

2015 Vancouver Litter Surveys

The City of Vancouver, BC

Prepared for

The City of Vancouver

Prepared by

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December 14, 2015

Project No. VAN_WAW1415_114



TABLE OF CONTENTS

EXECUTIVE SUMMARY	1
1.0 INTRODUCTION	3
1.1 Background	3
1.2 Objectives.....	4
2.0 METHODOLOGY.....	4
2.1 Site Selection Methodology.....	4
2.2 Litter Audit Summary.....	4
2.3 Survey Data Collection	5
2.4 Large Litter	5
2.5 Small Litter Data Collection.....	6
2.6 Supersite Data Collection.....	6
2.7 Photographic Record of the Site	6
3.0 SUMMARY OF LITTER RESULTS	8
3.1 Survey Results	8
3.2 Large Litter Results.....	8
3.2.1 Large Litter by Material Type.....	9
3.2.2 Large Litter by Category.....	10
3.2.3 Large Litter by Sub-Category	12
3.2.4 Large Litter by Sites.....	22
3.2.5 Other Cities Large Litter Comparison	24
3.2.6 Large Litter Statistical Analysis	25
3.3 Small Litter Results.....	25
3.3.1 Small Litter by Sites.....	26
3.3.2 Small Litter Comparison to Other Cities	28
3.3.3 Small Litter Statistical Analysis	31
3.4 Supersite Results.....	31
3.4.1 Supersites by Site.....	32
3.4.2 Vancouver to Other Cities Supersite Comparison	34
3.4.3 Supersite Litter Statistical Analysis	37
4.0 ADDITIONAL OBSERVATIONS.....	37
5.0 SITE RANKING AND ATTRIBUTES.....	38
6.0 CONCLUSIONS	39
6.1 Large Litter Conclusions	39
6.2 Small Litter Conclusions	40
6.3 Supersite Conclusions	40
7.0 RECOMMENDATIONS.....	40

LIST OF TABLES

Table 3.1 Top 20 Large Litter Items	9
Table 3.2 Large Litter totals by Category.....	11
Table 3.3 Large Litter Ranking 2015	23
Table 3.4 Vancouver Large Litter Comparison to Other Cities Percentages	24
Table 3.5 Vancouver Large Litter Comparison to Other Cities – Average Items/Site	24

Table 3.6 Small Litter Results 2015	26
Table 3.7 Small Litter Ranking 2015	27
Table 3.8 Vancouver Small Litter Comparison to Other Cities Percentage.....	28
Table 3.9 Vancouver Small Litter Comparison to Other Cities– Average Items/Site	29
Table 3.10 Supersite Results 2015.....	32
Table 3.11 Supersite Ranking 2015	33
Table 3.12 Supersite to Other Cities Comparison – Average Items/Site.....	35
Table 3.13 Supersite to Other Cities Comparison Percentage	36
Table 5.1 Combined Ranking for Combined Large and Small Litter.....	38
Table 5.2 Average Litter Per Site Based on Land Use.....	39

LIST OF FIGURES

Figure 1.1 Vancouver Litter Sites 2015.....	3
Figure 2.1 Photo of the Survey Sheet.....	7
Figure 2.2 Photo, Beginning of Site	7
Figure 2.3 Photo, Middle of Site.....	7
Figure 2.4 Photo, End of Site	7
Figure 3.1 Visual Assessment of Litter Sites	8
Figure 3.2 Large Litter by Material Type	10
Figure 3.3 Large Litter by Category Type 2015.....	11
Figure 3.4 Beverage Containers Composition 2015	12
Figure 3.5 Cups Composition 2015.....	13
Figure 3.6 Bags Composition 2015.....	14
Figure 3.7 Other Packaging (Boxes) Composition 2015	15
Figure 3.8 Other Containers Composition 2015.....	16
Figure 3.9 Take Out Extras Composition 2015	17
Figure 3.10 Confectionary/Snack Composition 2015	18
Figure 3.11 Other Miscellaneous Packaging Composition 2015	19
Figure 3.12 Paper/Fibre Materials Composition 2015	20
Figure 3.13 Other Miscellaneous Composition 2015	21
Figure 3.14 Additional Categories Composition 2015.....	22
Figure 3.15 Top 10 Large Litter Sites	23
Figure 3.16 Average Large Litter Items per Site per City.....	25
Figure 3.17 Top Small Litter Sites	27
Figure 3.18 Small Litter Averages for Other Cities	30
Figure 3.19 Cigarette Butts Surveyed in Small Litter Surveys	30
Figure 3.20 Supersite Locations.....	34
Figure 3.21 Cigarette Butts Surveyed in Supersite Litter Surveys.....	37
Figure 4.1 Street Litter Bin with Cage for Recyclable Material	38
Figure 4.2 Bus Stop Street Litter Bin.....	38

EXECUTIVE SUMMARY

The City of Vancouver contracted AET Group Inc. (AET) to conduct litter audits at 97 pre-selected locations within the public realm across the city. An additional 10 sites were randomly selected by the City to be added to the study. Three backup sites were selected in case pre-selected sites were not accessible. Overall 108 litter sites were surveyed for small and large litter. The audits were initially scheduled to be conducted from August 31st –September 4th 2015 with the purpose of assessing the composition and amount of litter present on Vancouver streets. Due to a large storm, litter surveys were postponed then completed during the days of September 14th to the 17th, 2015. Supersite surveys were also completed on 19 randomly selected sites.

During the study period AET staff examined large and small litter within the 108 sites across the City of Vancouver. The methodology used in this litter audit was similar to that used by other major cities including Toronto, Winnipeg, Edmonton and San Francisco. AET visually assessed the litter within these 108 locations and recorded the type and size of litter. For purposes of classifying litter, and in accordance with the methods used in previous litter surveys, large litter is defined as being greater than 4 square inches in size and small litter is smaller than 4 square inches. The small litter audit involves examining three segments, or slices taken through the audit site. Additionally, 19 of the 108 sites were randomly selected as “supersites”, where further examination of small litter was conducted across the entire site.

Key findings from the large litter audits:

- The average number of large litter items per site was 12.04. The amount of large litter is similar to other cities, which range from 11.20 to 34.00 large litter items per site
- The total number of large litter items surveyed is 1300.50
- The number of sites with no large litter recorded was 7 sites
- The most common category of large litter items was paper/fiber materials (primarily comprised of napkins, receipts and printed materials) representing 23.95% of the large litter found. The second most common category of items was cups (hot and cold cups as well as cup lids and pieces) which comprised 21.8% of the large litter items.
- The most commonly found item in the large litter audit was non-brand towels/napkins which represents 11.76% of all large items audited, followed by cup lids and pieces, which represented 10.46% of all large items audited.

Key findings from the small litter audits:

- The average number of small litter items per site was 7.29. The amount of small litter is less than other cities which range from 8.10 to 25.50 pieces per site.
- The most commonly found small litter item was cigarette butts, accounting for 30.88% of all small litter audited, followed by chewing gum at 29.35%

Key findings from the supersite audits:

- The average number of small litter items per supersite was 269.58. The amount of small litter was less than other cities. The City of Toronto averaged 1294 small litter pieces per supersite in 2006. San Francisco averaged 341 pieces of small litter per supersite in 2009, but it should be noted that they did not include a count of chewing gum deposits.
- The most commonly found small litter item was chewing gum accounting for 48.32% of all small litter audited, followed by cigarette butts/debris at 37.54%

1.0 INTRODUCTION

1.1 Background

The City of Vancouver contracted AET Group Inc. (AET) to conduct litter audits at 97 pre-selected locations within the public realm across the city. An additional 10 sites were randomly selected by the City to be added to the study. Three backup sites were selected in case pre-selected sites were not accessible. This was the case for site #29, as site #98 was used as a replacement. Site #100 was also audited. Overall, 108 litter sites were surveyed with the purpose of assessing the composition and amount of litter present on Vancouver streets. The type of litter was classified into two size categories: large litter, which is equal to or larger than four square inches, and small litter, which is smaller than four square inches.

The audits were initially scheduled to be conducted from August 31st – September 4th 2015. Due to a storm, litter surveys were postponed then completed from September 14th to 17th, 2015. Additionally, 19 of the 108 sites were randomly selected as “supersites”, where further examination of small litter was conducted across the entire site.

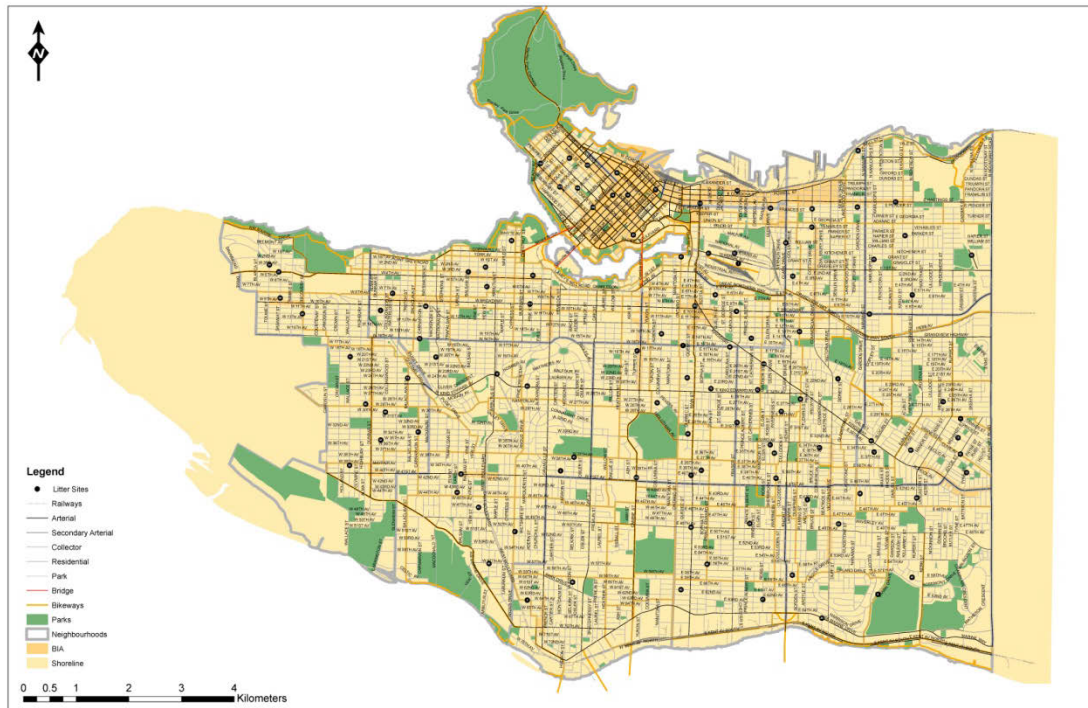


Figure 1.1 Vancouver Litter Sites 2015

1.2 Objectives

The litter audits were conducted to assess the amount and type of litter within the City of Vancouver, and included:

- A detailed analysis of large litter items that fall within the survey areas;
- A detailed analysis of small litter items that fall within the smaller subsections of the survey areas;
- A detailed analysis of small litter items as supersites that fall within the survey areas; and
- Analysis and reporting of the results with a focus on a comparison between previously completed audits for other cities.

2.0 METHODOLOGY

2.1 Site Selection Methodology

To select sites for the City of Vancouver Litter Audit, a geographical information system (GIS) database for the City of Vancouver was provided. Using GIS software, AET used all Vancouver's center-line coordinates for all potential public street locations within the boundary of the city. Inputting these data coordinates; AET used a computer sample generator program to randomly select 125 potential litter audit sites. These data points were then plotted on computer generated maps using GIS software, and detailed locations identified. After the litter audit locations were selected, locations were eliminated due to proximity to another litter site, active construction, land use, and road type until 97 sites were selected. Three back-up sites were selected in case a selected site was inaccessible. At City of Vancouver's request, an additional 10 sites were randomly selected within areas of Vancouver where the City spends much of its street cleaning time and effort. A total of 108 sites were surveyed.

This audit did not assess street cleanliness within areas of atypical street infrastructure such as separated bikeways, street closures and the seawall, as the litter audit methodology used by other jurisdictions would not provide a useful measure for these sites; rather a separate litter audit methodology will be developed for these type of sites for use in future audits.

2.2 Litter Audit Summary

The litter audit was conducted by surveying 108 pre-selected locations as per the methodology outlined above. Two teams of two AET staff were assigned to complete the audits within the one week time period. AET staff were responsible for observing accumulated litter and recording data for the classification of large litter, the classification of small litter and

background information for each of the 108 sites. Audit sites were typically 61 m (200 feet) long, and up to a maximum of 5.5 m (18 feet) wide. Audit site width was measured starting from 0.5 m (1.5 feet) into the street from the curb line, and extended back to either the private property line, or to a maximum of 5.5m. The methodology used in the 2015 litter audit was the same methodology used in previous audits completed in other cities. There are 120 large litter sub-categories and 26 small litter categories. More information about methodology can be found in Appendix C.

2.3 Survey Data Collection

AET staff completed the Site Surveyor Form provided by the City of Vancouver for each of the assigned 108 sites. The following information was recorded on these forms:

- Date and time
- Audit team
- Site ID and location
- Size of audit area
- Type and characteristics of adjacent road
- General attributes of the area
- Visual rating of site
- GPS Coordinates

The forms can be found in Appendix D.

GPS coordinates taken with a handheld Garmin GPS unit were also recorded for each site. Data from the Site Surveyor Forms were transferred to an Excel worksheet. Site location details can be found in Appendix A.

2.4 Large Litter Data Collection

After the site was measured and information about the site was recorded, an AET staff member completed the Large Items Count form. After two passes of the site were completed, information about the type of litter present within the study area was recorded. For purposes of classifying litter, and in accordance with the methods used in previous litter surveys, large litter is defined as being greater than 4 square inches in size. To assist the field teams with determining the litter sizes, each audit team will be provided with three templates of 4 square inches in rectangle, square and round shape form. This data was then transferred to an Excel worksheet. In the worksheet, the total amount of large litter at each site was calculated as the average of the two passes. Large litter collection data can be found in Appendix E.

2.5 Small Litter Data Collection

Results from the small litter audits were recorded on the Small Litter Count Sheet by AET staff after the site was measured, and information about the site was recorded. Data from each of the 108 sites was transferred into an Excel worksheet, results of which can be found in Appendix F. To be consistent with the audit methodology used by other municipalities, the small litter audit involves examining three segments, or slices taken through the audit site. Three successive “flips” of a one foot by 6 foot frame was completed crossing the site up to the 18 foot boundary of the site. The total site audit area audited for small litter is approximately 54 ft², or approximately 1.5% of a typical audit site. The litter auditor also observed and counted all the small litter contained within the frames at three locations within each site: at the start, mid-point and end of the site.

2.6 Supersite Data Collection

Results from the supersite audits were recorded on the Supersite Count Sheet by AET staff after the site was measured, and information about the site was recorded. Data from each of the 19 sites was transferred into an Excel worksheet, results of which can be found in Appendix G. Supersites were used to determine the overall small litter that was present at each of the 19 pre-determined sites. The entire site was surveyed for small litter within each supersite.

2.7 Photographic Record of the Site

At each site location, the litter audit team took digital photographs. One shot was taken at the start of the site, looking towards the end of the site away from the vehicle. The second shot was taken in the mid-point of the site looking across the width of the site toward the boundary. And the final photograph was taken at the end of the site – looking back towards the start of the site. The purpose of the photographs is to set the scene of the site but not to detail litter on the ground. Figures 2.1-2.4 below illustrate the photographic record made at each site.

Site Surveyor Form – Large Items and Branded Litter Count

Date: 08/19/2015 (DD/MM/YYYY) Start Time: 7:37 (AM/PM) End Time: _____

Team ID: A Surveyors Names: Klavissa and Kelly

Site ID Number: 79 Site Name: 2019 Ave East

Site Description (hundred block, street, side street, etc)
Hundred Block: 2019 Street Name: 2019 Ave East Side of Street (NS/E)

GPS Location of Centre of Site: _____

Site type: Fixed Variable Site length: Always 200 feet long

If variable:
Width 1 - Start: 15.5 ft. (up to 18ft.)
Width 2 - Middle: 15.5 ft. (up to 18ft.)
Width 3 - End: _____ ft. (up to 18ft.)

Road type (check one): Major City Street Minor City Street Laneway

Is roadway divided: Y (N)

Number of Lanes: 2 4 6 Other (explain): But cars parked to

Area Attributes: _____

Figure 2.1 Photo of the Survey Sheet

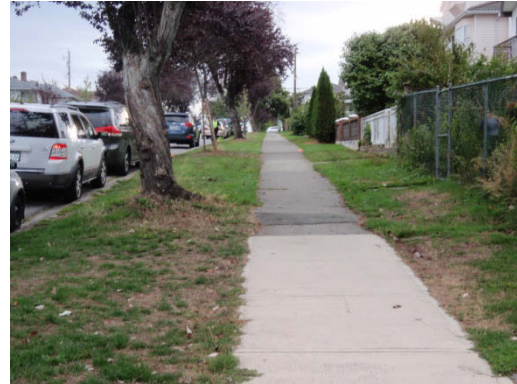


Figure 2.2 Photo, Beginning of Site



Figure 2.3 Photo, Middle of Site

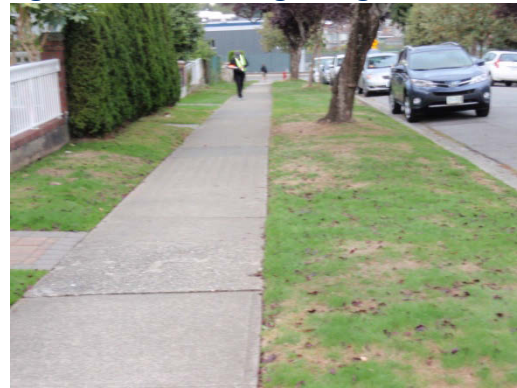


Figure 2.4 Photo, End of Site

3.0 SUMMARY OF LITTER RESULTS

3.1 Survey Results

During the audits, AET staff collected information about the roads adjacent to the audit sites. AET staff completed a visual rating for each site based on the amount of litter visible. The sites were rated on a scale from 1-4, 1 representing the cleanest sites with less than 5 pieces of litter visible, and 4 representing the dirtiest sites with greater than 20 pieces of litter visible. A chart illustrating the visual ratings of all audit sites can be seen below in Figure 3.1.

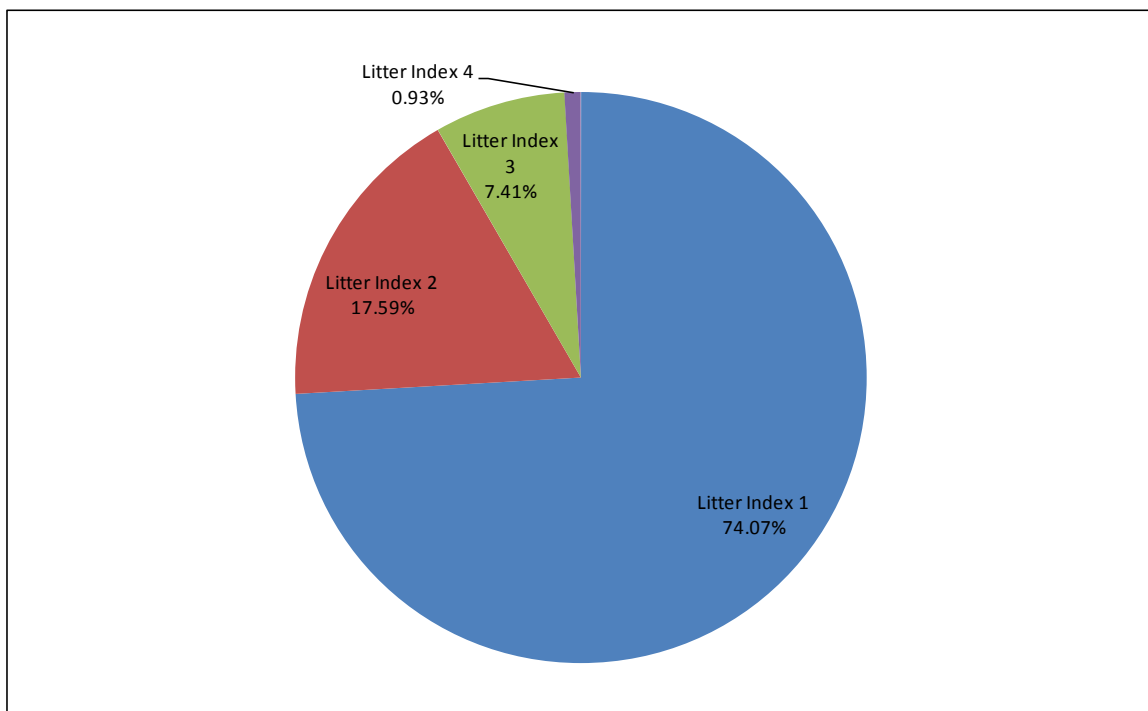


Figure 3.1 Visual Assessment of Litter Sites

3.2 Large Litter Results

Large litter is any piece of litter within the site that is equal to or greater than 4 square inches. The average amount of large litter found at each site is 12.04 pieces.

The most common type of large litter found was Non-Brand Towels/ Napkins which represent 11.76% of the large litter items surveyed.

Table 3.1 illustrates the 20 most common items of large litter found during the audit. These items account for 77.43% of the large litter identified. The complete list of all the items identified during the large litter audit can be found in Appendix E.

Table 3.1 Top 20 Large Litter Items

#	Large Litter Items	2015 Count	2015 Percent	Acc. %
1	Non-Brand Towels/Napkins	153.0	11.76%	11.76%
2	Cup Lids, Pieces	136.0	10.46%	22.22%
3	Misc. Plastic	98.0	7.54%	29.76%
4	Misc. Paper	87.0	6.69%	36.45%
5	Receipts (business forms, bus tickets)	75.0	5.77%	42.21%
6	Paper Cups (hot)	67.0	5.15%	47.37%
7	Printed Material	66.5	5.11%	52.48%
8	Plastic Drink Cups	42.0	3.23%	55.71%
9	Tobacco other	40.0	3.08%	58.79%
10	Misc. Cardboard	33.0	2.54%	61.32%
11	Snack Food Packaging	29.5	2.27%	63.59%
12	Paper Cups (cold)	28.0	2.15%	65.74%
13	Paperboard (boxboard)	27.0	2.08%	67.82%
14	Paper Food Wrap	21.0	1.61%	69.43%
15	Gum Wrappers	18.0	1.38%	70.82%
16	Clothing or Clothing Pieces	18.0	1.38%	72.20%
17	Plastic Packaging Other	18.0	1.38%	73.59%
18	Candy Bar Wrappers	17.0	1.31%	74.89%
19	Stationary (school, business etc.)	17.0	1.31%	76.20%
20	Paper Beverage Cases/Sleeves	16.0	1.23%	77.43%
Total Top 20		1007.0	77.43%	
Total - All Litter		1300.5	100.00%	

3.2.1 Large Litter by Material Type

Items within the large litter categories are composed of different material types. These items were categorized based on their known composition, including: paper, plastic, composite (made of multiple materials), metal, glass and other. Figure 3.2 illustrates the most common material types of the 1,300.50 large litter items observed. Paper is the largest material type representing 49.90% of the items observed. Plastic is the second largest material type at 29.91%. Other is the third largest type representing 15.46% of the items observed. This includes cloth, tobacco, and items such as food and road debris.

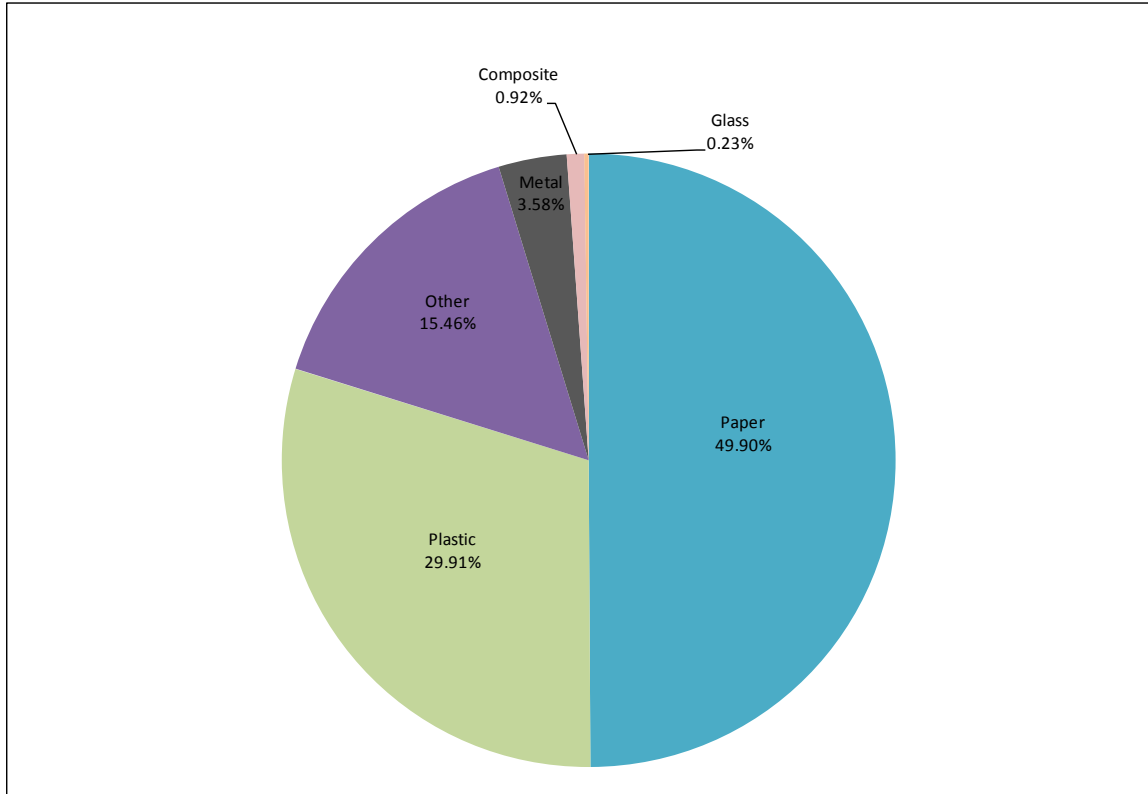


Figure 3.2 Large Litter by Material Type

3.2.2 Large Litter by Category

Table 3.2 provides a summary of the total amount of large litter observed by each of the 15 categories used for the analysis of the large litter items. The three most common categories of litter audited in 2015 are paper/fibres materials, cups, and other miscellaneous. Miscellaneous litter includes items such as miscellaneous paper and plastic.

Table 3.2 Large Litter totals by Category

Category	Items	Percent
Beverage Containers	16.0	1.23%
Other Packaging	7.0	0.54%
Cups	284.0	21.84%
Bags	54.5	4.19%
Other Packaging (boxes)	55.0	4.23%
Other Containers	17.0	1.31%
Food Wraps/ Containers	37.0	2.85%
Take Out Extras	34.5	2.65%
Trays	8.0	0.62%
Confectionary/Snack	77.5	5.96%
Cloth	32.0	2.46%
Other Miscellaneous Packaging	26.0	2.00%
Paper/ Fibre Material	311.5	23.95%
Tobacco Products	49.0	3.77%
Other Miscellaneous	259.5	19.95%
Additional Categories	32.0	2.46%
Total	1,300.5	100.00%

Figure 3.3 provides a comparison of each of the categories in the Large Litter audit.

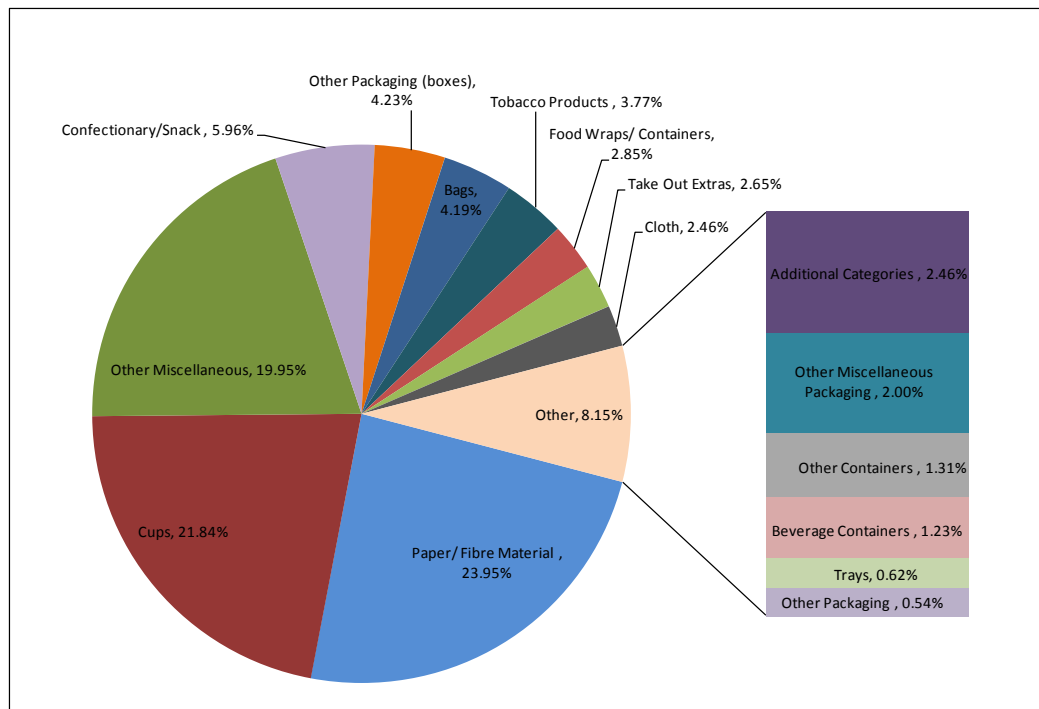


Figure 3.3 Large Litter by Category Type 2015

3.2.3 Large Litter by Sub-Category

Beverage Containers

Beverage containers account for 1.23% of the overall large litter found in the 2015 litter surveys. The largest contributor to the beverage container category is water bottles (plastic) at 25.00%, followed by juice (plastic) and milk-milk-type beverage (plastic) which both represent 18.75% of the beverage container category. Figure 3.4 illustrates the overall composition of beverage containers.

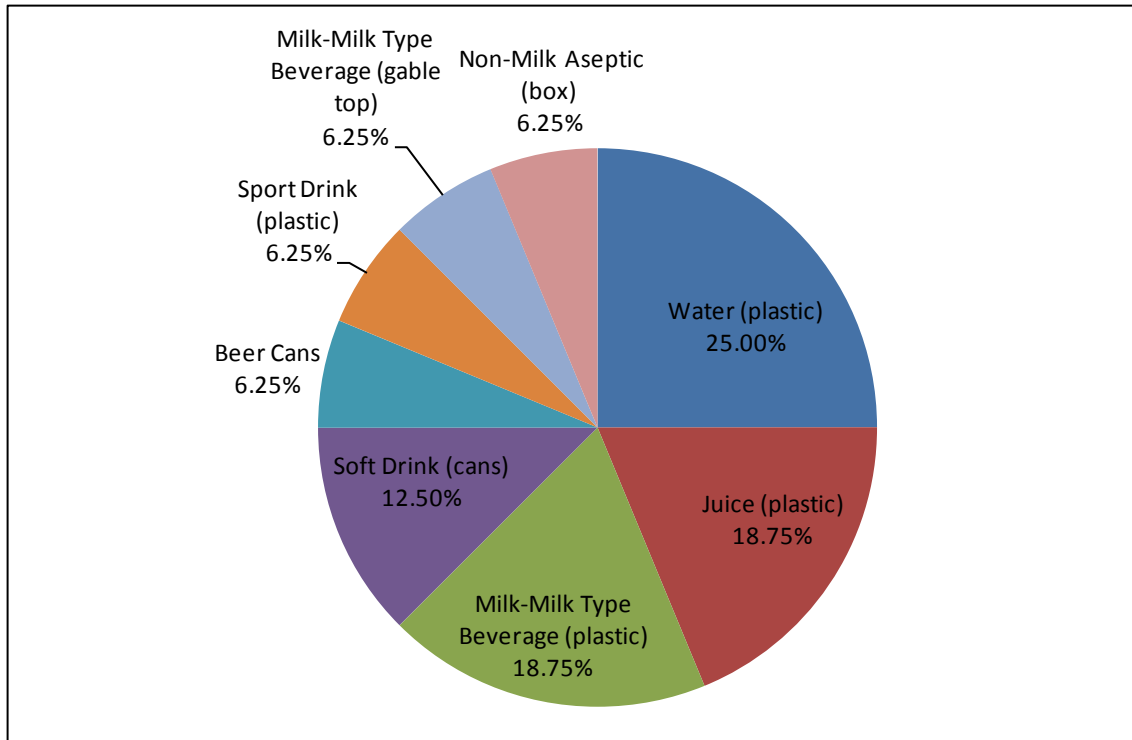


Figure 3.4 Beverage Containers Composition 2015

Other Packaging

Other packaging accounts for 0.54% of the overall large litter items surveyed for the City of Vancouver in 2015. Foil containers and foil pouches account for 100% of the other packaging category representing 85.71% and 14.29% respectively.

Cups

Cups account for 21.84% of the overall large litter found in the 2015 litter surveys. The largest contributor to the cups category is cup lids, pieces at 47.89%, followed by paper cups (hot) which represent 23.59% of the cups category. Figure 3.5 illustrates the overall composition of cups.

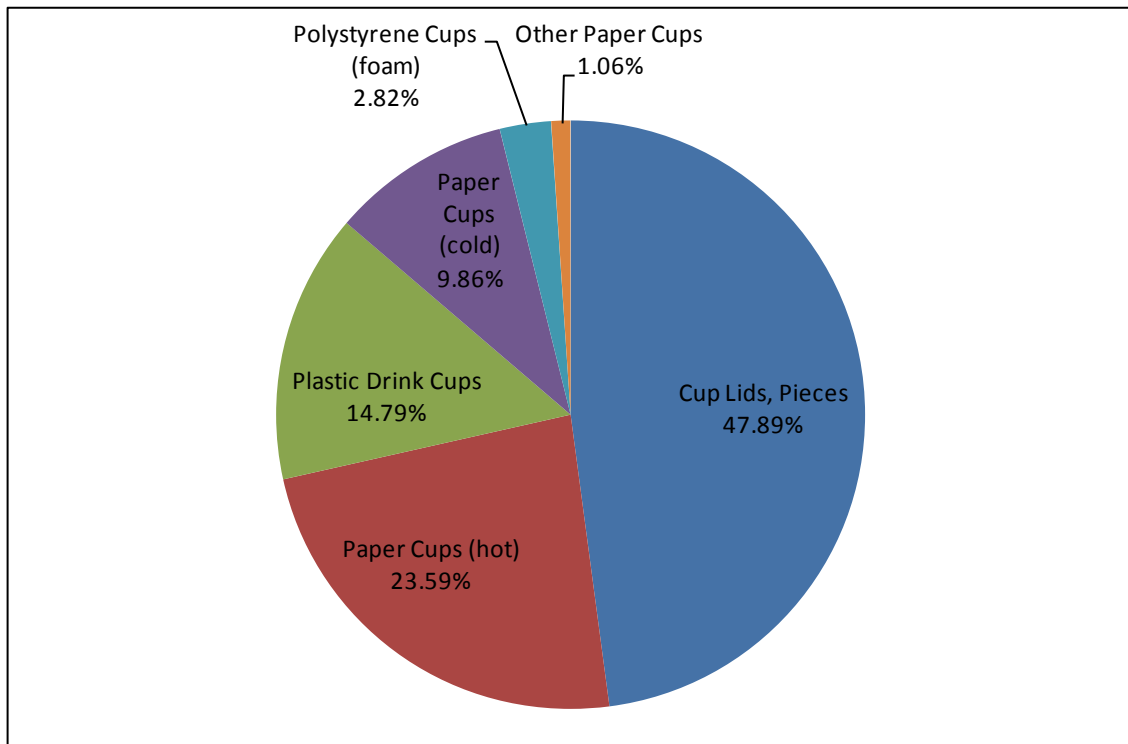


Figure 3.5 Cups Composition 2015

Bags

Bags account for 4.19% of the overall large litter found in the 2015 litter surveys. The largest contributor to the bags category is zipper bags/sandwich bags at 25.69%. Plastic retail bags & grocery, and paper bags-fast food also account for a significant portion of the bags category representing 23.85% and 21.10% respectively. Figure 3.6 illustrates the overall composition of bags.

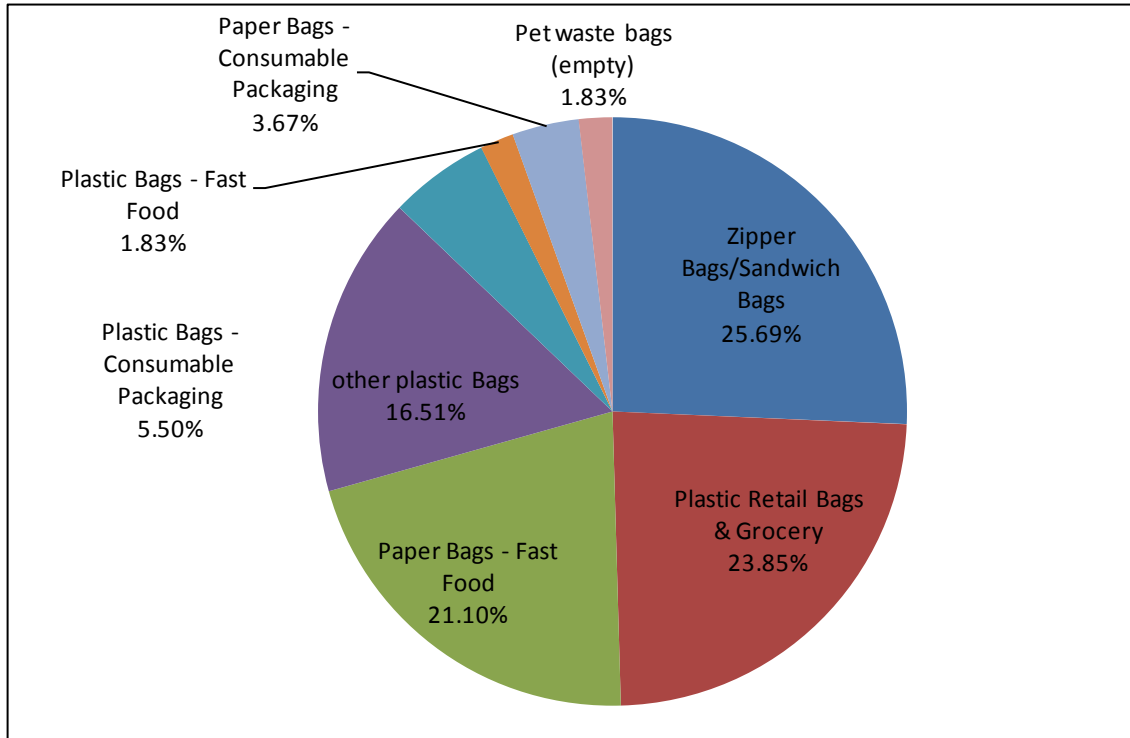


Figure 3.6 Bags Composition 2015.

Other Packaging (Boxes)

Other Packaging (Boxes) account for 4.23% of the overall large litter found in the 2015 litter surveys. The largest contributor to the other packaging (boxes) category is paperboard (boxboard) at 49.09%. Figure 3.7 illustrates the overall composition of other packaging (boxes).

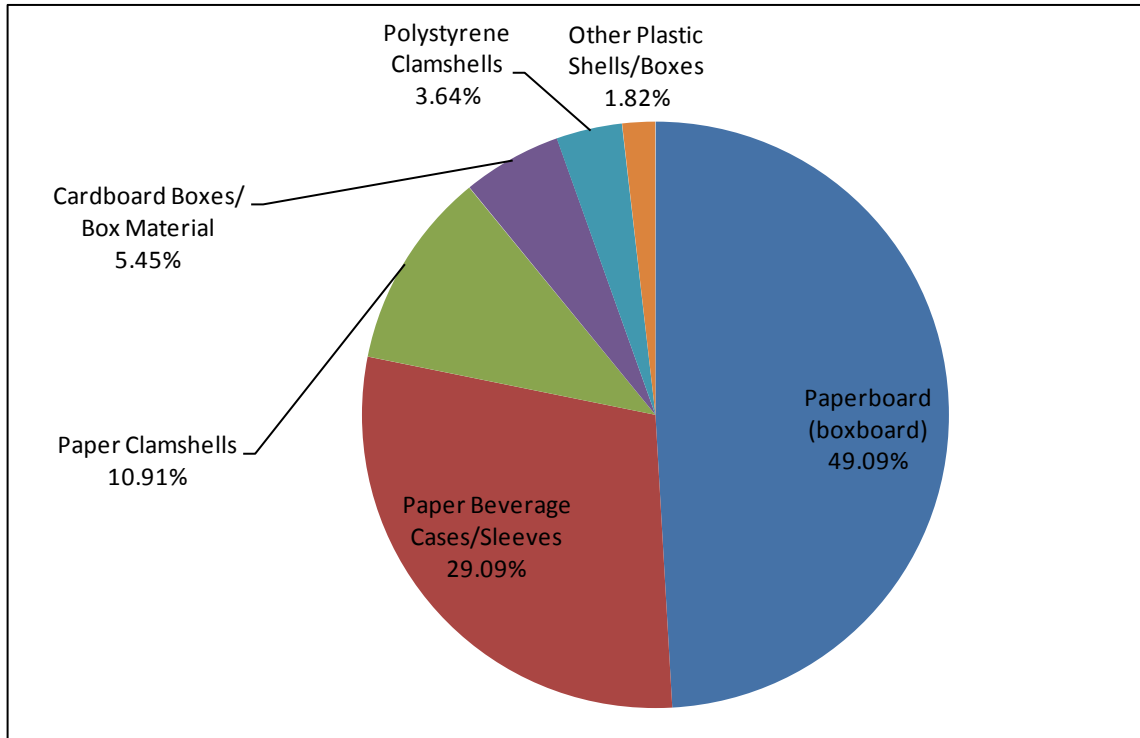


Figure 3.7 Other Packaging (Boxes) Composition 2015

Other Containers

Other containers account for 1.31% of the overall large litter found in the 2015 litter surveys for the City of Vancouver. The largest contributor to the other containers category is plastic jars/bottles/lids at 47.06%. Figure 3.8 illustrates the overall composition of other containers.

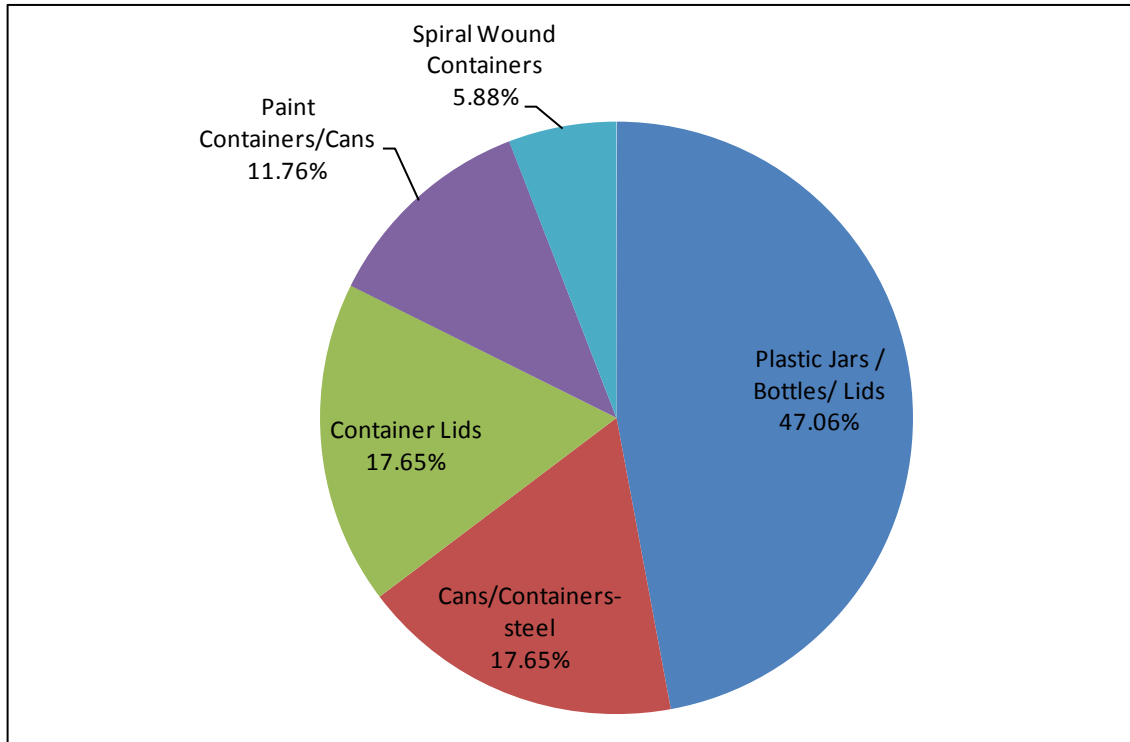


Figure 3.8 Other Containers Composition 2015

Food Wraps/ Containers

Food wraps/containers accounts for 2.85% of the overall large litter items surveyed for the City of Vancouver in 2015. Paper food wrap, plastic wrap, and paper/foil composite wrap account for 100% of the food wraps/containers category representing 56.76%, 27.03% and 16.22% respectively.

Take out Extras

Take out extras account for 2.65% of the overall large litter found in the 2015 litter surveys for the City of Vancouver. The largest contributor to the take out extra category is condiment packaging at 31.88% followed by utensils at 20.29%. Figure 3.9 illustrates the overall composition of take out extras.

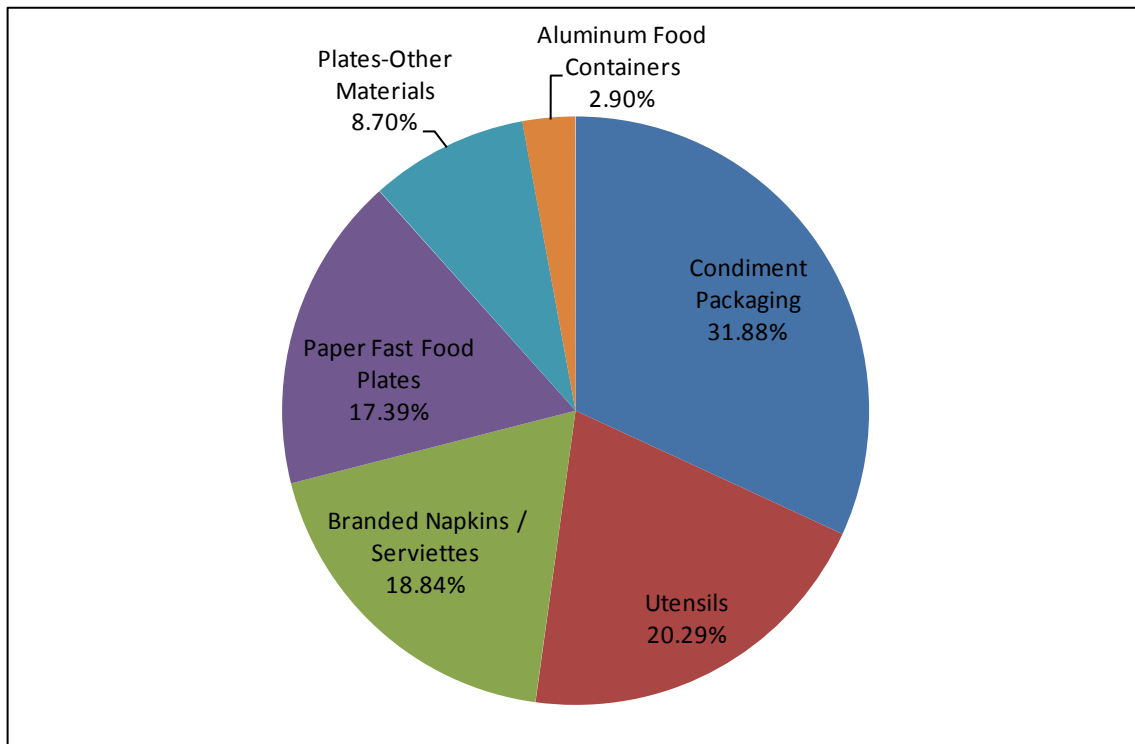


Figure 3.9 Take Out Extras Composition 2015

Trays

Trays account for 0.62% of the overall large litter items surveyed for the City of Vancouver in 2015. Polystyrene trays and paper trays account for 100% of the trays category representing 87.50% and 12.50% respectively.

Confectionary/Snack

Confectionary/snack accounts for 5.96% of the overall large litter found in the 2015 litter surveys. The largest contributor to confectionary/snack category is snack food packaging at 38.06% followed by gum wrappers and candy bar wrappers which represent 23.23% and 21.94% respectively. Figure 3.10 illustrates the overall composition of the confectionary/snack category.

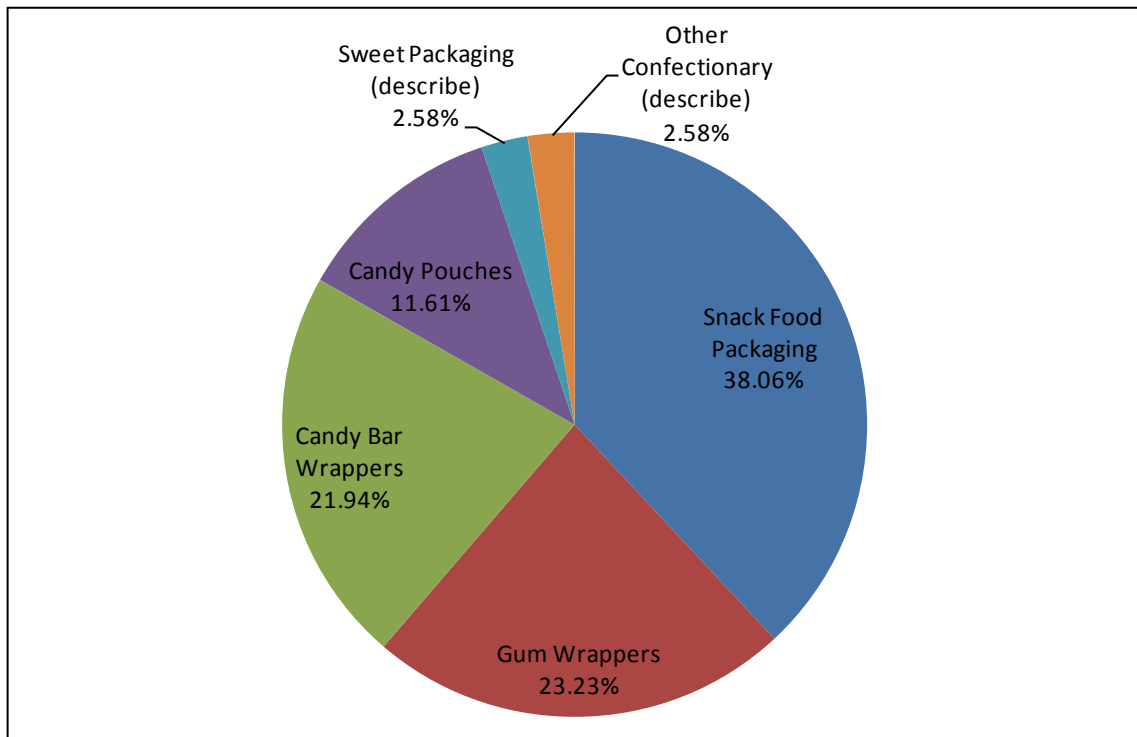


Figure 3.10 Confectionary/Snack Composition 2015

Cloth

Cloth accounts for 2.46% of the overall large litter items surveyed for the City of Vancouver in 2015. Clothing or clothing pieces and other cloth account for 100% of the cloth category representing 56.25% and 43.75% respectively.

Other Miscellaneous Packaging

Other miscellaneous packaging accounts for 2.00% of the overall large litter found in the 2015 large litter surveys. The largest other miscellaneous packaging sub-category is plastic packaging other at 69.23%. Figure 3.11 illustrates the overall composition of the other miscellaneous packaging category.

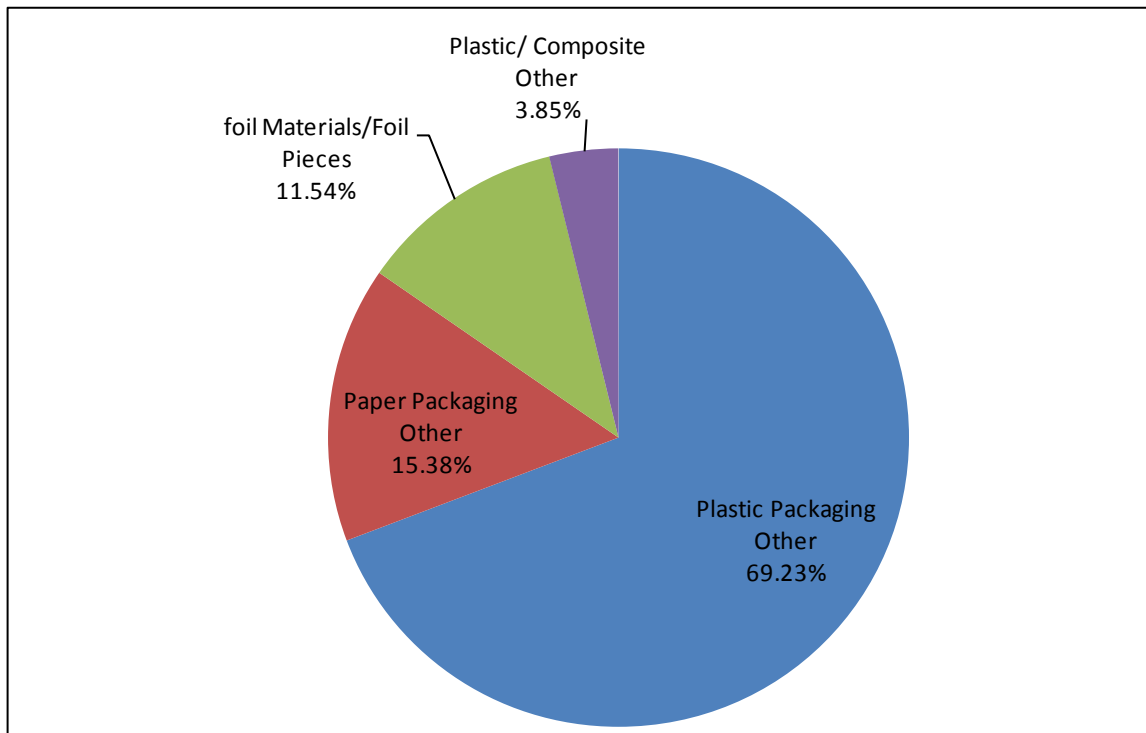


Figure 3.11 Other Miscellaneous Packaging Composition 2015

Paper/Fibre Materials

Paper/Fibre materials account for 23.95% of the overall large litter found in the 2015 large litter surveys. The largest paper/fibre sub-category is non-brand name towels/napkins at 49.12%, followed by receipts which represent 24.08%. Figure 3.12 illustrates the overall composition of the paper/fibre category.

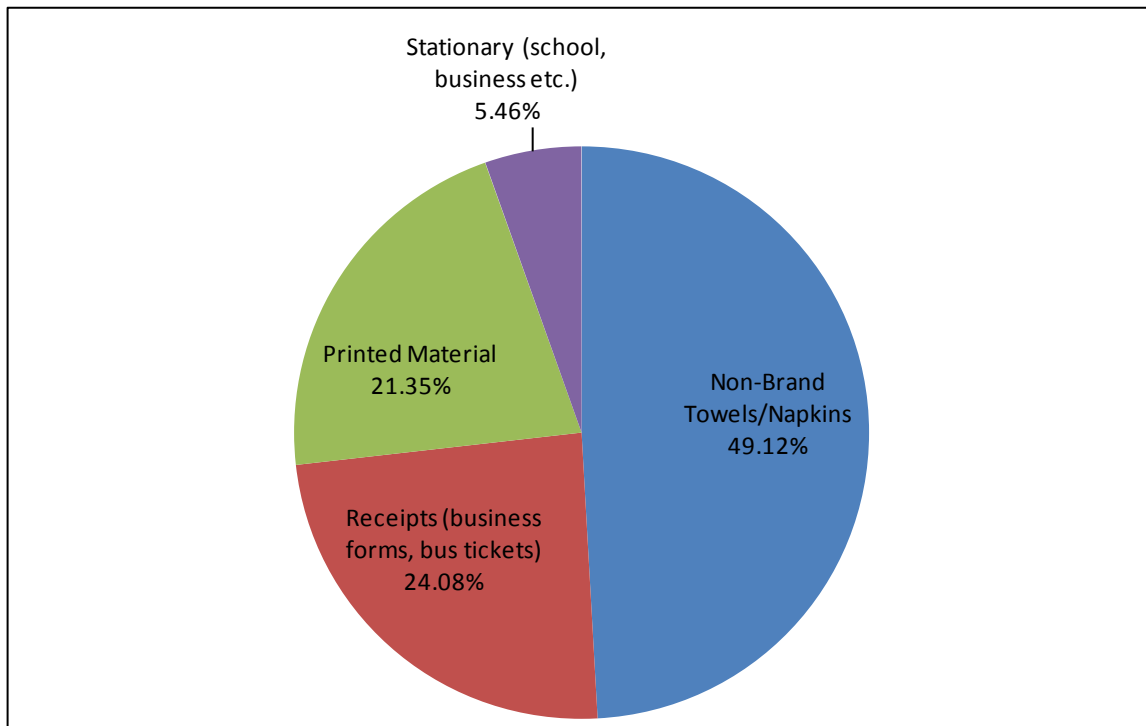


Figure 3.12 Paper/Fibre Materials Composition 2015

Tobacco Products

Tobacco Products account for 3.77% of the overall large litter items surveyed for the City of Vancouver in 2015. Tobacco other and cigarette/cigar debris account for 100% of the tobacco products category representing 81.63% and 18.37% respectively.

Other Miscellaneous

Other miscellaneous accounts for 19.95% of the overall large litter found in the 2015 large litter surveys for the City. The largest other miscellaneous sub-category is miscellaneous plastic at 37.76%, followed by miscellaneous paper at 33.53%. Figure 3.13 illustrates the overall composition of the other miscellaneous category.

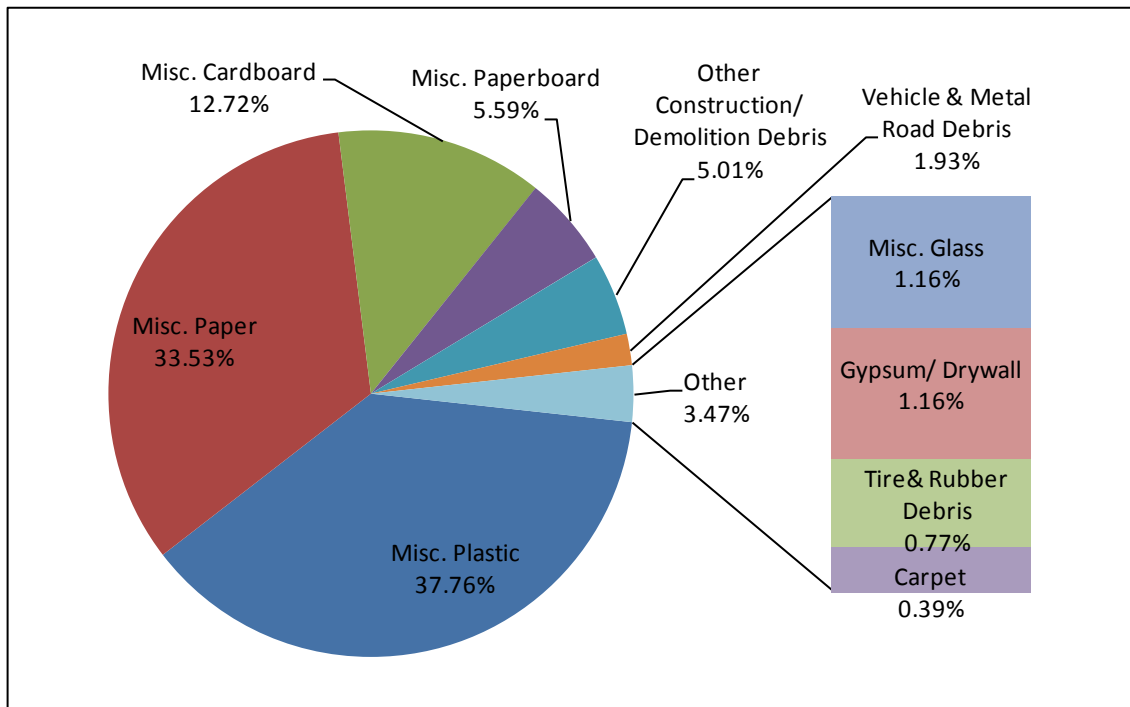


Figure 3.13 Other Miscellaneous Composition 2015

Additional Categories

Additional categories accounts for 2.46% of the overall large litter found in the 2015 large litter surveys for the City of Vancouver. Additional categories are categories that were added by the city that are not represented in other cities large litter surveys. The largest additional category sub-category is home articles other at 37.50%. The second largest contributor is food waste which represents 31.25% of the additional categories. Figure 3.14 illustrates the overall composition of the other additional categories.

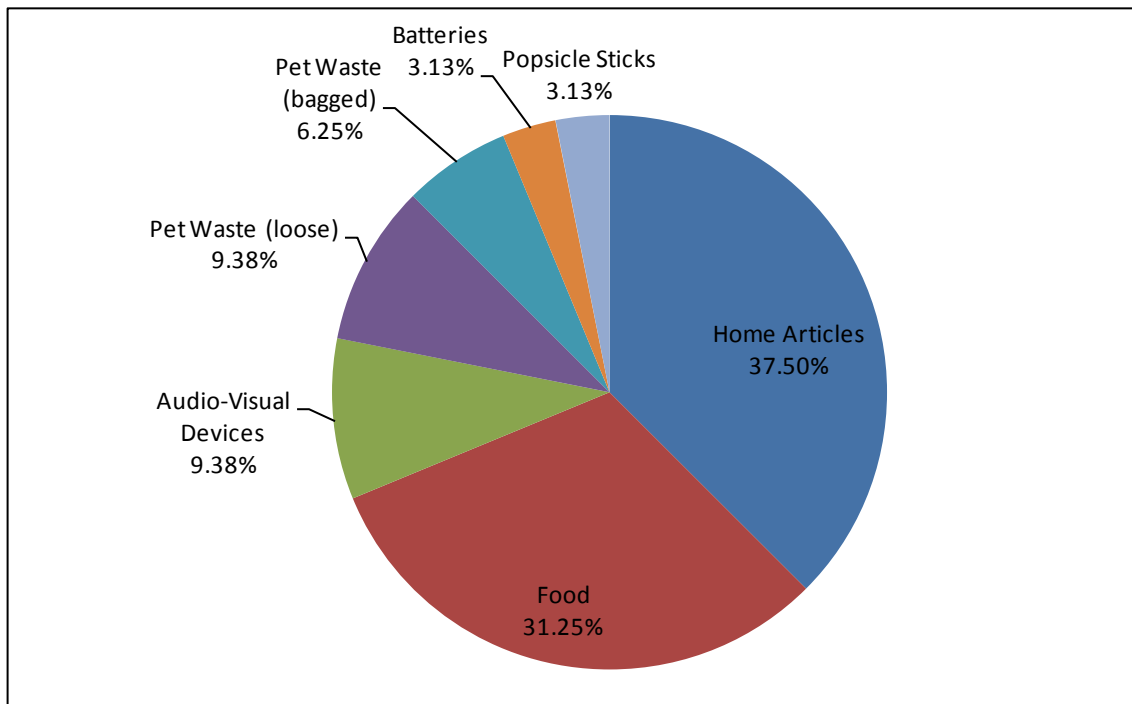


Figure 3.14 Additional Categories Composition 2015

3.2.4 Large Litter by Sites

Table 3.3 illustrates the 10 sites with the highest item counts for large litter in 2015. Site #41 had the highest amount of Large Litter with 115 pieces audited. The majority of the sites with the most amount of large litter were commercial sites, with the exception of site #40, and #44 which were residential. Figure 3.15 below illustrates the locations of the top 10 litter sites.

Table 3.3 Large Litter Ranking 2015

Site #	Lg Litter	Hundred Block	Street Name
41	115.0	300	Terminal Avenue
97	65.0	800	Commercial Drive
89	45.0	6500	Main Street
40	44.5	40	East 1st Avenue
76	44.0	700	East 30th Avenue
70	43.5	2400	East Broadway
44	41.0	2800	Woodland Drive
60	41.0	7200	Dumfries Street
16	31.0	3800	East Boulevard
92	30.0	2200	East Pender Street

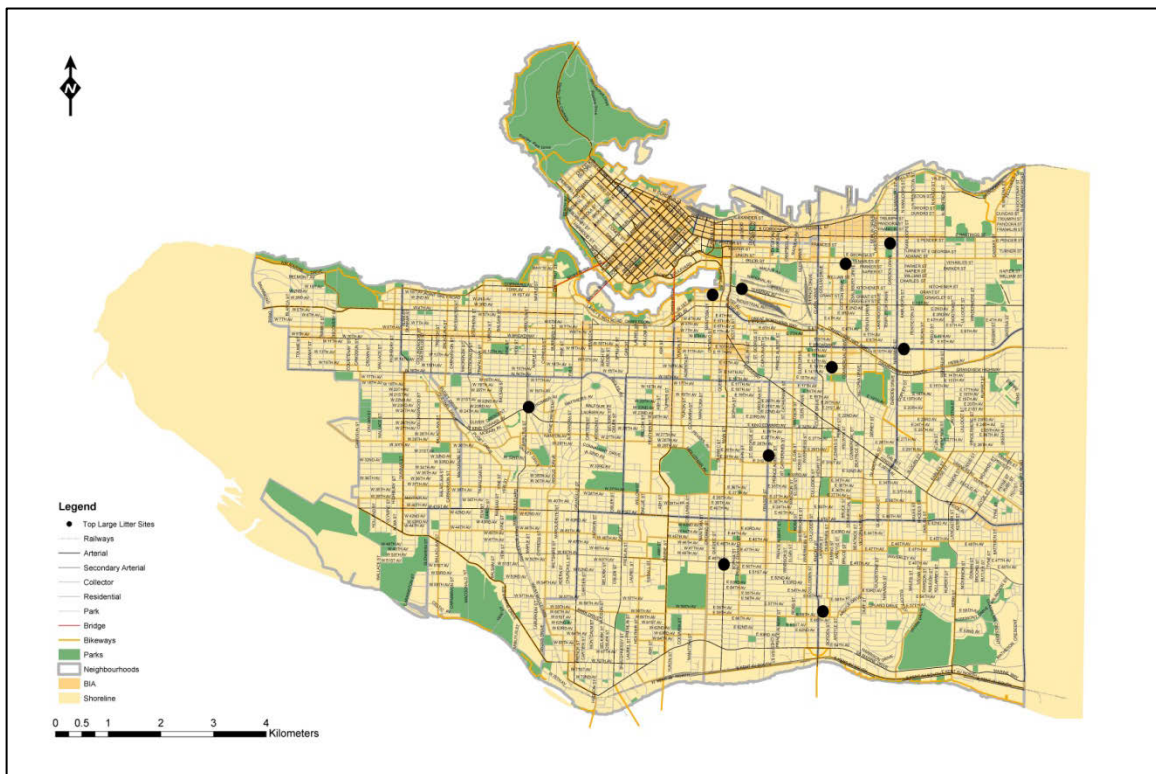


Figure 3.15 Top 10 Large Litter Sites

3.2.5 Other Cities Large Litter Comparison

Table 3.4 and 3.5 illustrates the large litter composition for the City of Vancouver in comparison to other cities. Table 3.4 is the percentage breakdown per category, and table 3.5 illustrates the average number of items counted per site. These tables show the most recent studies completed for each city. An additional table with earlier year's audits can be found in appendix E. Other miscellaneous materials and paper/fibre materials are often among the most common litter items surveyed.

Table 3.4 Vancouver Large Litter Comparison to Other Cities Percentages

Material	Toronto 2014	Edmonton 2014	Winnipeg 2014	San Francisco 2009	Vancouver 2015
Beverage Containers	6.21%	2.64%	10.40%	3.00%	1.23%
Other Packaging	4.22%	n/a	5.20%	3.30%	0.54%
Cups	10.46%	9.68%	7.30%	6.40%	21.84%
Bags	3.49%	5.30%	5.80%	5.90%	4.19%
Other Packaging (boxes)	n/a	0.90%	2.00%	3.40%	4.23%
Other Containers	0.63%	7.10%	0.70%	2.20%	1.31%
Food Wraps/ Containers	8.15%	2.93%	1.30%	3.60%	2.85%
Take Out Extras	1.43%	13.38%	13.40%	3.80%	2.65%
Trays	0.33%	n/a	n/a	0.10%	0.62%
Confectionary/Snack	6.07%	6.83%	6.40%	7.60%	5.96%
Cloth	1.66%	n/a	1.20%	1.00%	2.46%
Other Miscellaneous Packaging	0.78%	n/a	n/a	n/a	2.00%
Paper/ Fibre Material	29.54%	7.92%	7.40%	31.30%	23.95%
Tobacco Products	4.54%	7.39%	8.00%	3.70%	3.77%
Other Miscellaneous	22.50%	19.37%	31.00%	23.60%	19.95%
Additional Categories	n/a	0.00%	n/a	n/a	2.46%
Household Articles	n/a	16.57%	n/a	n/a	n/a
Total	100%	100%	100%	100%	100%

Table 3.5 Vancouver Large Litter Comparison to Other Cities – Average Items/Site

Material	Toronto 2014	Edmonton 2014	Winnipeg 2014	San Francisco 2009	Vancouver 2015
Beverage Containers	0.69	0.41	1.48	1.34	0.15
Other Packaging	0.09	n/a	0.77	1.90	0.06
Cups	1.17	1.49	0.97	3.03	2.63
Bags	0.39	0.82	0.78	1.44	0.50
Other Packaging (boxes)	n/a	0.14	0.27	0.66	0.51
Other Containers	0.07	1.09	0.09	0.71	0.16
Food Wraps/ Containers	0.91	0.45	1.78	1.16	0.34
Take Out Extras	0.16	2.06	0.00	1.37	0.32
Trays	0.04	n/a	n/a	0.19	0.07
Confectionary/Snack	0.68	1.05	0.85	3.19	0.72
Cloth	0.19	n/a	0.16	0.39	0.30
Other Miscellaneous Packaging	0.47	n/a	n/a	n/a	0.24
Paper/ Fibre Material	3.30	1.22	0.98	7.75	2.88
Tobacco Products	0.51	1.14	1.07	1.43	0.45
Other Miscellaneous	2.51	2.98	4.14	9.46	2.40
Additional Categories	n/a	0.00	n/a	n/a	0.30
Household Articles	n/a	2.55	n/a	n/a	n/a
Average Large Litter Items Per Site	11.17	15.41	13.33	34.02	12.04

The average number of large litter items per site in Vancouver was 12.04, which is similar to other cities. Figure 3.16 below illustrate the averages for large litter for other cities.

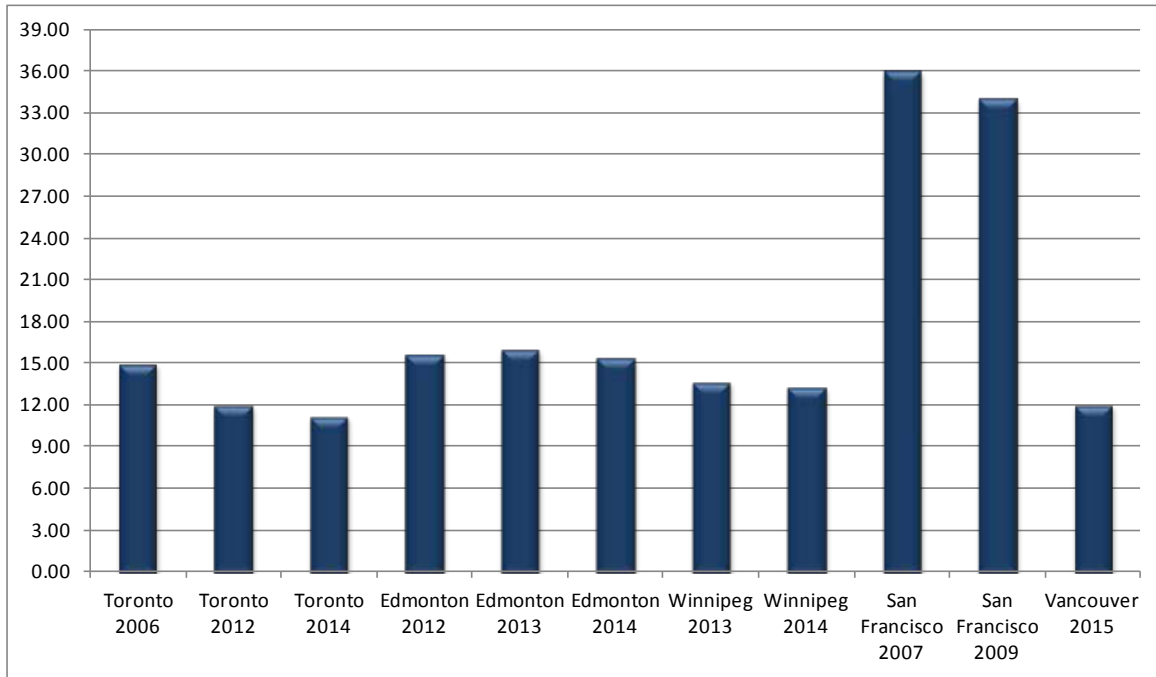


Figure 3.16 Average Large Litter Items per Site per City

3.2.6 Large Litter Statistical Analysis

The average number of large litter items per site in Vancouver was 12.04. There were 7 sites in 2015 that had no large litter surveyed. Of the 108 sites surveyed, 3 sites had the average of 12 pieces of large litter, 71 sites had less than the average amount of large litter, and 34 sites had more than the average amount of large litter.

3.3 Small Litter Results

There was a total of 787 pieces of Small Litter (< 4 square inches) observed by AET staff in the 2015 Small Litter audits for the City of Vancouver. Table 3.6 illustrates the audited small litter from 2015. The largest contributor to small litter was cigarette butts/debris at 30.88% followed by chewing gum which represents 29.35% of all the small litter surveyed.

Table 3.6 Small Litter Results 2015

Small Litter Items	2015	
	Items	Percent
Cigarette butts/debris	243	30.88%
Other tobacco	1	0.13%
Bottle caps	0	0.00%
Straws	0	0.00%
Candy packaging and wrappers	20	2.54%
Expanded Polystyrene packing materials, ie. foam peanuts	42	5.34%
Other polystyrene debris, ie. poly foam pieces	1	0.13%
Glass	13	1.65%
Paper	121	15.37%
Cup Sleeves	2	0.25%
Plastic film	18	2.29%
Hard plastic	39	4.96%
Aluminum/foil debris	24	3.05%
Rubber	4	0.51%
Metal (not aluminum)	8	1.02%
Chewing gum (stuck on pavement)	231	29.35%
Food & Food Scraps	10	1.27%
Pet Waste (bagged)	0	0.00%
Pet Waste (loose)	4	0.51%
Needles/Syringes	0	0.00%
Medications	0	0.00%
Cell Phones	0	0.00%
Audio-Visual devices	0	0.00%
Batteries	2	0.25%
Other Electronic Waste	0	0.00%
Other Material	4	0.51%
Total Site Litter	787	100.00%

3.3.1 Small Litter by Sites

Table 3.7 illustrates the 10 sites with the highest item counts for small litter in 2015. Site #39 had the highest amount of small litter with 47 pieces audited. The majority of the sites with the most amount of large litter were commercial sites. Figure 3.17 illustrates the locations of the top 10 small litter sites.

Table 3.7 Small Litter Ranking 2015

Site #	Sm Litter	Hundred Block	Street Name
39	47	1400	Kootenay Street
41	40	300	Terminal Avenue
89	28	6500	Main Street
75	24	400	Homer Street
107	24	600	Powell Street
38	23	1000	West Georgia Street
105	23	1300	Robson Street
110	23	400	Main Street
31	22	2700	East Hastings Street
106	20	1000	Burrard Street

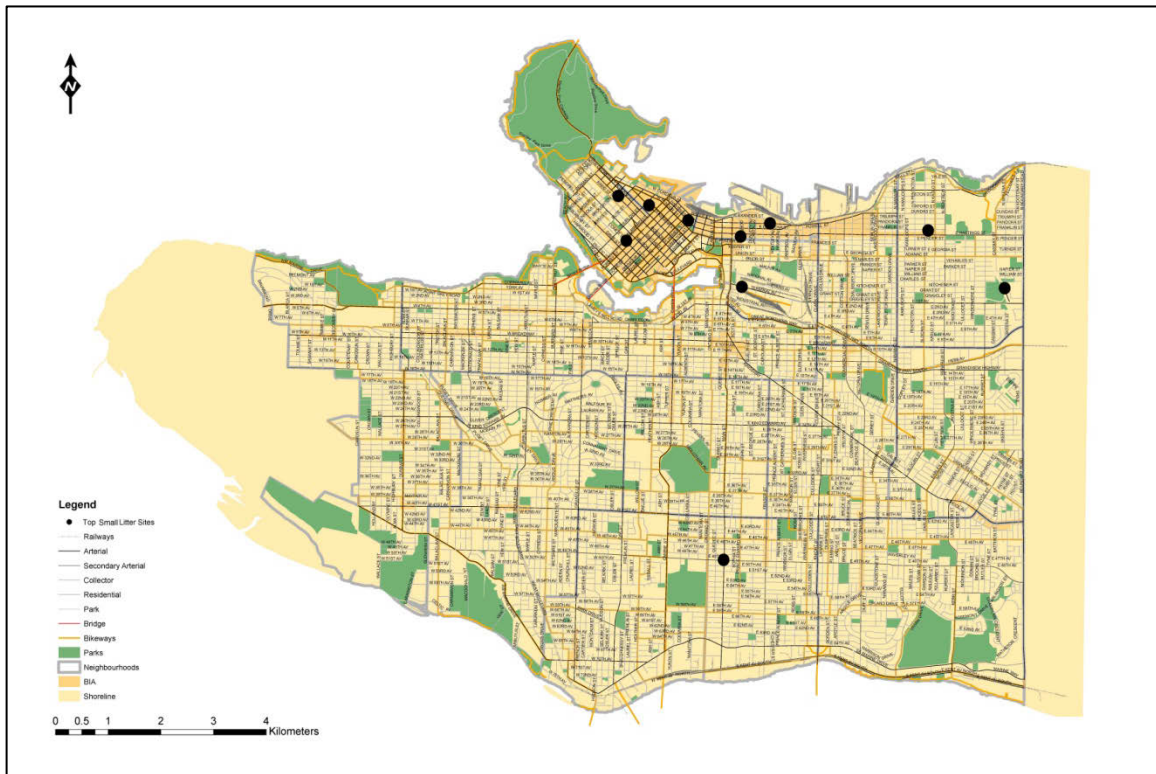


Figure 3.17 Top Small Litter Sites

3.3.2 Small Litter Comparison to Other Cities

Tables 3.8 and 3.9 illustrate the small litter composition for the City of Vancouver in comparison to other cities. Table 3.8 is the percentage breakdown per category, and table 3.9 illustrates the average number of items counted within the audited area of each site. As mentioned previously, to be consistent with the audit methodology used by other municipalities, small litter was audited in three slices across the site, for a total audited area of approximately 1.5% of a typical site. These tables show the most recent studies completed for each city. An additional table with earlier year's audits can be found in appendix G. Cigarette butts and chewing gum are consistently the most surveyed items in a small litter survey.

Table 3.8 Vancouver Small Litter Comparison to Other Cities Percentage

Small Litter	Toronto 2014	Edmonton 2014	Winnipeg 2014	San Francisco 2009	Vancouver 2015
Cigarette butts/debris	26.12%	47.49%	42.70%	12.60%	30.88%
Other tobacco	0.30%	0.08%	0.50%	2.00%	0.13%
Bottle caps	0.26%	0.96%	1.10%	0.20%	0.00%
Straws	0.33%	0.80%	0.90%	0.40%	0.00%
Candy packaging and wrappers	2.77%	0.00%	0.00%	1.50%	2.54%
Expanded Polystyrene packing materials, ie. foam peanuts	0.30%	0.08%	0.20%	1.50%	5.34%
Other polystyrene debris, ie. poly foam pieces	0.36%	3.51%	2.70%	0.90%	0.13%
Glass	4.74%	1.36%	7.60%	23.40%	1.65%
Paper	16.93%	17.24%	14.90%	8.00%	15.37%
Cup Sleeves	n/a	n/a	n/a	n/a	0.25%
Plastic film	2.64%	8.06%	7.70%	2.50%	2.29%
Hard plastic	4.78%	9.50%	10.90%	5.80%	4.96%
Aluminum/foil debris	2.11%	5.67%	4.30%	1.30%	3.05%
Rubber	0.36%	0.48%	0.80%	0.50%	0.51%
Metal (not aluminum)	1.52%	0.88%	1.30%	2.30%	1.02%
Chewing gum (stuck on pavement)	32.61%	2.31%	3.70%	32.10%	29.35%
Food & Food Scraps	1.12%	0.00%	n/a	n/a	1.27%
Pet Waste (bagged)	n/a	n/a	n/a	n/a	0.00%
Pet Waste (loose)	n/a	n/a	n/a	n/a	0.51%
Needles/Syringes	n/a	n/a	n/a	n/a	0.00%
Medications	n/a	n/a	n/a	n/a	0.00%
Cell Phones	n/a	n/a	n/a	n/a	0.00%
Audio-Visual devices	n/a	n/a	n/a	n/a	0.00%
Batteries	n/a	n/a	n/a	n/a	0.25%
Other Electronic Waste	n/a	n/a	n/a	n/a	0.00%
Other Material	2.77%	1.60%	0.80%	4.80%	0.51%
Total	100%	100%	100%	100%	100%

Table 3.9 Vancouver Small Litter Comparison to Other Cities– Average Items/Site

Small Litter	Toronto 2014	Edmonton 2014	Winnipeg 2014	San Francisco 2009	Vancouver 2015
Cigarette butts/debris	2.64	4.84	3.45	3.22	2.25
Other tobacco	1.71	0.01	0.04	0.51	0.01
Bottle caps	0.03	0.10	0.09	0.05	0.00
Straws	0.03	0.08	0.08	0.10	0.00
Candy packaging and wrappers	0.28	0.00	0.00	0.39	0.19
Expanded Polystyrene packing materials, ie. foam peanuts	0.04	0.01	0.22	0.23	0.39
Other polystyrene debris, ie. poly foam pieces	0.03	0.36	0.02	0.41	0.01
Glass	0.48	0.14	0.61	5.96	0.12
Paper	0.27	1.76	1.20	2.05	1.12
Cup Sleeves	n/a	n/a	n/a	n/a	0.02
Plastic film	0.04	0.82	0.62	0.64	0.17
Hard plastic	0.48	0.97	0.88	1.49	0.36
Aluminum/foil debris	0.21	0.58	0.34	0.33	0.22
Rubber	0.03	0.05	0.07	0.14	0.04
Metal (not aluminum)	0.15	0.09	0.10	0.58	0.07
Chewing gum (stuck on pavement)	3.30	0.24	0.30	8.20	2.14
Food & Food Scraps	0.11	n/a	n/a	n/a	0.09
Pet Waste (bagged)	n/a	n/a	n/a	n/a	0.00
Pet Waste (loose)	n/a	n/a	n/a	n/a	0.04
Needles/Syringes	n/a	n/a	n/a	n/a	0.00
Medications	n/a	n/a	n/a	n/a	0.00
Cell Phones	n/a	n/a	n/a	n/a	0.00
Audio-Visual devices	n/a	n/a	n/a	n/a	0.00
Batteries	n/a	n/a	n/a	n/a	0.02
Other Electronic Waste	n/a	n/a	n/a	n/a	0.00
Other Material	0.28	0.16	0.07	1.23	0.04
Average Small Litter Items/ Site	10.12	10.19	8.07	25.53	7.29

The average number of small litter items counted within the audited area of each site was 7.29. This amount of small litter is less than other cities, but comparable to Winnipeg in their 2014 litter surveys. An additional table with earlier studies can be found in appendix G. Figure 3.18 below illustrates the averages for small litter for other cities.

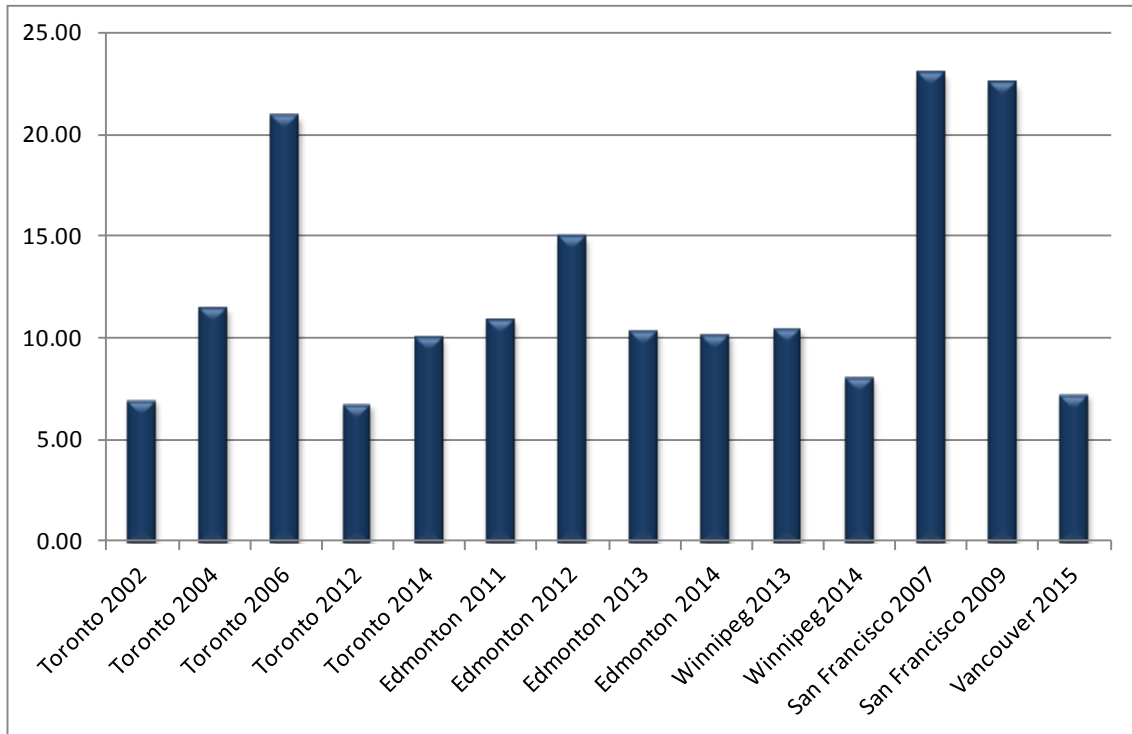


Figure 3.18 Small Litter Averages for Other Cities

The number of cigarette butts present in the small litter audit sites was also compared to other cities and is shown in Figure 3.19.

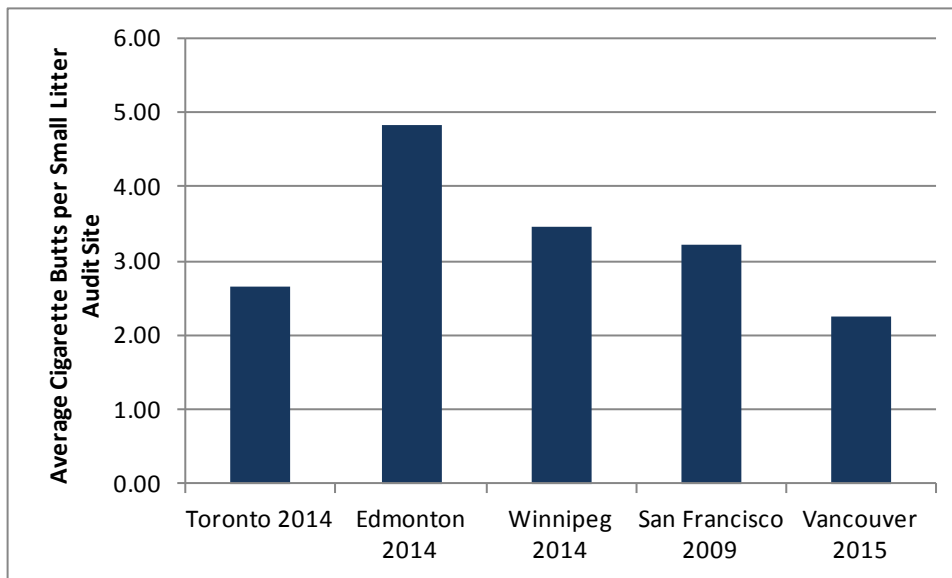


Figure 3.19 Cigarette Butts Surveyed in Small Litter Surveys

3.3.3 Small Litter Statistical Analysis

The average number of small litter items counted within the audited area of each site was 7.29. There were 9 sites in 2015 that had no small litter surveyed. Of the 108 sites surveyed, 5 sites had the average of 7 pieces of small litter, 71 sites had less than the average amount of small litter, and 32 sites had more than the average amount of small litter.

3.4 Supersite Results

As mentioned previously, 19 of the audit sites were selected for additional small litter analysis, where the entire site was surveyed for small litter. There was a total of 5,122 pieces of Small Litter (< 4 square inches) observed by AET staff in the 2015 supersite audits for the City of Vancouver. Table 3.10 illustrates the audited small litter from 2015 within the designated 19 supersites. The largest contributor was chewing gum at 48.32% followed by cigarette butts/debris which represents 37.54% of all the small litter surveyed.

Table 3.10 Supersite Results 2015

Small Litter Items	2015	
	Items	Percent
Cigarette butts/debris	1923	37.54%
Other tobacco	5	0.10%
Bottle caps	14	0.27%
Straws	0	0.00%
Candy packaging and wrappers	49	0.96%
Expanded Polystyrene packing materials, ie. foam peanuts	3	0.06%
Other polystyrene debris, ie. poly foam pieces	1	0.02%
Glass	35	0.68%
Paper	312	6.09%
Cup Sleeves	0	0.00%
Plastic film	38	0.74%
Hard plastic	84	1.64%
Aluminum/foil debris	69	1.35%
Rubber	16	0.31%
Metal (not aluminum)	9	0.18%
Chewing gum (stuck on pavement)	2475	48.32%
Food & Food Scraps	27	0.53%
Pet Waste (bagged)	1	0.02%
Pet Waste (loose)	1	0.02%
Needles/Syringes	0	0.00%
Medications	0	0.00%
Cell Phones	0	0.00%
Audio-Visual devices	0	0.00%
Batteries	2	0.04%
Other Electronic Waste	1	0.02%
Other Material	57	1.11%
Total Site Litter	5122	100.00%

3.4.1 Supersites by Site

Table 3.11 illustrates the supersites from the highest item counts to the lowest for Small Litter in 2015. The top 5 supersites are all commercial areas within the City of Vancouver. Figure 3.20 below illustrates the locations of all the supersites.

Table 3.11 Supersite Ranking 2015

Site #	Sm Litter	Hundred Block	Street Name
38	561	1000	West Georgia Street
41	533	300	Terminal Avenue
101	502	1700	West Broadway
108	470	2400	Main Street
31	461	2700	East Hastings Street
109	369	100	Kingsway
106	368	1000	Burrard Street
18	344	800	Hornby Street
97	282	800	Commercial Drive
54	248	1100	Clark Drive
77	211	5500	Main Street
104	196	1100	Denman Street
32	160	1800	Yew Street
42	126	1700	West 3rd Avenue
56	77	2900	Horley Street
52	71	620	Evans Street
26	69	2300	Wall Street
21	37	300	East 39th Avenue
82	37	900	East 24th Avenue

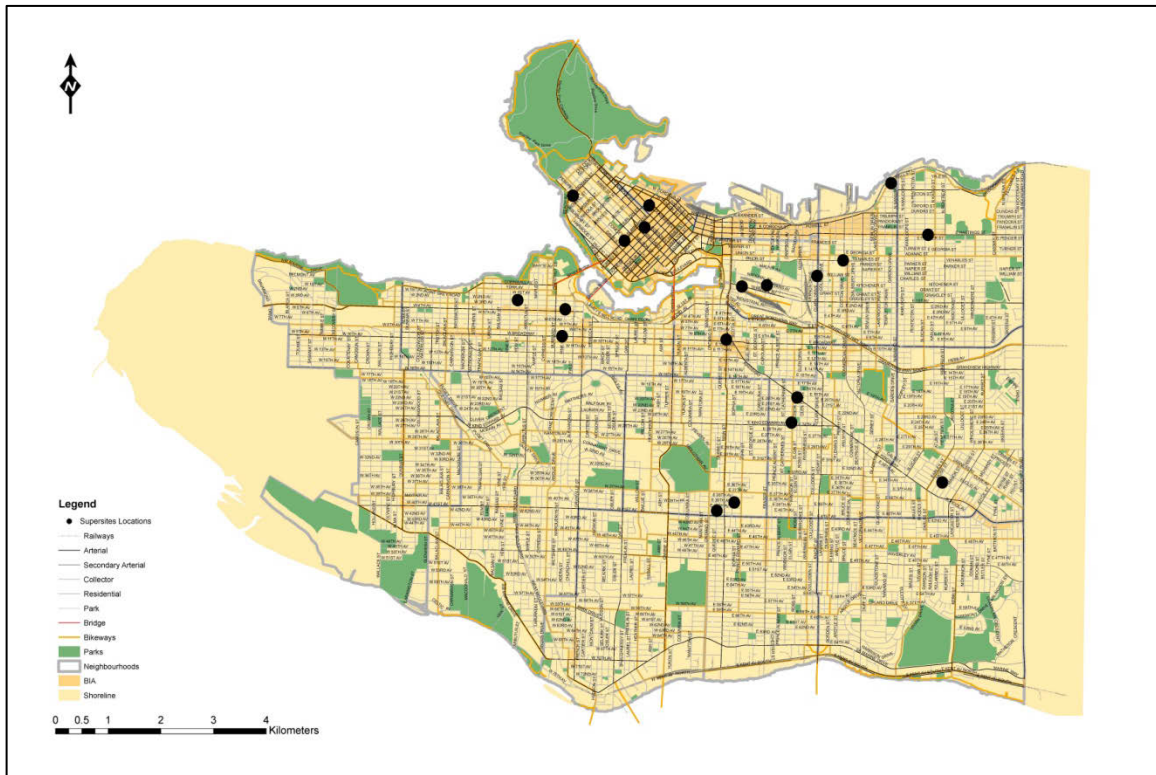


Figure 3.20 Supersite Locations

3.4.2 Vancouver to Other Cities Supersite Comparison

Tables 3.12 and 3.13 illustrate the supersite composition for the City of Vancouver in comparison to other cities. These tables show the most recent studies completed for each city that have completed supersites as a part of their litter study. Table 3.13 is the percentage breakdown per category, and table 3.12 illustrates the average number of items counted within the audited area of each site. Cigarette butts and chewing gum are consistently among the most surveyed items in a supersite survey. The City of San Francisco chose to not include chewing gum in their supersite assessments.

Table 3.12 Supersite to Other Cities Comparison – Average Items/Site

Small Litter	Toronto 2006	San Francisco 2009	Vancouver 2015
Cigarette butts/debris	176.56	83.84	101.21
Other tobacco	14.55	0.00	0.26
Bottle caps	8.60	2.03	0.74
Straws	4.65	1.72	0.00
Candy packaging and wrappers	16.89	12.19	2.58
Expanded Polystyrene packing materials, ie. foam peanuts	39.20	3.34	0.16
Other polystyrene debris, ie. poly foam pieces	14.45	0.50	0.05
Glass	218.71	128.13	1.84
Paper	154.27	56.84	16.42
Cup Sleeves	n/a	n/a	0.00
Plastic film	35.71	10.25	2.00
Hard plastic	34.07	22.50	4.42
Aluminum/foil debris	24.89	6.16	3.63
Rubber	5.40	1.78	0.84
Metal (not aluminum)	15.31	8.22	0.47
Chewing gum (stuck on pavement)	518.45	not included	130.26
Food & Food Scraps	n/a	n/a	1.42
Pet Waste (bagged)	n/a	n/a	0.05
Pet Waste (loose)	n/a	n/a	0.05
Needles/Syringes	n/a	n/a	0.00
Medications	n/a	n/a	0.00
Cell Phones	n/a	n/a	0.00
Audio-Visual devices	n/a	n/a	0.00
Batteries	n/a	n/a	0.11
Other Electronic Waste	n/a	n/a	0.05
Other Material	13.02	3.97	3.00
Average Small Litter per Site	1,294.75	341.47	269.58

Table 3.13 Supersite to Other Cities Comparison Percentage

Small Litter	Toronto 2006	San Francisco 2009	Vancouver 2015
Cigarette butts/debris	13.60%	24.60%	37.54%
Other tobacco	1.10%	0.00%	0.10%
Bottle caps	0.70%	0.60%	0.27%
Straws	0.40%	0.50%	0.00%
Candy packaging and wrappers	1.30%	3.60%	0.96%
Expanded Polystyrene packing materials, ie. foam peanuts	1.10%	1.00%	0.06%
Other polystyrene debris, ie. poly foam pieces	3.00%	0.10%	0.02%
Glass	16.90%	37.50%	0.68%
Paper	11.90%	16.60%	6.09%
Cup Sleeves	n/a	n/a	0.00%
Plastic film	2.80%	3.00%	0.74%
Hard plastic	2.60%	6.60%	1.64%
Aluminum/foil debris	1.90%	1.80%	1.35%
Rubber	0.40%	0.50%	0.31%
Metal (not aluminum)	1.20%	2.40%	0.18%
Chewing gum (stuck on pavement)	40.00%	not included	48.32%
Food & Food Scraps	n/a	n/a	0.53%
Pet Waste (bagged)	n/a	n/a	0.02%
Pet Waste (loose)	n/a	n/a	0.02%
Needles/Syringes	n/a	n/a	0.00%
Medications	n/a	n/a	0.00%
Cell Phones	n/a	n/a	0.00%
Audio-Visual devices	n/a	n/a	0.00%
Batteries	n/a	n/a	0.04%
Other Electronic Waste	n/a	n/a	0.02%
Other Material	1.00%	1.20%	1.11%
Total	100%	100%	100%

The average number of small litter items per supersite was 269.58. The amount of small litter is less than other cities. The City of Toronto averaged 1294 small litter pieces per supersite in 2006. San Francisco averaged 341 pieces of small litter per supersite in 2009, but it should be noted that they did not include a count of chewing gum deposits.

The number of cigarette butts present at the supersite audit sites was also compared to other cities and is shown in Figure 3.21 below.

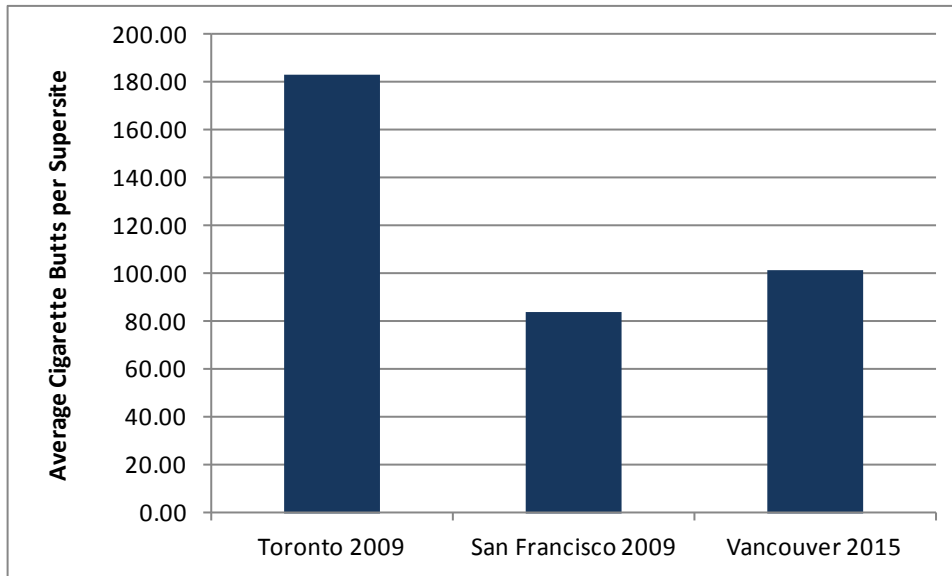


Figure 3.21 Cigarette Butts Surveyed in Supersite Litter Surveys

3.4.3 Supersite Litter Statistical Analysis

The average number of small litter items per supersite was 269.58 in 2015. Of the 19 sites surveyed, 10 sites had less than the average of 269.58 pieces of small litter and 9 sites had more than the average amount of small litter.

4.0 ADDITIONAL OBSERVATIONS

AET staff noted the presence of any City of Vancouver litter bins within sight of the litter survey location. Figures 4.1 and 4.2 are examples of litter bins that were present within or near some of the 108 audited sites. Figure 4.1 shows the City's litter bins that are present in high traffic areas. Figure 4.2 illustrates litter bins that were commonly found in the City of Vancouver at Bus Stop locations. Of the 108 sites that were audited, 17 sites (15.74%) had litter bins present within sight, while 91 sites did not (84.26%).



Figure 4.1 Street Litter Bin with Cage for Recyclable Material



Figure 4.2 Bus Stop Street Litter Bin

The areas with City of Vancouver litter bins nearby had on average 14.97 pieces of Large Litter within the site, and the areas without a nearby City of Vancouver litter bin had an average of 11.49 pieces of large litter. Litter bins were generally observed in areas with more public foot traffic. This could be the reason for the difference in the average amount of litter within areas with and without city litter bins.

5.0 SITE RANKING AND ATTRIBUTES

AET staff ranked each of the 108 audited sites three different ways: 1) By the total number of large litter items that were audited within each site; 2) By the total number of small litter items that were audited within each site; and, 3) The total combined amount of large and small litter. Table 5.1 illustrates the sites that have the greatest amount of large and small litter combined. A full list of all 123 sites can be found in Appendix H.

Table 5.1 Combined Ranking for Combined Large and Small Litter

Site #	All Litter	Hundred Block	Street Name	Fast Food	Conv Store	Stop	Bus Stop in Site	Litter Bin	Area
41	155.0	300	Terminal Avenue	Y	N	Traffic light	N	N	Commercial, Industrial
97	74.0	800	Commercial Drive	N	N	Stop sign	N	Y	Commercial, Residential
89	73.0	6500	Main Street	N	Y	Traffic light	Y	Y	Commercial
40	63.5	40	East 1st Avenue	N	N	Traffic light	N	N	Residential
76	63.0	700	East 30th Avenue	N	Y	Stop sign	N	N	Commercial, Residential
70	57.5	2400	East Broadway	N	N	Traffic light, stop sign	Y	N	Commercial, Residential
39	53.0	1400	Kootenay Street	N	N	N	N	N	Industrial
44	52.0	2800	Woodland Drive	N	N	Stop sign	N	N	Residential
75	46.5	400	Homer Street	N	N	N	N	Y	Commercial
60	46.0	7200	Dumfries Street	N	N	Stop sign	N	N	Residential

Attributes of the sites with the highest amount of combined small and large litter are provided in Table 5.1. Within these sites 10% have fast food and 20% have a convenience store, 80% are by a stop sign or light and 20% have a bus stop in the survey area. Of the top 10 sites 70% do not have litter bins present.

Litter sites were characterized by their land use and sites that were surveyed included commercial, single family, multi-family, mixed use, institutional and industrial sites. The mixed use sites were often commercial areas with residential areas. The averages of each type of litter based on land use are illustrated in table 5.2. The areas with the most amount of large litter include mixed use, commercial, and institutional areas. The areas with the highest average of small litter include industrial, commercial and mixed use areas. The areas that have the highest average of combined litter (small and large together) include mixed use, commercial and industrial areas.

Table 5.2 Average Litter Per Site Based on Land Use

Land Use	Average Large Litter Items per Site	Average Small Litter Items per Site	Average Combined Litter Items per Site
Commercial	17.08	15.89	32.97
Single Family Residential	9.05	3.52	12.57
Multi Family Residential	10.09	7.75	17.84
Mixed Use	36.90	11.60	48.50
Institutional	17.00	9.00	26.00
Industrial	8.67	23.33	32.00

6.0 CONCLUSIONS

AET was contracted to conduct litter audits at 97 pre-selected locations within the public realm across the city. An additional 10 sites were randomly selected by the City to be added to the study. Three backup sites were selected in case pre-selected sites were not accessible. Overall 108 litter sites were surveyed for small and large litter. The audits were initially scheduled to be conducted from August 31st – September 4th 2015 with the purpose of assessing the composition and amount of litter present on Vancouver streets. Due to a storm, litter surveys were postponed then completed during the days of September 14th to the 17th, 2015. Supersite surveys were also completed on 19 randomly selected sites.

The type of litter was classified into two size categories: large litter, which is equal to or larger than four square inches, and small litter, which is smaller than four square inches.

6.1 Large Litter Conclusions

Over the one-week study period, 108 sites within the City of Vancouver were audited for large litter. The key findings include:

- The average amount of large litter per site is 12.04 pieces
- The total number of large litter items surveyed is 1300.50
- The number of sites with no large litter recorded was 7 sites
- The most common category of large litter items was paper/fiber materials (primarily comprised of napkins, receipts and printed materials) representing 23.95% of the large litter found. The second most common category of items was cups (hot and cold cups as well as cup lids and pieces) which comprised 21.8% of the large litter items.
- The most commonly found item in the large litter audit was Non-Brand Towels/Napkins, which represents 11.76% of all large items audited, followed by cup lids and pieces at 10.46%.

6.2 Small Litter Conclusions

Over the one-week study period, 108 sites within the City of Vancouver were audited for small litter. The key findings include:

- The average amount of small litter per site is 7.29 pieces
- The most commonly found small litter item was cigarette butts, accounting for 30.88% of all small litter audited, followed by chewing gum at 29.35%.

6.3 Supersite Conclusions

Over the one-week study period, 19 sites within the City of Vancouver were audited for small litter as supersites. The key findings include:

- The average amount of small litter per site is 269.58 pieces
- The most commonly found small litter item was chewing gum accounting for 48.32% of all small litter audited, followed by cigarette butts/debris at 37.54%.

7.0 RECOMMENDATIONS

Should the City of Vancouver decide to supplement their current street cleanliness initiatives, consider focusing on the following:

- Targeting chewing gum, napkins, cup lids and pieces, receipts, and cigarette butts.
- Litter abatement efforts should be focused on the areas with the greatest amount of large litter and combined litter (large and small litter).
- The City should also consider conducting another litter audit in the future to assess the effectiveness of additional litter abatement strategies.

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Disclaimer

AET Group Inc. makes no warranty and assumes no liability for the information contained in this report outlining the litter audit results. These results reflect measurements made over a onetime “snapshot” time period, meaning they only represent the conditions for the period of time in which they were collected. Seasonal variability, holidays and weather, among other factors, can affect the amount of litter within an area.