universe of interstate miles is as follows. There are 764 total interstate miles in Washington which include 172 urban and 126 non-urban interchanges; therefore, the "universe" of interstate miles is approximately equal to (764 interstate miles – 0.70 miles/urban interchange) x (172 urban interchanges – 0.56 miles/non-urban interchange) x (126 non-urban interchanges), or 575 miles.

[45] For the roadway sites that were measured over an entire mile (non-urban county roads and state routes), the average cross-sectional area was calculated based on the site maps. For the urban road categories and non-urban interstate categories, an average cross-sectional area was computed for the site length measured (either 1/10 or 1/2 mile) and then extrapolated to a full mile. Site subcategories were weighted to determine the average cross-sectional area for all Washington interstates, state routes, county roads, and roadways overall.

Table B-3 Universe of Road Miles

	(miles) Total	Interchange	"Universe"	(Square Feet) Area Per Mile
Interstate	**764**	**189**	**575**	**978,377**
Urban Interstates	260	119	*141*	875,444
Non-Urban Interstates	504	70	*434*	1,011,914
State Routes	**6,283**	**129**	**6,154**	**314,080**
Urban State Routes	851	110	*741*	611,887
Non-Urban State Routes	5,432	19	*5,413*	273,334
County Roads	**40,495**	**0**	**40,495**	**193,498**
Urban County Roads	5,225	0	*5,225*	223,010
Non-Urban County Roads	35,270	0	*35,270*	189,125
Total Roads (Interstates, State Routes, County Roads)	**47,542**	**318**	**47,224**	**218,769**

Data for interstate highways, state routes and county roads can be applied only to these specific road subcategories in the state, and cannot accurately be applied to city streets, forest service roads, and other roads which were not included in this study.

INTERCHANGES

There are 492 interchanges on interstates and state routes in Washington (see Table B-4). Of those, 332 are in urban areas and 160 are in non-urban areas.[46] A standard interchange includes two on-ramps, two off-ramps, and the median; but there is variety in configurations (e.g., an interchange may have only one on-ramp and one off-ramp).[47]

Table B-4 Universe of Interchanges

	Number	(Square Feet) Area Per Interchange
Urban Interchanges	332	739,982
Non-Urban Interchanges	160	994,683
Total Interchanges	492	822,812

Because interchanges represent a unique sector of the population, they were not combined with the roadway categories. This is because they often relate to other road categories not included in the sample design. For example, litter deposited within an interchange could be coming from a city street, and city streets were not included in this study.

[46] Of the 332 urban interchanges, 172 are on interstates and 160 are on state routes. Of the 160 non-urban interchanges, 126 are on interstates and 34 are on state routes.

[47] The number of interchanges in the state was obtained from the Washington Department of Transportation's Roadway Operations Division.

COLLECTION AND SORTING OF SAMPLES

EYC median crews[48] collected spring samples between March and May of 2004, and fall samples between August and October, 2004. As in 1999, the following two circumstances resulted in the exclusion of litter from sample sites from the generation and composition estimates:

- *Site interference*
  While the Department of Ecology attempted to communicate with all groups that routinely or voluntarily collect litter from around the state, some of the groups may have cleaned up litter from survey sites during the course of the study. As a result, litter accumulation rates may have been underestimated.[49] To our knowledge, site interference affected eighteen samples in 2004. In twelve cases, Ecology was able to recover the bags; thus restoring these samples so they could be included in the analysis. The other eight samples were discarded, as noted in Appendix C.

- *Items not collected*
  For safety reasons, collection crews were instructed to leave certain items on site or to dispose of them separately. These included hazardous materials, explosives, "trucker bottles" (urine-filled bottles), knives, firearms, tissues containing human waste, and extra large or heavy objects. These items were documented, but were not included in the composition data. Table B-5 details the number of each type of item found but not collected for sorting. The table lists the number of items found across all sample sites in both sampling seasons. No analysis has been performed on this data as it is based solely on crew observations. "Items too large or heavy to be carried safely" included railroad ties, pallets, and concrete blocks. The "Other" category includes such items as surgical gloves, dead animals, and pipes.

[48] A few fall samples were collected by EYC youth crews, and the three remote sites on the Olympic Peninsula were cleaned and sampled by the Clallam County Litter Crew.

[49] All sites were subject to "scavenging" by individuals collecting materials for recycling. This may be especially true for aluminum beverage containers, which may be profitably recycled.

Table B-5 Litter Found, but Not Collected[50]

	Roads			Interchanges
	Interstates	*State Routes*	*County Roads*	*Interchanges*
Hazardous or potentially hazardous materials	8	1	1	3
Closed Bottles Containing Liquid	0	10	0	18
Trucker bottles or other human waste	144	36	35	180
Explosives	2	2	1	0
Knives	2	1	0	11
Firearms	0	0	0	1
Items too large or heavy to be carried safely	24	17	28	44
Condoms	11	1	2	18
Needles	8	11	3	64
Razors	4	5	2	12
Broken Glass	5	0	1	5
Other	47	19	14	4

The sample collection and sorting procedures were the same in 2004 as they were in 1999.[51] Aside from those items listed in Table B-5, crews cleaned everything from each site larger than one square inch. Certain smaller items like bottle caps, polystyrene peanuts, and cigarette butts were also collected. All crews participating in litter collection followed prescribed safety procedures.

Crews collected the litter samples in clear plastic bags with a two-cubic-foot capacity. Portable items too large for the bags were secured with twine or duct tape into bundles. Broken glass was collected separately in buckets for safety reasons. After completing each site, crews carefully tagged the full bags, bundles and buckets comprising the sample, and transported them to regional storage locations. Crew supervisors were also responsible for documenting the collection activity on a *Site Verification and Litter Inventory Form* (see Appendix F).

[50] In addition to all the urine bottles found on sites and not collected, some were found in and weighed with the sample although they were not included in the analysis. On interstates, 11.4 lbs. were collected from 5 sites; 6.73 lbs. were collected from 11 state route sites; 7.8 lbs. were found on 5 county road sites; and 8.4 lbs. were found on 10 interchange sites.

[51] For field specifics, please refer to the Training Manual presented as Appendix F of the *Washington State Litter Study Volume II: Litter Generation and Composition Report (2000)* at http://www.ecy.wa.gov/programs/swfa/litter/public.html#a1

Due to their quantity and the level of effort required for their removal, cigarette butts were collected only from a sub-sample area. Cigarette butt sub-sample areas were designated and marked as follows:

- For urban roadways, the sub-sample area was the first 10% of the site area (originating at the lower milepost) all the way across the site, including both shoulders and the median. It measured 52 feet (10% of 1/10 of a mile).
- For non-urban roadways, the sub-sample area measured 528 feet (10% of 1 mile for state routes and county roads and 20% of ½ mile for interstates).
- For interchanges, the sub-sample area was one of three sections; the on-ramp, the off-ramp or the median. The section was randomly selected.

At the end of each collection period, the samples were transported to Tacoma or Spokane to be sorted, weighed and tabulated by Sky Valley Associates, a professional waste characterization company. Figure B-1, below, shows the schedule used for sorting in 2004.

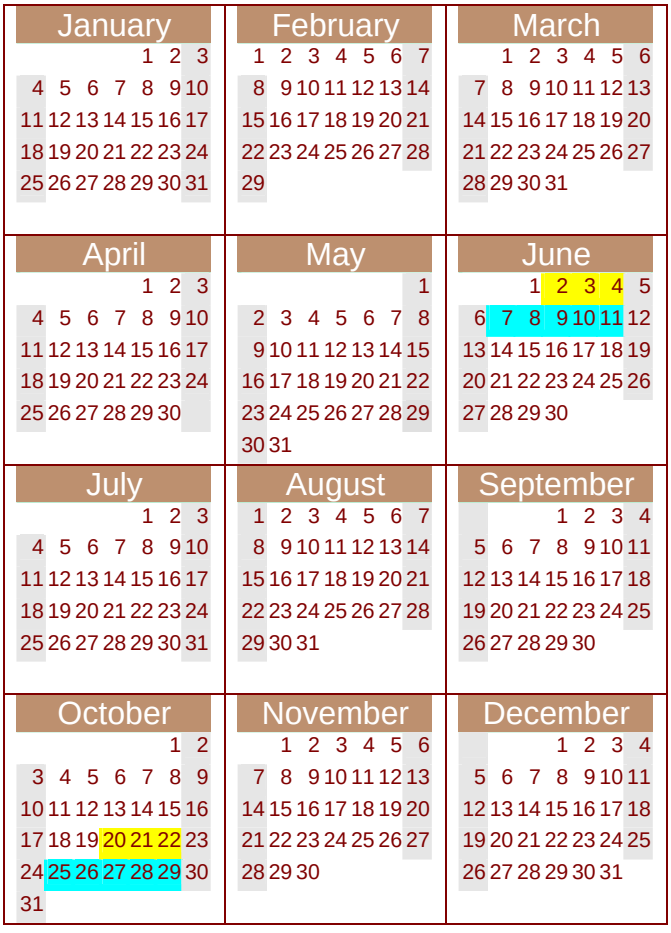
Figure B-1 2004 Sorting Schedule

1st Season

Sorting took place in Spokane from June 2nd through June 4th. Sampling in Tacoma occurred the following week, June 7th to the 11th. A total of 110 samples were sorted this season.

2nd Season

Sorting started on October 20 or 21st in Spokane and lasted three days. Sorting in Tacoma took place the week of October 25th. A total of 112 samples were sorted this season.



A total of 222 samples were collected in 2004. As Table B-6 shows, the weight of all samples totaled 47,818 pounds (or 23.9 tons), with an average sample weight of 215 pounds.

Table B-6 Number of Samples Sorted, Total Sample Weight, and Average Weight per Sample

Category	Sample Count	Total Sample Weight (Lbs)	Average Sample Weight (Lbs)
ROADS			
Interstates	*59*	*17,841*	*302*
Urban	29	4,744	164
Non-urban	30	13,097	437
State Routes	*53*	*4,848*	*91*
Urban	28	1,612	58
Non-urban	25	3,237	129
County Roads	*56*	*2,739*	*49*
Urban	26	687	26
Non-urban	30	2,053	68
INTERCHANGES	**54**	**22,389**	**415**
Urban	28	13,367	477
Non-urban	26	9,021	347
TOTAL	**222**	**47,818**	**215**

As in 1999, the measured weights of all bags, bundles, glass buckets, and containers of cigarettes associated with the sample were added together to find the total weight of each sample. Where samples exceeded 150 pounds, either all of the bags, or a subset of the bags weighing up to 500 pounds, were dumped on a tarp. Crews mixed the material on the tarp, and took a 150 pound subsample from the mixed material. They then sorted the 150-pound subsample into its material components and recorded the weight of each component on a Sorting Form. With the exception of interstates, the average sample weights were nearly identical to those in 1999. Interstate samples, on average, were substantially larger in 2004.

Sample data was later entered into a database, as follows:

- The weight of each material component;
- The total weight of the sample, subtracting 0.22 pounds for each bag that was used to contain the bagged portion of the sample; and
- The weights and characterization of each bundle, bucket of glass, and container of cigarette butts in each sample. Later, the information about the bagged

portion of the sample and the bundles, glass buckets, and cigarette butts was combined to form a composite picture of the entire sample.[52]

Appendix D describes the generation and composition calculations performed using this data.

[52] Two examples follow, illustrating how sample weights were calculated.

Example 1- Total sample weighs less than 150 pounds: One site had 6 bags and 6 bundles, and the total sample weight was less than 150 pounds. The entire sample was sorted. The sum of the sorted material equaled the total sample weight.

Example 2 – Total sample weighs more than 150 pounds: Another site had 21 bags and 3 bundles, and the total sample weight was greater than 150 pounds. The bags were weighed, the number of bags was multiplied by the average bag weight (21 bags x 0.22 lbs.), and the latter number was subtracted from the former to get a total bag weight. The content of the bags was thus emptied onto a tarp, mixed, and approximately 150 pounds of it were sorted and recorded. Bundles were weighed separately, and the total bundle weight was recorded. The total bag weight and total bundle weight were then added together for a total sample weight. .

Appendix C: Site Directory

The following tables list the sites that were randomly selected to be part of the study. Unless otherwise noted, sites were sampled in both the 1998 and 2004 study.

ROADS

Table C-1 Interstate Site Locations

Urban/Non-Urban	Site Number	Site Name	Closest City	County
Non-urban	IN-014[53]	90 MP 127	Vantage	Kittitas
Non-urban	IN-015	5 MP 239	Mount Vernon	Skagit
Non-urban	IN-016	90 MP 146	George	Grant
Non-urban	IN-018	90 MP 190	Moses Lake	Grant
Non-urban	IN-020	90 MP 266	Cheney	Spokane
Non-urban	IN-021[54]	90 MP 121	Kittitas	Kittitas
Non-urban	IN-022	90 MP 204	Ritzville	Adams
Non-urban	IN-023	5 MP 216	Mount Vernon	Snohomish
Non-urban	IN-024	90 MP 234	Ritzville	Adams
Non-urban	IN-025	82 MP 80	Prosser	Benton
Non-urban	IN-026	90 MP 227	Ritzville	Adams
Non-urban	IN-119	82 MP 77	Grandview	Benton
Non-urban	IN-137	5 MP 244	Southern border of county	Whatcom
Non-urban	IN-143	82 MP 45	Buena	Yakima
Non-urban	IN-300[55]	90 MP 177	Moses Lake	Grant
Non-urban	IN-312[56]	82 MP 29.7	Selah	Yakima
Urban	IN-001	5 MP 146	Federal Way	King
Urban	IN-002	82 MP 116	Kennewick	Benton
Urban	IN-003	5 MP 171	North Seattle	King
Urban	IN-005	90 MP 294	Opportunity	Spokane
Urban	IN-006	5 MP 37	Kelso	Cowlitz
Urban	IN-008	5 MP 7	Vancouver	Clark
Urban	IN-009	5 MP 111	Lacey	Thurston
Urban	IN-010[57]	5 MP 102	Tumwater	Thurston
Urban	IN-011	5 MP 44	Kelso	Cowlitz
Urban	IN-012	405 MP 21	Bothell	King
Urban	IN-118	5 MP 143	Federal Way	King
Urban	IN-132	5 MP 10	Duluth	Clark
Urban	IN-133	205 MP 27	Oregon border	Clark
Urban	IN-153	205 MP 36	Vancouver	Clark
Urban	IN-310[58]	90 MP 287	Opportunity	Spokane

[53] Site not included in the 2004 study due to construction.

[54] No fall sample in 1999 due to construction.

[55] New site in 2004.

[56] New site in 2004.

[57] Spring sample discarded in 2004 due to site interference.

[58] New site in 2004.

Table C-2 State Route Site Locations

Urban/Non-Urban	Site Number	Site Name	Closest City	County
Non-urban	SR-053	105 MP 36	Westport	Grays Harbor
Non-urban	SR-054	28 MP 32	Quincy	Grant
Non-urban	SR-055	97 MP 50	Toppenish	Yakima
Non-urban	SR-056[59]	20 MP 165	Mazama	Okanogan
Non-urban	SR-058	20 MP 8	Port Townsend	Jefferson
Non-urban	SR-059	97 MP 180	Blewett Pass	Chelan
Non-urban	SR-060	272 MP 17	Palouse	Whitman
Non-urban	SR-061	101 MP 189	Forks	Clallam
Non-urban	SR-062	6 MP 15	Lebam	Pacific
Non-urban	SR-063	395 MP 255	Orient	Ferry
Non-urban	SR-064[60]	410 MP 58	Mt Rainier	Pierce
Non-urban	SR-123	23 MP 27	St. John	Whitman
Non-urban	SR-136	305 MP 1	Bainbridge Is.	Kitsap
Non-urban	SR-144	2 MP 86	Coles Corner	Chelan
Non-urban	SR-302[61]	17 MP 33	Othello	Adams
Urban	SR-040[62]	16 MP 26	Port Orchard	Kitsap
Urban	SR-041	542 MP 5	Bellingham	Whatcom
Urban	SR-042	509 MP 23	Normandy Park	King
Urban	SR-044	3 MP 46	Keyport	Kitsap
Urban	SR-045	524 MP 7	Alderwood Manor	Snohomish
Urban	SR-048[63]	224 MP 4	Benton City	Benton
Urban	SR-049	18 MP 6	Auburn	King
Urban	SR-120	99 MP 12	Federal Way	King
Urban	SR-121	509 MP 7	Tacoma	Pierce
Urban	SR-122	99 MP 8	Federal Way	King
Urban	SR-134	167 MP 5	Puyallup	Pierce
Urban	SR-138	104 MP 31	Bothell	King
Urban	SR-139	900 MP 15	Renton	King
Urban	SR-152	99 MP 48	Lynnwood	Snohomish
Urban	SR-303[64]	SR 9 MP 45	Mount Vernon	Skagit

[59] No spring sample in 1999 due to road closure (snow). This site was not included in the 2004 study in anticipation of a winter road closure.

[60] Both spring and fall samples were accidentally lost in 1999. Samples were discarded in 2004 due to site interference.

[61] New site in 2004. The spring sample from 2004 was discarded due to site interference.

[62] Samples from both seasons in 2004 discarded due to site interference.

[63] No fall sample in 1999 due to construction.

[64] New site in 2004.

Table C-3 County Road Site Locations

Urban/Non-Urban	Site Number	Site Name[65]	Closest City	County
Non-urban	CR-079[66]	Whitehall Road	Baird	Douglas
Non-urban	CR-080	Yakima Valley Highway	Zillah	Yakima
Non-urban	CR-081	Eatonville Highway	Eatonville	Pierce
Non-urban	CR-082	Williams Lake Road	Colville	Stevens
Non-urban	CR-083	Shelton Matlock Brady Road	Shelton	Mason
Non-urban	CR-084	E. Leavenworth Road	Leavenworth	Chelan
Non-urban	CR-085	Quillayute Road	Forks	Clallam
Non-urban	CR-086	Winona South Road	Winona	Whitman
Non-urban	CR-088	E. Zillah Drive	Zillah	Yakima
Non-urban	CR-089	Hoko-Ozette Road	Neah Bay	Clallam
Non-urban	CR-090	Loomis Oroville Road	Oroville	Okanogan
Non-urban	CR-091	E. Camano Drive	Camano Island	Island
Non-urban	CR-142	Le Clerc Creek Road	Ione	Pend Oreille
Non-urban	CR-151	Cache Creek Road	Nespelem	Okanogan
Non-urban	CR-313[67]	S Skagit Hwy	Concrete	Skagit
Urban	CR-066	Illahee Road	Bremerton	Kitsap
Urban	CR-067	124th Ave. NE	Kirkland-Kingsgate	King
Urban	CR-068	Auburn-Black Diamond Rd.	Auburn	King
Urban	CR-070	Central Valley Road	Silverdale	Kitsap
Urban	CR-071	Yew Street Road	Bellingham	Whatcom
Urban	CR-072[68]	Steilacoom-DuPont Road	Fort Lewis	Pierce
Urban	CR-073[69]	Hatch Road	Spokane	Spokane
Urban	CR-074	Petrovitsky Road	Renton	King
Urban	CR-075	Harris Street Road	Kelso	Cowlitz
Urban	CR-076	Chico Way	Silverdale	Kitsap
Urban	CR-077	Toad Lake Road	Bellingham	Whatcom
Urban	CR-078	Sunnyside Boulevard	Marysville	Snohomish
Urban	CR-124	Bigelow Gulch Road	Spokane	Spokane
Urban	CR-141	Kitsap Lake Road	Bremerton	Kitsap
Urban	CR-314[70]	Wellesley Ave. / Halvern Rd	Spokane	Spokane

[65] Specific locations of the non-urban one-mile and urban 1/10-mile segments are available from the Statewide Litter Coordinator at Ecology's Headquarters in Olympia.

[66] No fall sample in 1999 due to construction.

[67] New site in 2004.

[68] Both spring and fall samples were discarded in 2004 due to site interference.

[69] Site dropped from the 2004 Survey due to construction.

[70] New site in 2004

INTERCHANGES

Table C-4 Interchange Site Locations

Urban/Non-Urban	Site Number	Site Name	Closest City	County
Non-urban	OR-105	5 MP 82.1	Centralia	Lewis
Non-urban	OR-106	5 MP 52.9	Castle Rock	Cowlitz
Non-urban	OR-107[71]	90 MP 71.0	Cle Elum	Kittitas
Non-urban	OR-108[72]	90 MP 80.7	Cle Elum	Kittitas
Non-urban	OR-109	90 MP 264.6	Medical Lake	Spokane
Non-urban	OR-110	5 MP 70.7	Chehalis	Lewis
Non-urban	OR-111	5 MP 274.8	Blaine	Whatcom
Non-urban	OR-112	5 MP 32.0	Kalama	Cowlitz
Non-urban	OR-113	5 MP 205.8	Arlington	Snohomish
Non-urban	OR-114	90 MP 32.1	North Bend	King
Non-urban	OR-115	82 MP 53.6	Zillah	Yakima
Non-urban	OR-116[73]	90 MP 70.0	Cle Elum	Kittitas
Non-urban	OR-117[74]	90 MP 149.3	George	Grant
Non-urban	OR-131	2 MP 8.8	Snohomish	Snohomish
Urban	OR-094[75]	5 MP 258.0	Bellingham	Whatcom
Urban	OR-095[76]	599 MP 22.7	Tukwila	King
Urban	OR-096[77]	16 MP 0.7	Tacoma	Pierce
Urban	OR-100	405 MP 17.6	Kirkland	King
Urban	OR-101[78]	18 MP 6.1	Auburn	King
Urban	OR-102[79]	90 MP 17.4	Issaquah	King
Urban	OR-126	518 MP 2.8	Tukwila	King
Urban	OR-127	5 MP 130.7	Tacoma	Pierce
Urban	OR-129	3 MP 41.4	Silverdale	Kitsap
Urban	OR-130	167 MP 19.9	Kent	King
Urban	OR-140[80]	90 MP 291.1	Opportunity	Spokane
Urban	OR-147	99 MP 26.0	Duwamish Industrial Area	King
Urban	OR-149	509 MP 26.0	Tukwila	King
Urban	OR-150	5 MP 182.3	Lynnwood	Snohomish
Urban	OR-304[81]	I-5 MP 137	Fife	Pierce
Urban	OR-306[82]	520 MP 9	Bellevue	King
Urban	OR-309[83]	I-5 MP 229	Whatcom	King
Urban	OR-311[84]]	SR 14 MP 3.69	Vancouver	Clark

[71] No spring sample in 1999 due to snow.
[72] No fall sample in 1999 due to snow.
[73] No spring sample in 1999 due to snow.
[74] Site not available in 2004 due to snow.
[75] No fall sample in 1999 due to construction.
[76] No spring or fall samples due to construction in 1999. This site was dropped in 2004 for the same reason.
[77] No spring sample in 1999.
[78] Site not included in 2004 due to construction.
[79] Site not included in 2004 due to construction.
[80] No spring sample in 1999. Site not included in 2004 due to construction.
[81] New site in 2004.
[82] New site in 2004.
[83] New site in 2004.
[84] New site in 2004.

Appendix D: Composition and Generation Calculations

COMPOSITION CALCULATIONS

The composition estimates represent the **ratio of the components' weight to the total waste** for each noted substream. They are derived by summing each component's weight across all of the selected samples and dividing by the sum of the total weight of waste, as shown in the following equation:

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

where:

c = weight of particular component
w = sum of all component weights

- for i = 1 to n

  where n = number of selected samples

- for j = 1 to m

  where m = number of components

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

$$\hat{V}_{r_j} = \left(\frac{1}{n}\right) \cdot \left(\frac{1}{\overline{w}^2}\right) \cdot \left(\frac{\sum_i \left(c_{ij} - r_j w_i\right)^2}{n-1}\right)$$

where:

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

Second, **precision levels** at the 90% confidence interval are calculated for a component's mean as follows:

$$r_j \pm \left(t \cdot \sqrt{\hat{V}_{r_j}}\right)$$

where:

t = the value of the t-statistic (1.645) corresponding to a 90% confidence level

For more detail, please refer to Chapter 6, "Ratio, Regression and Difference Estimation" of *Elementary Survey Sampling* by R.L. Scheaffer, W. Mendenhall and L. Ott (PWS Publishers, 1986).

GENERATION CALCULATIONS

POUNDS PER ACRE PER YEAR CALCULATIONS

The rate of litter generation per acre for each roadway subcategory was calculated by dividing the total amount of litter generated per year by the total acreage of roadside shoulders and medians in the universe. The total acreage of roadside shoulders and medians is equal to the average acreage of roadside shoulders and medians per mile (from the site measurements) multiplied by the number of miles in the universe of each category. The area of interchanges was calculated in the same fashion.

TOTAL GENERATION

The total number of tons statewide is calculated by multiplying the average pounds per mile, described below, by the total number of miles in the universe, and dividing by 2000.

POUNDS PER MILE PER YEAR CALCULATIONS

The sample weight is divided by the number of generation days. This is completed for each season separately. Each season is then summed and divided by the number of samples. That number is the average pounds per day for that road type (i.e. urban interstates). The average pounds per day is then multiplied by 365 to get pounds per year. In order to scale up to a full mile site (since many site types are less than a mile) the number of pounds per year is subsequently divided by the site length. This calculation is completed separately for each of the six road types. Ninety percent confidence intervals are calculated as above in the composition estimates.

$$\frac{\left[\sum_i W_i/G_i + \sum_j W_j/G_j\right]}{n+m} * 365 * 1/l$$

where:

W = sample weight

G = number of days between collections (generation days)

l = site length

for i = 1 to n

and

for j = 1 to m

where n = number of samples from season 1
where m = number of samples from season 2

POUNDS PER INTERCHANGE PER YEAR

The sample weight is multiplied by the interchange scaling factor, then divided by the number of generation days. This is completed for each season separately. The seasons are then summed and divided by the number of samples. That number is the average pounds per interchange for that interchange type (i.e., urban). The average pounds per day is then multiplied by 365 to get pounds per year. This calculation is completed separately for each of the six road types. Ninety percent confidence intervals are calculated as above in the composition estimates.

$$\frac{\left[\sum_i (W_i * C_i)/G_i + \sum_j (W_j * C_i)/G_j\right]}{n+m} * 365$$

where:

W = sample weight

G = number of days between collections (generation days)

C = multiplier to convert from cleaned area to total interchange area

for i = 1 to n

and

for j = 1 to m

where n = number of samples from season 1

where m = number of samples from season 2

TONS PER YEAR FOR INTERCHANGES

$$\frac{PPIY * R}{2000}$$

where:

PPIY = pounds per interchange per year
R = number of interchanges in universe.

WEIGHTED AVERAGES

The composition estimates for overall roads, interstates, state routes, county roads, and interchanges were calculated by performing a weighted average across the relevant categories.[85] For example, to develop composition estimates for Washington's interstates, both urban interstate and non-urban interstate waste samples were considered, with more importance given to the non-urban interstates (which contribute about 64% of the total waste along interstates).

[85] As this is a variation on the 1999 study methodology, the raw 1999 data were reweighted using this method for comparative purposes. See Appendices H and I.

The **weighted average for an overall composition estimate** is performed as follows:

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

where:

p = the proportion of tonnage contributed by the noted substream

r = ratio of component weight to total waste weight in the noted substream

for j = 1 to m
where m = number of components

The **variance of the weighted average** is calculated:

$$VarO_j = \left(p_1^{\,2} * \hat{V}_{r_{j1}}\right) + \left(p_2^{\,2} * \hat{V}_{r_{j2}}\right) + \left(p_3^{\,2} * \hat{V}_{r_{j3}}\right) + \ldots$$

The following tables show the sets of relative weighting percentages that were used to produce the estimates for overall roads, interstates, state routes, county roads, and interchanges.

Table D-1 Weighting Percentages, All Roadways

	Mean Tons per Year	Percent of Total
Urban Interstates	266	4.21%
Non-Urban Interstates	416	6.59%
Urban State Routes	481	7.61%
Non-Urban State Routes	763	12.09%
Urban County Roads	1,582	25.06%
Non-Urban County Roads	2,806	44.44%
Overall	**6,315**	**100.00%**

Table D-2 Weighting Percentages, Interstates

	Mean Tons per Year	Percent of Total
Urban Interstates	266	38.97%
Non-Urban Interstates	416	61.03%
Overall	**682**	**100.00%**

Table D-3 Weighting Percentages, State Routes

	Mean Tons per Year	Percent of Total
Urban State Routes	481	38.64%
Non-Urban State Routes	763	61.36%
Overall	**1,244**	**100.00%**

Table D-4 Weighting Percentages, County Roads

	Mean Tons per Year	Percent of Total
Urban County Roads	1,582	36.06%
Non-Urban County Roads	2,806	63.94%
Overall	**4,389**	**100.00%**

Table D-5 Weighting Percentages, Interchanges

	Mean Tons per Year	Percent of Total
Urban Interchanges	324	73.07%
Non-Urban Interchanges	119	26.93%
Overall	**443**	**100.00%**

Appendix E: Composition Results, by Subcategory

This appendix provides the *unweighted* composition estimates for each individual category sampled in the study.

Roadways
- Urban Interstates
- Non-Urban Interstates
- Urban State Routes
- Non-Urban State Routes
- Urban County Roads
- Non-Urban County Roads

Interchanges
- Urban Interchanges
- Non-urban Interchanges

Table E-1 and Table E-2 show the litter composition on urban and non-urban interstates. To summarize, *other organics* represented a considerably greater proportion of the total interstate litter in non-urban areas than in urban areas (about 47% in non-urban areas versus about 12% in urban areas). The component *wood/lumber/particleboard* was more prevalent in urban interstate areas (13.4%) than in non-urban areas (5.9%) as was *metal automotive parts* (7.9% in urban areas compared with 3.2% in non-urban areas).

Table E-1 Composition by Weight, Urban Interstates

Calculated at a 90% confidence interval

	Tons	Mean %	Low %	High %		Tons	Mean %	Low %	High %
PAPER	**27**	**10.1%**			**ORGANIC**	**39**	**14.6%**		
Beverage Containers	0	0.0%	0.0%	0.1%	Food (Human And Pet)	2	0.7%	0.4%	1.1%
One-Time Fast Food Service Items	2	0.9%	0.8%	1.0%	Cigarettes and Other Tobacco	5	1.9%	1.1%	2.7%
Other Food and Beverage Packaging	2	0.8%	0.5%	1.1%	Other Organics	32	12.0%	7.5%	16.5%
Non-food Packaging	0	0.2%	0.1%	0.2%	**CDL**	**55**	**20.5%**		
Other Cardboard/Boxboard	7	2.6%	2.0%	3.2%	Wood/Lumber/Particleboard	36	13.4%	10.6%	16.1%
Paper Bags	6	2.2%	0.9%	3.6%	Mineral Aggregates	15	5.5%	0.9%	10.1%
Newspapers and Magazines	2	0.7%	0.5%	0.9%	Roofing	3	1.2%	0.6%	1.7%
Other Paper/Composite Materials	7	2.7%	1.8%	3.5%	Insulation	0	0.1%	0.0%	0.2%
PLASTIC	**35**	**13.1%**			Drywall	0	0.0%	0.0%	0.0%
Beverage Containers	0	0.0%	0.0%	0.1%	Other Construction/Demolition Debris	1	0.3%	0.2%	0.5%
One-Time Fast Food Service Items	2	0.6%	0.4%	0.8%	**HAZARDOUS MATERIALS**	**5**	**2.0%**		
Other Food and Beverage Packaging	2	0.7%	0.5%	0.8%	Latex paint	0	0.0%	0.0%	0.0%
Non-food Packaging	0	0.0%	0.0%	0.0%	Oil based paints	0	0.0%	0.0%	0.0%
Plastic Bags and Film	5	1.9%	1.6%	2.2%	Oil	1	0.4%	0.2%	0.7%
Automotive Parts	8	3.1%	2.3%	3.8%	Batteries	4	1.4%	0.0%	2.9%
Other Plastics/Composite Materials	18	6.9%	4.3%	9.4%	Flammable gas	0	0.0%	0.0%	0.0%
GLASS	**8**	**3.0%**			Flammable liquids	0	0.0%	0.0%	0.0%
Beverage Containers	8	2.8%	1.1%	4.5%	Explosives	0	0.0%	0.0%	0.0%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.0%	Pesticides/Herbicides	0	0.0%	0.0%	0.0%
Other Food and Beverage Packaging	0	0.0%	0.0%	0.0%	Cleaners (Hazardous)	0	0.0%	0.0%	0.0%
Non-food Packaging	0	0.0%	0.0%	0.0%	Medical waste	0	0.0%	0.0%	0.0%
Automotive Parts	0	0.1%	0.0%	0.1%	Other	0	0.1%	0.0%	0.2%
Other Glass/Composite Materials	0	0.1%	0.1%	0.2%	**OTHER MATERIALS**	**56**	**21.0%**		
METAL	**42**	**15.6%**			Tires/Auto Rubber Products	38	14.1%	8.0%	20.3%
Beverage Containers	4	1.4%	0.8%	2.1%	Rubber/Latex toiletries	0	0.0%	0.0%	0.1%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.0%	Other Rubber/Latex products	3	1.1%	0.3%	1.9%
Other Food and Beverage Packaging	0	0.1%	0.1%	0.2%	Disposable diapers	0	0.1%	0.0%	0.3%
Non-food Packaging	0	0.0%	0.0%	0.0%	Textiles/Leather	8	3.0%	2.2%	3.7%
Automotive Parts	21	7.9%	3.3%	12.5%	Carpet	1	0.4%	0.1%	0.8%
Other Metals/Composite Materials	16	6.1%	4.8%	7.5%	Furniture/Mattresses/Appliances	0	0.0%	0.0%	0.0%
					Ceramics/Porcelain	0	0.0%	0.0%	0.1%
					Toys/Sporting goods	1	0.5%	0.0%	1.2%
					Miscellaneous/Other	4	1.7%	1.0%	2.4%
Total Tons	**266**	***Sample Count***	**29**						

Table E-2 Composition by Weight, Non-Urban Interstates

Calculated at a 90% confidence interval

	Tons	Mean %	Low %	High %		Tons	Mean %	Low %	High %
PAPER	**19**	**4.5%**			**ORGANIC**	**202**	**48.5%**		
Beverage Containers	0	0.0%	0.0%	0.1%	Food (Human And Pet)	2	0.6%	0.3%	0.9%
One-Time Fast Food Service Items	4	0.9%	0.2%	1.6%	Cigarettes and Other Tobacco	2	0.5%	0.2%	0.8%
Other Food and Beverage Packaging	2	0.6%	0.2%	1.0%	Other Organics	197	47.4%	24.7%	70.1%
Non-food Packaging	1	0.2%	0.1%	0.2%	**CDL**	**32**	**7.7%**		
Other Cardboard/Boxboard	4	1.0%	0.4%	1.7%	Wood/Lumber/Particleboard	25	5.9%	3.0%	8.8%
Paper Bags	3	0.8%	0.0%	1.7%	Mineral Aggregates	4	1.0%	0.1%	1.9%
Newspapers and Magazines	1	0.1%	0.1%	0.2%	Roofing	2	0.4%	0.1%	0.8%
Other Paper/Composite Materials	4	0.9%	0.4%	1.4%	Insulation	0	0.1%	0.0%	0.3%
PLASTIC	**30**	**7.2%**			Drywall	0	0.0%	0.0%	0.1%
Beverage Containers	0	0.0%	0.0%	0.0%	Other Construction/Demolition Debris	1	0.2%	0.0%	0.3%
One-Time Fast Food Service Items	1	0.3%	0.1%	0.5%	**HAZARDOUS MATERIALS**	**3**	**0.6%**		
Other Food and Beverage Packaging	2	0.4%	0.2%	0.6%	Latex paint	0	0.0%	0.0%	0.0%
Non-food Packaging	0	0.0%	0.0%	0.0%	Oil based paints	0	0.0%	0.0%	0.0%
Plastic Bags and Film	3	0.8%	0.3%	1.2%	Oil	2	0.4%	0.0%	0.8%
Automotive Parts	8	1.9%	0.9%	2.9%	Batteries	0	0.1%	0.0%	0.3%
Other Plastics/Composite Materials	16	3.7%	0.9%	6.5%	Flammable gas	0	0.0%	0.0%	0.0%
GLASS	**15**	**3.5%**			Flammable liquids	0	0.0%	0.0%	0.0%
Beverage Containers	12	2.9%	0.8%	4.9%	Explosives	0	0.0%	0.0%	0.0%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.0%	Pesticides/Herbicides	0	0.0%	0.0%	0.0%
Other Food and Beverage Packaging	0	0.0%	0.0%	0.0%	Cleaners (Hazardous)	0	0.0%	0.0%	0.0%
Non-food Packaging	0	0.0%	0.0%	0.0%	Medical waste	0	0.0%	0.0%	0.0%
Automotive Parts	2	0.4%	0.1%	0.7%	Other	0	0.1%	0.0%	0.1%
Other Glass/Composite Materials	1	0.3%	0.0%	0.5%	**OTHER MATERIALS**	**81**	**19.4%**		
METAL	**36**	**8.6%**			Tires/Auto Rubber Products	62	15.0%	4.9%	25.1%
Beverage Containers	2	0.5%	0.2%	0.9%	Rubber/Latex toiletries	0	0.0%	0.0%	0.1%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.0%	Other Rubber/Latex products	4	0.9%	0.3%	1.5%
Other Food and Beverage Packaging	0	0.1%	0.1%	0.2%	Disposable diapers	0	0.0%	0.0%	0.0%
Non-food Packaging	0	0.0%	0.0%	0.0%	Textiles/Leather	5	1.2%	0.5%	1.8%
Automotive Parts	13	3.2%	0.1%	6.2%	Carpet	2	0.4%	0.0%	0.9%
Other Metals/Composite Materials	20	4.8%	3.1%	6.5%	Furniture/Mattresses/Appliances	3	0.6%	0.0%	1.7%
					Ceramics/Porcelain	0	0.0%	0.0%	0.0%
					Toys/Sporting goods	0	0.1%	0.0%	0.1%
					Miscellaneous/Other	5	1.2%	0.5%	1.9%
Total Tons	**416**	***Sample Count***		**30**					

Table E-3 and Table E-4 show the litter composition of urban and non-urban state routes. The component *furniture/mattresses/appliances* was more prevalent in urban state routes (7.4%) than in non-urban areas (0.2%). *Other construction/demolition debris* also represented a larger proportion of state route litter in urban areas than in non-urban areas (about 5% in urban areas versus close to 0% in non-urban areas). *Glass beverage containers* and *tires/auto rubber products* were more prominent on non-urban state routes (*glass beverage containers* comprised about 12% in non-urban areas compared with about 8% in urban areas; and *tires/auto rubber products* were about 13% in non-urban areas as compared to about 5% in urban areas).

Table E-3 Composition by Weight, Urban State Routes

Calculated at a 90% confidence interval

	Tons	Mean %	Low %	High %		Tons	Mean %	Low %	High %
PAPER	**55**	**11.4%**			**ORGANIC**	**58**	**12.1%**		
Beverage Containers	1	0.2%	0.0%	0.4%	Food (Human And Pet)	5	1.1%	0.5%	1.7%
One-Time Fast Food Service Items	5	1.1%	0.7%	1.5%	Cigarettes and Other Tobacco	22	4.7%	1.6%	7.8%
Other Food and Beverage Packaging	3	0.6%	0.3%	0.9%	Other Organics	31	6.4%	3.9%	8.8%
Non-food Packaging	1	0.2%	0.1%	0.3%	**CDL**	**105**	**21.9%**		
Other Cardboard/Boxboard	12	2.6%	1.4%	3.7%	Wood/Lumber/Particleboard	55	11.4%	5.1%	17.7%
Paper Bags	8	1.8%	0.3%	3.2%	Mineral Aggregates	25	5.1%	0.0%	12.4%
Newspapers and Magazines	11	2.3%	1.0%	3.5%	Roofing	2	0.5%	0.0%	0.9%
Other Paper/Composite Materials	13	2.7%	1.5%	3.9%	Insulation	0	0.0%	0.0%	0.0%
PLASTIC	**78**	**16.3%**			Drywall	2	0.3%	0.0%	0.8%
Beverage Containers	1	0.1%	0.0%	0.2%	Other Construction/Demolition Debris	22	4.6%	0.0%	9.4%
One-Time Fast Food Service Items	4	0.9%	0.6%	1.2%	**HAZARDOUS MATERIALS**	**8**	**1.7%**		
Other Food and Beverage Packaging	7	1.4%	0.9%	1.8%	Latex paint	0	0.0%	0.0%	0.0%
Non-food Packaging	3	0.6%	0.0%	1.7%	Oil based paints	0	0.1%	0.0%	0.2%
Plastic Bags and Film	17	3.5%	1.5%	5.5%	Oil	3	0.7%	0.2%	1.2%
Automotive Parts	12	2.5%	1.5%	3.5%	Batteries	2	0.3%	0.0%	0.6%
Other Plastics/Composite Materials	35	7.2%	3.8%	10.6%	Flammable gas	0	0.0%	0.0%	0.0%
GLASS	**39**	**8.0%**			Flammable liquids	0	0.0%	0.0%	0.0%
Beverage Containers	36	7.5%	3.2%	11.7%	Explosives	0	0.0%	0.0%	0.0%
One-Time Fast Food Service Items	0	0.1%	0.0%	0.2%	Pesticides/Herbicides	0	0.0%	0.0%	0.0%
Other Food and Beverage Packaging	0	0.0%	0.0%	0.0%	Cleaners (Hazardous)	0	0.0%	0.0%	0.0%
Non-food Packaging	0	0.0%	0.0%	0.0%	Medical waste	0	0.0%	0.0%	0.0%
Automotive Parts	1	0.1%	0.0%	0.3%	Other	3	0.6%	0.1%	1.0%
Other Glass/Composite Materials	2	0.4%	0.1%	0.6%	**OTHER MATERIALS**	**78**	**16.3%**		
METAL	**59**	**12.2%**			Tires/Auto Rubber Products	25	5.2%	0.9%	9.6%
Beverage Containers	8	1.8%	0.9%	2.7%	Rubber/Latex toiletries	0	0.0%	0.0%	0.0%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.0%	Other Rubber/Latex products	2	0.3%	0.1%	0.6%
Other Food and Beverage Packaging	1	0.2%	0.1%	0.3%	Disposable diapers	0	0.0%	0.0%	0.0%
Non-food Packaging	0	0.0%	0.0%	0.0%	Textiles/Leather	8	1.7%	1.0%	2.5%
Automotive Parts	10	2.2%	0.7%	3.6%	Carpet	0	0.1%	0.0%	0.2%
Other Metals/Composite Materials	39	8.1%	4.5%	11.7%	Furniture/Mattresses/Appliances	36	7.4%	0.0%	16.1%
					Ceramics/Porcelain	0	0.0%	0.0%	0.0%
					Toys/Sporting goods	0	0.1%	0.0%	0.2%
					Miscellaneous/Other	7	1.4%	0.7%	2.2%
Total Tons	**481**	***Sample Count***	**28**						

Table E-4 Composition by Weight, Non-Urban State Routes

Calculated at a 90% confidence interval

	Tons	Mean %	Low %	High %		Tons	Mean %	Low %	High %
PAPER	**105**	**13.8%**			**ORGANIC**	**92**	**12.1%**		
Beverage Containers	1	0.1%	0.0%	0.1%	Food (Human And Pet)	12	1.6%	0.8%	2.4%
One-Time Fast Food Service Items	11	1.4%	1.2%	1.7%	Cigarettes and Other Tobacco	13	1.7%	0.9%	2.4%
Other Food and Beverage Packaging	12	1.6%	1.1%	2.0%	Other Organics	67	8.8%	5.1%	12.4%
Non-food Packaging	3	0.4%	0.3%	0.5%	**CDL**	**108**	**14.1%**		
Other Cardboard/Boxboard	28	3.6%	1.5%	5.7%	Wood/Lumber/Particleboard	92	12.0%	8.5%	15.5%
Paper Bags	22	2.9%	0.9%	5.0%	Mineral Aggregates	4	0.6%	0.0%	1.2%
Newspapers and Magazines	5	0.7%	0.5%	0.9%	Roofing	10	1.3%	0.5%	2.0%
Other Paper/Composite Materials	23	3.0%	1.8%	4.2%	Insulation	0	0.0%	0.0%	0.1%
PLASTIC	**95**	**12.5%**			Drywall	0	0.0%	0.0%	0.1%
Beverage Containers	1	0.1%	0.0%	0.1%	Other Construction/Demolition Debris	2	0.2%	0.0%	0.4%
One-Time Fast Food Service Items	6	0.8%	0.7%	0.9%	**HAZARDOUS MATERIALS**	**14**	**1.9%**		
Other Food and Beverage Packaging	10	1.3%	0.9%	1.6%	Latex paint	0	0.0%	0.0%	0.0%
Non-food Packaging	1	0.1%	0.0%	0.1%	Oil based paints	0	0.0%	0.0%	0.0%
Plastic Bags and Film	22	2.9%	2.0%	3.7%	Oil	9	1.2%	0.5%	1.8%
Automotive Parts	8	1.0%	0.7%	1.3%	Batteries	3	0.4%	0.0%	0.9%
Other Plastics/Composite Materials	48	6.3%	4.3%	8.4%	Flammable gas	0	0.0%	0.0%	0.0%
GLASS	**106**	**13.8%**			Flammable liquids	0	0.0%	0.0%	0.0%
Beverage Containers	95	12.4%	6.7%	18.2%	Explosives	0	0.0%	0.0%	0.1%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.0%	Pesticides/Herbicides	0	0.0%	0.0%	0.0%
Other Food and Beverage Packaging	1	0.1%	0.0%	0.2%	Cleaners (Hazardous)	0	0.0%	0.0%	0.0%
Non-food Packaging	0	0.0%	0.0%	0.0%	Medical waste	0	0.0%	0.0%	0.0%
Automotive Parts	5	0.7%	0.2%	1.2%	Other	2	0.2%	0.1%	0.3%
Other Glass/Composite Materials	5	0.6%	0.2%	1.0%	**OTHER MATERIALS**	**147**	**19.2%**		
METAL	**96**	**12.6%**			Tires/Auto Rubber Products	95	12.5%	6.2%	18.9%
Beverage Containers	17	2.2%	1.3%	3.1%	Rubber/Latex toiletries	0	0.0%	0.0%	0.1%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.0%	Other Rubber/Latex products	9	1.2%	0.6%	1.9%
Other Food and Beverage Packaging	3	0.4%	0.3%	0.6%	Disposable diapers	1	0.1%	0.0%	0.3%
Non-food Packaging	0	0.0%	0.0%	0.0%	Textiles/Leather	17	2.3%	1.7%	2.9%
Automotive Parts	37	4.8%	2.1%	7.5%	Carpet	3	0.3%	0.0%	0.7%
Other Metals/Composite Materials	39	5.1%	3.6%	6.7%	Furniture/Mattresses/Appliances	2	0.2%	0.0%	0.6%
					Ceramics/Porcelain	2	0.2%	0.0%	0.4%
					Toys/Sporting goods	0	0.0%	0.0%	0.1%
					Miscellaneous/Other	17	2.2%	0.9%	3.5%
Total Tons	**763**	***Sample Count***		**25**					

Table E-5 and Table E-6 show the composition of material collected from urban and non-urban county roads. As with state routes, *furniture/mattresses/appliances* on urban county roads represented a greater proportion of the total litter than on non-urban county roads (about 18% in urban areas versus 0% in non-urban areas). *Wood/lumber/particleboard* also comprised a somewhat higher percentage of litter in urban areas (slightly more than 9% in urban areas and about 6% in non-urban areas). *Glass beverage containers* were more prevalent in non-urban areas (this component was found to be about 17% in non-urban areas as compared to an estimated 8% in urban areas).

Table E-5 Composition by Weight, Urban County Roads

Calculated at a 90% confidence interval

	Tons	Mean %	Low %	High %		Tons	Mean %	Low %	High %
PAPER	**185**	**11.7%**			**ORGANIC**	**105**	**6.6%**		
Beverage Containers	0	0.0%	0.0%	0.1%	Food (Human And Pet)	11	0.7%	0.2%	1.3%
One-Time Fast Food Service Items	35	2.2%	1.4%	3.1%	Cigarettes and Other Tobacco	23	1.5%	0.7%	2.2%
Other Food and Beverage Packaging	22	1.4%	0.4%	2.4%	Other Organics	70	4.4%	1.7%	7.1%
Non-food Packaging	9	0.5%	0.2%	0.9%	**CDL**	**185**	**11.7%**		
Other Cardboard/Boxboard	29	1.9%	0.6%	3.2%	Wood/Lumber/Particleboard	149	9.4%	4.5%	14.3%
Paper Bags	15	1.0%	0.1%	1.9%	Mineral Aggregates	1	0.1%	0.0%	0.2%
Newspapers and Magazines	47	2.9%	0.7%	5.2%	Roofing	2	0.1%	0.0%	0.2%
Other Paper/Composite Materials	28	1.8%	1.1%	2.5%	Insulation	0	0.0%	0.0%	0.0%
PLASTIC	**284**	**17.9%**			Drywall	0	0.0%	0.0%	0.0%
Beverage Containers	8	0.5%	0.2%	0.8%	Other Construction/Demolition Debris	33	2.1%	0.0%	5.4%
One-Time Fast Food Service Items	20	1.3%	0.9%	1.7%	**HAZARDOUS MATERIALS**	**19**	**1.2%**		
Other Food and Beverage Packaging	35	2.2%	1.4%	3.1%	Latex paint	0	0.0%	0.0%	0.0%
Non-food Packaging	1	0.1%	0.0%	0.2%	Oil based paints	2	0.1%	0.0%	0.3%
Plastic Bags and Film	66	4.2%	2.8%	5.5%	Oil	14	0.9%	0.2%	1.6%
Automotive Parts	28	1.8%	0.4%	3.2%	Batteries	1	0.1%	0.0%	0.1%
Other Plastics/Composite Materials	125	7.9%	3.2%	12.5%	Flammable gas	0	0.0%	0.0%	0.0%
GLASS	**156**	**9.9%**			Flammable liquids	0	0.0%	0.0%	0.0%
Beverage Containers	133	8.4%	2.8%	14.0%	Explosives	0	0.0%	0.0%	0.0%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.0%	Pesticides/Herbicides	0	0.0%	0.0%	0.0%
Other Food and Beverage Packaging	0	0.0%	0.0%	0.1%	Cleaners (Hazardous)	0	0.0%	0.0%	0.0%
Non-food Packaging	0	0.0%	0.0%	0.0%	Medical waste	1	0.1%	0.0%	0.2%
Automotive Parts	1	0.1%	0.0%	0.2%	Other	0	0.0%	0.0%	0.1%
Other Glass/Composite Materials	21	1.3%	0.0%	3.5%	**OTHER MATERIALS**	**376**	**23.8%**		
METAL	**272**	**17.2%**			Tires/Auto Rubber Products	26	1.7%	0.2%	3.1%
Beverage Containers	39	2.5%	1.0%	4.0%	Rubber/Latex toiletries	0	0.0%	0.0%	0.0%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.0%	Other Rubber/Latex products	1	0.1%	0.0%	0.2%
Other Food and Beverage Packaging	5	0.3%	0.1%	0.6%	Disposable diapers	1	0.1%	0.0%	0.2%
Non-food Packaging	0	0.0%	0.0%	0.0%	Textiles/Leather	38	2.4%	1.4%	3.4%
Automotive Parts	67	4.3%	0.9%	7.6%	Carpet	0	0.0%	0.0%	0.0%
Other Metals/Composite Materials	160	10.1%	0.0%	20.9%	Furniture/Mattresses/Appliances	291	18.4%	0.0%	39.0%
					Ceramics/Porcelain	0	0.0%	0.0%	0.0%
					Toys/Sporting Goods	6	0.4%	0.0%	0.7%
					Miscellaneous/Other	11	0.7%	0.0%	1.6%
Total Tons	**1,582**	***Sample Count***		**26**					

Table E-6 Composition by Weight, Non-Urban County Roads

Calculated at a 90% confidence interval

	Tons	Mean %	Low %	High %		Tons	Mean %	Low %	High %
PAPER	**280**	**10.0%**			**ORGANIC**	**344**	**12.3%**		
Beverage Containers	3	0.1%	0.0%	0.2%	Food (Human And Pet)	65	2.3%	1.4%	3.2%
One-Time Fast Food Service Items	44	1.6%	1.1%	2.1%	Cigarettes and Other Tobacco	56	2.0%	0.6%	3.3%
Other Food and Beverage Packaging	53	1.9%	1.3%	2.5%	Other Organics	223	7.9%	3.8%	12.1%
Non-food Packaging	10	0.4%	0.3%	0.5%	**CDL**	**289**	**10.3%**		
Other Cardboard/Boxboard	36	1.3%	0.7%	1.9%	Wood/Lumber/Particleboard	166	5.9%	3.1%	8.7%
Paper Bags	49	1.7%	0.4%	3.1%	Mineral Aggregates	99	3.5%	0.0%	8.2%
Newspapers and Magazines	26	0.9%	0.6%	1.3%	Roofing	17	0.6%	0.2%	1.1%
Other Paper/Composite Materials	59	2.1%	1.4%	2.8%	Insulation	4	0.1%	0.0%	0.3%
PLASTIC	**384**	**13.7%**			Drywall	0	0.0%	0.0%	0.0%
Beverage Containers	5	0.2%	0.0%	0.4%	Other Construction/Demolition Debris	2	0.1%	0.0%	0.2%
One-Time Fast Food Service Items	25	0.9%	0.7%	1.1%	**HAZARDOUS MATERIALS**	**65**	**2.3%**		
Other Food and Beverage Packaging	44	1.6%	1.2%	2.0%	Latex paint	0	0.0%	0.0%	0.0%
Non-food Packaging	1	0.0%	0.0%	0.0%	Oil based paints	0	0.0%	0.0%	0.0%
Plastic Bags and Film	70	2.5%	1.4%	3.7%	Oil	50	1.8%	0.7%	2.8%
Automotive Parts	45	1.6%	0.8%	2.4%	Batteries	6	0.2%	0.0%	0.4%
Other Plastics/Composite Materials	194	6.9%	4.4%	9.4%	Flammable gas	0	0.0%	0.0%	0.0%
GLASS	**495**	**17.6%**			Flammable liquids	0	0.0%	0.0%	0.0%
Beverage Containers	466	16.6%	8.8%	24.4%	Explosives	0	0.0%	0.0%	0.0%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.0%	Pesticides/Herbicides	0	0.0%	0.0%	0.0%
Other Food and Beverage Packaging	5	0.2%	0.0%	0.4%	Cleaners (Hazardous)	0	0.0%	0.0%	0.0%
Non-food Packaging	0	0.0%	0.0%	0.0%	Medical waste	0	0.0%	0.0%	0.0%
Automotive Parts	2	0.1%	0.0%	0.1%	Other	8	0.3%	0.1%	0.5%
Other Glass/Composite Materials	22	0.8%	0.2%	1.3%	**OTHER MATERIALS**	**363**	**12.9%**		
METAL	**588**	**21.0%**			Tires/Auto Rubber Products	156	5.6%	1.9%	9.2%
Beverage Containers	118	4.2%	2.3%	6.2%	Rubber/Latex toiletries	0	0.0%	0.0%	0.0%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.0%	Other Rubber/Latex products	16	0.6%	0.1%	1.0%
Other Food and Beverage Packaging	26	0.9%	0.4%	1.4%	Disposable diapers	1	0.0%	0.0%	0.1%
Non-food Packaging	1	0.0%	0.0%	0.0%	Textiles/Leather	60	2.1%	1.5%	2.8%
Automotive Parts	247	8.8%	2.5%	15.1%	Carpet	87	3.1%	0.0%	7.4%
Other Metals/Composite Materials	196	7.0%	4.1%	9.8%	Furniture/Mattresses/Appliances	0	0.0%	0.0%	0.0%
					Ceramics/Porcelain	2	0.1%	0.0%	0.2%
					Toys/Sporting goods	3	0.1%	0.0%	0.2%
					Miscellaneous/Other	36	1.3%	0.7%	1.9%
Total Tons	**2,806**	***Sample Count***	**30**						

Table E-7 and Table E-8 show the composition of urban and non-urban interchanges. There were few notable differences between urban and non-urban litter composition on interchanges, with the exception of *other organics* (about 19% on non-urban interchanges versus approximately 7% on urban interchanges) and *tires/auto rubber products*, comprising nearly 15% in non-urban areas versus about 8% in urban interchange areas.

Table E-7 Composition by Weight, Urban Interchanges

Calculated at a 90% confidence interval

	Tons	Mean %	Low %	High %		Tons	Mean %	Low %	High %
PAPER	**52**	**16.0%**			**ORGANIC**	**35**	**10.9%**		
Beverage Containers	0	0.1%	0.0%	0.1%	Food (Human And Pet)	5	1.4%	0.5%	2.3%
One-Time Fast Food Service Items	4	1.4%	1.1%	1.7%	Cigarettes and Other Tobacco	7	2.1%	1.5%	2.7%
Other Food and Beverage Packaging	4	1.1%	0.8%	1.5%	Other Organics	24	7.4%	5.1%	9.8%
Non-food Packaging	1	0.3%	0.2%	0.3%	**CDL**	**41**	**12.6%**		
Other Cardboard/Boxboard	18	5.6%	3.4%	7.9%	Wood/Lumber/Particleboard	32	9.9%	6.0%	13.8%
Paper Bags	6	1.7%	0.6%	2.9%	Mineral Aggregates	4	1.3%	0.2%	2.4%
Newspapers and Magazines	7	2.1%	1.4%	2.8%	Roofing	4	1.1%	0.0%	2.2%
Other Paper/Composite Materials	12	3.7%	3.0%	4.5%	Insulation	0	0.1%	0.0%	0.2%
PLASTIC	**56**	**17.2%**			Drywall	0	0.0%	0.0%	0.0%
Beverage Containers	0	0.1%	0.0%	0.1%	Other Construction/Demolition Debris	0	0.1%	0.0%	0.2%
One-Time Fast Food Service Items	3	1.0%	0.7%	1.4%	**HAZARDOUS MATERIALS**	**7**	**2.2%**		
Other Food and Beverage Packaging	4	1.2%	0.9%	1.5%	Latex paint	0	0.0%	0.0%	0.0%
Non-food Packaging	0	0.0%	0.0%	0.0%	Oil based paints	0	0.0%	0.0%	0.0%
Plastic Bags and Film	12	3.6%	3.1%	4.2%	Oil	2	0.7%	0.3%	1.1%
Automotive Parts	8	2.4%	1.6%	3.3%	Batteries	3	1.1%	0.0%	2.3%
Other Plastics/Composite Materials	28	8.8%	5.6%	12.0%	Flammable gas	0	0.0%	0.0%	0.0%
GLASS	**23**	**7.0%**			Flammable liquids	0	0.0%	0.0%	0.0%
Beverage Containers	19	5.9%	2.6%	9.2%	Explosives	0	0.0%	0.0%	0.1%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.0%	Pesticides/Herbicides	0	0.0%	0.0%	0.0%
Other Food and Beverage Packaging	0	0.0%	0.0%	0.0%	Cleaners (Hazardous)	0	0.0%	0.0%	0.0%
Non-food Packaging	0	0.0%	0.0%	0.0%	Medical waste	0	0.0%	0.0%	0.0%
Automotive Parts	1	0.3%	0.0%	0.6%	Other	1	0.4%	0.2%	0.6%
Other Glass/Composite Materials	2	0.8%	0.2%	1.3%	**OTHER MATERIALS**	**63**	**19.4%**		
METAL	**47**	**14.6%**			Tires/Auto Rubber Products	26	8.2%	4.7%	11.6%
Beverage Containers	7	2.1%	1.0%	3.1%	Rubber/Latex toiletries	0	0.0%	0.0%	0.0%
One-Time Fast Food Service Items	0	0.1%	0.0%	0.2%	Other Rubber/Latex products	1	0.2%	0.1%	0.3%
Other Food and Beverage Packaging	1	0.2%	0.1%	0.3%	Disposable diapers	0	0.1%	0.0%	0.1%
Non-food Packaging	0	0.0%	0.0%	0.0%	Textiles/Leather	21	6.4%	1.8%	11.0%
Automotive Parts	15	4.8%	2.0%	7.5%	Carpet	2	0.7%	0.0%	1.4%
Other Metals/Composite Materials	24	7.4%	4.8%	10.0%	Furniture/Mattresses/Appliances	5	1.6%	0.0%	3.7%
					Ceramics/Porcelain	0	0.1%	0.0%	0.3%
					Toys/Sporting goods	0	0.1%	0.0%	0.2%
					Miscellaneous/Other	6	2.0%	1.2%	2.8%
Total Tons	**324**	***Sample Count***	**28**						

Table E-8 Composition by Weight, Non-Urban Interchanges

Calculated at a 90% confidence interval

	Tons	Mean %	Low %	High %		Tons	Mean %	Low %	High %
PAPER	**10**	**8.6%**			**ORGANIC**	**25**	**21.0%**		
Beverage Containers	0	0.1%	0.0%	0.1%	Food (Human And Pet)	2	1.3%	0.9%	1.7%
One-Time Fast Food Service Items	2	1.3%	1.1%	1.5%	Cigarettes and Other Tobacco	1	1.0%	0.6%	1.4%
Other Food and Beverage Packaging	1	1.0%	0.7%	1.2%	Other Organics	22	18.7%	8.6%	28.9%
Non-food Packaging	0	0.2%	0.2%	0.3%	**CDL**	**16**	**13.6%**		
Other Cardboard/Boxboard	2	1.8%	1.2%	2.4%	Wood/Lumber/Particleboard	9	7.8%	5.7%	10.0%
Paper Bags	2	1.5%	0.5%	2.5%	Mineral Aggregates	6	4.7%	1.4%	8.1%
Newspapers and Magazines	1	0.7%	0.4%	1.0%	Roofing	1	0.4%	0.2%	0.7%
Other Paper/Composite Materials	3	2.1%	1.8%	2.4%	Insulation	0	0.1%	0.0%	0.2%
PLASTIC	**16**	**13.0%**			Drywall	0	0.1%	0.0%	0.2%
Beverage Containers	0	0.1%	0.0%	0.2%	Other Construction/Demolition Debris	0	0.4%	0.2%	0.7%
One-Time Fast Food Service Items	1	0.7%	0.6%	0.9%	**HAZARDOUS MATERIALS**	**2**	**1.8%**		
Other Food and Beverage Packaging	1	0.8%	0.6%	1.0%	Latex paint	0	0.0%	0.0%	0.0%
Non-food Packaging	0	0.0%	0.0%	0.0%	Oil based paints	0	0.0%	0.0%	0.1%
Plastic Bags and Film	2	1.8%	1.4%	2.2%	Oil	1	1.0%	0.3%	1.7%
Automotive Parts	2	1.8%	1.2%	2.3%	Batteries	0	0.1%	0.0%	0.3%
Other Plastics/Composite Materials	9	7.8%	5.0%	10.6%	Flammable gas	0	0.0%	0.0%	0.0%
GLASS	**8**	**6.6%**			Flammable liquids	0	0.0%	0.0%	0.0%
Beverage Containers	7	5.7%	3.2%	8.2%	Explosives	0	0.1%	0.0%	0.1%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.0%	Pesticides/Herbicides	0	0.0%	0.0%	0.0%
Other Food and Beverage Packaging	0	0.1%	0.0%	0.1%	Cleaners (Hazardous)	0	0.0%	0.0%	0.0%
Non-food Packaging	0	0.0%	0.0%	0.0%	Medical waste	0	0.0%	0.0%	0.0%
Automotive Parts	1	0.4%	0.1%	0.8%	Other	1	0.5%	0.1%	1.0%
Other Glass/Composite Materials	0	0.4%	0.1%	0.6%	**OTHER MATERIALS**	**25**	**20.6%**		
METAL	**18**	**14.9%**			Tires/Auto Rubber Products	17	14.5%	8.9%	20.1%
Beverage Containers	2	1.5%	0.9%	2.1%	Rubber/Latex toiletries	0	0.0%	0.0%	0.0%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.0%	Other Rubber/Latex products	1	0.7%	0.4%	1.0%
Other Food and Beverage Packaging	0	0.2%	0.1%	0.2%	Disposable diapers	0	0.1%	0.0%	0.1%
Non-food Packaging	0	0.0%	0.0%	0.0%	Textiles/Leather	3	2.5%	1.9%	3.2%
Automotive Parts	9	7.5%	2.8%	12.1%	Carpet	0	0.3%	0.1%	0.4%
Other Metals/Composite Materials	7	5.7%	3.9%	7.6%	Furniture/Mattresses/Appliances	0	0.1%	0.0%	0.3%
					Ceramics/Porcelain	0	0.1%	0.0%	0.1%
					Toys/Sporting goods	0	0.2%	0.0%	0.4%
					Miscellaneous/Other	3	2.1%	1.3%	3.0%
Total Tons	**119**	***Sample Count***		**26**					

Appendix F: Field Forms

Site Documentation Form
Site Mapping Form
Site Verification and Litter Inventory
Sorting Form

SITE DOCUMENTATION FORM - ROADWAYS

To be used when verifying the safety and measuring the boundaries of the site

A. General Information

1. Date: _____

2. Site inspector: _____

Daytime phone: _____

3. Site Number: _____

4. Site Location (Road, milepost, intersection):

_____

5. Circle: Urban Non-urban

B. Site Boundaries

6. On an attached sheet, please draw a map of the designated site.

- For each corner and edge please describe the physical boundaries or barriers.
- For each edge, please include the **EXACT distance** as measured in the field.
- Indicate what method would be best for collecting the litter (i.e. shoulder-to-shoulder, a zigzagging pattern, etc.)

Please be as EXACT AND DESCRIPTIVE as possible. This information will be used as the site guide for the supervisors and also to calculate the site's total area. It is extremely important for the statistical analysis that the litter catchment area is clearly defined and accurately measured.

C. Factors Affecting Litter Collection Within the Designated Area

7. Garbage Receptacles:

a. How many? _____

b. Clearly visible and accessible? YES NO

c. Please indicate their location on the attached map

8. Speed limit within the designated area: _____ mph

9a. Entrapments:

- ❑ Ditch
- ❑ Fence
- ❑ Guardrail
- ❑ Other (Please describe)
- ❑ Large bushes or trees
- ❑ High grass or weeds
- ❑ Rock wall/cliff
- ❑ Sound barrier

9b. Indicate the number and size of each entrapment below. Clearly draw each entrapment on the attached map and then describe the location below.

_____

_____

_____

_____

10. What type of median exists within the designated area?

❑ No median ❑ Jersey barrier ❑ Grass ❑ Bushes/trees ❑ Other

If found, please call Cascadia Consulting Group at (206) 343-9759. Reward offered

11a. What other factors will affect litter collection within the designated area?

- ❑ Road construction or repair
- ❑ Mowed grass
- ❑ Private residence
- ❑ Shopping/strip mall
- ❑ Bridges
- ❑ Underpass
- ❑ Bus stop
- ❑ Other

11b. Please describe "Other" and how these factors will affect litter collection

_____
_____
_____
_____
_____

12. Is this section of the road part of Adopt-A-Highway? YES NO If yes, what group? _____

13. Can litter be collected from at least 90% of the designated sampling area? YES NO

D. Factors Affecting Litter Collection Outside the Designated Area

14. Describe surrounding land use area. Check all items that you can see from the site.

- ❑ Parking lot
- ❑ Industrial area
- ❑ Residential area
- ❑ Agriculture/farmland
- ❑ Farmettes
- ❑ Forest
- ❑ Lake/River/Stream
- ❑ Bridge
- ❑ Overpass
- ❑ Exit ramp
- ❑ Fast-food restaurant
- ❑ Other restaurant
- ❑ Grocery/convenience store
- ❑ Retail stores
- ❑ School
- ❑ Transfer station (landfill, dump)
- ❑ Road construction/repair
- ❑ Other (please describe)

_____

15. List entrapments that would affect litter from entering or escaping the designated area (i.e. fence or large trees):

_____
_____
_____
_____
_____
_____
_____
_____

E. Additional Notes and Information

_____
_____
_____

If found, please call Cascadia Consulting Group at (206) 343-9759. Reward offered

SITE MAP

1. Date: _____ 3. Site Location (Road; milepost, interchange 4. Site inspector: _____

2. Site Number: _____ or name of area): _____ Daytime phone: _____

If found, please call Cascadia Consulting Group at (206) 343-9759. Reward offered

SITE VERIFICATION AND LITTER INVENTORY

To be used when collecting litter from a site

Upon Arrival **Fall Clean 2004**

A. General Information

1. Site Number: _____
2. Site Location (Road; milepost, interchange or name of the area): _____
3. Date: _____
4. Time Started: _____
5. Supervisor: _____
6. Crew: EYC DOC OTHER
7. Crew Member Names:

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

B. Site Boundaries

8. Please verify the existing boundaries with the attached map. If you see any changes, please draw them on the map or describe them below. If you cannot find the physical landmarks that identify the boundaries or if you are unsure as to what they are, please contact the initial site inspector and/or Vicki Colgan at (425) 649-7224 before beginning fieldwork.

_____

_____

_____

C. Factors Affecting Litter Collection Within the Designated Areas

9. Have the number, location, or accessibility of the litter/recycling receptacles changed since the last visit? YES NO
10. Have the number, location, or size of the entrapments changed since the initial site inspection? YES NO

If answered yes to 9 or 10, please describe the changes and mark them on the map: _____

_____

_____

11. a. Has the area recently been mowed? YES NO

b. If yes, does it affect litter collection in more than 10% of the site's total area? YES NO

If found, please call Dept. of Ecology at (360) 407-6900. Thank you!

Before Departure

D. INVENTORY OF LITTER NOT COLLECTED BY CREW – list quantity, dimensions, and estimated weight

12. a. Were there items not collected in the site area because of safety reasons? YES NO

b. If yes, please indicate the number of each of the following items left behind:

_____ Items left at last site pick-up (list in #14)
_____ Hazardous or potentially hazardous materials
_____ Closed bottles containing liquid
_____ Urine bottles (keep out of survey bags!)
_____ Explosives
_____ Knives
_____ Firearms
_____ Items too large or heavy to be carried safely

Please list & estimate weight/size: _____

_____

_____

13. Please indicate the number of items collected in the "Sharps" bag. These items will not be sent to sorters.

_____ Condoms
_____ Needles
_____ Razors
_____ Other: Please describe. _____

_____

14. Please describe any additional observations or items that were not picked up; like money, litter shredded by a mower, or a large amount of small broken glass pieces.

_____

_____

_____

E. BAG TAGGING AND IDENTIFICATION

	How many?	Tag Numbers
16 a. Bags:	_____	_____
b. Bundles:	_____	_____
c. Buckets:	_____	_____
d. **TOTAL NUMBER**:	_____	

6.4

17. Describe each bundle:

_____

_____

_____

_____

F. GENERAL INFORMATION

18. Time Finished: _____

19. Weather: ❑ Sunny ❑ Overcast/Cloudy ❑ Light rain ❑ Heavy rain ❑ Snowing ❑ Hailing ❑ Windy ❑ Other

G. ADDITIONAL NOTES AND INFORMATION

_____

_____

_____

If found, please call Dept. of Ecology at (360) 407-6900. Thank you!

Sorting Form (front)

PAPER				
Alcoholic Bev				
Non-alcoholic Bev				
Unknown Bev				
Fast Food/One-time				
Other Food/Beverage				
Tobacco products				
Cleaning (non-haz)				
Hazardous Material				
Other Non-Food				
Cardboard				
Paper Bags				
Newspapers/Magazines				
Other Paper				

PLASTIC				
Alcoholic Bev				
Non-alcoholic Bev				
Unknown Bev				
Fast Food/One-time				
Other Food/Beverage				
Tobacco products				
Cleaning (non-haz)				
Hazardous Material				
Other Non-Food				
Other Film				
Plastic Auto Parts				
Other Plastics				

OTHER MATERIALS				
Textiles/Leather				
Carpet				
Furniture & Appliances				
Tires				
Rubber Toiletries				
Other Rubber Products				
Auto Rubber Products				
Diapers				
Ceramics				
Toys/Sporting Goods				
Miscellaneous/Other				

ORGANICS				
Food				
Cigarettes/Tobacco				
Other Organics				

GLASS				Glass Subsample
Alcoholic Bev				
Non-alcoholic Bev				
Unknown Bev				
Fast Food/One-time				
Other Food/Beverage				
Tobacco products				
Cleaning (non-haz)				
Hazardous Material				
Other Non-Food				
Glass Auto Parts				
Other Glass				

METAL				Alum Can Subsample
Alcoholic Bev				
Non-alcoholic Bev				
Unknown Bev				
Fast Food/One-time				
Other Food/Beverage				
Tobacco products				
Cleaning (non-haz)				
Hazardous Material				
Other Non-Food				
Metal Auto Parts				
Oil Filters				
Other Metals				

CDL				
Lumber				
Concrete/Brick/Asphalt				
Roofing				
Insulation				
Drywall				
Construction Debris				

HAZARDOUS MATERIAL				
Oil				
Oil Based Paints				
Flammable Liquids				
Latex Paint				
Flammable Gas				
Vehicle Batteries				
Medical Waste				
Pesticides/Herbicides				
Explosives				
Cleaners (hazardous)				
Human Wastes				
Other Haz Materials				

Site Number:

Note: Circle direct-weighed items.

Sorting Form (back)

Total Bag Weights

(include number of bags)

Total Bundle Weights

(include number of bundles)

Total Separate Glass

(note all tare weights)

Total Separate Cigarette Butts

(note all tare weights)

Total Separate Aluminum Cans

(note all tare weights)

Site Number	Collection Date	# of Pieces	Sort Date
		Bags	
		Bundles	
		Buckets	

Appendix G: Litter Prevention Campaign

In 2001, Ecology began planning a comprehensive litter prevention strategy to change the behavior of litterers. Based on the litter study conducted in 1999, the campaign focuses on roadside litter deposited through the following behaviors: deliberate tossing of cigarette butts, beverage containers, and other packaging; uncovered and unsecured loads; and failure to clean out the beds of pickup trucks. Based on adjunct focus group research, the campaign messages have an enforcement theme with information about littering fines and penalties.

The "Litter and it will hurt" campaign uses multiple strategies over a three-year period to first raise awareness, then alter beliefs, and ultimately change behaviors. Key elements include a media campaign (television, print, and radio); operation of a litter hotline; a roadway and retail signage program; a Web site; ongoing public relations; distribution of litterbags and campaign materials; and an enforcement plan.

The Solid Waste & Financial Assistance Program (SW&FAP) launched the "Litter and it will hurt" campaign with a series of news conferences in April 2002. Held in Seattle, Spokane, Richland and Vancouver, the news conferences generated significant media attention to the litter problem and the campaign.

One of the goals of the 2004 litter study was to measure the impact of the campaign. In 2005, Ecology will use the results of the study to evaluate campaign efforts and make adjustments to the campaign plan. In addition, the campaign was designed to include interim measures to track progress. Telephone survey results provided to Ecology by Belo Marketing Solutions and Survey U.S.A. are presented in the table below.

Comparison of Benchmark and Tracking for the Litter Campaign Spring 2002 – Fall 2004
➢ 70% of respondents have seen or heard the slogan "Litter and it will hurt." Up from 14% in the benchmark study.
➢ 39% of respondents are aware of a toll free number to report littering. Up from 20% in the benchmark.
➢ 58% of respondents would say that fines for littering are very severe or severe. Up from 31% in the benchmark.
➢ 46% of respondents remember seeing or hearing any advertising, news or public messaging about the fine for littering a cigarette butt. Up from 30% in the benchmark.
➢ Results indicate that television and road signs are effective in getting the litter message out. When asked where they most remember seeing litter messages, respondents answered road signs first (91%), and television second (69%).

Phone survey data suggest that the State has made good progress towards achieving the objectives of raising awareness and altering beliefs about littering. The 2004 litter study results suggest we may also have made progress in changing behaviors.

For more information about the "Litter and it will hurt" campaign, please visit the State's litter Web site.[86]

[86] http://www.ecy.wa.gov/programs/swfa/litter/campaign.html

Appendix H: 1999 Study Composition Results

To assist in the identification of changes over time, this appendix presents quantity and composition findings that reflect the condition of roadside litter in 1999, in a format that is comparable to the findings for 2004. The data in the current study were weighted using tonnages, while road miles were used to weight the data in the 1999 study. The change in the calculations produces quantity and composition estimates that more accurately characterize the composition of statewide litter.

WEIGHTING PERCENTAGES

Because the weighting scheme in 2004 differed from that used in the previous study, the 1999 weighted composition estimates were recalculated using the 2004 weighting scheme. The following tables display the weighting percentages that were used to recalculate the 1999 weighted composition estimates. For an explanation of how the weighting percentages are used to develop composition estimates, please see Appendix D.

Table H-1 Weighting Percentages, All Roadways

	Mean Tons per Year	Percent of Total
Urban Interstates	210	2.53%
Non-Urban Interstates	333	4.00%
Urban State Routes	765	9.19%
Non-Urban State Routes	698	8.39%
Urban County Roads	2,427	29.17%
Non-Urban County Roads	3,889	46.73%
Overall	**8,322**	**100.00%**

Table H-2 Weighting Percentages, Interstates

	Mean Tons per Year	Percent of Total
Urban Interstates	210	38.72%
Non-Urban Interstates	333	61.28%
Overall	**543**	**100.00%**

Table H-3 Weighting Percentages, State Routes

	Mean Tons per Year	Percent of Total
Urban State Routes	765	52.28%
Non-Urban State Routes	698	47.72%
Overall	**1,463**	**100.00%**

Table H-4 Weighting Percentages, County Roads

	Mean Tons per Year	Percent of Total
Urban County Roads	2,427	38.43%
Non-Urban County Roads	3,889	61.57%
Overall	**6,316**	**100.00%**

Table H-5 Weighting Percentages, Interchanges

	Mean Tons per Year	Percent of Total
Urban Interchanges	462	74.84%
Non-Urban Interchanges	155	25.16%
Overall	**617**	**100.00%**

WEIGHTED COMPOSITION ESTIMATES

This section provides the 1999 composition estimates for all roadways, each road type, and interchanges that have been recalculated using the above weighting percentages.

The composition estimates are displayed in the following order.

Roadways

- All Roadways
- Interstate Highways
- State Routes
- Country Roads

Interchanges

Table H-6 Composition by Weight, Roadways (Interstates, State Routes, and County Roads)

Calculated at a 90% confidence interval

	Tons	Mean %	Low %	High %		Tons	Mean %	Low %	High %
PAPER	**831**	**10.0%**			**ORGANIC**	**1230**	**14.8%**		
Beverage Containers	20	0.2%	0.1%	0.4%	Food (Human And Pet)	135	1.6%	1.0%	2.3%
One-Time Fast Food Service Items	192	2.3%	1.7%	2.9%	Cigarettes and Other Tobacco	82	1.0%	0.2%	1.7%
Other Food and Beverage Packaging	66	0.8%	0.5%	1.1%	Other Organics	1013	12.2%	7.7%	16.6%
Non-food Packaging	99	1.2%	0.0%	2.4%	**CDL**	**1154**	**13.9%**		
Other Cardboard/Boxboard	220	2.6%	2.0%	3.3%	Wood/Lumber/Particleboard	1032	12.4%	9.7%	15.1%
Paper Bags	55	0.7%	0.0%	1.3%	Mineral Aggregates	29	0.4%	0.0%	0.7%
Newspapers and Magazines	87	1.0%	0.7%	1.4%	Roofing	36	0.4%	0.2%	0.7%
Other Paper/Composite Materials	92	1.1%	0.8%	1.4%	Insulation	5	0.1%	0.0%	0.1%
PLASTIC	**999**	**12.0%**			Drywall	2	0.0%	0.0%	0.1%
Beverage Containers	111	1.3%	0.8%	1.9%	Other Construction/Demolition Debris	49	0.6%	0.3%	0.9%
One-Time Fast Food Service Items	51	0.6%	0.5%	0.8%	**HAZARDOUS MATERIALS**	**41**	**0.5%**		
Other Food and Beverage Packaging	57	0.7%	0.5%	0.9%	Latex paint	0	0.0%	0.0%	0.0%
Non-food Packaging	67	0.8%	0.4%	1.2%	Oil based paints	3	0.0%	0.0%	0.1%
Plastic Bags and Film	377	4.5%	3.6%	5.5%	Oil	0	0.0%	0.0%	0.0%
Automotive Parts	99	1.2%	0.9%	1.5%	Batteries	13	0.2%	0.0%	0.3%
Other Plastics/Composite Materials	237	2.8%	2.1%	3.6%	Flammable gas	0	0.0%	0.0%	0.0%
GLASS	**1773**	**21.3%**			Flammable liquids	0	0.0%	0.0%	0.0%
Beverage Containers	1619	19.4%	12.0%	26.9%	Explosives	2	0.0%	0.0%	0.1%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.0%	Pesticides/Herbicides	2	0.0%	0.0%	0.1%
Other Food and Beverage Packaging	40	0.5%	0.0%	1.1%	Cleaners (Hazardous)	4	0.0%	0.0%	0.1%
Non-food Packaging	4	0.1%	0.0%	0.1%	Medical waste	1	0.0%	0.0%	0.0%
Automotive Parts	20	0.2%	0.1%	0.4%	Other	17	0.2%	0.1%	0.3%
Other Glass/Composite Materials	90	1.1%	0.0%	2.5%	**OTHER MATERIALS**	**1161**	**13.9%**		
METAL	**1134**	**13.6%**			Tires/Auto Rubber Products	705	8.5%	4.8%	12.1%
Beverage Containers	271	3.3%	2.1%	4.5%	Rubber/Latex toiletries	7	0.1%	0.0%	0.2%
One-Time Fast Food Service Items	4	0.1%	0.0%	0.1%	Other Rubber/Latex products	13	0.2%	0.1%	0.2%
Other Food and Beverage Packaging	50	0.6%	0.3%	0.9%	Disposable diapers	14	0.2%	0.0%	0.3%
Non-food Packaging	52	0.6%	0.1%	1.2%	Textiles/Leather	161	1.9%	1.5%	2.4%
Automotive Parts	265	3.2%	2.2%	4.1%	Carpet	26	0.3%	0.1%	0.5%
Other Metals/Composite Materials	491	5.9%	4.1%	7.7%	Furniture/Mattresses/Appliances	32	0.4%	0.0%	0.8%
					Ceramics/Porcelain	4	0.0%	0.0%	0.1%
					Toys/Sporting goods	6	0.1%	0.0%	0.1%
					Miscellaneous/Other	192	2.3%	1.4%	3.2%
Total Tons	**8,322**	***Sample Count***	**162**						

Table H-7 Composition by Weight, Interstate Highways

Calculated at a 90% confidence interval

	Tons	Mean %	Low %	High %		Tons	Mean %	Low %	High %
PAPER	**46**	**8.5%**			**ORGANIC**	**70**	**12.8%**		
Beverage Containers	0	0.1%	0.0%	0.1%	Food (Human And Pet)	2	0.4%	0.3%	0.6%
One-Time Fast Food Service Items	10	1.8%	1.2%	2.4%	Cigarettes and Other Tobacco	1	0.2%	0.1%	0.3%
Other Food and Beverage Packaging	3	0.5%	0.3%	0.6%	Other Organics	66	12.2%	5.9%	18.4%
Non-food Packaging	2	0.4%	0.2%	0.7%	**CDL**	**89**	**16.5%**		
Other Cardboard/Boxboard	21	3.8%	2.4%	5.2%	Wood/Lumber/Particleboard	79	14.6%	11.7%	17.6%
Paper Bags	1	0.2%	0.1%	0.3%	Mineral Aggregates	0	0.0%	0.0%	0.1%
New spapers and Magazines	3	0.5%	0.3%	0.7%	Roofing	6	1.1%	0.7%	1.5%
Other Paper/Composite Materials	7	1.3%	1.0%	1.5%	Insulation	1	0.1%	0.0%	0.2%
PLASTIC	**45**	**8.3%**			Dryw all	2	0.3%	0.0%	0.7%
Beverage Containers	4	0.7%	0.3%	1.0%	Other Construction/Demolition Debris	2	0.3%	0.1%	0.5%
One-Time Fast Food Service Items	3	0.5%	0.3%	0.6%	**HAZARDOUS MATERIALS**	**3**	**0.6%**		
Other Food and Beverage Packaging	2	0.3%	0.2%	0.4%	Latex paint	0	0.0%	0.0%	0.0%
Non-food Packaging	3	0.5%	0.2%	0.8%	Oil based paints	0	0.0%	0.0%	0.0%
Plastic Bags and Film	11	2.1%	1.7%	2.4%	Oil	0	0.0%	0.0%	0.0%
Automotive Parts	12	2.3%	1.7%	2.8%	Batteries	1	0.1%	0.0%	0.3%
Other Plastics/Composite Materials	11	2.0%	1.6%	2.4%	Flammable gas	0	0.0%	0.0%	0.0%
GLASS	**59**	**11.0%**			Flammable liquids	0	0.0%	0.0%	0.0%
Beverage Containers	56	10.2%	4.6%	15.9%	Explosives	0	0.0%	0.0%	0.0%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.0%	Pesticides/Herbicides	0	0.0%	0.0%	0.0%
Other Food and Beverage Packaging	0	0.0%	0.0%	0.0%	Cleaners (Hazardous)	0	0.0%	0.0%	0.0%
Non-food Packaging	0	0.0%	0.0%	0.0%	Medical w aste	0	0.0%	0.0%	0.0%
Automotive Parts	3	0.5%	0.1%	0.9%	Other	3	0.5%	0.1%	0.9%
Other Glass/Composite Materials	1	0.2%	0.0%	0.4%	**OTHER MATERIALS**	**162**	**29.8%**		
METAL	**68**	**12.5%**			Tires/Auto Rubber Products	133	24.4%	15.8%	33.1%
Beverage Containers	9	1.6%	0.8%	2.5%	Rubber/Latex toiletries	1	0.1%	0.0%	0.3%
One-Time Fast Food Service Items	0	0.1%	0.0%	0.1%	Other Rubber/Latex products	4	0.7%	0.3%	1.1%
Other Food and Beverage Packaging	1	0.2%	0.1%	0.3%	Disposable diapers	0	0.1%	0.0%	0.1%
Non-food Packaging	1	0.2%	0.0%	0.3%	Textiles/Leather	10	1.9%	1.4%	2.3%
Automotive Parts	35	6.5%	4.4%	8.5%	Carpet	1	0.3%	0.1%	0.4%
Other Metals/Composite Materials	21	4.0%	2.9%	5.0%	Furniture/Mattresses/Appliances	0	0.1%	0.0%	0.2%
					Ceramics/Porcelain	0	0.0%	0.0%	0.0%
					Toys/Sporting goods	1	0.1%	0.0%	0.2%
					Miscellaneous/Other	12	2.2%	1.0%	3.4%
Total Tons	**543**	***Sample Count***		**55**					

Table H-8 Composition by Weight, State Routes

Calculated at a 90% confidence interval

	Tons	Mean %	Low %	High %		Tons	Mean %	Low %	High %
PAPER	**168**	**11.5%**			**ORGANIC**	**214**	**14.6%**		
Beverage Containers	3	0.2%	0.1%	0.3%	Food (Human And Pet)	49	3.4%	0.3%	6.4%
One-Time Fast Food Service Items	34	2.3%	1.8%	2.9%	Cigarettes and Other Tobacco	29	2.0%	0.0%	4.5%
Other Food and Beverage Packaging	9	0.6%	0.4%	0.9%	Other Organics	136	9.3%	6.5%	12.2%
Non-food Packaging	8	0.6%	0.3%	0.8%	**CDL**	**285**	**19.5%**		
Other Cardboard/Boxboard	66	4.5%	3.4%	5.6%	Wood/Lumber/Particleboard	243	16.6%	12.6%	20.6%
Paper Bags	7	0.5%	0.3%	0.7%	Mineral Aggregates	16	1.1%	0.0%	2.5%
Newspapers and Magazines	14	1.0%	0.6%	1.4%	Roofing	10	0.7%	0.2%	1.2%
Other Paper/Composite Materials	27	1.9%	1.3%	2.4%	Insulation	1	0.1%	0.0%	0.1%
PLASTIC	**198**	**13.5%**			Drywall	0	0.0%	0.0%	0.1%
Beverage Containers	16	1.1%	0.6%	1.6%	Other Construction/Demolition Debris	14	1.0%	0.1%	1.9%
One-Time Fast Food Service Items	13	0.9%	0.7%	1.0%	**HAZARDOUS MATERIALS**	**6**	**0.4%**		
Other Food and Beverage Packaging	13	0.9%	0.6%	1.2%	Latex paint	0	0.0%	0.0%	0.0%
Non-food Packaging	13	0.9%	0.3%	1.5%	Oil based paints	1	0.0%	0.0%	0.1%
Plastic Bags and Film	69	4.7%	3.1%	6.3%	Oil	0	0.0%	0.0%	0.0%
Automotive Parts	18	1.3%	0.9%	1.7%	Batteries	1	0.1%	0.0%	0.2%
Other Plastics/Composite Materials	56	3.8%	2.7%	5.0%	Flammable gas	0	0.0%	0.0%	0.0%
GLASS	**199**	**13.6%**			Flammable liquids	0	0.0%	0.0%	0.0%
Beverage Containers	183	12.5%	7.1%	17.9%	Explosives	0	0.0%	0.0%	0.1%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.0%	Pesticides/Herbicides	2	0.1%	0.0%	0.3%
Other Food and Beverage Packaging	0	0.0%	0.0%	0.0%	Cleaners (Hazardous)	0	0.0%	0.0%	0.1%
Non-food Packaging	1	0.1%	0.0%	0.1%	Medical waste	0	0.0%	0.0%	0.0%
Automotive Parts	12	0.8%	0.0%	1.6%	Other	2	0.2%	0.1%	0.3%
Other Glass/Composite Materials	4	0.3%	0.1%	0.4%	**OTHER MATERIALS**	**210**	**14.4%**		
METAL	**181**	**12.4%**			Tires/Auto Rubber Products	100	6.8%	3.6%	10.1%
Beverage Containers	33	2.3%	1.3%	3.3%	Rubber/Latex toiletries	5	0.3%	0.0%	0.7%
One-Time Fast Food Service Items	1	0.0%	0.0%	0.1%	Other Rubber/Latex products	4	0.3%	0.1%	0.4%
Other Food and Beverage Packaging	3	0.2%	0.1%	0.3%	Disposable diapers	0	0.0%	0.0%	0.0%
Non-food Packaging	3	0.2%	0.0%	0.4%	Textiles/Leather	35	2.4%	1.6%	3.1%
Automotive Parts	60	4.1%	2.6%	5.6%	Carpet	19	1.3%	0.1%	2.6%
Other Metals/Composite Materials	82	5.6%	3.1%	8.1%	Furniture/Mattresses/Appliances	5	0.4%	0.0%	0.8%
					Ceramics/Porcelain	1	0.0%	0.0%	0.1%
					Toys/Sporting goods	1	0.1%	0.0%	0.1%
					Miscellaneous/Other	41	2.8%	1.7%	3.8%
Total Tons	**1,463**	***Sample Count***	**52**						

Table H-9 Composition by Weight, County Roads

Calculated at a 90% confidence interval

	Tons	Mean %	Low %	High %		Tons	Mean %	Low %	High %
PAPER	**616**	**9.7%**			**ORGANIC**	**947**	**15.0%**		
Beverage Containers	17	0.3%	0.1%	0.4%	Food (Human And Pet)	83	1.3%	0.8%	1.8%
One-Time Fast Food Service Items	149	2.4%	1.5%	3.2%	Cigarettes and Other Tobacco	53	0.8%	0.0%	1.6%
Other Food and Beverage Packaging	54	0.9%	0.5%	1.2%	Other Organics	811	12.8%	7.1%	18.6%
Non-food Packaging	88	1.4%	0.0%	3.0%	**CDL**	**779**	**12.3%**		
Other Cardboard/Boxboard	134	2.1%	1.3%	2.9%	Wood/Lumber/Particleboard	710	11.2%	7.8%	14.7%
Paper Bags	47	0.7%	0.0%	1.6%	Mineral Aggregates	13	0.2%	0.0%	0.5%
Newspapers and Magazines	70	1.1%	0.7%	1.5%	Roofing	20	0.3%	0.0%	0.6%
Other Paper/Composite Materials	57	0.9%	0.5%	1.3%	Insulation	4	0.1%	0.0%	0.1%
PLASTIC	**756**	**12.0%**			Drywall	0	0.0%	0.0%	0.0%
Beverage Containers	91	1.4%	0.7%	2.2%	Other Construction/Demolition Debris	32	0.5%	0.1%	0.9%
One-Time Fast Food Service Items	36	0.6%	0.4%	0.8%	**HAZARDOUS MATERIALS**	**31**	**0.5%**		
Other Food and Beverage Packaging	42	0.7%	0.4%	0.9%	Latex paint	0	0.0%	0.0%	0.0%
Non-food Packaging	51	0.8%	0.3%	1.3%	Oil based paints	2	0.0%	0.0%	0.1%
Plastic Bags and Film	297	4.7%	3.5%	5.9%	Oil	0	0.0%	0.0%	0.0%
Automotive Parts	68	1.1%	0.7%	1.4%	Batteries	11	0.2%	0.0%	0.4%
Other Plastics/Composite Materials	170	2.7%	1.8%	3.6%	Flammable gas	0	0.0%	0.0%	0.0%
GLASS	**1514**	**24.0%**			Flammable liquids	0	0.0%	0.0%	0.0%
Beverage Containers	1380	21.9%	12.1%	31.6%	Explosives	2	0.0%	0.0%	0.1%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.0%	Pesticides/Herbicides	0	0.0%	0.0%	0.0%
Other Food and Beverage Packaging	40	0.6%	0.0%	1.5%	Cleaners (Hazardous)	3	0.1%	0.0%	0.1%
Non-food Packaging	4	0.1%	0.0%	0.1%	Medical waste	1	0.0%	0.0%	0.0%
Automotive Parts	5	0.1%	0.0%	0.2%	Other	12	0.2%	0.1%	0.3%
Other Glass/Composite Materials	85	1.3%	0.0%	3.3%	**OTHER MATERIALS**	**788**	**12.5%**		
METAL	**885**	**14.0%**			Tires/Auto Rubber Products	473	7.5%	2.8%	12.2%
Beverage Containers	229	3.6%	2.1%	5.2%	Rubber/Latex toiletries	2	0.0%	0.0%	0.1%
One-Time Fast Food Service Items	3	0.1%	0.0%	0.1%	Other Rubber/Latex products	5	0.1%	0.0%	0.1%
Other Food and Beverage Packaging	46	0.7%	0.3%	1.2%	Disposable diapers	14	0.2%	0.0%	0.4%
Non-food Packaging	48	0.8%	0.0%	1.5%	Textiles/Leather	116	1.8%	1.3%	2.4%
Automotive Parts	170	2.7%	1.5%	3.9%	Carpet	5	0.1%	0.0%	0.2%
Other Metals/Composite Materials	388	6.1%	3.9%	8.4%	Furniture/Mattresses/Appliances	26	0.4%	0.0%	0.9%
					Ceramics/Porcelain	3	0.0%	0.0%	0.1%
					Toys/Sporting goods	5	0.1%	0.0%	0.1%
					Miscellaneous/Other	140	2.2%	1.0%	3.4%
Total Tons	**6,316**	***Sample Count***		**55**					

Table H-10 Composition by Weight, Interchanges

Calculated at a 90% confidence interval

	Tons	Mean %	Low %	High %		Tons	Mean %	Low %	High %
PAPER	**70**	**11.4%**			**ORGANIC**	**100**	**16.3%**		
Beverage Containers	1	0.1%	0.0%	0.2%	Food (Human And Pet)	5	0.7%	0.5%	1.0%
One-Time Fast Food Service Items	13	2.1%	1.8%	2.3%	Cigarettes and Other Tobacco	6	1.0%	0.4%	1.6%
Other Food and Beverage Packaging	3	0.4%	0.4%	0.5%	Other Organics	90	14.5%	11.4%	17.6%
Non-food Packaging	5	0.9%	0.3%	1.4%	**CDL**	**129**	**20.9%**		
Other Cardboard/Boxboard	30	4.8%	4.0%	5.7%	Wood/Lumber/Particleboard	103	16.7%	13.8%	19.5%
Paper Bags	2	0.3%	0.3%	0.4%	Mineral Aggregates	11	1.8%	0.4%	3.2%
Newspapers and Magazines	5	0.7%	0.6%	0.9%	Roofing	3	0.5%	0.3%	0.8%
Other Paper/Composite Materials	12	2.0%	1.6%	2.5%	Insulation	0	0.0%	0.0%	0.1%
PLASTIC	**79**	**12.8%**			Drywall	4	0.7%	0.0%	1.4%
Beverage Containers	5	0.8%	0.5%	1.2%	Other Construction/Demolition Debris	7	1.2%	0.2%	2.1%
One-Time Fast Food Service Items	3	0.5%	0.4%	0.6%	**HAZARDOUS MATERIALS**	**3**	**0.5%**		
Other Food and Beverage Packaging	3	0.4%	0.3%	0.5%	Latex paint	1	0.1%	0.0%	0.2%
Non-food Packaging	7	1.1%	0.3%	2.0%	Oil based paints	0	0.0%	0.0%	0.0%
Plastic Bags and Film	24	3.9%	3.3%	4.6%	Oil	0	0.0%	0.0%	0.0%
Automotive Parts	15	2.4%	1.6%	3.2%	Batteries	0	0.1%	0.0%	0.2%
Other Plastics/Composite Materials	22	3.5%	2.7%	4.3%	Flammable gas	0	0.0%	0.0%	0.0%
GLASS	**85**	**13.8%**			Flammable liquids	0	0.0%	0.0%	0.0%
Beverage Containers	79	12.8%	6.6%	18.9%	Explosives	0	0.1%	0.0%	0.1%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.0%	Pesticides/Herbicides	0	0.0%	0.0%	0.0%
Other Food and Beverage Packaging	0	0.0%	0.0%	0.0%	Cleaners (Hazardous)	0	0.0%	0.0%	0.0%
Non-food Packaging	0	0.1%	0.0%	0.1%	Medical waste	0	0.0%	0.0%	0.0%
Automotive Parts	3	0.5%	0.0%	1.0%	Other	1	0.2%	0.1%	0.4%
Other Glass/Composite Materials	3	0.5%	0.0%	0.9%	**OTHER MATERIALS**	**79**	**12.8%**		
METAL	**71**	**11.6%**			Tires/Auto Rubber Products	44	7.2%	4.8%	9.6%
Beverage Containers	8	1.3%	0.8%	1.9%	Rubber/Latex toiletries	0	0.0%	0.0%	0.0%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.0%	Other Rubber/Latex products	2	0.4%	0.1%	0.6%
Other Food and Beverage Packaging	1	0.1%	0.1%	0.2%	Disposable diapers	3	0.4%	0.0%	0.9%
Non-food Packaging	2	0.4%	0.1%	0.7%	Textiles/Leather	13	2.1%	1.8%	2.5%
Automotive Parts	30	4.9%	3.7%	6.0%	Carpet	2	0.3%	0.0%	0.5%
Other Metals/Composite Materials	30	4.8%	3.8%	5.8%	Furniture/Mattresses/Appliances	0	0.1%	0.0%	0.1%
					Ceramics/Porcelain	1	0.1%	0.0%	0.2%
					Toys/Sporting goods	0	0.0%	0.0%	0.0%
					Miscellaneous/Other	14	2.2%	0.8%	3.6%
Total Tons	**617**	***Sample Count***	**47**						

UNWEIGHTED COMPOSITION ESTIMATES

Table H-11 through Table H-18 provide the unweighted composition estimates for each individual category sampled in the 1999 study. These tables are reproduced here, in the following order, for the convenience of the reader.

Roadways

- Urban Interstates
- Non-urban Interstates
- Urban State Routes
- Non-urban State Routes
- Urban County Roads
- Non-urban County Roads

Interchanges

- Urban Interchanges
- Non-urban Interchanges

Table H-11 Composition by Weight, Urban Interstates

Calculated at a 90% confidence interval

	Tons	Mean %	Low %	High %		Tons	Mean %	Low %	High %
PAPER	**22**	**10.4%**			**ORGANIC**	**26**	**12.4%**		
Beverage Containers	0	0.1%	0.0%	0.2%	Food (Human And Pet)	1	0.6%	0.3%	1.0%
One-Time Fast Food Service Items	4	2.1%	1.5%	2.6%	Cigarettes and Other Tobacco	1	0.3%	0.2%	0.5%
Other Food and Beverage Packaging	1	0.4%	0.3%	0.6%	Other Organics	24	11.5%	7.2%	15.7%
Non-food Packaging	1	0.6%	0.2%	1.0%	**CDL**	**49**	**23.1%**		
Other Cardboard/Boxboard	9	4.5%	3.0%	6.0%	Wood/Lumber/Particleboard	43	20.5%	15.7%	25.3%
Paper Bags	1	0.3%	0.2%	0.4%	Mineral Aggregates	0	0.0%	0.0%	0.1%
Newspapers and Magazines	1	0.5%	0.3%	0.6%	Roofing	3	1.4%	0.5%	2.3%
Other Paper/Composite Materials	4	1.9%	1.5%	2.4%	Insulation	0	0.2%	0.0%	0.4%
PLASTIC	**22**	**10.4%**			Drywall	2	0.7%	0.0%	1.8%
Beverage Containers	1	0.4%	0.2%	0.7%	Other Construction/Demolition Debris	1	0.3%	0.0%	0.6%
One-Time Fast Food Service Items	1	0.5%	0.3%	0.6%	**HAZARDOUS MATERIALS**	**2**	**0.8%**		
Other Food and Beverage Packaging	1	0.5%	0.3%	0.6%	Latex paint	0	0.0%	0.0%	0.0%
Non-food Packaging	1	0.4%	0.1%	0.8%	Oil based paints	0	0.0%	0.0%	0.0%
Plastic Bags and Film	7	3.2%	2.6%	3.9%	Oil	0	0.0%	0.0%	0.0%
Automotive Parts	6	3.0%	1.9%	4.1%	Batteries	0	0.0%	0.0%	0.0%
Other Plastics/Composite Materials	5	2.4%	1.8%	3.0%	Flammable gas	0	0.0%	0.0%	0.0%
GLASS	**9**	**4.0%**			Flammable liquids	0	0.0%	0.0%	0.0%
Beverage Containers	6	2.8%	1.2%	4.4%	Explosives	0	0.0%	0.0%	0.0%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.0%	Pesticides/Herbicides	0	0.0%	0.0%	0.0%
Other Food and Beverage Packaging	0	0.0%	0.0%	0.0%	Cleaners (Hazardous)	0	0.0%	0.0%	0.0%
Non-food Packaging	0	0.0%	0.0%	0.0%	Medical waste	0	0.0%	0.0%	0.0%
Automotive Parts	2	1.1%	0.1%	2.1%	Other	2	0.8%	0.0%	1.8%
Other Glass/Composite Materials	0	0.1%	0.0%	0.2%	**OTHER MATERIALS**	**52**	**24.6%**		
METAL	**30**	**14.2%**			Tires/Auto Rubber Products	37	17.6%	10.5%	24.8%
Beverage Containers	2	0.8%	0.4%	1.2%	Rubber/Latex toiletries	0	0.1%	0.0%	0.1%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.0%	Other Rubber/Latex products	1	0.5%	0.0%	1.1%
Other Food and Beverage Packaging	0	0.1%	0.0%	0.1%	Disposable diapers	0	0.1%	0.0%	0.2%
Non-food Packaging	0	0.2%	0.0%	0.4%	Textiles/Leather	6	2.9%	1.8%	4.0%
Automotive Parts	16	7.8%	5.2%	10.4%	Carpet	1	0.4%	0.1%	0.8%
Other Metals/Composite Materials	11	5.4%	3.3%	7.4%	Furniture/Mattresses/Appliances	0	0.2%	0.0%	0.5%
					Ceramics/Porcelain	0	0.0%	0.0%	0.0%
					Toys/Sporting goods	0	0.1%	0.0%	0.2%
					Miscellaneous/Other	6	2.6%	0.2%	5.1%
Total Tons	**210**	***Sample Count***		**28**					

Table H-12 Composition by Weight, Non-urban Interstates

Calculated at a 90% confidence interval

	Tons	Mean %	Low %	High %		Tons	Mean %	Low %	High %
PAPER	**25**	**7.4%**			**ORGANIC**	**43**	**13.1%**		
Beverage Containers	0	0.1%	0.0%	0.1%	Food (Human And Pet)	1	0.3%	0.1%	0.5%
One-Time Fast Food Service Items	5	1.6%	0.7%	2.5%	Cigarettes and Other Tobacco	0	0.1%	0.1%	0.2%
Other Food and Beverage Packaging	2	0.5%	0.3%	0.7%	Other Organics	42	12.6%	2.8%	22.5%
Non-food Packaging	1	0.3%	0.1%	0.6%	**CDL**	**41**	**12.3%**		
Other Cardboard/Boxboard	11	3.4%	1.4%	5.4%	Wood/Lumber/Particleboard	36	10.9%	7.2%	14.7%
Paper Bags	0	0.1%	0.1%	0.2%	Mineral Aggregates	0	0.0%	0.0%	0.0%
Newspapers and Magazines	2	0.5%	0.2%	0.8%	Roofing	3	0.9%	0.5%	1.4%
Other Paper/Composite Materials	3	0.8%	0.5%	1.2%	Insulation	0	0.1%	0.0%	0.2%
PLASTIC	**23**	**7.0%**			Drywall	0	0.0%	0.0%	0.0%
Beverage Containers	3	0.8%	0.3%	1.4%	Other Construction/Demolition Debris	1	0.3%	0.1%	0.5%
One-Time Fast Food Service Items	2	0.5%	0.3%	0.7%	**HAZARDOUS MATERIALS**	**2**	**0.5%**		
Other Food and Beverage Packaging	1	0.3%	0.1%	0.4%	Latex paint	0	0.0%	0.0%	0.0%
Non-food Packaging	2	0.5%	0.1%	1.0%	Oil based paints	0	0.0%	0.0%	0.0%
Plastic Bags and Film	5	1.4%	0.9%	1.8%	Oil	0	0.0%	0.0%	0.0%
Automotive Parts	6	1.8%	1.3%	2.4%	Batteries	1	0.2%	0.0%	0.4%
Other Plastics/Composite Materials	6	1.7%	1.2%	2.2%	Flammable gas	0	0.0%	0.0%	0.0%
GLASS	**51**	**15.3%**			Flammable liquids	0	0.0%	0.0%	0.0%
Beverage Containers	50	14.9%	5.8%	24.1%	Explosives	0	0.0%	0.0%	0.0%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.0%	Pesticides/Herbicides	0	0.0%	0.0%	0.0%
Other Food and Beverage Packaging	0	0.0%	0.0%	0.0%	Cleaners (Hazardous)	0	0.0%	0.0%	0.0%
Non-food Packaging	0	0.0%	0.0%	0.0%	Medical waste	0	0.0%	0.0%	0.0%
Automotive Parts	1	0.2%	0.0%	0.4%	Other	1	0.3%	0.1%	0.6%
Other Glass/Composite Materials	1	0.2%	0.0%	0.5%	**OTHER MATERIALS**	**110**	**33.0%**		
METAL	**38**	**11.4%**			Tires/Auto Rubber Products	96	28.7%	15.3%	42.2%
Beverage Containers	7	2.2%	0.8%	3.5%	Rubber/Latex toiletries	1	0.2%	0.0%	0.5%
One-Time Fast Food Service Items	0	0.1%	0.0%	0.2%	Other Rubber/Latex products	3	0.8%	0.2%	1.4%
Other Food and Beverage Packaging	1	0.3%	0.1%	0.4%	Disposable diapers	0	0.1%	0.0%	0.2%
Non-food Packaging	1	0.2%	0.0%	0.4%	Textiles/Leather	4	1.2%	0.8%	1.6%
Automotive Parts	19	5.6%	2.7%	8.5%	Carpet	0	0.1%	0.0%	0.3%
Other Metals/Composite Materials	10	3.1%	2.0%	4.1%	Furniture/Mattresses/Appliances	0	0.0%	0.0%	0.0%
					Ceramics/Porcelain	0	0.0%	0.0%	0.0%
					Toys/Sporting goods	0	0.1%	0.0%	0.2%
					Miscellaneous/Other	6	1.9%	0.6%	3.1%
Total Tons	**333**	***Sample Count***		**27**					

Table H-13 Composition by Weight, Urban State Routes

Calculated at a 90% confidence interval

	Tons	Mean %	Low %	High %		Tons	Mean %	Low %	High %
PAPER	**102**	**13.3%**			**ORGANIC**	**116**	**15.1%**		
Beverage Containers	1	0.2%	0.0%	0.4%	Food (Human And Pet)	11	1.4%	0.3%	2.6%
One-Time Fast Food Service Items	16	2.1%	1.2%	2.9%	Cigarettes and Other Tobacco	28	3.6%	0.0%	8.4%
Other Food and Beverage Packaging	3	0.4%	0.1%	0.7%	Other Organics	77	10.1%	6.5%	13.8%
Non-food Packaging	3	0.5%	0.1%	0.8%	**CDL**	**177**	**23.1%**		
Other Cardboard/Boxboard	46	6.0%	4.2%	7.9%	Wood/Lumber/Particleboard	160	20.9%	14.0%	27.9%
Paper Bags	4	0.5%	0.2%	0.8%	Mineral Aggregates	2	0.3%	0.0%	0.8%
Newspapers and Magazines	11	1.4%	0.7%	2.2%	Roofing	7	0.9%	0.0%	1.8%
Other Paper/Composite Materials	17	2.2%	1.3%	3.2%	Insulation	1	0.1%	0.0%	0.2%
PLASTIC	**115**	**15.1%**			Drywall	0	0.0%	0.0%	0.0%
Beverage Containers	7	0.9%	0.3%	1.6%	Other Construction/Demolition Debris	6	0.8%	0.0%	2.0%
One-Time Fast Food Service Items	8	1.0%	0.7%	1.3%	**HAZARDOUS MATERIALS**	**2**	**0.3%**		
Other Food and Beverage Packaging	5	0.6%	0.4%	0.9%	Latex paint	0	0.0%	0.0%	0.0%
Non-food Packaging	6	0.8%	0.1%	1.6%	Oil based paints	1	0.1%	0.0%	0.2%
Plastic Bags and Film	48	6.2%	3.5%	9.0%	Oil	0	0.0%	0.0%	0.0%
Automotive Parts	7	0.9%	0.6%	1.2%	Batteries	1	0.1%	0.0%	0.3%
Other Plastics/Composite Materials	35	4.6%	2.8%	6.4%	Flammable gas	0	0.0%	0.0%	0.0%
GLASS	**70**	**9.1%**			Flammable liquids	0	0.0%	0.0%	0.0%
Beverage Containers	61	8.0%	2.4%	13.5%	Explosives	0	0.0%	0.0%	0.0%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.0%	Pesticides/Herbicides	0	0.0%	0.0%	0.0%
Other Food and Beverage Packaging	0	0.0%	0.0%	0.0%	Cleaners (Hazardous)	0	0.0%	0.0%	0.0%
Non-food Packaging	0	0.0%	0.0%	0.0%	Medical waste	0	0.0%	0.0%	0.0%
Automotive Parts	8	1.0%	0.0%	2.5%	Other	1	0.1%	0.0%	0.2%
Other Glass/Composite Materials	1	0.1%	0.0%	0.3%	**OTHER MATERIALS**	**105**	**13.7%**		
METAL	**78**	**10.2%**			Tires/Auto Rubber Products	36	4.8%	2.3%	7.2%
Beverage Containers	9	1.2%	0.4%	1.9%	Rubber/Latex toiletries	1	0.1%	0.0%	0.2%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.1%	Other Rubber/Latex products	2	0.3%	0.0%	0.5%
Other Food and Beverage Packaging	1	0.2%	0.0%	0.4%	Disposable diapers	0	0.0%	0.0%	0.0%
Non-food Packaging	2	0.2%	0.0%	0.5%	Textiles/Leather	25	3.3%	1.9%	4.6%
Automotive Parts	26	3.5%	1.5%	5.5%	Carpet	16	2.1%	0.0%	4.4%
Other Metals/Composite Materials	39	5.1%	1.2%	9.0%	Furniture/Mattresses/Appliances	4	0.6%	0.0%	1.5%
					Ceramics/Porcelain	0	0.1%	0.0%	0.1%
					Toys/Sporting goods	1	0.1%	0.0%	0.2%
					Miscellaneous/Other	19	2.5%	0.8%	4.1%
Total Tons	**765**	***Sample Count***		**27**					

Table H-14 Composition by Weight, Non-urban State Routes

Calculated at a 90% confidence interval

	Tons	Mean %	Low %	High %		Tons	Mean %	Low %	High %
PAPER	**66**	**9.5%**			**ORGANIC**	**98**	**14.1%**		
Beverage Containers	1	0.2%	0.1%	0.3%	Food (Human And Pet)	38	5.5%	0.0%	11.8%
One-Time Fast Food Service Items	18	2.6%	2.0%	3.3%	Cigarettes and Other Tobacco	1	0.1%	0.1%	0.2%
Other Food and Beverage Packaging	6	0.9%	0.6%	1.2%	Other Organics	59	8.4%	4.0%	12.9%
Non-food Packaging	5	0.7%	0.2%	1.1%	**CDL**	**109**	**15.5%**		
Other Cardboard/Boxboard	20	2.8%	1.7%	3.9%	Wood/Lumber/Particleboard	83	11.9%	8.5%	15.4%
Paper Bags	3	0.4%	0.3%	0.6%	Mineral Aggregates	13	1.9%	0.0%	4.8%
Newspapers and Magazines	3	0.5%	0.2%	0.7%	Roofing	3	0.5%	0.2%	0.7%
Other Paper/Composite Materials	10	1.5%	0.9%	2.1%	Insulation	0	0.0%	0.0%	0.0%
PLASTIC	**83**	**11.9%**			Drywall	0	0.1%	0.0%	0.1%
Beverage Containers	9	1.3%	0.5%	2.1%	Other Construction/Demolition Debris	8	1.1%	0.0%	2.6%
One-Time Fast Food Service Items	5	0.7%	0.5%	0.9%	**HAZARDOUS MATERIALS**	**4**	**0.6%**		
Other Food and Beverage Packaging	8	1.1%	0.5%	1.8%	Latex paint	0	0.0%	0.0%	0.0%
Non-food Packaging	7	1.0%	0.1%	1.9%	Oil based paints	0	0.0%	0.0%	0.0%
Plastic Bags and Film	21	3.0%	1.7%	4.4%	Oil	0	0.0%	0.0%	0.0%
Automotive Parts	12	1.7%	0.9%	2.5%	Batteries	0	0.0%	0.0%	0.1%
Other Plastics/Composite Materials	21	3.0%	1.6%	4.4%	Flammable gas	0	0.0%	0.0%	0.0%
GLASS	**130**	**18.6%**			Flammable liquids	0	0.0%	0.0%	0.0%
Beverage Containers	121	17.4%	7.8%	27.0%	Explosives	0	0.1%	0.0%	0.1%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.0%	Pesticides/Herbicides	2	0.2%	0.0%	0.6%
Other Food and Beverage Packaging	0	0.0%	0.0%	0.1%	Cleaners (Hazardous)	0	0.1%	0.0%	0.2%
Non-food Packaging	1	0.1%	0.0%	0.3%	Medical waste	0	0.0%	0.0%	0.0%
Automotive Parts	4	0.6%	0.0%	1.3%	Other	2	0.3%	0.1%	0.4%
Other Glass/Composite Materials	3	0.4%	0.0%	0.7%	**OTHER MATERIALS**	**105**	**15.1%**		
METAL	**103**	**14.7%**			Tires/Auto Rubber Products	64	9.1%	2.9%	15.3%
Beverage Containers	24	3.4%	1.5%	5.4%	Rubber/Latex toiletries	4	0.5%	0.0%	1.3%
One-Time Fast Food Service Items	0	0.1%	0.0%	0.1%	Other Rubber/Latex products	2	0.2%	0.1%	0.4%
Other Food and Beverage Packaging	1	0.2%	0.1%	0.3%	Disposable diapers	0	0.0%	0.0%	0.1%
Non-food Packaging	1	0.1%	0.0%	0.3%	Textiles/Leather	10	1.4%	1.0%	1.9%
Automotive Parts	33	4.7%	2.4%	7.1%	Carpet	3	0.5%	0.0%	1.0%
Other Metals/Composite Materials	43	6.1%	3.2%	9.0%	Furniture/Mattresses/Appliances	1	0.1%	0.0%	0.3%
					Ceramics/Porcelain	0	0.0%	0.0%	0.0%
					Toys/Sporting goods	0	0.0%	0.0%	0.1%
					Miscellaneous/Other	22	3.1%	1.7%	4.5%
Total Tons	**698**	***Sample Count***		**25**					

Table H-15 Composition by Weight, Urban County Roads

Calculated at a 90% confidence interval

	Tons	Mean %	Low %	High %		Tons	Mean %	Low %	High %
PAPER	**214**	**8.8%**			**ORGANIC**	**507**	**20.9%**		
Beverage Containers	3	0.1%	0.0%	0.3%	Food (Human And Pet)	23	1.0%	0.4%	1.5%
One-Time Fast Food Service Items	52	2.1%	1.0%	3.3%	Cigarettes and Other Tobacco	21	0.9%	0.1%	1.6%
Other Food and Beverage Packaging	22	0.9%	0.1%	1.7%	Other Organics	463	19.1%	4.9%	33.3%
Non-food Packaging	8	0.3%	0.0%	0.6%	**CDL**	**324**	**13.3%**		
Other Cardboard/Boxboard	59	2.4%	1.1%	3.7%	Wood/Lumber/Particleboard	297	12.2%	7.4%	17.1%
Paper Bags	6	0.2%	0.1%	0.4%	Mineral Aggregates	1	0.1%	0.0%	0.2%
Newspapers and Magazines	41	1.7%	0.7%	2.7%	Roofing	3	0.1%	0.0%	0.2%
Other Paper/Composite Materials	22	0.9%	0.3%	1.6%	Insulation	0	0.0%	0.0%	0.0%
PLASTIC	**376**	**15.5%**			Drywall	0	0.0%	0.0%	0.0%
Beverage Containers	23	1.0%	0.2%	1.7%	Other Construction/Demolition Debris	22	0.9%	0.0%	1.8%
One-Time Fast Food Service Items	15	0.6%	0.3%	0.9%	**HAZARDOUS MATERIALS**	**13**	**0.5%**		
Other Food and Beverage Packaging	19	0.8%	0.5%	1.0%	Latex paint	0	0.0%	0.0%	0.0%
Non-food Packaging	15	0.6%	0.0%	1.3%	Oil based paints	2	0.1%	0.0%	0.2%
Plastic Bags and Film	189	7.8%	4.9%	10.6%	Oil	0	0.0%	0.0%	0.0%
Automotive Parts	39	1.6%	0.8%	2.4%	Batteries	3	0.1%	0.0%	0.2%
Other Plastics/Composite Materials	75	3.1%	2.2%	4.0%	Flammable gas	0	0.0%	0.0%	0.0%
GLASS	**456**	**18.8%**			Flammable liquids	0	0.0%	0.0%	0.0%
Beverage Containers	345	14.2%	3.5%	24.9%	Explosives	2	0.1%	0.0%	0.2%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.0%	Pesticides/Herbicides	0	0.0%	0.0%	0.0%
Other Food and Beverage Packaging	32	1.3%	0.0%	3.5%	Cleaners (Hazardous)	3	0.1%	0.0%	0.3%
Non-food Packaging	0	0.0%	0.0%	0.0%	Medical waste	0	0.0%	0.0%	0.0%
Automotive Parts	1	0.0%	0.0%	0.1%	Other	3	0.1%	0.0%	0.2%
Other Glass/Composite Materials	78	3.2%	0.0%	8.2%	**OTHER MATERIALS**	**250**	**10.3%**		
METAL	**289**	**11.9%**			Tires/Auto Rubber Products	120	4.9%	0.0%	11.8%
Beverage Containers	41	1.7%	0.4%	3.0%	Rubber/Latex toiletries	1	0.0%	0.0%	0.1%
One-Time Fast Food Service Items	1	0.0%	0.0%	0.1%	Other Rubber/Latex products	1	0.0%	0.0%	0.1%
Other Food and Beverage Packaging	5	0.2%	0.0%	0.4%	Disposable diapers	1	0.0%	0.0%	0.1%
Non-food Packaging	4	0.1%	0.0%	0.3%	Textiles/Leather	50	2.1%	0.9%	3.2%
Automotive Parts	90	3.7%	1.2%	6.2%	Carpet	4	0.2%	0.0%	0.3%
Other Metals/Composite Materials	148	6.1%	1.5%	10.8%	Furniture/Mattresses/Appliances	26	1.1%	0.0%	2.4%
					Ceramics/Porcelain	3	0.1%	0.0%	0.3%
					Toys/Sporting goods	3	0.1%	0.0%	0.3%
					Miscellaneous/Other	41	1.7%	0.7%	2.6%
Total Tons	**2,427**	***Sample Count***		**28**					

Table H-16 Composition by Weight, Non-urban County Roads

Calculated at a 90% confidence interval

	Tons	Mean %	Low %	High %		Tons	Mean %	Low %	High %
PAPER	**402**	**10.3%**			**ORGANIC**	**440**	**11.3%**		
Beverage Containers	14	0.4%	0.1%	0.6%	Food (Human And Pet)	60	1.5%	0.8%	2.3%
One-Time Fast Food Service Items	97	2.5%	1.3%	3.6%	Cigarettes and Other Tobacco	32	0.8%	0.0%	2.0%
Other Food and Beverage Packaging	32	0.8%	0.5%	1.2%	Other Organics	348	8.9%	5.9%	12.0%
Non-food Packaging	81	2.1%	0.0%	4.6%	**CDL**	**455**	**11.7%**		
Other Cardboard/Boxboard	75	1.9%	0.9%	3.0%	Wood/Lumber/Particleboard	413	10.6%	6.0%	15.3%
Paper Bags	41	1.0%	0.0%	2.4%	Mineral Aggregates	12	0.3%	0.0%	0.8%
Newspapers and Magazines	29	0.7%	0.4%	1.1%	Roofing	17	0.4%	0.0%	0.9%
Other Paper/Composite Materials	35	0.9%	0.4%	1.4%	Insulation	4	0.1%	0.0%	0.2%
PLASTIC	**380**	**9.8%**			Drywall	0	0.0%	0.0%	0.0%
Beverage Containers	68	1.8%	0.7%	2.8%	Other Construction/Demolition Debris	10	0.3%	0.0%	0.5%
One-Time Fast Food Service Items	21	0.5%	0.3%	0.8%	**HAZARDOUS MATERIALS**	**18**	**0.5%**		
Other Food and Beverage Packaging	23	0.6%	0.3%	0.9%	Latex paint	0	0.0%	0.0%	0.0%
Non-food Packaging	36	0.9%	0.2%	1.6%	Oil based paints	0	0.0%	0.0%	0.0%
Plastic Bags and Film	108	2.8%	1.9%	3.7%	Oil	0	0.0%	0.0%	0.0%
Automotive Parts	29	0.7%	0.4%	1.1%	Batteries	8	0.2%	0.0%	0.5%
Other Plastics/Composite Materials	95	2.4%	1.1%	3.8%	Flammable gas	0	0.0%	0.0%	0.0%
GLASS	**1058**	**27.2%**			Flammable liquids	0	0.0%	0.0%	0.0%
Beverage Containers	1036	26.6%	12.2%	41.0%	Explosives	0	0.0%	0.0%	0.0%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.0%	Pesticides/Herbicides	0	0.0%	0.0%	0.0%
Other Food and Beverage Packaging	8	0.2%	0.0%	0.4%	Cleaners (Hazardous)	0	0.0%	0.0%	0.0%
Non-food Packaging	3	0.1%	0.0%	0.2%	Medical waste	1	0.0%	0.0%	0.1%
Automotive Parts	4	0.1%	0.0%	0.3%	Other	9	0.2%	0.1%	0.4%
Other Glass/Composite Materials	7	0.2%	0.0%	0.4%	**OTHER MATERIALS**	**538**	**13.8%**		
METAL	**596**	**15.3%**			Tires/Auto Rubber Products	352	9.1%	2.7%	15.4%
Beverage Containers	189	4.8%	2.4%	7.3%	Rubber/Latex toiletries	1	0.0%	0.0%	0.0%
One-Time Fast Food Service Items	2	0.1%	0.0%	0.1%	Other Rubber/Latex products	4	0.1%	0.0%	0.2%
Other Food and Beverage Packaging	41	1.1%	0.3%	1.8%	Disposable diapers	13	0.3%	0.0%	0.6%
Non-food Packaging	44	1.1%	0.0%	2.3%	Textiles/Leather	67	1.7%	1.1%	2.3%
Automotive Parts	81	2.1%	0.9%	3.2%	Carpet	1	0.0%	0.0%	0.1%
Other Metals/Composite Materials	239	6.2%	3.9%	8.4%	Furniture/Mattresses/Appliances	0	0.0%	0.0%	0.0%
					Ceramics/Porcelain	0	0.0%	0.0%	0.0%
					Toys/Sporting goods	1	0.0%	0.0%	0.1%
					Miscellaneous/Other	99	2.5%	0.7%	4.4%
Total Tons	**3,889**	***Sample Count***		**27**					

Table H-17 Composition by Weight, Urban Interchanges

Calculated at a 90% confidence interval

	Tons	Mean %	Low %	High %		Tons	Mean %	Low %	High %
PAPER	**59**	**12.9%**			**ORGANIC**	**73**	**15.9%**		
Beverage Containers	0	0.1%	0.0%	0.1%	Food (Human And Pet)	3	0.6%	0.3%	0.9%
One-Time Fast Food Service Items	10	2.1%	1.9%	2.4%	Cigarettes and Other Tobacco	5	1.1%	0.3%	1.9%
Other Food and Beverage Packaging	2	0.4%	0.3%	0.5%	Other Organics	66	14.2%	10.5%	18.0%
Non-food Packaging	5	1.0%	0.2%	1.7%	**CDL**	**102**	**22.1%**		
Other Cardboard/Boxboard	27	5.8%	4.7%	6.9%	Wood/Lumber/Particleboard	80	17.4%	13.7%	21.1%
Paper Bags	2	0.4%	0.3%	0.5%	Mineral Aggregates	10	2.1%	0.2%	3.9%
Newspapers and Magazines	3	0.7%	0.5%	1.0%	Roofing	2	0.4%	0.1%	0.7%
Other Paper/Composite Materials	11	2.3%	1.7%	2.9%	Insulation	0	0.0%	0.0%	0.1%
PLASTIC	**62**	**13.4%**			Drywall	3	0.7%	0.0%	1.6%
Beverage Containers	4	0.8%	0.4%	1.2%	Other Construction/Demolition Debris	7	1.5%	0.2%	2.7%
One-Time Fast Food Service Items	2	0.5%	0.4%	0.6%	**HAZARDOUS MATERIALS**	**2**	**0.3%**		
Other Food and Beverage Packaging	2	0.4%	0.3%	0.5%	Latex paint	1	0.1%	0.0%	0.3%
Non-food Packaging	3	0.7%	0.1%	1.3%	Oil based paints	0	0.0%	0.0%	0.0%
Plastic Bags and Film	21	4.5%	3.7%	5.4%	Oil	0	0.0%	0.0%	0.0%
Automotive Parts	13	2.7%	1.7%	3.8%	Batteries	0	0.1%	0.0%	0.2%
Other Plastics/Composite Materials	17	3.8%	2.7%	4.8%	Flammable gas	0	0.0%	0.0%	0.0%
GLASS	**65**	**14.1%**			Flammable liquids	0	0.0%	0.0%	0.0%
Beverage Containers	59	12.9%	5.1%	20.7%	Explosives	0	0.0%	0.0%	0.1%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.0%	Pesticides/Herbicides	0	0.0%	0.0%	0.0%
Other Food and Beverage Packaging	0	0.0%	0.0%	0.0%	Cleaners (Hazardous)	0	0.0%	0.0%	0.0%
Non-food Packaging	0	0.0%	0.0%	0.0%	Medical waste	0	0.0%	0.0%	0.0%
Automotive Parts	3	0.6%	0.0%	1.3%	Other	0	0.1%	0.0%	0.2%
Other Glass/Composite Materials	3	0.6%	0.0%	1.2%	**OTHER MATERIALS**	**46**	**10.0%**		
METAL	**52**	**11.3%**			Tires/Auto Rubber Products	22	4.8%	2.3%	7.3%
Beverage Containers	6	1.2%	0.6%	1.8%	Rubber/Latex toiletries	0	0.0%	0.0%	0.0%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.0%	Other Rubber/Latex products	1	0.3%	0.1%	0.5%
Other Food and Beverage Packaging	1	0.1%	0.1%	0.2%	Disposable diapers	1	0.1%	0.0%	0.2%
Non-food Packaging	2	0.4%	0.0%	0.9%	Textiles/Leather	10	2.1%	1.8%	2.4%
Automotive Parts	20	4.4%	3.0%	5.8%	Carpet	1	0.2%	0.0%	0.5%
Other Metals/Composite Materials	24	5.1%	3.9%	6.3%	Furniture/Mattresses/Appliances	0	0.1%	0.0%	0.2%
					Ceramics/Porcelain	1	0.1%	0.0%	0.2%
					Toys/Sporting goods	0	0.0%	0.0%	0.0%
					Miscellaneous/Other	11	2.3%	0.5%	4.1%
Total Tons	**462**	***Sample Count***		**23**					

Table H-18 Composition by Weight, Non-urban Interchanges

Calculated at a 90% confidence interval

	Tons	Mean %	Low %	High %		Tons	Mean %	Low %	High %
PAPER	**11**	**7.1%**			**ORGANIC**	**27**	**17.3%**		
Beverage Containers	0	0.2%	0.0%	0.3%	Food (Human And Pet)	2	1.1%	0.6%	1.6%
One-Time Fast Food Service Items	3	1.8%	1.2%	2.4%	Cigarettes and Other Tobacco	1	0.8%	0.2%	1.3%
Other Food and Beverage Packaging	1	0.5%	0.4%	0.7%	Other Organics	24	15.4%	10.3%	20.5%
Non-food Packaging	1	0.5%	0.1%	0.9%	**CDL**	**27**	**17.4%**		
Other Cardboard/Boxboard	3	1.9%	1.3%	2.5%	Wood/Lumber/Particleboard	23	14.6%	11.4%	17.8%
Paper Bags	0	0.2%	0.1%	0.3%	Mineral Aggregates	1	0.9%	0.0%	2.2%
Newspapers and Magazines	1	0.7%	0.4%	1.0%	Roofing	1	1.0%	0.5%	1.4%
Other Paper/Composite Materials	2	1.2%	0.7%	1.7%	Insulation	0	0.1%	0.0%	0.2%
PLASTIC	**17**	**11.0%**			Drywall	1	0.6%	0.0%	1.2%
Beverage Containers	2	1.0%	0.4%	1.6%	Other Construction/Demolition Debris	0	0.3%	0.0%	0.7%
One-Time Fast Food Service Items	1	0.5%	0.4%	0.7%	**HAZARDOUS MATERIALS**	**1**	**0.9%**		
Other Food and Beverage Packaging	1	0.5%	0.3%	0.8%	Latex paint	0	0.0%	0.0%	0.0%
Non-food Packaging	4	2.5%	0.0%	5.5%	Oil based paints	0	0.0%	0.0%	0.0%
Plastic Bags and Film	4	2.3%	1.3%	3.2%	Oil	0	0.0%	0.0%	0.1%
Automotive Parts	2	1.3%	0.9%	1.7%	Batteries	0	0.0%	0.0%	0.0%
Other Plastics/Composite Materials	4	2.8%	2.0%	3.7%	Flammable gas	0	0.0%	0.0%	0.0%
GLASS	**20**	**13.0%**			Flammable liquids	0	0.0%	0.0%	0.0%
Beverage Containers	19	12.5%	4.7%	20.2%	Explosives	0	0.1%	0.0%	0.2%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.0%	Pesticides/Herbicides	0	0.0%	0.0%	0.0%
Other Food and Beverage Packaging	0	0.0%	0.0%	0.1%	Cleaners (Hazardous)	0	0.0%	0.0%	0.0%
Non-food Packaging	0	0.2%	0.0%	0.6%	Medical waste	0	0.0%	0.0%	0.0%
Automotive Parts	0	0.2%	0.0%	0.5%	Other	1	0.7%	0.1%	1.3%
Other Glass/Composite Materials	0	0.1%	0.0%	0.1%	**OTHER MATERIALS**	**33**	**21.0%**		
METAL	**19**	**12.4%**			Tires/Auto Rubber Products	22	14.4%	8.4%	20.5%
Beverage Containers	3	1.8%	0.8%	2.7%	Rubber/Latex toiletries	0	0.0%	0.0%	0.0%
One-Time Fast Food Service Items	0	0.0%	0.0%	0.0%	Other Rubber/Latex products	1	0.5%	0.0%	1.1%
Other Food and Beverage Packaging	0	0.2%	0.1%	0.2%	Disposable diapers	2	1.2%	0.0%	3.2%
Non-food Packaging	0	0.2%	0.0%	0.5%	Textiles/Leather	4	2.3%	1.5%	3.1%
Automotive Parts	10	6.3%	4.3%	8.3%	Carpet	1	0.5%	0.0%	1.0%
Other Metals/Composite Materials	6	4.0%	2.6%	5.4%	Furniture/Mattresses/Appliances	0	0.0%	0.0%	0.0%
					Ceramics/Porcelain	0	0.1%	0.0%	0.1%
					Toys/Sporting goods	0	0.0%	0.0%	0.0%
					Miscellaneous/Other	3	1.9%	0.3%	3.6%
Total Tons	**155**	***Sample Count***		**24**					

Appendix I: Statistical Methods for Comparing 1999 and 2004 Data

In order to determine whether observed differences were statistically significant, statistical analyses were performed to compare the 1999 and 2004 data. This appendix describes the statistical methods used to perform the comparisons.

TESTS

One-sided, paired t-tests were chosen as the best method of detecting significant differences to assess the change in total litter generation and in quantities of individual material types between 1999 and 2004. The main goal of the statistical analysis was to test for decreases in litter from 1999 to 2004 in order to measure the effectiveness of Ecology's Litter Campaign in changing the behavior of litterers.[87] In order to have the most statistical power to detect those differences, we chose one-sided t-tests. Two sided t-tests would have tests for both increases and decreases but the reduction in statistical power would have made it difficult to identify statistically significant decreases. Large increases were noted and, while they were not tested for statistical significance, they do suggest trends.

Because of the large site-to-site variability in accumulated total litter and in accumulation of individual components, paired t-tests were more powerful than standard t-tests. Anticipating the use of standard t-tests, to maintain a strong database for future analyses, and to best quantify litter accumulation in 2004, 11 sites were added in 2004 to adjust for construction reconfiguration or inaccessibility due to snow.[88] Despite the addition of these new sites, paired t-tests (which can only use sites sampled in both 1999 and 2004) were more powerful than standard t-tests (which can use all sites). The high variance between sites and the relative consistency of patterns between years could not have been predicted until the 2004 data came in. The 2004 data provides guidance for future studies – adding new sites is less beneficial than expected, and it appears worth some extra cost to resurvey the original set of sites in the next litter survey. In future surveys, the sites added in 2004 will be very useful for increasing the sample size of paired tests.

The distribution of observed differences in litter generation across all sites sampled in both study years was compared to the expected increase in litter generation from 1999 to 2004 (described below). If the observed difference was less than the expected difference, then it is possible that litter generation per mile driven in 2004 was less than in 1999. If the difference between the observed and expected litter generation was large enough – and the variability in observed differences between sites was small enough – then the change was labeled as statistically significant.

To compare intentional littering behavior in 1999 and 2004, the consultant team examined the number of glass, metal, and plastic beverage containers discarded during each study year. Since the litter samples were weighed, not counted, the data on these containers were reported by weight. To calculate a count of bottles from the weights, the statistician transformed the weight data into Bottle Equivalents (BE) by dividing the sample weight of each beverage

[87] Appendix G describes this campaign.

[88] Please refer to Appendix C for a list of all sites included in either the 1999 or 2004 study.

container material by the conversion factors in Table 4-1 to estimate the number of bottles or cans in each study year. One-sided paired t-tests were then conducted for all beverage containers and for the alcoholic beverage subset.

EXPECTED DIFFERENCE

The consultant team expected difference based on Department of Transportation data showing a relative increase in miles driven in Washington from 1999 to 2004. To apply the tests, it was assumed that littering behavior (or litter generation per mile driven) remained unchanged since 1999, and there should be an increase in litter accumulation in 2004, due to the increase in miles driven. This expected change was calculated uniquely for each season, for each road type, and for each material type.

For interstates and interchanges, the consultant team used the ratio of interstate miles driven in 2004 to interstate miles driven in 1999 (1.0856). For state routes, the ratio of miles driven on state roads (1.0747) was used. For county roads, the team calculated the average of the state and interstate ratios (1.0801)[89] and for tests looking at all roads combined, the ratio of all roads driven in 2004 to all roads driven in 1999 (1.0799).

To derive the expected difference, the consultant team multiplied one minus the mileage ratio calculated above by the average amount of material in question for all sites surveyed in 1999.

Units of expected difference and of observed difference are *pounds of litter per mile per year* for all waste types, except cigarettes, and for all three linear road types. Units of expected and observed difference for cigarettes and interchanges are in *pounds per square foot per year*.[90]

SIGNIFICANCE

The data analysis consisted of tests performed on sets of data, such as road types, material types, or all overall sample weight. Because different numbers of tests were performed on each data set, the consultant team used different values as cut-offs for statistical significance. The team selected these values, known as alpha levels, for each test such that the overall alpha level for each set of tests would be as close to 0.05 as possible. An alpha level of 0.05 means that the data give evidence against the null hypothesis that is so strong that it would happen no more than 5% of the time if the null hypothesis were true.[91] In this case, the null hypothesis is that no decrease in litter generation occurred between 1999 and 2004.

For overall litter generation, the consultant team conducted 15 tests, resulting in a per-test alpha level of 0.003. Therefore, to be statistically significant, the p-value of a test must be less than 0.003. The consultant team considered p-values between 0.003 and 0.05 to represent strong trends.

Tests on several individual components, including CDL, tires/auto rubber, cigarettes, all beverage containers, all alcoholic beverage containers, and fast-food containers, were

[89] Miles driven on county roads is not reported in the Washington State Department of Transportation Annual Traffic Report.

[90] Expected and observed changes for cigarettes and interchanges were analyzed using the units *pounds per square foot*, although the results are presented in Section 5.2 as *pounds per acre* so they are more easily understood.

[91] Moore, D. S., and George P. McCabe, 1993. *Introduction to the practice of statistics*. New York: W. H. Freeman and Company.

performed, as were tests on the Bottle Equivalents described above. Six tests on each of these components and the Bottle Equivalents, resulting in a per-test alpha level of 0.008 for each component material. P-values less than 0.008 are statistically significant; p-values between 0.008 and 0.05 are considered strong trends.

For beverage containers, the consultant team performed 18 tests, resulting in a per-test alpha level of 0.0027 for glass, metal, plastic beverage containers. P-values less than 0.0027 are statistically significant, while p-values between 0.003 and 0.05 are considered strong trends.

SITES NOT USED

If sites were not sampled both seasons in both 1999 and 2004, they were not included in the statistical comparisons. One additional site was excluded from the statistical analysis, Site OR-147, because data from the 1999 Winter/Spring sample was not included in the 1999 analysis.

RESULTS

Table I-1 and Table I-2 summarize the results of the paired t-tests performed for this study. Table 1 presents the results for overall litter generation on each road type, all road types combined, and interchanges. Table 2 lists the results for selected litter components, such as glass beverage containers.

For each material or group of materials listed in the tables, the top number is the expected difference. It is always positive, because it is based on the increase in miles driven. The middle number is the observed difference, which indicates the average change that was observed. It may be either positive or negative. The bottom number is the p-value, which serves as an index of the significance of the difference between the expected and observed differences, as described above.

Results for each material are given for the entire year and for the winter and summer seasons.[92] Samples were collected in the spring of 2004 and the fall of 2004, so the litter collected represents litter that accumulated in the winter of 2003-2004 and the summer of 2004, respectively.

Statistically significant decreases are pink dots; strong downward trends are blue stripes. Data for roads are presented in pounds per mile of road per year at the test sites, while data for interchanges and for cigarette butts are presented in pounds per square foot per year at these test sites.[93]

[92] The statistician tried a number of approaches to find meaningful differences in the data, and seasonal distinctions proved one of the more successful. Although not used in determining generation rates in 1999 or in 2004, sampling and data compilation were done seasonally in both study years. See Appendix B on sampling methodology.

[93] Since cigarette butts were cleaned from a subarea of the sample site, the generation rate for cigarette butts was expressed in units of area rather than distance.

Table I-1 Summary of Changes in Overall Litter Generation, 1999 to 2004

= statistically significant difference (p-value is less than 0.003)
= strong trend (p-value is greater than 0.003 and less than 0.05)

	All roadways combined (not interchanges)*		
Difference	**Both Seasons**	**Winter**	**Summer**
Expected	77.75	90.76	63.74
Observed	-266.96	-738.60	283.30
P-Value	**0.0700**	**0.0181**	**0.8706**

	Interstates*		
Difference	**Both Seasons**	**Winter**	**Summer**
Expected	188.50	214.90	161.12
Observed	348.78	-11.37	708.94
P-Value	**0.6877**	**0.3479**	**0.9563**

	State routes*		
Difference	**Both Seasons**	**Winter**	**Summer**
Expected	63.42	63.58	63.25
Observed	-112.11	-16.59	-211.61
P-Value	**0.1156**	**0.3079**	**0.1393**

	County roads*		
Difference	**Both Seasons**	**Winter**	**Summer**
Expected	43.53	59.82	26.64
Observed	-211.30	-442.21	28.84
P-Value	**0.0192**	**0.0119**	**0.5091**

	Interchanges‡		
Difference	**Both Seasons**	**Winter**	**Summer**
Expected	0.0002300	0.0002000	0.0002600
Observed	-0.0003700	-0.0008100	0.0000580
P-Value	**0.0182**	**0.0041**	**0.3150**

* Change in litter accumulation expressed in pounds per mile of road per year at selected test sites
‡ Change in litter accumulation expressed in pounds per square foot per year at selected test sites

Table I-2 Comparisons of Generation of Selected Litter Components in 1999 and 2004

= statistically significant difference (p-value is less than 0.003)
= strong trend (p-value is greater than 0.003 and less than 0.05)

		All roadways combined*			Interchanges‡		
	Difference	**Both Seasons**	**Winter**	**Summer**	**Both Seasons**	**Winter**	**Summer**
Glass Beverage	Expected	10.59	17.43	3.22	0.0000189	0.0000174	0.0000203
	Observed	-47.62	-80.47	-9.28	-0.0002122	-0.0002010	-0.0002228
	P-Value	**0.0006**	**0.0007**	**0.2105**	**0.0018**	**0.0074**	**0.0331**
Plastic Beverage	Expected	0.65	0.74	0.56	0.0000023	0.0000025	0.0000022
	Observed	4.89	3.12	6.96	0.0000101	0.0000123	0.0000080
	P-Value	**0.9681**	**0.8200**	**0.9455**	**0.9953**	**0.9827**	**0.9300**
Metal Beverage	Expected	1.43	1.81	1.02	0.0000029	0.0000030	0.0000028
	Observed	-0.68	-3.31	2.39	0.0000062	-0.0000006	0.0000127
	P-Value	**0.1973**	**0.0851**	**0.6651**	**0.6816**	**0.3483**	**0.8237**

= statistically significant difference (p-value is less than 0.008)
= strong trend (p-value is greater than 0.008 and less than 0.05)

		All roadways combined*			Interchanges‡		
All Beverage	Expected	12.67	19.97	4.80	0.0000241	0.0000229	0.0000253
	Observed	-43.40	-80.67	0.07	-0.0001959	-0.0001893	-0.0002021
	P-Value	**0.0025**	**0.0013**	**0.3996**	**0.0029**	**0.0109**	**0.0425**
CDL	Expected	11.37	10.21	12.62	0.0000422	0.0000323	0.0000525
	Observed	-120.08	-194.54	-33.21	-0.0002785	-0.0004627	-0.0001036
	P-Value	**0.0336**	**0.0545**	**0.1706**	**0.0019**	**0.0067**	**0.0637**
Tires/ Auto Rubber	Expected	13.35	17.57	8.80	0.0000206	0.0000228	0.0000182
	Observed	-102.50	-213.42	26.91	0.0000611	0.0000139	0.0001059
	P-Value	**0.0179**	**0.0088**	**0.7073**	**0.8023**	**0.4418**	**0.8800**
Cigarettes ‡	Expected	0.0000085	0.0000132	0.0000036	0.0000029	0.0000024	0.0000033
	Observed	-0.0001121	-0.0000634	-0.0001690	0.0000054	0.0000194	-0.0000079
	P-Value	**0.0873**	**0.0889**	**0.1741**	**0.5899**	**0.8829**	**0.2598**
Fast Food Containers	Expected	2.43	1.86	3.04	0.0000047	0.0000039	0.0000056
	Observed	-14.58	-9.11	-21.01	-0.0000186	-0.0000218	-0.0000156
	P-Value	**0.0129**	**0.1574**	**0.0136**	**0.0006**	**0.0115**	**0.0127**

= statistically significant difference (p-value is less than 0.003)
= strong trend (p-value is greater than 0.003 and less than 0.05)

		All roadways combined*			Interchanges‡		
Glass Alcoholic Beverage Containers	Expected	7.83	12.87	2.41	0.0000107	0.0000099	0.0000116
	Observed	-30.02	-45.61	-11.83	-0.0001164	-0.0000657	-0.0001646
	P-Value	**0.0034**	**0.0052**	**0.1722**	**0.0227**	**0.0680**	**0.0648**
Plastic Alcoholic Beverage Containers	Expected	0.05	0.09	0.02	0.0000001	0.0000001	0.0000001
	Observed	0.92	0.85	1.01	-0.0000009	-0.0000007	-0.0000012
	P-Value	**0.9421**	**0.8556**	**0.8698**	**0.0785**	**0.2308**	**0.1084**
Metal Alcoholic Beverage Containers	Expected	0.92	1.24	0.57	0.0000017	0.0000017	0.0000017
	Observed	-0.86	-2.92	1.53	0.0000065	0.0000001	0.0000126
	P-Value	**0.1575**	**0.0207**	**0.6230**	**0.8224**	**0.4029**	**0.9085**

= statistically significant difference (p-value is less than 0.008)
= strong trend (p-value is greater than 0.008 and less than 0.05)

		All roadways combined*			Interchanges‡		
All Alcoholic Beverage Containers	Expected	8.80	14.20	2.99	0.0000126	0.0000117	0.0000134
	Observed	-29.96	-47.68	-9.29	-0.0001109	-0.0000663	-0.0001532
	P-Value	**0.0034**	**0.0038**	**0.2193**	**0.0273**	**0.0761**	**0.0760**
Bottle equivalents, Alcoholic Beverage Container	Expected	46.21	67.03	23.79	0.0001688	0.0000772	0.0000800
	Observed	-71.23	-170.21	44.24	-0.0000335	-0.0001320	0.0000907
	P-Value	**0.0446**	**0.0036**	**0.5737**	**0.2495**	**0.2281**	**0.5124**
Bottle equivalents, All Beverage Container	Expected	77.62	104.48	48.71	0.0001688	0.0001715	0.0001661
	Observed	-37.23	-214.24	169.29	-0.0000335	-0.0002060	0.0001303
	P-Value	**0.1708**	**0.0383**	**0.7766**	**0.2495**	**0.1789**	**0.4682**

* Change in litter accumulation expressed in pounds per mile of road per year at selected test sites
‡ Change in litter accumulation expressed in pounds per square foot per year at selected test sites