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Characterisation of Non-Household Municipal Waste in Ireland and the Development of an Approach to Tracking Municipal Waste Composition

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Final Report

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by
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DISCLAIMER

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EXECUTIVE SUMMARY

Background

The Waste Management Act 1996 defines municipal waste as '*household waste as well as commercial and other waste which, because of its nature or composition, is similar to household waste'*.

In Ireland, there is a considerable body of information available on the composition of household waste. However, there is relatively little information available on the composition of non-household municipal waste (NHMW). The composition of NHMW is more diverse than household waste as it includes waste from supermarkets, offices, hotels, restaurants, shops, hospitals, schools, cinemas, etc., as well as non-process industrial waste, each of which have a unique waste composition.

Non-process industrial waste consists of waste generated at industrial facilities that does not arise from industrial activities or processes, for example canteen waste, office waste and packaging waste from material deliveries. The distinction between 'non-process industrial waste' and 'industrial waste' is not always clear and there is often overlap between these datasets.

Commercial waste composition data in the National Waste Database (1998) arose from surveys from just four commercial waste surveys. Since then, a limited number other surveys have been conducted. Clearly there is a need to carry out further surveys in order to determine a more comprehensive picture of NHMW composition in Ireland.

The aim of this project is to develop a reliable and realistic methodology for determining the waste character of NMHW nationally.

In Ireland, the current commercial waste characterisation methodology is outlined in the EPA document '*Municipal Waste Characterisation*'.

This document sets out a standard procedure to conduct commercial surveys. This methodology is based on selecting a waste sample from the retail trade, wholesale trade, non-distribution or education sector. The sample size of the collected sample is reduced by coning and quartering. However, there are a number of concerns with this methodology which include a limited number of sectors chosen to represent the entire non-household municipal waste sector, variations in commercial waste composition which arise from changes in business activity and waste arisings which were diverted to recycling which can be a major percentage of non-household municipal waste arisings. A major limitation of determining waste character of NHMW, without segregation of organic waste, is that wet waste streams, contaminate dry waste materials. Once this occurs its is not possible to accurately determine individual waste material weights and thus characterisation is impossible.

NHMW Studies Internationally and in Ireland

Examination of various studies carried out abroad shows that 'paper and cardboard' is the largest NHMW fraction, followed by organic waste. The two fractions account for as much as 70% of the total NHMW stream. It should be noted, however, that different countries apply differing terminologies, so direct comparison is difficult. Furthermore, the sampling and analytical regimes also differ somewhat. Nevertheless the over-riding conclusion points to the significance of the two fractions referred to above.

Based on the limited number of studies in Ireland a similar trend can be seen. More than 60% of the NHMW measured in these studies was contributed by paper, cardboard, and organics. This figure can only be taken as indicative, since a limited number of sectors were involved (hotel, retail, school, office). In addition, the number of samples was small.

Preparation of a Characterisation Methodology for an Enterprise

Within this project, a methodology to characterise commercial waste from an enterprise has been devised. This methodology was developed after an extensive review of existing waste characterisation practices in Ireland and abroad.

The waste arising from any commercial sector can be broadly divided into mixed waste and segregated waste as outlined in Figure 1.

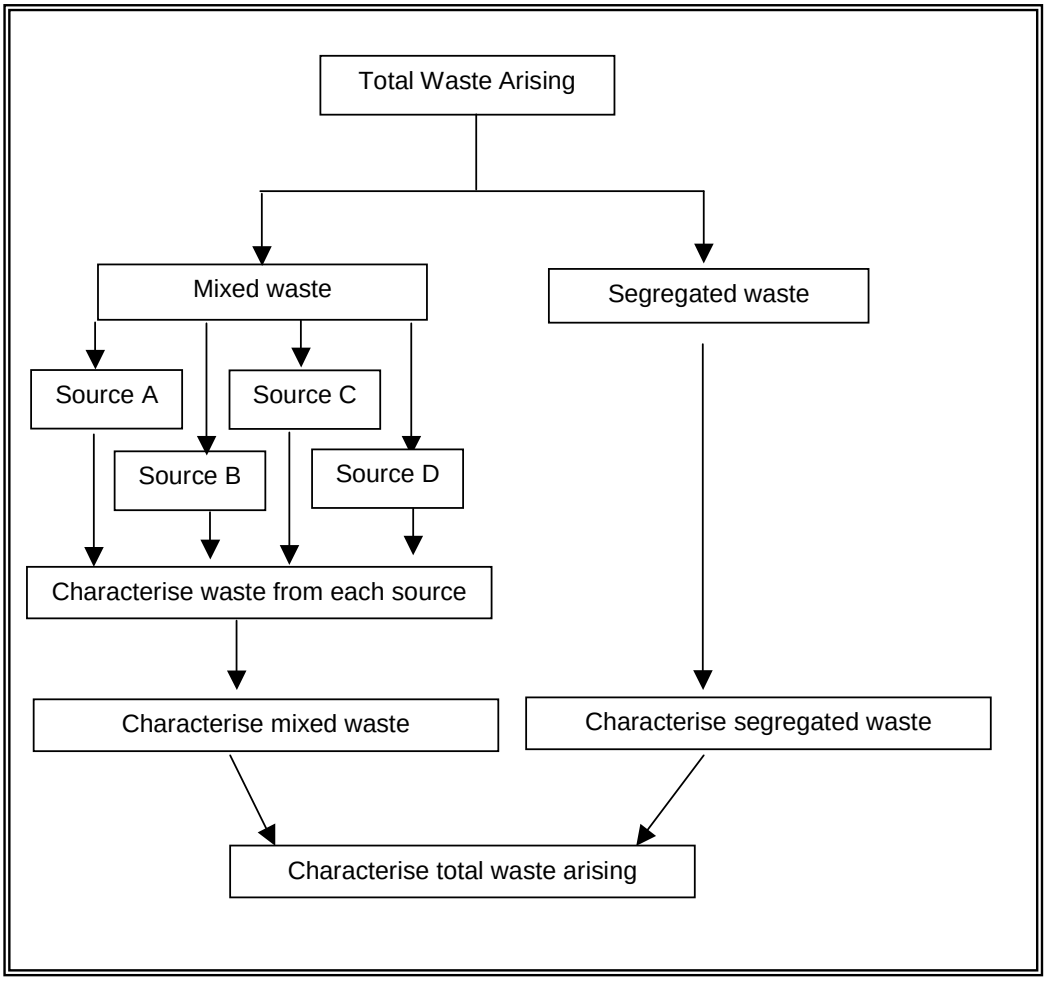


Figure 1 Flow diagram of waste characterisation methodology steps

Although the volume of mixed waste is usually known from waste disposal records the composition of this waste stream is often difficult to determine. Mixed waste consists of a wide number of waste materials and will vary in composition depending on the nature of the enterprise and its activities. The methodology proposed requires that a waste characterisation survey of all the major waste sources within an

organisation be conducted. The number of sources in an organisation will depend on the complexity of the activities and the associated waste. For example, waste from a hotel might be grouped into waste arising from the kitchen area, bedroom area, office and bar.

Qualitative and quantitative data on the character of the waste arising from the main sources can be gathered to calculate the character of the total waste stream.

Within the methodology, guidelines are developed for three phases of the characterisation: before the survey, during the survey, and after the survey

An electronic spreadsheet has been prepared for the collation of data. This allows input from the segregated and mixed waste worksheets. Details of the spreadsheet are given in the main body and appendices of this report (chapter 4).

Non routine wastes should also be considered. For example, WEEE may arise during the course of the survey. This would not be a routine event. It is necessary to establish the frequency and magnitude of such events, so as to determine the average arisings, consistent with a period corresponding to the survey period.

Segmentation of Economic Sectors

In order to determine which sectors might contribute most to the NHMW stream, the European NACE code system was employed. This gives a main division of some 17 sectors (designated A-Q), with as much as 640 sub-sectors.

As quantities and character of industrial waste are already reported to the EPA using the codes from Chapter 15 and Chapter 20 of the EWC (European Waste Catalogue), it was considered that the focus of this study should be on the characterisation of commercial waste sectors represented by NACE codes G to O. Some of these were combined (where their character was considered to be similar), while others were sub-divided (where the character of the sub-categories was considered to differ).

Using the extensive information sources of a commercial waste contractor, estimates of the percentage contribution to the waste stream of each of the sectors were made.

For example, Figure 2 illustrates the estimated arisings in the Dublin region.

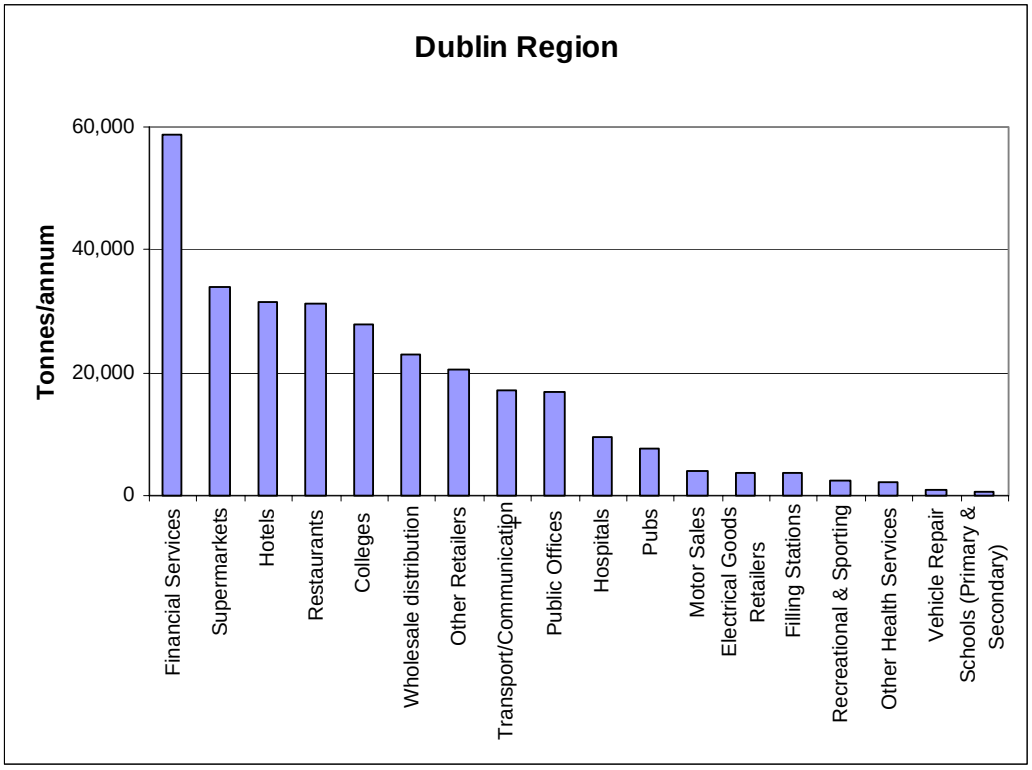


Figure 2: Significant Waste Sectors in the Dublin Region

Analysis of the data shows that the top 5 sectors chosen account for an average 65.2% of the total waste arising from the commercial sector while the top 10 sectors account for 82.7% of the commercial waste arising. This information suggests that the characterisation of waste from the top 10 sectors will allow for 82.7% characterisation of national commercial waste arisings.

Waste Compositional Studies of Selected Economic Sectors

Based on the methodology outlined above, the most significant sectors producing commercial waste in Ireland were identified. These sectors are:

- Hotels
- Supermarkets
- Transport & Communication
- Financial Services
- Colleges
- Restaurants
- Hospitals
- Public Offices
- Wholesale Distribution
- Other Retailers

The composition of waste from these sectors was determined by the waste characterisation methodology developed in this study. The results from individual characterisation studies are given in the main body of this report (chapter 6) and are not included here. They are, however, summarised in Table 1.

Determination of National Commercial Waste Character

Based on the EPA National Waste database figures, the percentage contributions of each sector, and the compositional analyses carried out, the national character of the commercial sector in Ireland has been estimated. Details of the tonnages, etc. are given in the main body of the report. They are illustrated on a percentage basis in Figure 3.

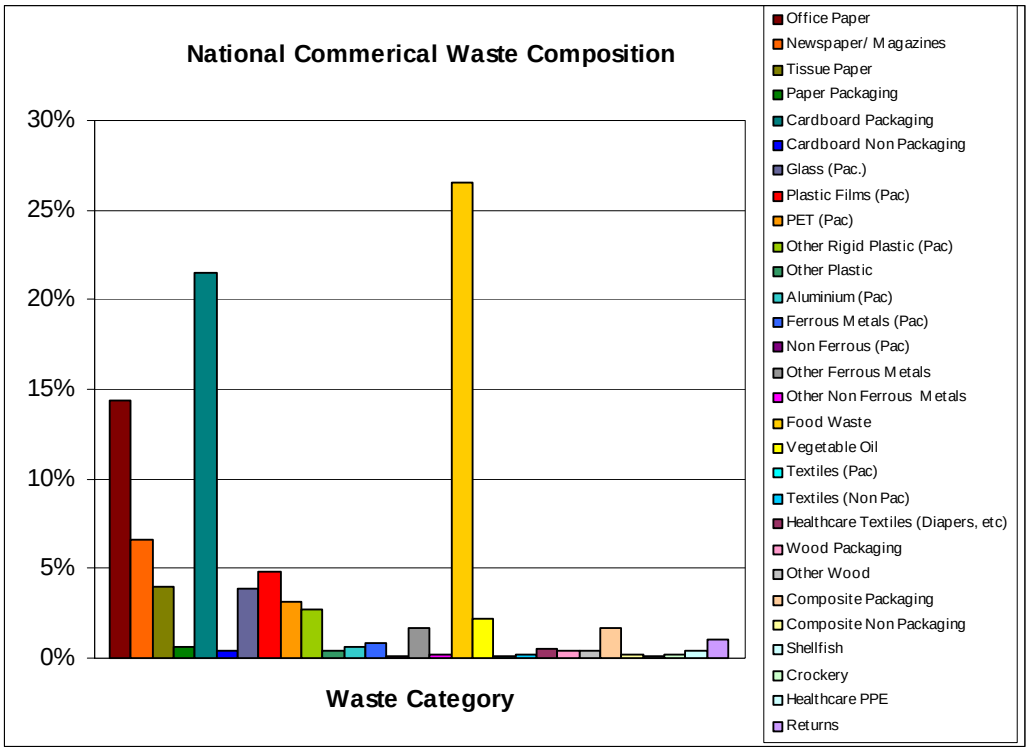


Figure 3: National Commercial Waste Composition

Conclusions and Recommendations

The methodology used in this project to determine the national commercial waste character appears to represent a viable approach. While the results obtained on this occasion cannot be regarded as totally accurate, considerably more information has been generated than was previously available. Similarly, shortcomings and gaps have been identified. Therefore, the study has laid the foundation for a national waste characterisation methodology, which can be progressed based on the findings of this project.

The methodology proposed can be enhanced by improving the accuracy of results at a number of levels. These include additional sampling per enterprise, and additional enterprises per sector. It should be noted that certain sectors, such as Transport and Communication, may be quite heterogeneous and could therefore require further segmentation.

Municipal waste can be regarded as coming from three sources. These can be identified by NACE codes. The three sources are:

- Non Process Industrial Waste (mainly EWC chapters 15 and 20 from NACE codes A-F)

- ‘Commercial ‘ waste (NACE codes G-O)
- Household waste (NACE codes P and Q).

These three categories should be characterised and combined to give the total national characteristic for municipal waste. The main methods employed to date for the characterisations are:

- Non-process industrial waste: EPA questionnaire returns from IPC and non-IPC companies
- Commercial waste: characterisation studies
- Household waste: characterisation studies

This study was devoted to the characterisation of the ‘commercial sector’. However, it is argued that the methodology can find use in the other two sectors.

Commercial Waste Characterisation

The method recommended, based on the results of this study is as follows:

(a) Sub-contract a large enough sample of waste contractors to measure their waste collected per NACE sectors and sub-sectors.

(b) Based on their business share determine the estimated percentage that each NACE sector contributes as outlined in Chapter 5.

(c) Based on the information obtained in (a) and (b) select sectors for study. These should represent a large proportion of the waste (at least 80%-90%). Applying the Pareto principle (80:20) will result in a diminishing return on resource investment.

(d) Identify enterprises and/or organisations within each sector, such that there is confidence that all major deviations are covered. For example at least one university and one Institute of Technology should be examined within the colleges sector.

(e) Where sectors are particularly diverse consider breaking them into the major sub-sectors. Transport and Communications is one example of such a sector.

(f) Carry out a waste characterisation survey at the enterprise level following the methodology outlined in this report. Ensure that enough samples are taken to give a reasonable degree of confidence in the results. Unfortunately, where particular waste streams are small, this may imply more sampling than is feasible from a resource input point of view. In such cases, complete segregation of the smaller streams may be the only accurate method of determination.

(g) From the information gleaned in (f) produce a “Fingerprint” of the enterprise. Where more than one enterprise is surveyed, produce a “Fingerprint” of the sector – unless results are at variance, in which case it may be better to work in sub-sectors.

(h) From the “Fingerprint” of each sector scale up to a national level. This can be performed in two ways, as outlined in (i) And (j) below.

(i) Using national Waste database figures and the percentage contributions obtained from (a) and (b) above determine the quantity of waste arising from each sector. Combine this with the various “Fingerprints” obtained in (g) above. The accuracy of this technique depends on the accuracy of both the ‘Total’ waste figure and the reliability of the sectoral contributions. The two sets of information must, at least, be consistent in their scope.

(j) Using statistical and demographic data deduce a scale-up parameter. The accuracy of this parameter will depend on the quality of statistical information available, and on the establishment of a good correlation between the scale-up parameter and waste produced. An example of a reliable scale-up parameter is found in the hotel sector, where waste arisings correlate very well with number of bedroom nights sold, and where the number of bedroom nights is known with a fair degree of accuracy. On the other hand scale-up on the basis of number of employees in the Financial Services sector may not be so reliable.

(k) Good correspondence between results obtained from the methods described under (i) and (j) above would lead to a high degree of confidence in the overall result.

It is strongly recommended that the method described under (i) above be the primary method. Waste contractors will generally keep precise records. From these records, it is possible to obtain a good estimate of the total waste produced by a sector. Reliance on landfill records is not recommended at this point. Commercial contractors often do not distinguish between 'commercial' and non-process industrial wastes. Hence, landfill records are hampered. However, if the commercial contractor is given a precise request (in terms of NACE codes, for example), the information provided tends to be reliable.

Overall Municipal Waste

The waste stream can be regarded as stemming from several source types. If the sub-division of the waste stream fractions is consistent across these source types, amalgamation can readily be achieved. Figure 4 illustrates how this might happen, and where the municipal waste stream fits in.

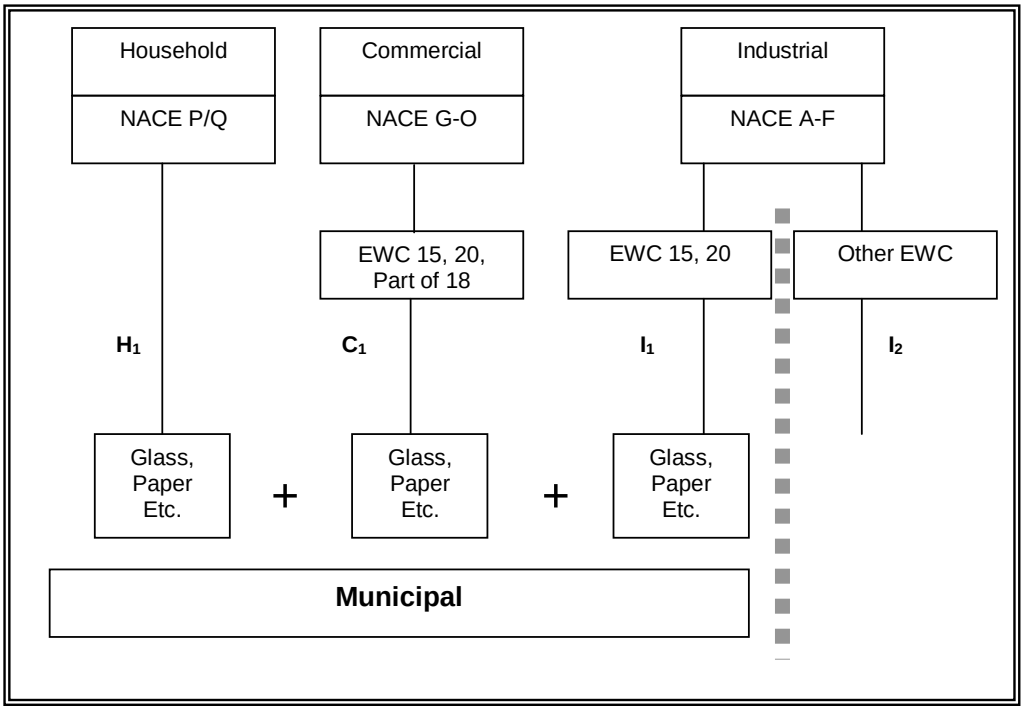
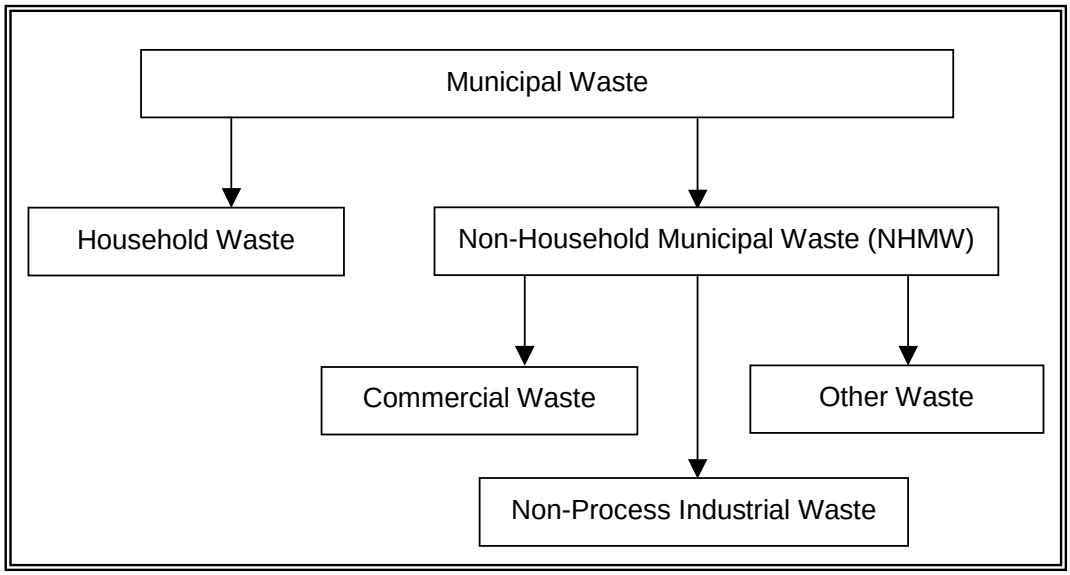


Figure 4: Definition of Municipal Waste

CHAPTER ONE: INTRODUCTION

1.1 Background

The Waste Management Act 1996 defines municipal waste as '*household waste*[1] *as well as commercial*[2] *and other waste*[3] *which, because of its nature or composition, is similar to household waste'*.



In Ireland, there is a considerable body of information available on the composition of household waste. Many local authorities have conducted waste composition surveys on household waste during the last decade. This information has been forwarded to the EPA and included in their National Waste Database Reports.

However, there is relatively little information available on the composition of non-household municipal waste (NHMW). The composition of NHMW is more diverse than household waste as it includes waste from supermarkets, offices, hotels, restaurants, shops, hospitals, schools, cinemas as well as non-process industrial waste, each of which have a unique waste composition.

Non-process industrial waste consists of waste generated at industrial facilities that does not arise from industrial activities or processes, for example canteen waste, office waste and packaging waste from material deliveries. The distinction between 'non-process industrial waste' and 'industrial waste' is not always clear and there is often overlap between these datasets.

Commercial waste composition data in the National Waste Database (1998)[4] arose from surveys from just four commercial waste surveys. The figures given in this report relate only to the composition in the small outlets surveyed. In order to generate representative NHMW

[1] **Household Waste** defined in the Waste Management Act, 1996 as '*waste produced within the curtilage of a building or self-contained part of a building used for the purposes of living accommodation'*.
[2] **Commercial Waste** defined in the Waste Management Act, 1996 as '*waste from premises used wholly or mainly for the purpose of trade or business or for he purpose of sport, recreation, education or entertainment but does not include household, agricultural or industrial waste*'.
[3] **Other Waste** may include street sweepings, litter and parks/garden (green) waste
[4] EPA, 1998, National Waste Database

data it is necessary to determine the amounts generated from all the major NHMW sectors and to determine the character of waste generated from them.

Various methodologies exist for analysing NHMW in order to provide information of waste types and volumes. Results from waste composition studies help local authorities and governments to develop solid waste management policies by clearly identifying the different components of the waste stream. Good information assists such decision making bodies in selecting appropriate waste management initiatives and the implementation of those initiatives in their communities.

The national Waste Database (2001) incorporates the results of additional studies and characterisations, including those performed in this project.

1.2 Scope of the Study

The aim of this project is to develop a reliable and realistic methodology for determining the waste character of NMHW nationally. The report outlines the work which has been carried out by the Clean Technology Centre on this project.

Chapter 2 examines data generated on NHMW composition internationally and examines methodologies used to generate this data.

Chapter 3 assesses previous waste characterisation studies carried out in Ireland in relation to NHMW.

Chapter 4 outlines the limitations of the current methodology used to characterise NHMW in Ireland and proposes a new methodology, developed in the course of this study.

Chapter 5 outlines how the most significant generators of NHMW have been identified by this study.

Chapter 6 outlines waste characterisation data which has been generated by ten of the most significant NHMW sectors.

Chapter 7 estimates the character of the NHMW national waste arisings and attempts to determine the volume and composition of waste arising from each of the major NHMW sectors.

Chapter 8 proposes how the methodology developed in this study can be improved in the future for national waste characterisation.

CHAPTER TWO: LITERATURE REVIEW OF FOREIGN PRACTICE

2.1 Introduction

A number of commercial waste composition surveys have been conducted abroad. The results from the following areas are presented below and summarised in Table 2.1 and Figure 2.1. The data reviewed is from: Seattle, USA; California, USA; Alameda County, USA; Alberta, Canada and Sydney, Australia

	Seattle, USA	California State, USA	Alameda County, USA	Alberta, Canada	Sydney, Australia
Sector Composition Determined	**Yes**	**Yes**	**No**	**No**	**No**
Paper	33%	39%	37%	54%	9%
Organics	28%	31%	32%	13%	26%
Plastic	11%	10%	17%	7%	8%
CDL Wastes[5]	10%	6%	-	-	16%
Other Materials	8%	1%	6%	15%	27%
Metal	7%	6%	5%	7%	2%
Glass	3%	2%	3%	4%	-
Special	-	4%	-	-	-
Wood/Timber	-	-	-	-	8%
Textile/Rags	-	-	-	-	4%

Table 2.1: Summary of Foreign Commercial Waste Studies

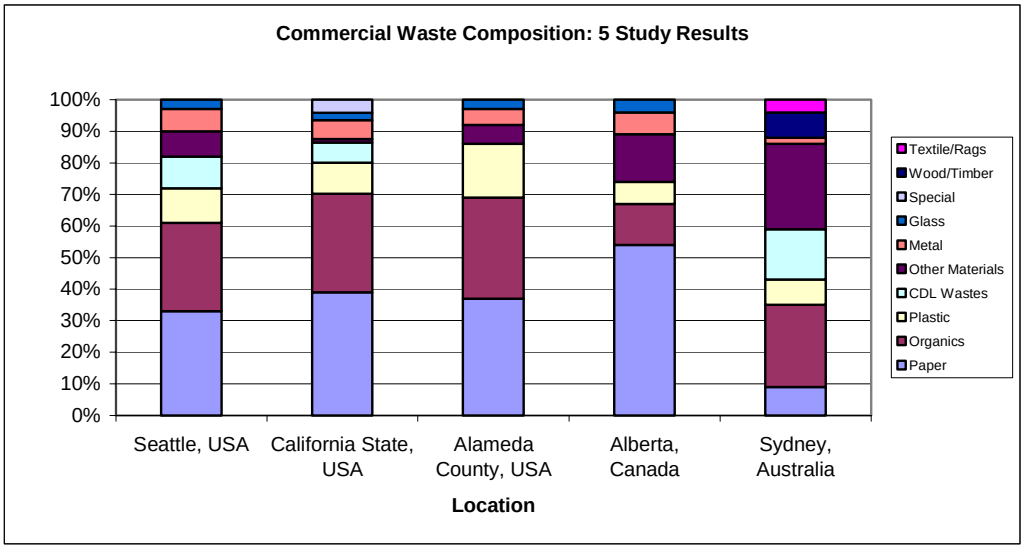


Figure 2.1: Summary of Foreign Commercial Waste Studies

[5] CDL is an acronym for Construction, Demolition and Land-clearing waste

2.2 Seattle, USA

2.2.1 Background

The 1996 phase of Seattle's waste study[6] focused on the commercial substreams. A total of 348 loads were sampled from January to December 1996.

2.2.2 Method

The drivers of sampled vehicles were asked to identify from which type of business they had collected the load. In cases where the driver could indicate that the entire load was from a single business type, that information was noted; otherwise, "mixed generator types" was recorded. There was no intent to capture a certain number of samples from any particular generator type.

2.2.3 Results

The sample information for each commercial sector is presented in Appendix A and summarized in Table 2.2.

Sector (No. of Samples)	Paper	Organics	Plastic	CDL Wastes	Other Materials	Metal	Glass	Hazardous
Office (19)	48.0%	13.2%	9.1%	7.2%	12.1%	5.1%	4.3%	0.9%
Health Care (9)	46.6%	11.7%	16.5%	4.9%	7.7%	2.8%	1.5%	8.4%
Education (15)	42.8%	23.4%	11.3%	7.8%	5.2%	5.8%	3.6%	0.1%
Other Services (28)	41.0%	18.7%	12.1%	9.2%	7.8%	8.3%	2.7%	0.2%
Wholesale (29)	40.9%	27.2%	19.6%	4.2%	2.6%	5.1%	0.3%	0.0%
Hotel/Motel (5)	36.8%	43.3%	10.1%	0.2%	2.7%	2.4%	4.1%	0.4%
Retail (34)	33.4%	39.8%	13.0%	2.4%	5.9%	3.9%	1.5%	0.0%
Restaurant (5)	26.4%	50.8%	18.4%	0.0%	0.7%	1.5%	2.1%	0.0%
Manufacturing (25)	23.6%	12.9%	23.3%	13.1%	15.9%	9.5%	1.6%	0.0%
Transportation (10)	22.8%	28.1%	5.6%	24.4%	7.5%	6.6%	4.9%	0.1%
Construction, Demolition and Landclearing (5)	4.4%	0.1%	4.4%	73.0%	9.5%	8.4%	0.2%	0.0%
Mixed Commercial Generators (151)	32.5%	30.6%	7.7%	9.6%	9.0%	6.5%	2.6%	0.5%
Overall Commercial	**33.3%**	**28.1%**	**11.0%**	**9.9%**	**8.2%**	**6.5%**	**2.5%**	**0.5%**

Table 2.2: Summary of Sector Composition Study from Seattle, 1996

Overall composition results are illustrated in Figure 2.2. As shown, paper and organics account for more than 60% of the commercial substream.

[6] Seattle Public Utilities, 1996, Commercial & Self-Haul Waste Streams Composition Study

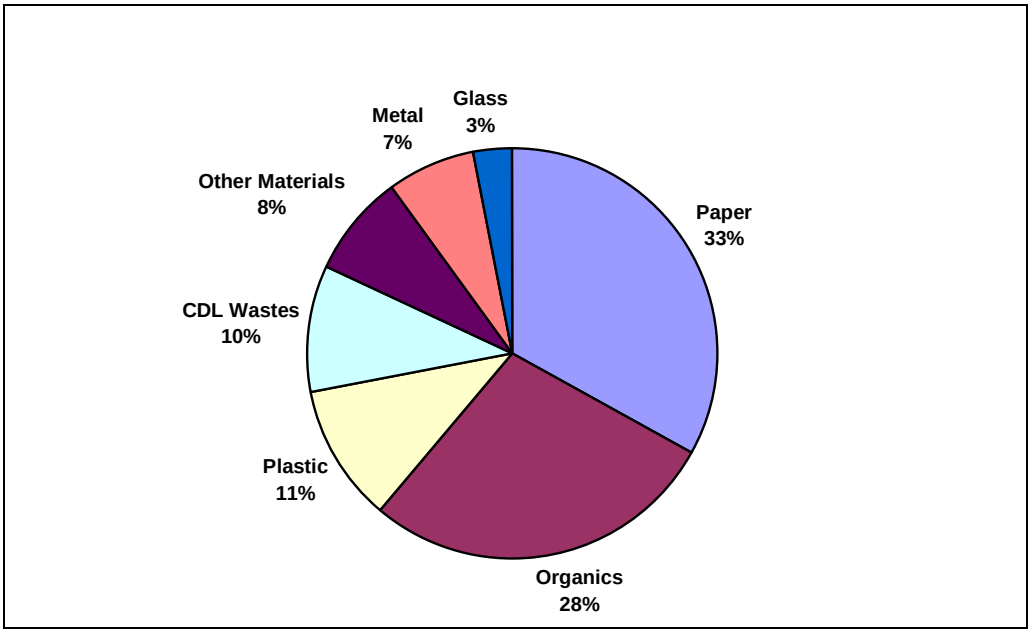


Figure 2.2: Overall Commercial Composition, Seattle 1996

2.3 California, USA

2.3.1 Background

During 1999, the California Integrated Waste Management Board (CIWMB) conducted a statewide study[7] whose primary objective was to obtain information on the types and amounts of materials still being disposed in the state. The first such study of this magnitude, it encompassed gathering data from the commercial, residential, and self-haul waste streams throughout California. No information was gathered on materials diverted from disposal through source reduction, recycling, or composting. The standard methods contained in the *California Uniform Waste Disposal Characterisation Method* were used.

The data gathered during the sampling efforts was reduced and statistical analyses were performed in order to extrapolate the findings to statewide estimates. The findings show that, statewide, the commercial sector comprises 48.8% (17,358,359 tonnes), the residential sector represents 38.1% (13,525,504 tonnes) and the self-haul sector is responsible for the remaining 13.1 % (4,651,591 tonnes).

2.3.2 Method

Twelve-hundred samples were chosen from among the 26 business groups. This ensured that the minimum number of samples required by the *California Uniform Waste Disposal Characterisation Method* were collected from each business group. The samples were further allocated among the five regions of the state based on the relative contribution of each region to the statewide employment in each business group. Within each region, samples were allocated evenly between the two sampling seasons. For the Southern and Bay Area regions, two waste sheds were sampled during each season. Therefore, samples

[7] California Integrated Waste Management Board, 1999, Statewide Waste Characterisation Study

were further allocated among waste sheds based on the relative contribution of each waste shed to the regional employment in each business group.

Within each business group in each waste shed, samples were distributed so that the majority of the samples were drawn from businesses that contribute large amounts of waste. This was accomplished using the 80/20 rule as a guide. This rule states that generally, 80% of the waste disposed by a group came from the largest businesses which make up about 20% of the group, and 20% of the waste came from the remaining 80% of the (smaller) businesses.

Specific businesses were selected randomly using NameFinders, a research organisation that uses Dun and Bradstreet business data. Over 10,000 business names were obtained to draw from, in order to ensure that a minimum of 1,200 samples could be collected.

Samples of commercial waste were obtained at generator sites (the sites of individual businesses, organisations, and institutions) after arrangements were made with the managers of each site. In total, 1,207 waste samples were collected from generators belonging to the 26 industry groups. There were 532 samples in the winter and 675 samples in the summer.

Following the completion of each season of commercial generator sampling, subcontractor Veterans Assistance Network (VAN) contacted each of the sampled business sites to verify its SIC classification, and the number of employees working at the site.

2.3.3 Results

Composition results for commercial waste are presented in Appendix B and summarised in Table 2.3 and Figure 2.3. The overall commercial composition was developed by aggregating data from each of the 26 industry groups. The material class 'Paper' accounts for approximately 39% of disposed commercial waste, and the class 'Other Organic' accounts for about 31% ('Other Organic' waste includes materials such as food, yard waste, textiles, carpet, and rubber).

Material	Estimated Percentage
Paper	39.0%
Other Organic	31.3%
Plastic	9.8%
Construction and Demolition	6.4%
Metals	6.0%
Special Waste	4.1%
Glass	2.4%
Mixed Residue	0.5%
Household Hazardous Waste	0.3%

Table 2.3: Summary of Composition Study from California, 1999

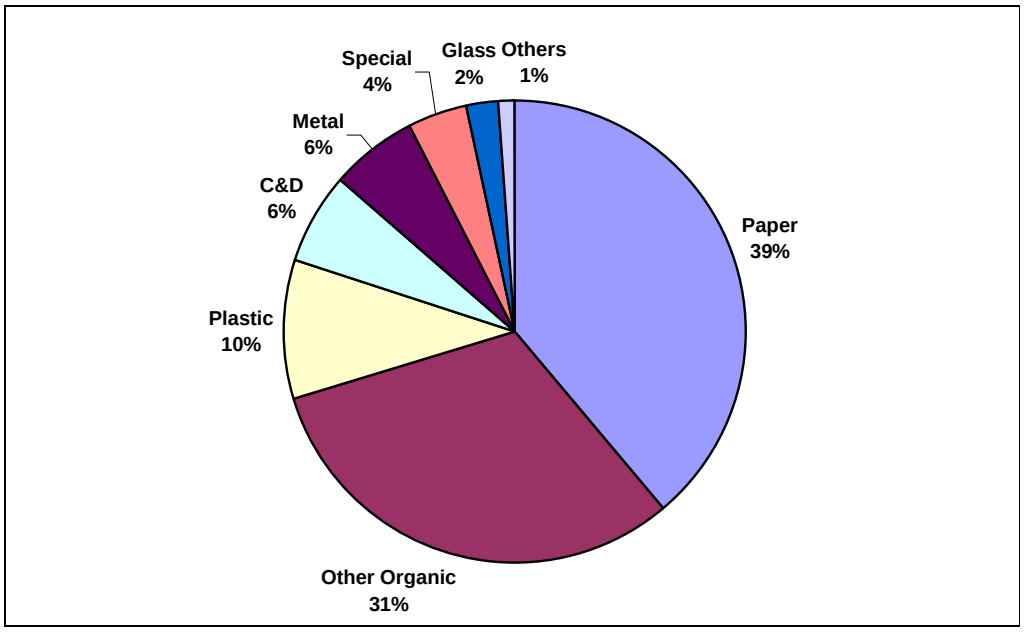


Figure 2.3: Material Classes in the Commercial Disposed Waste Stream, California 1999

Together, materials from the 'Paper' and 'Other Organic' waste classes comprise eight of the top ten materials in commercial waste. Table 2.4 presents the materials that account for approximately 68% of commercial waste.

Material Type	Class	Estimated %
Food	Other Organic	16.3%
Remainder/Composite Paper	Paper	13.2%
Leaves & Grass	Other Organic	6.9%
Uncoated Corrugated Cardboard	Paper	6.6%
Other Miscellaneous Paper	Paper	5.0%
Remainder/Composite Organic	Other Organic	4.6%
Film Plastic	Plastic	4.5%
White Ledger Paper	Paper	4.2%
Lumber	C&D	3.8%
Newspaper	Paper	3.6%

Table 2.4: Most Prevalent Materials in Commercial Waste

2.4 Alameda County, USA

2.4.1 Background

A waste characterisation study[8] was performed in 1995/96 in Alameda County, California. Alameda County is situated along the eastern shore of San Francisco Bay, across from the San Francisco peninsula and the City of San Francisco. The County includes Oakland, Fremont, Hayward, and Berkeley as its largest cities. The County has a strong and diversified commercial and light industrial base.

2.4.2 Method

The study characterises municipal solid waste (MSW) from each of 17 jurisdictions in the County and from the County as a whole. Information sources for the characterisation include:

- weight measurements made on incoming waste loads as reported by the disposal and transfer facility operators and
- composition measurements based on an extensive waste sampling and sorting program performed by the study team.

A total of 1,046 hand-sorted samples were collected using the American Society for Testing and Materials procedure (D 5231-92) and an additional 739 visual composition estimates were made on relatively homogeneous loads. In order to reduce the potential for seasonal biases, sampling was performed four times (quarterly) in a 12-month period. The study characterises discarded wastes only, which in Alameda County are disposed by landfilling. Characterisation of wastes diverted from landfilling was not a part of this study.

2.4.3 Results

A countywide summary of the estimated waste compositions for commercial waste is presented in Appendix C and D and summarised in Table 2.5 and Figure 2.4:

Material	Commercial Average Waste Composition (Weight Percent)
Paper	36.89
Organics	31.84
Plastic	12.02
Other Waste	6.07
Metals	5.29
Yard Waste	4.92
Glass	2.98

Table 2.5: Summary of Composition Study from Alameda County, 1995/96

[8] Alameda County Waste Management Authority and Alameda County Source Reduction and Recycling Board, 1996, Alameda County Waste Characterisation Study

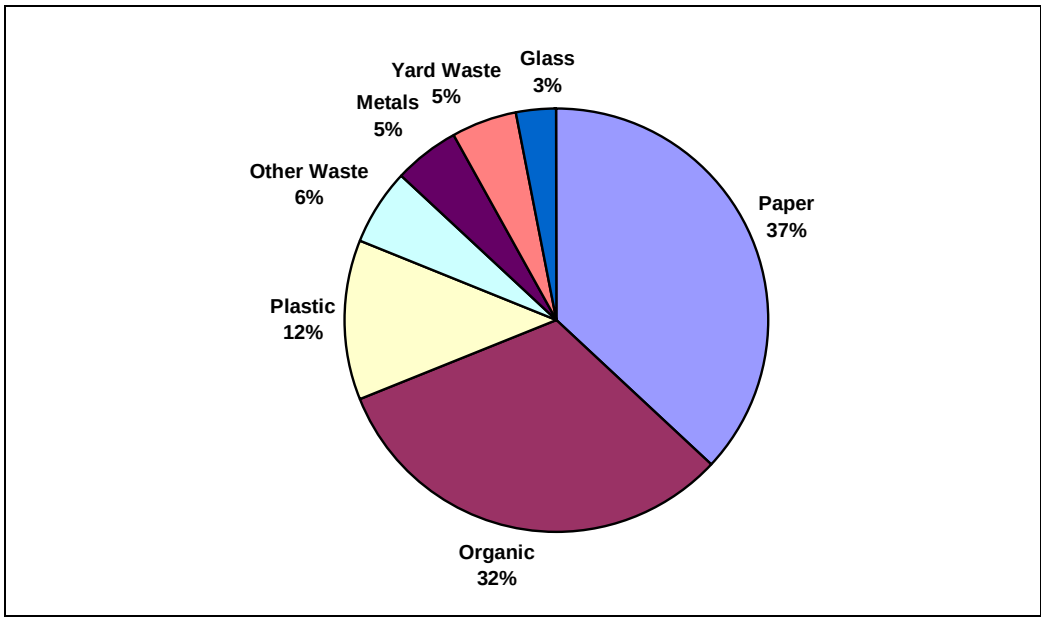


Figure 2.4: Commercial Waste Composition, Alameda County California, 1996

The 1996 Alameda County Waste Characterisation Study was one of the largest such studies ever conducted in the United States. The study results served as a useful tool for integrated waste management planning efforts in the County. In addition, the results provided a benchmark for analysing trends in the waste stream over time, both for current and future use.

2.5 Alberta, Canada

2.5.1 Results

Sources of waste materials in Alberta[9] comprise residential (33%), C&D waste (27%) and industrial/commercial/institutional (40%). The average industrial/commercial/institutional composition (% by weight) is provided below:

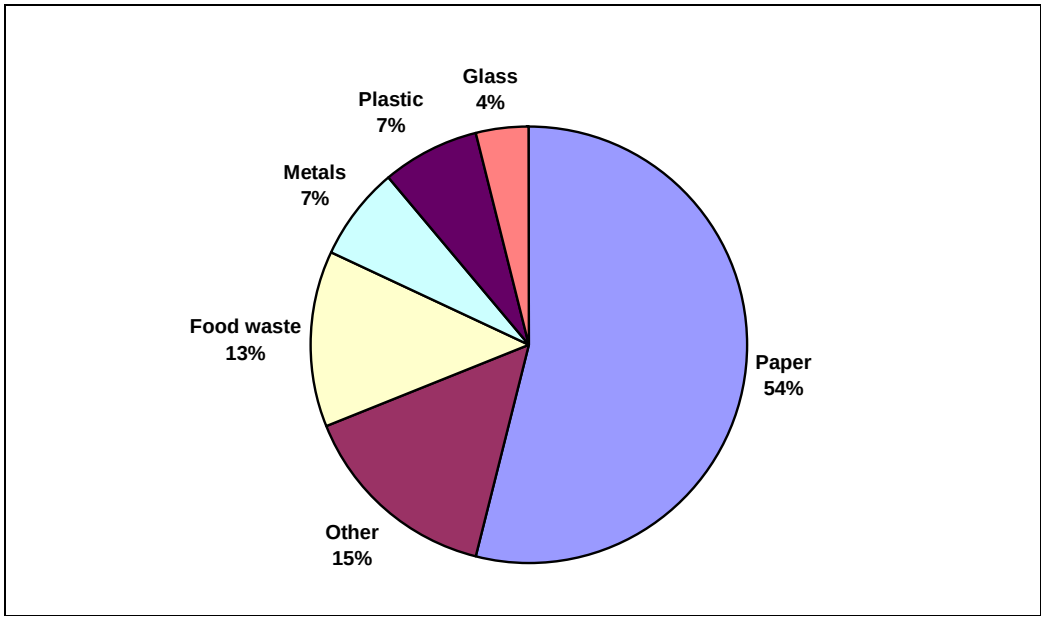


Figure 3.5: Average Industrial/Commercial/Institutional Composition, Alberta Canada 1997

2.6 Sydney, Australia

2.6.1 Background

In 1998, the first Waste Plan for the Inner Sydney Waste Region[10] was prepared. It set out a 10-year vision of sustainable waste minimisation and outlined an integrated program to achieve the New South Wales Government's stated objective, to reduce the amount of material going into landfill by 60% by the year 2000. The Plan set out a range of programs that cover the municipal, commercial and industrial, and construction and demolition waste streams in the Region. These programs were developed in partnership with the councils, industry and the community.

2.6.2 Results

Sources of waste materials in the Inner Sydney Region comprise 60% Construction and Demolition (410,000 tonnes), 26% Commercial and Industrial (180,000 tonnes) and 14% Council (100,000 tonnes). For 'Commercial and Industrial Waste' the largest contributors are food and other retailers, manufacturing and transport operations and the hospitality sector - hotels, cafes and restaurants. Figure 3.6 shows most of this waste stream is food and kitchen waste (20%), soil and concrete (16%), paper and cardboard (9%) and wood and timber (8%).

[9] Government of Alberta, Canada, 1997, Sources of Waste Materials Generated in Alberta
[10] Inner Sydney Waste Board, 1998, Regional Waste Plan 1998

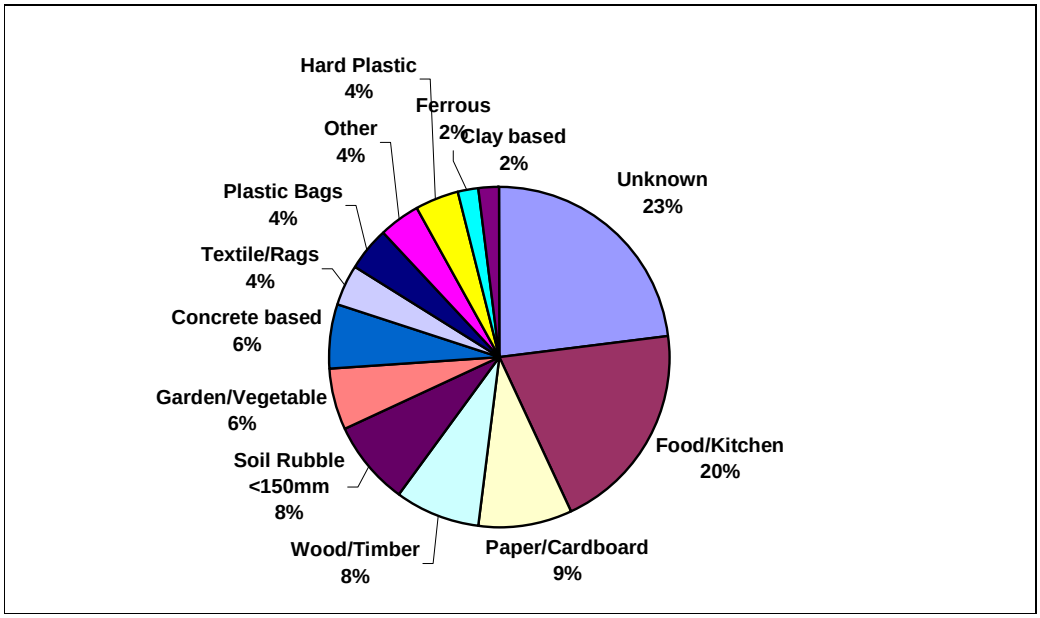


Figure 2.6: Commercial & Industrial Waste Composition, Inner Sydney Waste Region 1998

Analysis of waste sources in Sydney since 1970 has revealed that a Pareto Principle applies, in which 80% of waste is generated by 20% of business premises. It is estimated that the 1,400 business operations in the Region with 20 or more staff (excluding offices) produce some 65% of the commercial and industrial waste.

Further information on these and other international methodologies are outlined in Appendix E.

2.7 England and Wales

2.7.1 Background

In 1999, the Environment Agency (EA) conducted a National Waste Production Survey in order to obtain information on both the types and the total quantities of waste generated by the industrial and commercial sectors in England and Wales. At the time, the survey was thought to have been the largest of its kind in Europe. Approximately 20,000 companies were surveyed regarding the types and quantities of waste they produced, methods of disposal or recovery employed and the disposal cost incurred or any income generated from recovery. The data gathered was used subsequently in DEFRA's Waste Strategy 2000, in the EA's regional Strategic Waste Management Assessments and the EA's Waste Statistics for England and Wales 1998/99.

2.7.2 Method

The sample criteria for the survey were business sector, company size and location. The sample was deliberately biased so as to include a higher proportion of large companies and manufacturers. The EA conducted 12,000 company visits while an additional 8,000 companies were interviewed by telephone by a contracted company. A standard questionnaire was used to gather the required information. For companies which could be found, a response rate of nearly 90% was achieved. Response rates for the telephone survey were lower (approximately 40%). The quality of data collected was generally high

and around 18,600 useable responses were obtained from the original 20,000 companies identified.

The total national waste arisings were estimated using the survey data, the national population statistics and a number of complex statistical methods. These statistical methods were developed to process the data and estimate a range of figures including the types and quantities of waste generated by business sectors and region/sub-region. Finally, grossing up, was used to calculate the overall total waste generated using the following steps:

- companies were divided into 32 sectors based on the European NACE code system.
- the population was grouped based on employment sectors and company employee numbers,
- the average weight of waste for each site in each category was calculated,
- the average weight per site was multiplied by the number of similar sites in the population to estimate the total waste for each site category and
- the results for each category were added to calculate the total waste generated.

2.7.3 Results

The survey calculated that in 1998/99, the industrial sector generated over 50 million tonnes of waste while the commercial sector created almost 25 million tonnes as shown in Table 2.6.

Of the commercial waste, 'retail (others)', 'travel agents, other business and others', 'hotels - catering' and 'wholesale' accounted for over 70% of waste arisings.

In addition, the composition of the commercial waste stream comprised of 73% 'general, industrial and commercial', 10.1% 'paper and card' and 7.7% 'other general and biodegradable'. The remainder consisted of inert/C&D, food, metals and scrap equipment, contaminated general, mineral wastes & residues and chemical & other.

	Business sector / waste type	Inert/C&D	Paper & card	Food	General Industrial & Commercial	Other general & biodegradable	Metals & scrap equipment	Contaminated general	Mineral wastes & residues	Chemical & other	**Total**
	Industry										
1	Food, drink and tobacco	435	233	1,939	1,076	2,118	67	417	8	909	**7,203**
2.1	Textiles	1	60	1	321	97	5	49	2	11	**548**
2.2	Wearing apparel	0	11	1	171	16	1	6		0	**207**
2.3	Leather, luggage, handbags and footwea	8	5		69	99	1	56		18	**255**
2.4	Wood and wood products	29	22	0	230	763	6	5	0	9	**1,064**
2.5	Pulp, paper and paper products	5	409	3	469	1,165	12	15	34	155	**2,265**
2.6	Publishing, printing and recordin	2	1,056	2	699	78	28	22	1	46	**1,935**
3.1	Chemicals and chemical products	214	21	3	234	605	376	698	134	1,585	**3,870**
3.2	Cleaning products, man-made fibres etc	10	44	2	148	90	24	72	6	159	**555**
3.3	Rubber and plastic products	69	91	2	572	446	55	33	3	69	**1,339**
3.4	Other non-metallic mineral product	957	37	1	402	68	36	174	443	98	**2,217**
4.1	Basic metals	173	26	1	268	77	1,066	720	6,218	559	**9,108**
4.2	Fabricated metal products	16	25	0	631	57	835	78	11	120	**1,774**
5.1	Machinery and equipmen	24	36	3	466	71	571	123	13	159	**1,467**
5.2	Office machinery, computers and electrica	11	46	2	262	32	270	14	11	22	**670**
5.3	Radio, television and communicatio	8	21	1	114	55	13	3	0	30	**244**
5.4	Medical and optical instruments and clock	1	10	2	166	6	17	11	0	7	**219**
5.5	Motor vehicles	9	31	2	323	81	512	43	1	281	**1,283**
5.6	Other transport equipmen	2	10	1	168	36	126	432		50	**825**
5.7	Furniture and other manufacturin	4	56	1	442	446	47	207	22	27	**1,252**
6	Coke, oil, gas, electricity, wate	131	23	3	298	44	50	17	5,821	198	**6,585**
7	Transport, storage, communication	11	349	208	1,673	310	119	71	0	525	**3,266**
8	Miscellaneous	55	123	9	1,047	112	18	11	56	512	**1,942**
	Total	**2,176**	**2,744**	**2,185**	**10,248**	**6,873**	**4,254**	**3,278**	**12,785**	**5,549**	**50,090**
	Commerce										
9	Wholesale	7	539	54	2,098	306	149	26	1	113	**3,293**
10	Retail - motor vehicles, parts and fue	6	62	0	654	171	125	12	0	67	**1,097**
10	Retail - others	10	951	253	3,515	329	49	511	1	35	**5,654**
11	Hotels, catering	47	126	10	3,083	199	51	63	1	16	**3,596**
12	Finance	8	173	4	653	7	10	6	0	5	**865**
13	Education	32	78	41	1,681	370	24	13	0	11	**2,251**
14	Travel agents, other business and other	71	305	19	3,977	333	64	71	7	40	**4,887**
14	Real estate and computer	2	63	2	877	40	14	9	0	5	**1,013**
14	Social work and public administratio	19	206	20	1,566	156	51	23	9	96	**2,146**
	Total	**203**	**2,502**	**404**	**18,105**	**1,911**	**537**	**734**	**19**	**388**	**24,802**
	National total	**2,379**	**5,245**	**2,589**	**28,353**	**8,784**	**4,790**	**4,012**	**12,804**	**5,936**	**74,892**

These data are rounded to the nearest 1,000; zeros indicate values more than 0 but less than 500 (i.e don't round up to 1,000); totals are correct but because of rounding errors may n always equal the sum of entries in the column

Table 2.6: Industrial & Commercial Waste Data in 000s tonnes for England & Wales

2.8 Additional Comments Re Europe (from ETC/W studies)

Data on the generation of waste from commerce and service activities are very scarce and connected with substantial uncertainties. This is due to the fact that commercial waste is partly collected as municipal waste and partly as industrial/commercial waste. Even countries with well-developed data registration systems on waste have difficulties in distinguishing waste from commerce and household waste, because the waste often is collected simultaneously (by the municipality or on behalf of the municipality). For example, restaurants will to some extent use public containers for paper and glass and similarly, the same truck that collects waste from the surrounding residential area often collects mixed waste from shops and small businesses. When the waste arrives at the recycling plant it is more or less impossible to trace the source.

Table 2.7 shows the available data on the generation of commercial waste in different countries[11]. As it appears, there are huge variations in the waste generation and the data availability from one country to another. The disparity between the figures reflects to a great extent differences in registration and classification of commercial waste. For example, the figures for some countries include construction and demolition waste.

Waste from hospitals is not included in the table, even though it is included in the definition of waste from commercial and service activities. This is due to the fact that figures on hospital waste are even more scarce than on other commercial waste.

[11] Source: ETC/W, Generation of household waste and municipal waste in member countries of the European Environment agency (Comparability and non-comparability), 1998

Country	Year	Total amounts		Of which (1,000 tonnes)					
		1,000 tonnes	kg per capita	Bagged waste	Paper & cardboard	Glass & bottles	Metals	Food & garden waste	Other
Austria	1993	1,130	317						
Denmark	1994	225	49	76	103			75	1
	1995	418	80	73	181	38		123	3
	1996	357	68	46	173	38		103	3
France	1994	5,000							
	1995	5,200	87						
Germany	1993	7,389	97	7,839					
Ireland	1993			656	71	12	16		12
	1995	476	136	404	52	21			
Italy	1994	4,200	73						
Norway	1994	1,243	288						
	1995					2	28	23	53
	1996	1,476	339	1,202		2	40	31	146
Spain	1993					190			
	1994				1,823	213			
	1995				2,118	209			
	1996				2,125	236			
Netherlands	1993	878	57	425				453	
	1994	874	57	406				468	
	1995	854	55	371				483	
	1996	866	56	391				475	
United Kingdom	1995	2,120	37	2,010					
	1996	2,500	43	2,400					

Table 2.7: Waste from Commercial Activities

CHAPTER THREE: ASSESSMENT OF PREVIOUS & CURRENT STUDIES IN IRELAND

3.1 Historical Data

When this research work was carried out in 2000, national figures for the character of non-household municipal waste were based on those published in the 1998 National Waste Database Report. This information was based on four commercial waste composition surveys as outlined below:

- Shopping centre in Finglas, Dublin
- Large supermarket, Co. Kerry
- General commercial waste survey in Tralee, Co Kerry
- Commercial waste from office-based commercial activities

The results of these surveys are detailed in Table 3.1 and were used to produce an average compositional analysis for the 1998 report:

Material	Finglas Shopping Centre	Kerry Supermarket	Kerry General Commercial	Office Waste	Average
Paper	55.3%	70.4%	43.7%	65.0%	58.6%
Plastics	9.5%	8.5%	10.9%	13.6%	10.6%
Glass	4.8%	0.6%	7.1%	1.2%	3.4%
Ferrous Metals	0.7%	0.2%	1.9%	1.2%	1.0%
Aluminium	0.5%	0.5%	0.9%	0.6%	0.6%
Other Metals	0.0%	0.0%	0.2%	0.0%	0.1%
Textiles	0.0%	0.4%	1.1%	1.0%	0.6%
Organics	22.3%	12.0%	13.5%	12.6%	15.1%
Others	7.0%	7.4%	20.6%	4.7%	9.9%
	100%	**100%**	**100%**	**100%**	**100%**

Table 3.1: Summary of Commercial Waste Composition Surveys

It was argued, at the time of this research, that the 1998 compositional data on commercial waste was limited and did not reflect that character of commercial waste produced nationally because:

- The data represented is limited to a number of commercial sectors over a limited period (usually one day). While the data from the four surveys is not radically different, they cannot be safely used as being indicative of overall national commercial waste compositions.
- The data provides a reasonably accurate breakdown of waste composition for the sample date. However, the extrapolation of the data to a longer period of time (for example, a year) is not reliable.
- Due to the limited number of sectors and small sample sizes, reliable scale up to incorporate all sectors on a national level is not possible
- There is no correlation between the amounts generated in the different commercial sectors. The figures given relate only to the composition in the small outlets surveyed. In order to approximate the national arisings, it is necessary to estimate both the characterisation and the amounts generated from each sector.

- Many sectors, including hotels, restaurants, schools and hospitals were not surveyed. These sectors would be expected to generate large quantities of waste and to contain a high organic fraction.

The 2001 National waste database based its compositional data on a much wider range of surveys, including the current study.

3.2 Local Authority Data

In 2001, the EPA requested Local Authorities to submit waste composition surveys on household waste and on non-household municipal waste (NHMW) consigned to landfill. Five Local Authorities submitted waste characterisation data for NHMW:

- Cork County Council[12] submitted surveys on a hotel waste and waste arising from a number of retail outlets;
- Clare County Council[13] submitted data from a survey of 57 retail premises;
- Kildare County Council[14] submitted data from three pubs, three shops and a restaurant;
- Wicklow County Council[15] submitted data from a secondary school; and
- Offaly County Council[16] submitted data from three national schools.

The results of the waste composition surveys submitted by the Local Authorities in 2001 is presented in Table 3.2:

[12] Cork County Council, 2001, Waste Characterisation Study Spring 2001
[13] Clare County Council, 2001, Waste Characterisation Survey 2001
[14] Kildare County Council, 2001, Waste Characterisation Study Winter 2001
[15] Wicklow County Council, 2001, Muncipal Waste Characterisation Survey
[16] Offaly County Coucnil, 2002, Waste Characterisation Study Spring 2002

Material	Co. Cork (Non-distribution: Hotel)	Co. Cork (Retail)	Co. Kildare (Retail)	Co. Clare (Retail)	Co. Wicklow (School: Education)	Co. Offaly (Education)	Average[17]
Paper	3.4%	56.3%	29.9%	33.6%	25.2%	29.4%	29.6%
Cardboard	4.7%	4.3%	7.3%	11.2%	7.6%	4.2%	6.6%
Plastic	5.3%	10.6%	9.1%	10.7%	19.0%	15.7%	11.7%
Glass	38.0%	0.4%	2.2%	1.8%	1.1%	0.0%	7.3%
Metal	0.9%	1.5%	2.0%	4.0%	8.8%	2.9%	3.4%
Textile	0.4%	-	0.3%	4.1%	2.3%	0.0%	1.4%
Organic	44.2%	8.2%	37.6%	1.1%	31.0%	29.6%	25.3%
Composite	0.3%	-	2.0%	5.0%	2.5%	12.9%	4.5%
Unclassified Combustibles	0.7%	11.6%	3.4%	20.6%	0.0%	4.4%	6.8%
Unclassified Incombustibles	2.0%	7.1%	6.0%	2.1%	0.0%	0.5%	3.0%

Table 3.2: Summary of Local Authority Commercial Waste Composition Surveys

Details of the methodology used and the results from each of these studies is included in Appendix F.

3.3 Data From Green Flag Award and Green Schools Programme

A number of waste composition studies have been carried out throughout Ireland, in both primary and secondary schools, in connection with the 'Green Flag' award in Cork and the 'Green Schools Programme' throughout the rest of the country.

The *Green Schools Programme* is a European-wide environmental education programme, which aims to promote and acknowledge environmental action programmes. The programme is both an education project and an award scheme and will help pupils to recognise the importance of environmental issues. Green-Schools is operated in Ireland by An Taisce (The National Trust for Ireland) in partnership with Local Authorities.

The *Green Flag Scheme* for schools recognises the efforts of students to improve their school environment by implementing a waste management scheme. The applicants generally:

a) perform an audit of waste production and

b) examine the purchasing policy in their school.

They are then required to improve their current situation through the implementation of some waste management measures (e.g. purchase of recycled goods, implementation of

[17] Due to the wide variation between different sectors the average value has little meaning, but is merely indicative.

composting schemes, etc.). Cork County Council and Cork Corporation have integrating An Taisce's Green-Schools programme into their environmental education campaigns.

In the Cork area, waste characterisation studies have been conducted in a number of schools, as detailed in Appendix G.

CHAPTER FOUR: PREPARATION OF CHARACTERISATION METHODOLOGY

CTC has devised a methodology to characterise the waste from the non household municipal sectors. In order to achieve this, a number of methodologies for the characterisation of waste currently used in Ireland and abroad were examined.

4.1 Existing Irish Methodology

In Ireland, the current commercial waste characterisation methodology is outlined in the EPA document '*Municipal Waste Characterisation*'[18]. This document sets out a standard procedure to conduct commercial surveys. This methodology is based on selecting a waste sample from the retail trade, wholesale trade, non-distribution or education sector. The sample size of the collected sample is reduced by coning and quartering. The larger items in the waste sample are then sorted. The remainder of the sample is finally sieved. This methodology requires the waste to be sorted into 55 different components.

The methodology outlined in '*Municipal Waste Characterisation*' yields very detailed results of waste composition - for example plastics are characterised into 11 different types. This methodology has been used by a number of local authorities to characterise commercial waste (as detailed in Chapter 3). However, there are a number of concerns with this methodology:

- Due to the high level of detail required for each sample sort, only a limited number of surveys have been conducted to date.
- This methodology is labour and time intensive.
- The non-household municipal waste sector is broken down into four broad categories. This has focused past studies on retail trade, supermarkets, hotels, offices and schools. Other important sectors such as hospitals and airports were not included.
- The methodology does not specify the duration of the waste characterisation survey. Surveys to date have consisted of individual grab samples. Therefore the results are reflective of the waste character on a particular day and do not account for:
    - variations in commercial waste composition which arise from changes in business activity over longer time periods, or
    - the occasional waste streams arising from occasional activities such as stocktaking or maintenance.

  Waste characterisation surveys are best carried out over as long a period as practical and should include checks for registering wastes disposed of on a periodic basis.
- The level of recycling in an organisation is not addressed. This may affect the results when comparing waste composition results within a sector. For example, two hotels producing the same waste will display different results using this methodology if one recycles a large proportion of their waste. This inaccuracy occurs since the surveys are conducted off-site on waste intended for disposal only.
- The 'Coning and Quartering' technique has its limitations with regard to characterising commercial waste.
- The technique requires that the waste stream be homogenously mixed before it is quartered. While this may be reasonably feasible for household waste which consists of small waste items this is less feasible for commercial waste which consists of large

[18] EPA, 1996,'Muncipal Waste Characterisation'

bulky items such as pallets and cardboard. Quartering such a waste stream will lead to uneven division of material types and to inaccurate characterisation.

- Commercial waste is often segregated at source into a number of waste types. It does not make any sense to combine these waste streams so that one can attempt to segregate them again for characterisation purposes.
- Combining dry waste streams with wet waste streams, such as food waste, results in the dry waste materials becoming contaminated with wet waste. Once this occurs its is not possible to accurately determine individual waste material weights and thus characterisation is impossible.

Bearing these factors in mind the Clean Technology Centre proposes a new methodology which will attempt to overcome the inadequacies of the current methodology.

4.2 Proposed Methodology

CTC has devised a methodology to characterise commercial waste. This methodology was developed after an extensive review of existing waste characterisation practices in Ireland and abroad.

4.2.1 Background

The waste arising from any commercial sector can be broadly divided into mixed waste and segregated waste as outlined in Figure 4.1.

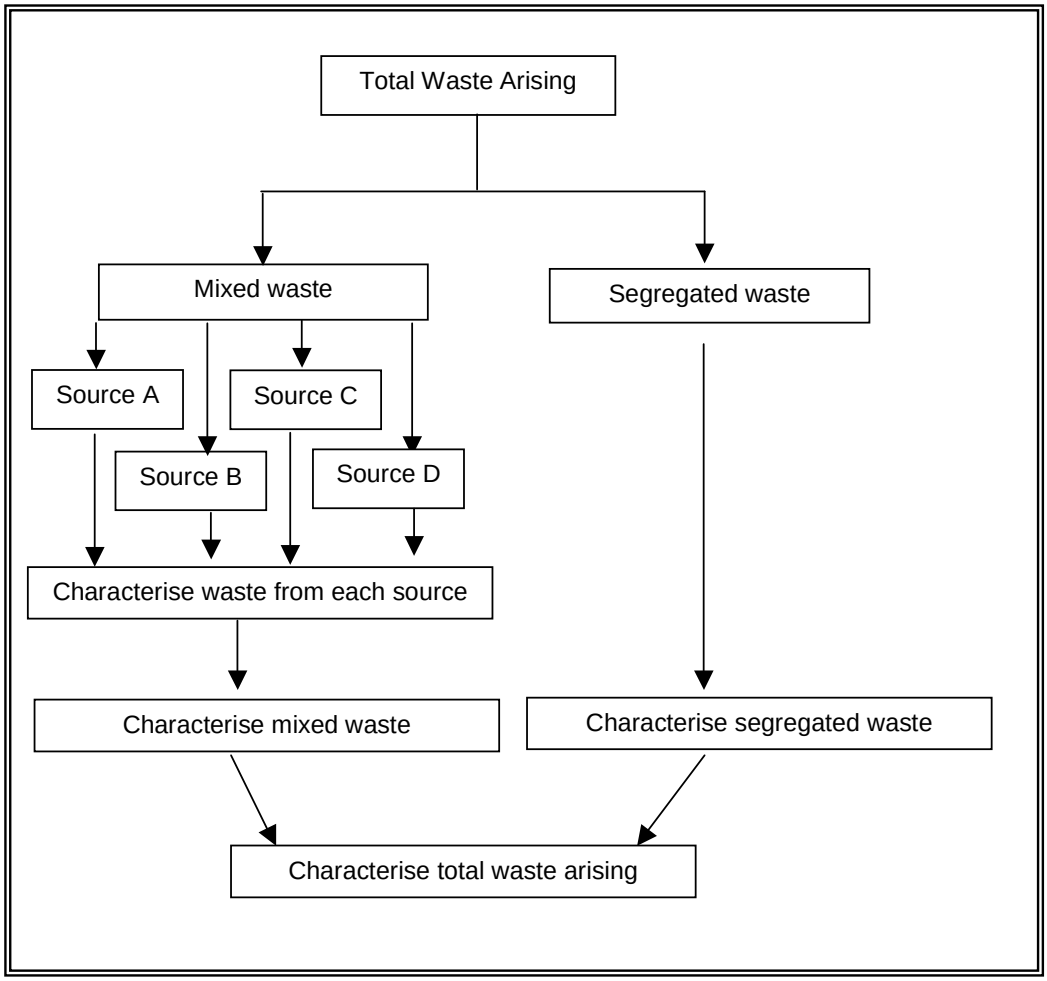


Figure 4.1 Flow Diagram of Waste Characterisation Methodology Steps

Although the volume of mixed waste is usually known from waste disposal records the composition of this waste stream is often difficult to determine. Mixed waste consists of a wide number of waste materials and will vary in composition depending on the nature of the enterprise and its activities. For example the mixed waste stream arising from a hotel will contain a higher percentage of food waste than that from a public office. Mixed wastes also vary in character within an enterprise. For example, the waste from the kitchen of a hotel will vary considerably in composition to the waste arising from the bedrooms of the same hotel.

Wastes streams that are easily segregated include waste paper, cardboard, glass and metal. These segregated waste streams are often collected and sent for recycling. For the purposes of this study, the segregated waste is further sub-divided and characterised.

This methodology requires that a waste characterisation survey of all the major waste sources within an organisation be conducted. The number of sources in an organisation will depend on the complexity of the activities and the associated waste. For example, waste from a hotel might be grouped into waste arising from the kitchen area, bedroom area, office and bar.

Qualitative and quantitative data on the character of the waste arising from the main sources can be gathered to calculate the character of the total waste stream.

4.2.2 Before the Survey Begins

Before beginning the waste characterisation survey there are a number of tasks which need to be conducted. These are outlined below:

1. **Meet with the management** of the enterprise whose waste is to be characterised. It is essential that management commitment is given to the waste characterisation study so that necessary resources are assigned during the study period.
2. Schedule the waste characterisation survey period:
    - Arrange to conduct the waste characterisation study during **typical business activities/operations**. Avoid scheduling the survey on or around any special events that would produce wastes not representative of a normal workday/workweek. For example, surveys should not be conducted during bank holidays, Christmas, Easter or public holidays.
    - It is also important to select a survey **time period that is sufficiently long** to account for fluctuations in waste character and volume that occur in an organisation. For example the volume of waste produced from a hotel may increase at weekends. The recommended duration for the survey is 5 to 7 days. However the longer the survey period, the more accurate and reflective will be the results (The spreadsheets have been developed to store data for a maximum 7-day survey period).
3. Divide the organisation into **areas with similar waste composition** (these are referred to as 'Waste Sources' for the purpose of this methodology). The number of sources will depend on the complexity of the organisation. (The spreadsheets have been developed to store data for a maximum of six 'waste sources' for any organisation).
    - For example, waste arising from a small green grocer may be split into two waste areas: office and warehouse/shop-floor. Each of these 'waste sources' has a different waste composition – office (mostly waste paper), warehouse/shop floor (mostly organic waste and cardboard).
    - For example, waste arising from hotel bedrooms will be similar in composition. Bedrooms are then chosen as a 'waste source' within hotels from which a specific character of waste arises.
4. **Inform relevant staff** of their duties and responsibilities during the waste characterisation survey. They may be required to segregate waste, label waste arisings, etc.
    - Staff should be encouraged to segregate as many waste streams as possible at each 'waste source' for the duration of the waste study. Staff should be encouraged to segregate waste streams which may not normally be segregated, for the duration of the waste study.

- It is especially important to segregate 'wet' wastes (high water content, for example food waste) from 'dry' wastes. Combining 'wet' waste streams with 'dry' waste streams, results in moisture transfer and contamination of the waste. Once this occurs its is impossible to accurately determine individual waste material weights and thus characterisation is more difficult.
- Staff should be discouraged from disposing of non-routine waste during the course of the study, for example, stockpiled electronic waste.

5. **Select a central 'waste collection area'** where all waste arisings can be collected, sorted weighed and characterised for the duration of the waste characterisation study. A parking garage, shipping area or other large flat area is preferable. This area should be covered, if possible to provide shelter from adverse weather conditions.
6. **Gather the necessary equipment** to aid in the waste characterisation survey.
   - Transparent waste bags/boxes should be available at each 'waste source' to allow wastes to be collected. Pens and labels should also be distributed to each 'waste source'.
   - The 'waste collection area' should contain a weighing scales (with a range of 0.1 kg to 20kg), several containers for holding and sorting the waste, shovels, a brush, a first aid kit, clipboard, labels, pens and worksheets. Several copies of the 'Waste Collection Area Worksheets' available in Appendix H should be on hand for each day of the survey.
   - Health and safety issues should also be considered. All members of the waste characterisation team should wear protective clothing (such as rubber gloves, heavy duty shoes, safety glasses and coveralls) and precautions should be taken to ensure that the waste does not come into contact with food or drink.

4.2.3 Conducting the Survey

Once these tasks have been addressed, the waste characterisation survey may begin. At each 'waste source', two categories of waste will be generated:

(a) Segregated waste streams – This waste stream will be homogenous and consist of material of a single type, for example cardboard, paper, plastic, food waste etc.

(b) Mixed waste streams – This waste stream will be heterogeneous in nature and consist of mixed waste of various types. The characterisation of this waste stream is more difficult.

The procedure involved in characterising each of these waste streams is presented below. Refer to Appendix H for 'Waste Collection Area Worksheets'.

<u>Segregated waste</u>

1. ***All*** segregated waste must be sorted and weighed.
2. Segregated wastes can be **sorted** easily. All segregated wastes should be sorted into the materials listed in the '*Waste Collection Area Worksheet – Segregated Sheet (1 of 1)*'. For example, waste glass must be sorted into 'glass packaging' and 'other glass'.
3. Each of these fractions must be weighed independently and the total values recorded (excluding the weight of the container) in the '*Waste Collection Area Worksheet – Segregated Sheet (1 of 1)*'.

Mixed waste

1. As the mixed waste is collected at each 'waste source', each bag/box of **waste should be labelled** with the day/date and source of the waste, as follows:

MIXED WASTE	
Day/Date	*Thurs 20th May 04*
Waste Source	*Restaurant*

2. As the labelled mixed waste arrives at the 'waste collection area' **all waste bags/boxes** should be weighed and the details recorded in the '*Waste Collection Area Worksheet – Mixed Waste Sheet (1 of 2)*'.
3. Only ***representative samples*** of mixed waste must be sorted and weighed.
    - During the survey period randomly take samples of mixed waste (>10kg) from each of the 'waste sources'.
    - The number of samples, which are sorted and characterised from each 'waste source', should be representative of the total volume of waste produced from each 'waste source'. For example, if ten bags of mixed waste arise from the offices of an organisation per day and only two bags of mixed waste are produced from the canteen then the sampling regime should reflect this ratio.
    - The greater the number of mixed waste samples which are characterised, the more accurate the results will be. Attempt to characterise as many samples as time allows.

Ideally a segregation analysis should be carried out repeatedly for each mixed waste source.

The frequency of sampling should be sufficient to ensure that the samples are statistically representative of the entire population. For example, if 3 bags per day are opened from a population of 15, then it is important to know that the sampling regime is adequate. A simple method is to determine the mean and standard deviation (SD) over a number of days. If the ratio of SD:mean is small (say less than 15%-20% of mean), then the sample size is acceptable. More rigorous statistical techniques are available (e.g. student's-t) but are probably unnecessary.

To calculate a 95% confidence interval for the mean of a population, greater than 30 samples should be taken as a rough guide[19]. However, this will obviously result in an increased workload.

4. The waste samples can then be **sorted**.
    - Sort the mixed waste into the waste materials specified in the '*Waste Collection Area Worksheet – Mixed Waste Sheet (2 of 2)*'. For example, waste wood must be sorted into 'wood packaging' and 'other wood'.
    - Each of these fractions must be weighed independently and the total values recorded (excluding the weight of the container) in the '*Waste Collection Area Worksheet – Mixed Waste Sheet (2 of 2)*'.

[19] D.G. Rees, 2001. Essential Statistics (4th Edition), Chapman and Hall Page 120

4.2.4 After the Survey

Following the waste characterisation survey, the collected data must be compiled into a useful format. The steps involved are different for mixed wastes and segregated waste.

Segregated waste

1. From the '*Waste Collection Area Worksheet – Segregated Waste Sheet (1 of 1)*', the daily totals of each material generated should be calculated.
2. The daily totals of segregated waste for each waste material should be transferred on to the 'Segregated Waste' tab of the electronic spreadsheet (see Appendix I).

Mixed waste

Each 'waste source' needs to be calculated separately. Up to six 'waste sources' can be entered onto the electronic spreadsheet. Enter data for each waste source into a separate spreadsheet.

1. Determine total quantity generated from each 'waste source' (for example the canteen)
    - From the '*Waste Collection Area Worksheet – Mixed Waste Sheet (1 of 2)*', the total quantity of mixed waste generated each day from each 'waste source' must be calculated, for example total daily waste arisings from the canteen of 154 Kg.
    - This figure should be input into 'Total Waste Arising (sampled & non-sampled) box for each 'waste source' (i.e. canteen) in the electronic spreadsheet.
2. Determine composition of sorted mixed waste from each 'waste source' (for example the canteen)
    - From the '*Waste Collection Area Worksheet – Mixed Waste Sheet (2 of 2)'*, the daily totals of sorted mixed waste should be calculated
    - The daily totals of mixed sorted waste for each waste material should be transferred on to the 'Mixed Waste' tabs of the electronic spreadsheet (maximum of six 'waste sources'). See Appendix I. For example, mixed waste arising from the offices of an organisation will be input into a different 'mixed waste' tab than mixed waste arising from the canteen.
    - The spreadsheets will then automatically calculate the composition of the waste (segregated waste and mixed waste) and the totals are presented in the 'Summary' tab of the electronic spreadsheet (see Appendix I).

Establish the frequency of non-routine waste and record these details. Non-routine wastes arise as a result of non-routine activities such as stock clearance, maintenance, refurbishment of premises and so on. These waste are not typical of the daily wastes arising on site and may include waste such as construction and demolition waste, obsolete electrical equipment, obsolete furniture and so on. Based on this data, daily estimates of non-routine waste should be estimated and inserted onto the spreadsheet.

CHAPTER FIVE: SEGMENTATION OF ECONOMIC SECTORS

From the NHMW composition studies conducted abroad, a number of sectors were identified as contributing the largest proportion of the waste stream. These included the hospitality sector – hotels and restaurants, medical/health sector, retail sectors and transport operations. The initial phase of this study focused on developing a methodology to determine the most significant commercial waste sectors in Ireland.

5.1 Sector Coding System

In order to divide the various NHMW generators into specific sectors for the purposes of waste characterisation, the European NACE code system[20] was adopted. The NACE-code system is based on the European standard for industry classifications and was introduced in 1970. In 1990, a revised version became available. The 16 markets (manufacturers, agriculture, etc.) are denoted by letters from A to Q, as listed in Table 5.1:

NACE Code	Industry
A	Agriculture, hunting and forestry
B	Fishing
C	Mining and quarrying
D	Manufacturing
E	Electricity, gas and water supply
F	Construction
G	Wholesale and retail trade; repair of motor vehicles, motorcycles & personal and household goods
H	Hotels and restaurants
I	Transport, storage and communication
J	Financial intermediation
K	Real estate, renting and business activities
L	Public administration and defence; compulsory social security
M	Education
N	Health and social work
O	Other community, social and personal service activities
P & Q	Private households with employed persons/extra-territorial organizations & bodies

Table 5.1: NACE Codes and Industry List

These groups can be subdivided into a further 59 principal groups have been given two-digit NACE codes, which can then be subdivided into 640 individual groups (four-digit NACE codes). Therefore, each NACE code has a number of sub sectors. For example NACE code H (Hotels and Restaurants) has a number of sub-sectors including hotels, restaurants, bars, camping sites and hostels.

[20] European NACE Code System

5.2 Determination of Predominant NHMW Waste Generator Sectors

At the inception of this study it was considered that the majority of non-household municipal waste arose from the commercial sectors represented by NACE codes G to O. It was also understood that a quantity of NHMW arose from industry represented by NACE codes A to F.

As quantities and character of industrial waste were already reported to the EPA using the codes from Chapter 15 and Chapter 20 of the EWC (European Waste Catalogue) it was considered that the focus of this study should be on the characterisation of commercial waste sectors represented by NACE codes G to O.

For the purposes of this research a limited list of twenty-one commercial sectors were identified from NACE code sectors G to O, as outlined in Table 5.2. This limited number of sectors were chosen on the basis that:

a) they represent a significant commercial sector in the Irish economy and

b) the anticipated character of the waste arising from the selected sectors should represent waste arising from that NACE code.

Where variations in the character of waste within a NACE sector were expected a number of sub sectors within the NACE code were chosen for the purpose of waste characterisation. For example NACE code sector G was divided into 10 sub-sectors, as it is believed that each sub sector is significant and produces a distinctive waste. On the other hand, it was decided to combine NACE sectors J and K at this stage as both sectors primarily produce office waste.

Of course the selection of additional sectors could add to the accuracy of the waste characterisation study. However the number of sectors that can be surveyed is limited by time and resources. Should this methodology be adopted for further studies where more resources are available additional sectors can be selected and surveyed.

	Preliminary List of Commercial Sectors	NACE code
1	Supermarkets	G
2	Grocery Shops	G
3	Wholesale Distribution (including agriculture and food)	G
4	Electrical Goods Retailers	G
5	Filling Stations (and other fuel retailers)	G
6	Other Retailers	G
7	Motor Sales	G
8	Vehicle Repair	G
9	Repair Of Other Goods (electrical, shoes etc)	G
10	Hotels	H
11	Guesthouse/Other Accommodation	H
12	Restaurants	H
13	Pubs	H
14	Transport & Communication Services (taxis, trains, port authorities, post offices, TV and telecommunications)	I
15	Financial Services (banks, credit unions, insurance, solicitors, estate agents, auctioneers, etc.)	J/K
16	Public Offices (local authorities, tax offices, etc.)	L
17	Schools (primary and secondary)	M
18	Colleges	M
19	Hospitals	N
20	Other Health Services (GP's, dentists, vets.)	N
21	Recreational & Sporting (cinemas, ballrooms, betting premises, amusement arcades)	O

Table 5.2: List of Selected Commercial Sectors

IPODEC Ireland were partners in this study. They operate nationally and currently hold a large share of the waste collection business in Dublin, Cork, Limerick and Waterford.

At IPODEC Limerick, IPODEC Waterford and IPODEC Dublin:

- Each site independently quantified the waste collected in their area for each of the twenty-one commercial sectors identified above based on actual tonnages measured at their weigh bridges (for example, IPODEC Limerick collected 20 tonnes[21] of waste from supermarkets per annum).
- Each facility then estimated their business share of each of the twenty–one sectors (for example, IPODEC Limerick estimated that their business share for supermarkets was 50%).
- Based on this business share estimation the total quantity of waste arising from each sector was calculated (for example, IPODEC Limerick estimated total weight from supermarkets in their area was 40 tonnes per annum).

[21] Figures used for illustrative purposes only

- The percentage share of each sector in each area was then calculated (for example, IPODEC Limerick estimated that the total weight from all commercial sectors was 1,000 tonnes per annum, then the % share for supermarkets would be 4%).
- The sector share in Limerick, Waterford and Dublin was calculated. The results are presented in Table 5.3.

Sector	Limerick	Waterford	Dublin
Hotels	13.3%	17.6%	10.7%
Supermarkets	14.2%	25.3%	11.4%
Transport/Communication	26.0%	1.1%	5.8%
Financial Services	0.6%	1.2%	19.9%
Other Retailers	8.2%	11.78%	7.1%
Colleges	2.8%	4.5%	9.5%
Restaurants	4.4%	4.6%	10.5%
Hospitals	6.2%	5.7%	3.2%
Wholesale distribution	1.0%	3.6%	7.7%
Grocery Shops	6.0%	5.6%	0.1%
Public Offices	1.5%	2.1%	5.7%
Pubs	2.7%	1.9%	2.6%
Motor Sales	2.7%	3.2%	1.3%
Recreational and Sporting	2.0%	3.0%	0.8%
Filling Stations	3.0%	1.6%	1.2%
Schools (Primary & Secondary)	2.7%	2.2%	0.2%
Vehicle Repair	2.5%	1.1%	0.3%
Electrical Goods Retailers	0.6%	1.8%	1.2%
Other Health Services	0.0%	2.0%	0.7%
Other Accommodation	0.0%	0.0%	0.0%
Repair of other goods	0.0%	0.0%	0.0%
TOTAL	**100.0%**	**100.0%**	**100.0%**

Table 5.3: Estimated % of Main Commercial Producers in Waterford, Limerick and Dublin Regions

From the IPODEC figures, it is evident that the most significant commercial waste producers are similar for all three regions chosen. The main commercial sectors identified in all three regions were: Hotels, Supermarkets, Transport/ Communication, Financial Services, Other Retailers, Colleges, Restaurants, Hospitals Public offices and Wholesale Distribution. Some sectors are more significant than others depending on regional commerce. For instance the financial services sector is found to be the most significant commercial waste producer in the Dublin region while it is not so significant in the other regions. The percentage weighting given to each sector from each region is illustrated in Figures 5.1, 5.2 and 5.3.

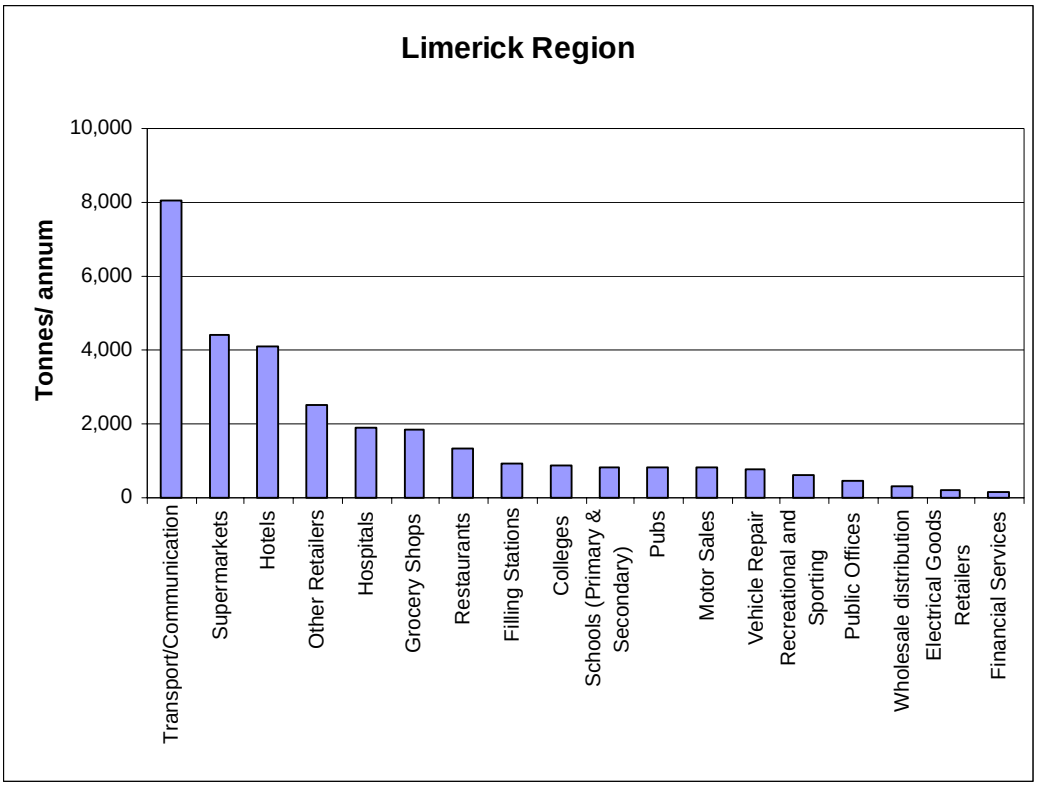


Figure 5.1: Significant Waste Sectors In Limerick Region

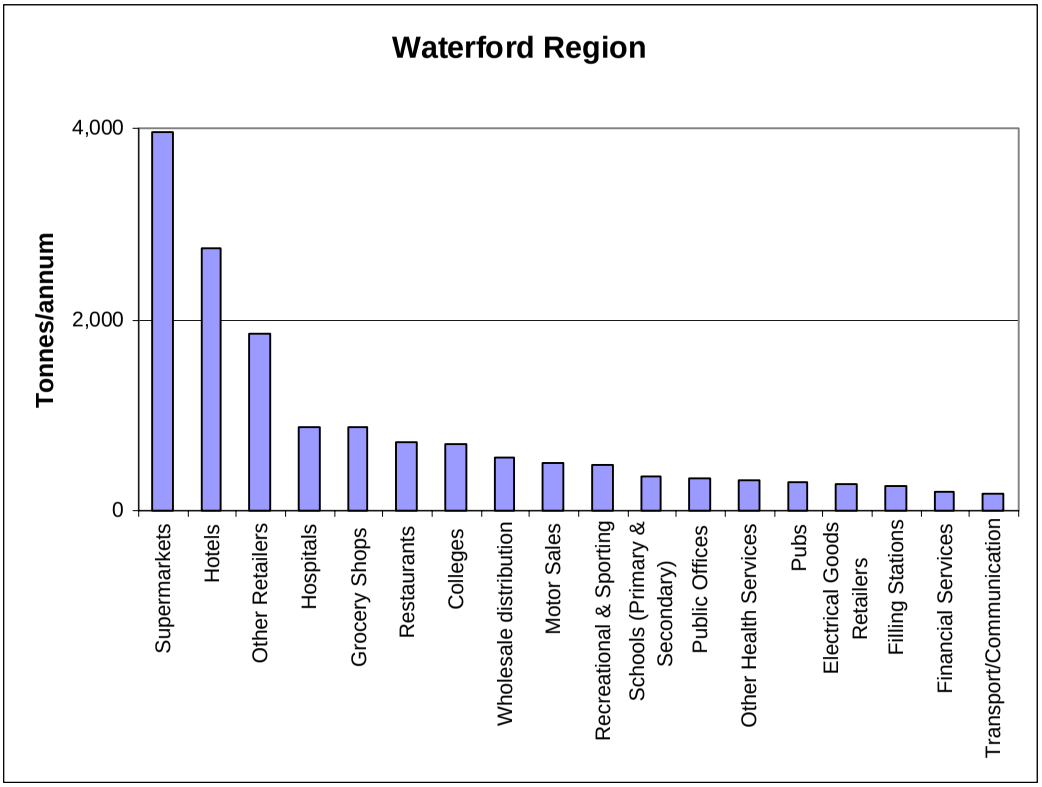


Figure 5.2: Significant Waste Sectors In Waterford Region

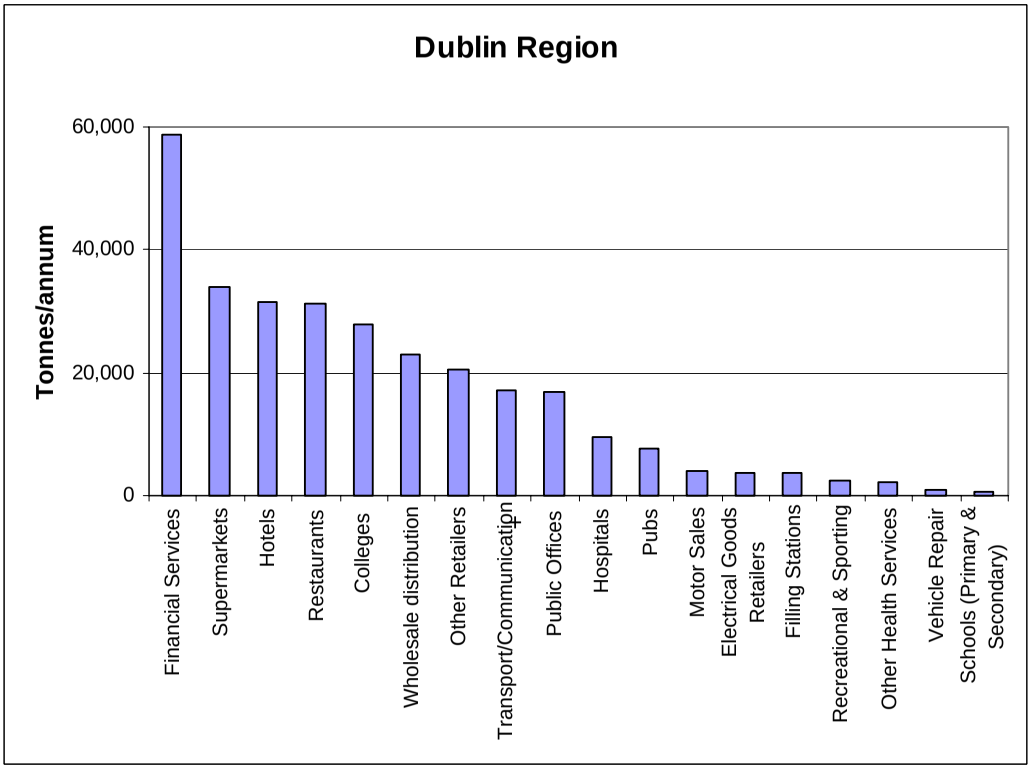


Figure 5.3: Significant Waste Sectors In Dublin Region

Analysis of this data from all three regions shows that the top 5 sectors chosen account for an average 65.2% of the total waste arising from the commercial sector while the top 10 sectors account for 87.5% of the commercial waste arising. The details are shown in Table 5.4. This information suggests that the characterisation of waste from the top 10 sectors will allow for 87.5% characterisation of national commercial waste arisings.

Location	Top 5 Sectors (%)	Top 10 Sectors (%)
Limerick	67.8%	86.5%
Waterford	65.9%	84.7%
Dublin	62.0%	91.4%
Average	**65.2%**	**87.5%**

Table 5.4: Contribution to Overall Waste Stream of Largest Sub-sectors

The steps involved in determining the most predominant commercial waste sectors are provided below:

Summary Guide to Determining Most Significant Commercial Sectors for the Purposes of Determining Non-Household Municipal Waste

1. The major commercial sectors are organised according to NACE code system. Sectors G to O represent the commercial sectors. (Each of these sectors can be further divided into sub sectors.)
2. Consider the waste character that one would expect from each of these sectors and identify sectors which may have similar waste character. (e.g. Sectors J & K both produce similar type waste). For the purposes of waste characterisation these sectors can be combined as a source.
3. Now consider sub sectors within each sector, and predict if the character of waste for each sub sector will vary considerably. For example NACE code sector G is divided into 10 sub-sectors. All of these each sub sectors are expected to produce distinctive waste. Choose as many of these sub sectors as practicable as the number of sectors which can be surveyed is limited by time and resources.
4. The waste arising from each of the sectors chosen can be measured with the assistance of waste contractors in the region. Ideally all contractors responsible for waste collection need to be consulted in order to determine total waste arising from each of the sectors chosen.
5. Sectors which produce the greatest tonnages, or sectors for which waste characterisation surveys have not yet been carried out, should be chosen for waste characterisation studies.

CHAPTER SIX: WASTE COMPOSITIONAL STUDIES OF SELECTED ECONOMIC SECTORS

Based on the methodology outlined above, the most significant sectors producing commercial waste in Ireland were identified. These sectors are:

- Hotels
- Supermarkets
- Transport & Communication
- Financial Services
- Colleges
- Restaurants
- Hospitals
- Public Offices
- Wholesale Distribution
- Other Retailers

The composition of waste from these sectors was determined by the waste characterisation methodology developed in this study. The results from these characterisation studies are outlined in the following Chapter and Appendix J.

6.1 Hotel Sector

6.1.1 NACE code

The hotel sector is a sub-sector of NACE code sector H (Hotels and restaurants). Hotels produce a significant percentage of commercial waste in Ireland contributing an estimated 10.7 % of commercial waste arisings in the Dublin region or 14.8 % of commercial waste arisings outside the Dublin region.

6.1.2 Waste Characterisation Study Results.

As part of this project, waste was characterised in a number of hotels. These included Jury's Hotel, Dublin; Jury's Inn, Cork; and Brandon Hotel, Tralee. The results from the Brandon Hotel are the most complete of the three studies and therefore were used to represent the character of waste produced in a typical hotel.

The Brandon Hotel, Tralee, is a three star hotel located in Tralee Town Centre. The hotel comprises 184 bedrooms and suites with leisure centre, a choice of bars and restaurants and conference centre.

The Brandon Hotel has a high waste recycling rate, recycling up to 67.2% of waste arisings. Wastes, which are segregated for recycling include food waste, cardboard, glass, cooking oil, aluminium cans, plastic mushroom cartons and wooden pallets. This high recycling rate is achieved through good waste management practices, which include segregation of waste at source. The hotel also operates an organic waste digester which reduces the majority of food waste arising to a compostable pulp. This pulp is composted by municipal composting.

Such a high recycling rate allows for much of the waste character to be determined through recycling records. The character of the remaining waste was determined by segregation analysis.

Mixed waste was measured from a number of recognised 'waste sources' each with an individual waste character. Four 'waste sources' were chosen for segregation analysis: bedrooms, kitchen, bar and lobby, and office.

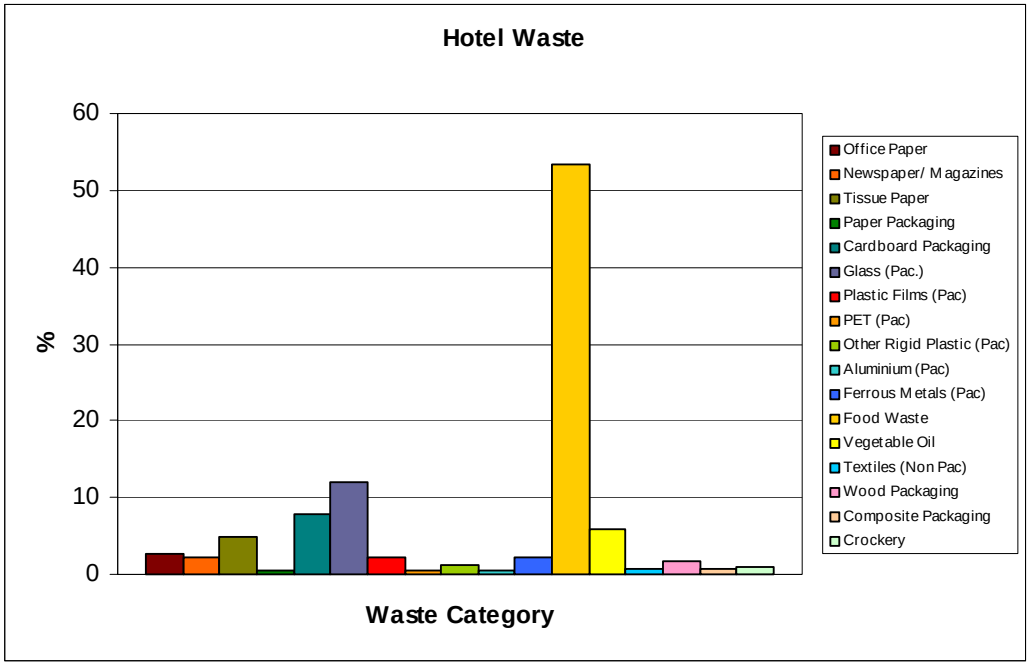


Figure 6.1 Waste Character of Brandon Hotel, Tralee

Waste Category	%
Office Paper	2.70
Newspaper/ Magazines	2.22
Tissue Paper	4.91
Paper Packaging	0.42
Cardboard Packaging	7.81
Glass (Pac.)	12.01
Plastic Films (Pac)	2.12
PET (Pac)	0.57
Other Rigid Plastic (Pac)	1.23
Aluminium (Pac)	0.40
Ferrous Metals (Pac)	2.13
Food Waste	53.45
Vegetable Oil	5.86
Textiles (Non Pac)	0.78
Wood Packaging	1.67
Composite Packaging	0.67
Crockery	1.05

Table 6.1.1 Hotel Waste Composition

6.1.3 Other Waste Characterisations for this sector.

At the earlier stages of this project characterisation studies were carried out at Jury's Hotel, Dublin and Jury's Inn, Cork. At these hotels the survey methodology was limited to determining the composition of segregated waste streams (both those segregated for recycling on a regular basis and those which were readily segregated from the purposes of this study). It was possible to segregate and weigh 78 % of the waste streams arising at Jury's Hotel, Dublin while 72% was segregated at Jury's Inn, Cork. For a complete compositional analysis, a segregation analysis is required on the non-segregated fraction.

While data gathered for Jury's Hotel and Jury's Inn is not complete, a comparison of the data generated with that for the Brandon Hotel does show a relatively close correlation, as presented in Table 6.1.2. The most significant waste fraction is food waste in all three hotels. The figures obtained for the Brandon Hotel is the most precise, as the mixed waste fraction has been fully characterised.

	Jurys Hotel (%)	**Jurys Inn (%)**	**Brandon Hotel (%)**
Food waste	49.2	36.7	53.5
Glass	13.4	11.4	12.0
Cardboard	7.5	8.9	7.8
Office Paper	4.6	5.5	2.7
Cooking Oil	1.3	4.3	5.9
Plastic	1.2	2.7	3.9
Aluminium and Tin Cans	0.5	2.3	2.3
Newspaper	-	1.7	2.2
Tissue Paper	-	-	4.9
Mixed Waste	22.3	26.5	4.8

Table 6.1.2: Comparison of Waste Composition from Surveyed Irish Hotels

6.2 The Supermarket Sector.

6.2.1 NACE code.

The supermarket sector is a sub-sector of NACE code sector G (wholesale and retail trade; repair of motor vehicles, motorcycles & personal and household goods). As supermarkets represent a large section of the retail trade and produce a large fraction of the retail trade waste, this sector was chosen for this study. Analysis of data from IPODEC in Chapter 5 suggests that the supermarket sector produces an estimated 11.4 % of commercial waste arisings in the Dublin region or 17.9 % of commercial waste arisings outside the Dublin region.

6.2.2 Waste Characterisation Study Results.

The supermarket chosen in this study was a large 'Supervalu' supermarket based in a Cork City suburb. The store chosen was considered the flagship store in terms of floor space and range of services and products offered to customers. For a period of five days, all the waste generated in the store was analysed for its composition and weight prior to recycling and disposal.

The Supervalu store surveyed recycles 43.9% of waste arisings. See Appendix J. Such a high recycling rate allows for much of the waste character to be determined through rate recycling records. The character of the remaining percentage of waste arising was determined by segregation analysis.

Mixed waste was measured from a number of recognised 'waste sources' each with an individual waste character. The sources chosen for segregation analysis were: the bakery, the deli counter, the staff canteen, the shop floor, the office and a public restaurant. In addition waste streams segregated from the mixed waste were also monitored as separate sources. These included meat from the meat counter, contaminated plastic from the meat counter and shop returns.

The waste characterisation survey results are outlined in Table 6.2.1 and Figure 6.2.

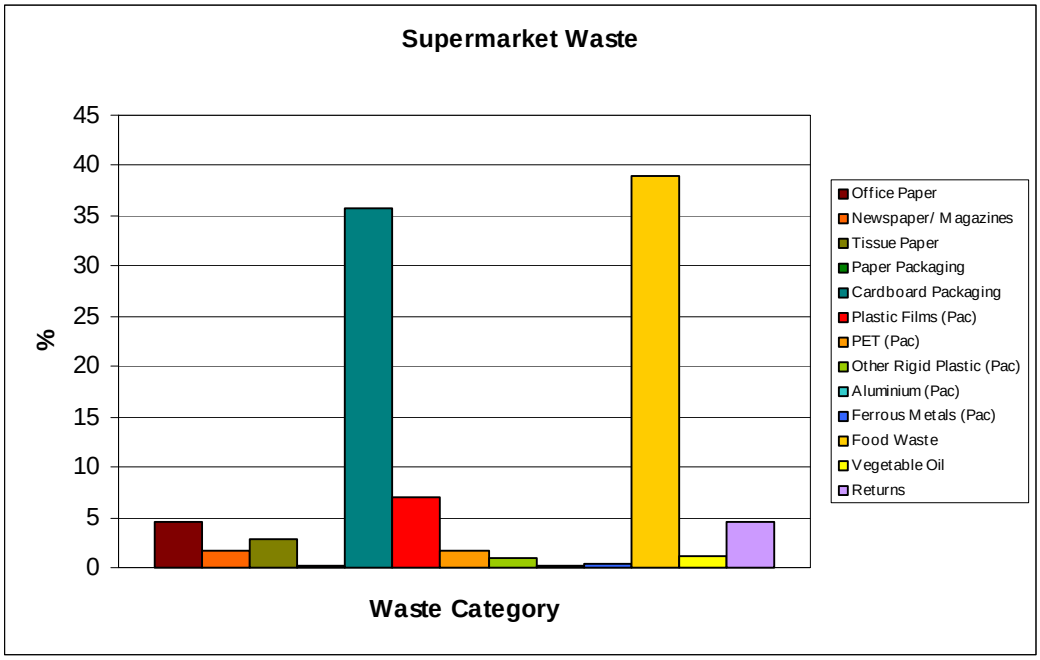


Figure 6.2 Supermarket Waste Composition

Waste Category	%
Office Paper	4.62
Newspaper/ Magazines	1.75
Tissue Paper	2.88
Paper Packaging	0.12
Cardboard Packaging	35.75
Plastic Films (Pac)	6.97
PET (Pac)	1.77
Other Rigid Plastic (Pac)	1.02
Aluminium (Pac)	0.26
Ferrous Metals (Pac)	0.29
Food Waste	38.96
Vegetable Oil	1.05
Returns	4.56

Table 6.2.1 Supermarket Waste Composition

6.2.3 Other Waste Characterisations for this sector.

Musgrave Group is Ireland's largest grocery and food distributor. The company operates a countrywide distribution network, servicing 24% of the market in the Republic of Ireland. The Musgrave Group conducted a waste characterization project at two distribution centers (Cork and Dublin), three SuperValu stores (ranging in area from large to mid-range) and two Centra stores (both small high-street stores). The stores were chosen to reflect the range of premises across the business. The surveys undertaken were carried out over a one-day period, but were structured to estimate the wastes generated over a week-long period. Table 6.5 demonstrates the breakdown of wastes generated at each type of premises.

Material	Cash & Carry (Wholesale)	SuperValu (Retail)	Centra (Retail)
Cardboard /Plastic	78%	49%	34%
Food waste	12%	36%	32%
Newspaper/Office waste	6%	6%	21%
Misc.	4%	9%	13%

Table 6.2.2 Typical Waste Categories (% by weight) at Musgrave Stores

6.3 Transport & Communication Sector

6.3.1 NACE code

The Transport & Communication sector is denoted by NACE code I (Transport, storage and communication). This is a diverse sector including land transport via railways, freight by road and taxis, marine and inland shipping, air transport and cargo handling. This sector also includes post and telecommunications.

The significance of this sector in terms of commercial waste arisings varies depending on the concentration of transport and telecommunications in a region. IPODEC waste collection figures suggest that this sector is highly significant in a region such as Limerick/ Clare where there is significant air and sea transportation facilities.

6.3.2 Waste Characterisation Study Results.

In this study the waste from Cork Airport was characterised to represent this sector. Cork Airport hosts a range of enterprises all with differing waste compositions. The waste character of each of these enterprises was determined which allowed for the characterisation of waste arising from the entire Airport operation.

Waste was characterised from the following 'waste sources'; Aer Rianta, Service air (an airline service company), Alpha catering (an airline catering company), Air Lingus, Knights Cleaners, the Kylemore Restaurant and the airport bar. Recycled waste streams account for 13.4% of waste arisings. These include recycled cardboard from Aer Rianta and glass from the Airport bar. The remaining mixed waste streams were characterised through segregation analysis.

The character of waste from the entire airport complex is illustrated in Figure 6.3. The most significant waste stream was food waste at 22.1% (arising from the Kylemore Restaurant, from aircraft and from Alpha catering) followed by Newspapers and Magazines at 21.98%. The main source of newspapers / magazines is from aircraft.

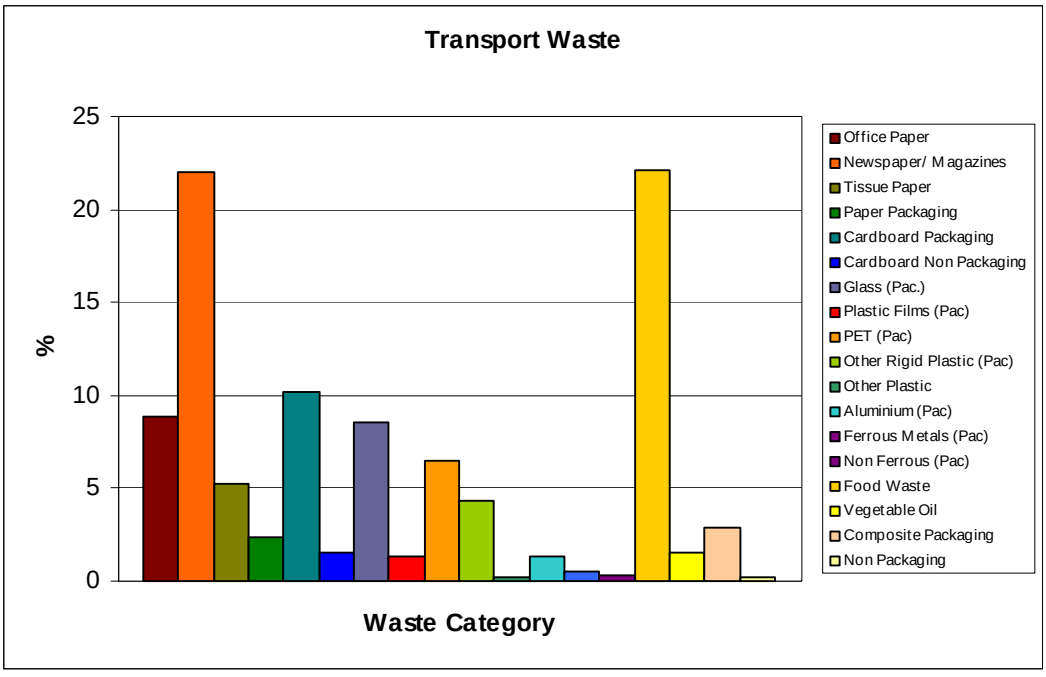


Figure 6.3 Airport Waste Composition

Waste Category	%
Office Paper	8.84
Newspaper/ Magazines	21.98
Tissue Paper	5.25
Paper Packaging	2.35
Cardboard Packaging	10.22
Cardboard Non Packaging	1.57
Glass (Pac.)	8.57
Plastic Films (Pac)	1.37
PET (Pac)	6.46
Other Rigid Plastic (Pac)	4.31
Other Plastic	0.19
Aluminium (Pac)	1.38
Ferrous Metals (Pac)	0.51
Non Ferrous (Pac)	0.27
Food Waste	22.10
Vegetable Oil	1.51
Composite Packaging	2.91
Non Packaging	0.21

Table 6.3 Airport Waste Composition

6.4 Financial Services

6.4.1 NACE code.

Financial service is denoted by the NACE code J (Financial intermediation) which included banking, insurance and stock broking. The significance of this sector in terms of commercial waste arisings varies depending on the concentration of financial services in a region. IPODEC waste collection figures suggest that this sector is highly significant in the Dublin region where the sector produces 20% of the commercial waste arisings. In the combined Limerick / Waterford region the Financial sector accounts just 1% of waste arisings.

6.4.2 Waste Characterisation Study Results.

A medium sized branch of the Bank Of Ireland was chosen to characterise its waste. The bank employs 20 staff. Most of the waste produced is office type waste with the exception of waste from the staff kitchen.

The character of waste from the Bank Of Ireland survey is illustrated in Figure 6.4. The most significant waste stream is office paper waste at 82 %. Approximately 62% of this office paper is sent for shredding and recycling. The food waste percentage is just 4.5%. One would expect this to be higher if the financial service had an in-house restaurant (for example, the central bank).

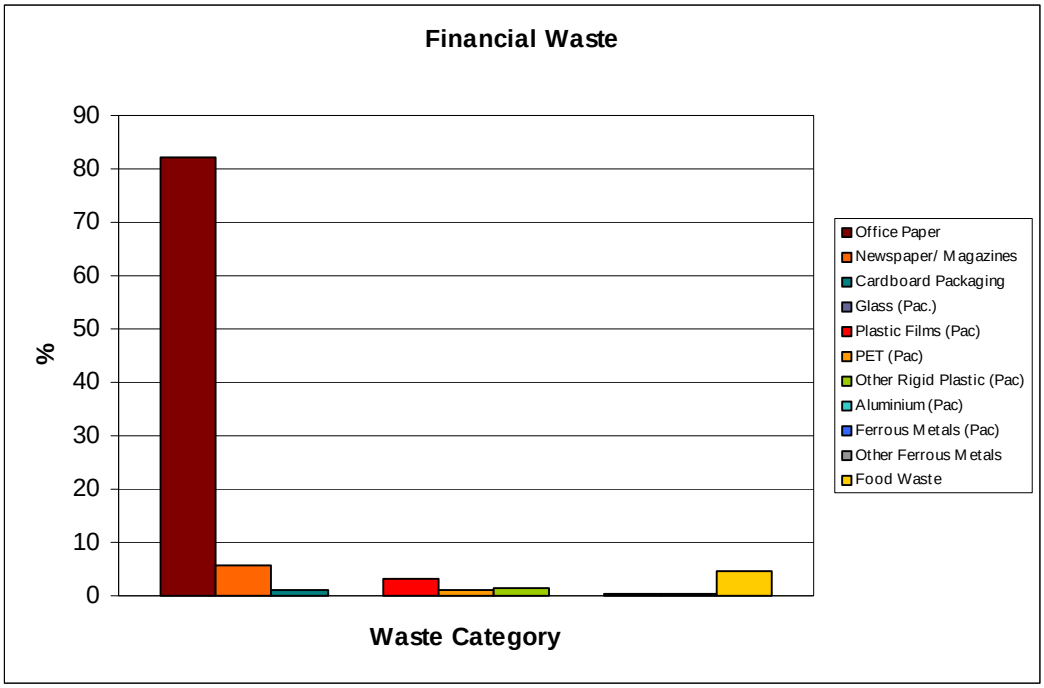


Figure 6.4 Bank Waste Composition

Waste Category	%
Office Paper	82.28
Newspaper/ Magazines	5.72
Cardboard Packaging	1.12
Glass (Pac.)	0.12
Plastic Films (Pac)	3.24
PET (Pac)	0.99
Other Rigid Plastic (Pac)	1.37
Aluminium (Pac)	0.06
Ferrous Metals (Pac)	0.37
Other Ferrous Metals	0.25
Food Waste	4.48

Table 6.4 Bank Waste Composition

6.5 The College Sector

6.5.1 NACE code.

The college sector is a sub-sector of NACE code sector M which represents 'Education'. For the purposes of this study NACE code M was subdivided into the college sector, which includes all third level education institutions, and the schools sector which includes secondary and primary schools and other educational schools. In Chapter 5, it was demonstrated that the college sector is more significant than schools in terms of waste production, albeit this is based on waste arisings from city regions.

6.5.2 Waste Characterisation Study Results.

A waste characterisation study was carried out over a two-week period at the Cork Institute of Technology (CIT). The total quantity of waste arising from the CIT (main campus) sent to landfill during the study period was 11.3 tonnes. The CIT has 7,800 full time student equivalents and 800 full time staff.

Recycling records were obtained for paper, cooking oil, brown glass, metal and timber. As there was limited recycling at the CIT at the time of this study the methodology focused on determining the composition of mixed waste which was destined for landfill. For the purpose of this study, the campus was segmented into 27 separate established cleaning areas. Mixed waste was collected from 27 different areas of the Institute.

The character of waste arising from the Institute departments is quite varied and the sources analysed included: canteen waste, kitchen waste, laboratory waste, administration waste, general classroom waste, litter bin waste, printshop waste and mechanical workshop waste.

In order to determine the composition of waste arising from the entire institute, figures for waste sent to landfill were combined with figures for recycling. No weights were available for the landfilled waste. Therefore, annual figures for waste sent to landfill were extrapolated from the two-week survey. The extrapolation assumed that the quantity of waste produced is proportionate to the volume of student traffic (which is proportionate to sales in the canteen). The CIT finance figures state that the sales figures for the canteen for the two-week study period were 3.36 % of the annual figure. Extrapolation gives 335 tonnes of waste sent to landfill on an annual basis.

Therefore, approx. 335 tonnes of waste is landfilled and 197.3 tonnes are recycled annually. The composition of total waste arising from CIT annually is outlined in Table 6.5 and Figure 6.5

The most significant waste stream is steel arising from mechanical workshops. While this figure may be typical of an Institute of Technology it may not be so for third level institutions which do not offer a technical curriculum. Further waste characterisation studies are required in order to produce a more accurate character of waste arisings from colleges nationally.

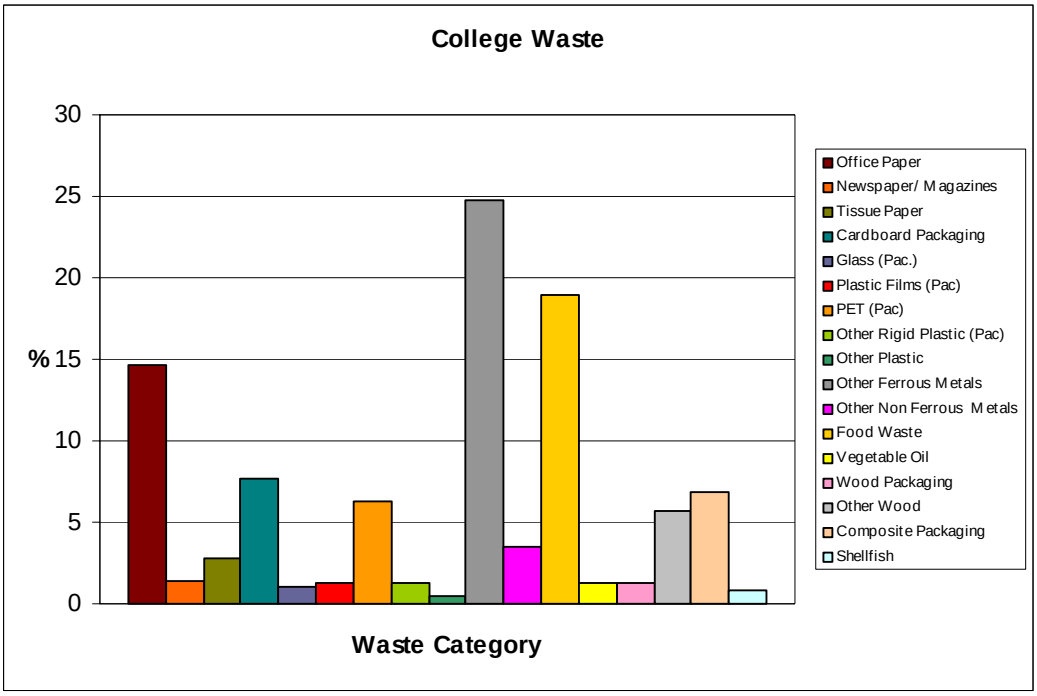


Figure 6.5 College Waste Composition

Waste Category	%
Office Paper	14.62
Newspaper/ Magazines	1.37
Tissue Paper	2.75
Cardboard Packaging	7.65
Glass (Pac.)	1.05
Plastic Films (Pac)	1.32
PET (Pac)	6.30
Other Rigid Plastic (Pac)	1.32
Other Plastic	0.41
Other Ferrous Metals	24.82
Other Non Ferrous Metals	3.51
Food Waste	18.92
Vegetable Oil	1.32
Wood Packaging	1.28
Other Wood	5.64
Composite Packaging	6.88
Shellfish	0.84

Table 6.5 College Waste Composition

6.6 The Restaurant Sector.

6.6.1 NACE code.

The restaurant sector is a sub-sector of NACE code sector H which denotes hotels and restaurants. For the purpose of this study restaurant waste arisings do not include waste from the canteens from commerce or manufacturing. Canteen waste arisings from the commercial sectors in this study is characterised as part of the overall waste arising from the commercial sector.

IPODEC figures for waste generated from the restaurant sector, as defined by this study estimate that restaurants produce 10.5 % of commercial waste arisings in the Dublin region or 4.4 % of commercial waste arisings outside the Dublin region.

6.6.2 Waste Characterisation study Results.

Waste characterisation data for the restaurant sector is based on three studies. These include a Kylemore restaurant, a restaurant based in a shopping centre and the Institute of Technology canteen.

As expected food waste is the most significant waste material accounting for 36.81% of the overall arisings. Vegetable oil which is recycled by most restaurants, accounts for 9.09% of waste arisings while cardboard accounts for 18.82% of arisings. See Figure 6.6 and Table 6.6 for full characterisation data.

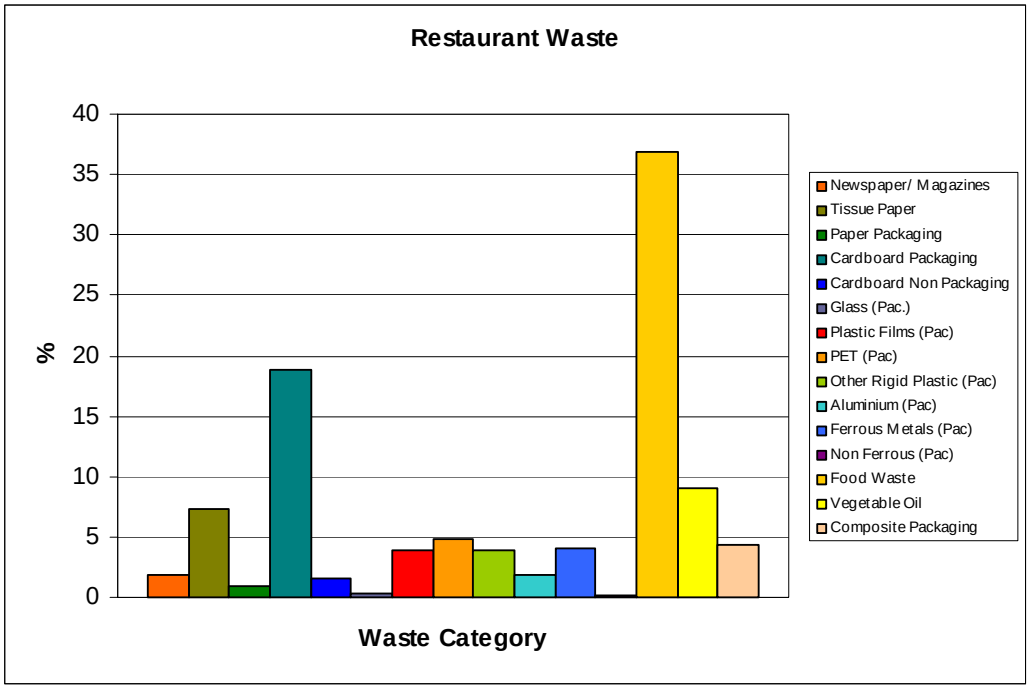


Figure 6.6 Restaurant Waste Composition

Waste Category	%
Newspaper/ Magazines	1.91
Tissue Paper	7.32
Paper Packaging	0.95
Cardboard Packaging	18.82
Cardboard Non Packaging	1.62
Glass (Pac.)	0.30
Plastic Films (Pac)	3.96
PET (Pac)	4.88
Other Rigid Plastic (Pac)	3.91
Aluminium (Pac)	1.85
Ferrous Metals (Pac)	4.02
Non Ferrous (Pac)	0.16
Food Waste	36.82
Vegetable Oil	9.09
Composite Packaging	4.39

Table 6.6 Restaurant Waste Composition

6.7 Hospital Sector

6.7.1 NACE code

The hospital sector is a sub-sector of NACE code sector N which represents 'Health and social work'. Hospitals represent a large section of waste produced from this NACE code. Analysis of data from IPODEC in Chapter 5 suggests that the hospital sector produces an estimated 3.2 % of commercial waste arisings in the Dublin region or 6.0 % of commercial waste arisings outside the Dublin region.

6.7.2 Waste Characterisation Study Results.

CTC carried out a waste compositional study in a Regional Hospital over a week period. In order to determine the precise composition of waste arising from the entire hospital complex it was necessary to survey the many different waste producing activities in the hospital which by their nature produce various waste compositions. For example the waste arising from the hospital kitchen is of a very different nature to waste arising from the theatre.

The hospital complex was separated into 12 'waste sources'. The waste from each of these areas was sorted in detail in order to determine the exact composition of their individual waste materials. The results of the compositional survey are outline in Figure 6.7, Table 6.7 and 'Hospital Fingerprint' in Appendix J. A significant waste fraction arising from the hospital was tissue paper which includes tissue paper from the kitchen, the wards and surgery. This fraction is for tissue which contains moisture in many cases. If it were possible to measure the weight of dry tissue the percentage tissue paper contained in the waste stream would appear lower. Similarly the percentage PET packaging contained in the waste stream is inclusive of liquid contained in this packaging. It was estimated that during this study that 50% of the weight allocated to PET packaging was in fact attributed to liquid residing in the waste packaging.

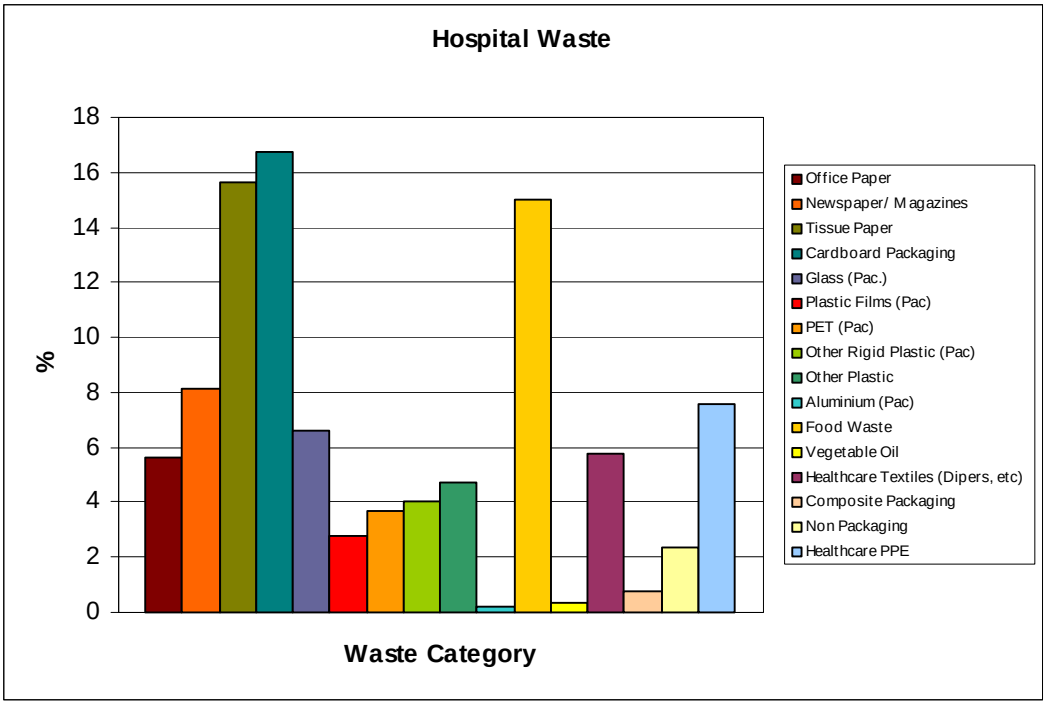


Figure 6.7 Hospital Waste Composition

Waste Category	%
Office Paper	5.61
Newspaper/ Magazines	8.13
Tissue Paper	15.63
Cardboard Packaging	16.74
Glass (Pac.)	6.63
Plastic Films (Pac)	2.76
PET (Pac)	3.69
Other Rigid Plastic (Pac)	4.03
Other Plastic	4.74
Aluminium (Pac)	0.22
Food Waste	15.00
Vegetable Oil	0.32
Healthcare Textiles (Diapers, etc)	5.76
Composite Packaging	0.79
Non Packaging	2.37
Healthcare PPE	7.58

Table 6.7 Hospital Waste Composition

6.8 The Public Administration Sector

6.8.1 NACE code.

The Public Administration Sector is denoted by the NACE code L. IPODEC waste collection figures suggest that this sector is significant in the Dublin region where the sector produces 5.7% of the commercial waste arisings. In the combined Limerick/Waterford region the financial sector accounts for just 1.7% of waste arisings.

6.8.2 Waste Characterisation Study Results.

The Cork County Council Office complex was chosen to represent the public administration system for the purpose of this study. The County Hall incorporates various departments, a canteen, and a separate motor taxation office.

The characterisation study was conducted over a two-week period, and involved weighing both segregated and mixed wastes The results from this study are summarised in Table 6.8 and illustrated in figure 6.8.

Results show that paper, food, and cardboard were the predominant streams with office paper accounting for 54.6% of the waste stream.

'One-off' waste arisings were noted during this survey, e.g. waste electrical and electronic equipment (WEEE). Such incidences should be taken into consideration when analysing data as is outlined in the proposed methodology in Section 4.2.

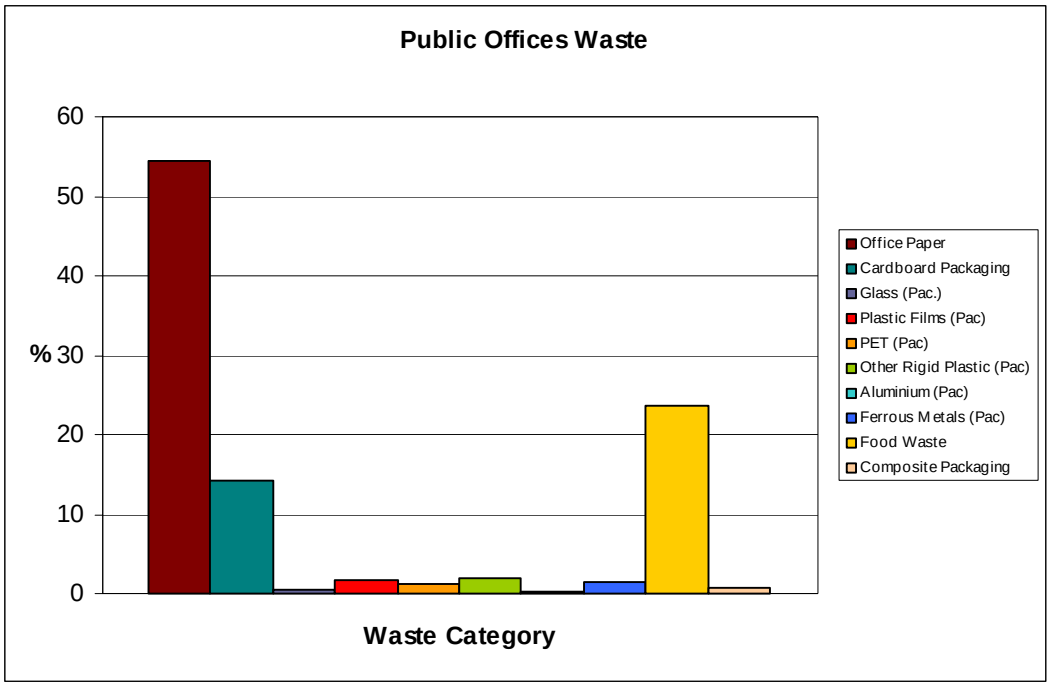


Figure 6.8 Public Office Waste Composition

Waste Category	%
Office Paper	54.55
Cardboard Packaging	14.18
Glass (Pac.)	0.60
Plastic Films (Pac)	1.73
PET (Pac)	1.26
Other Rigid Plastic (Pac)	1.87
Aluminium (Pac)	0.19
Ferrous Metals (Pac)	1.33
Food Waste	23.63
Composite Packaging	0.66

Table 6.8.1 Public Office Waste Composition

6.8.3 Other Waste Characterisations for this sector.

In March 2002 Kerry County Council conducted a survey of waste arising from their administration buildings. The results of this survey, while not as detailed as the 'Fingerprint' generated by this project, are comparable, as seen in Table 6.8.2.

Waste Category	Cork County Council Office (%)	Kerry County Council Office (%)
Office Paper	54.55	44.0
Cardboard Packaging	14.18	7.0
Glass	0.60	1.0
Plastic	4.86	8.0
Metals	1.52	1.0
Food Waste	23.63	20.0
Composites	0.66	5.0
Green Waste	N/A	9.0

Table 6.8.2 Comparison of Waste composition from Two Public Offices

6.9 The Wholesale Sector

6.9.1 NACE code.

The wholesale sector is a sub-sector of NACE code sector G which represents 'The Wholesale and Retail Trade'. As the wholesale trade represents a large fraction of commercial waste produced in Ireland it was chosen as a specific sector for this study. Analysis of data from IPODEC in Chapter 5 suggests that the wholesale sector produces an estimated 7.7 % of commercial waste arisings in the Dublin region or 1.8 % of commercial waste arisings outside the Dublin region.

6.9.2 Waste Characterisation Study Results.

While it was not possible to gain access to a wholesale distribution centre for this study, figures were obtained from the Musgrave distribution network on the estimated waste character of one of their main depots. See Figure 6.9 and Table 6.9

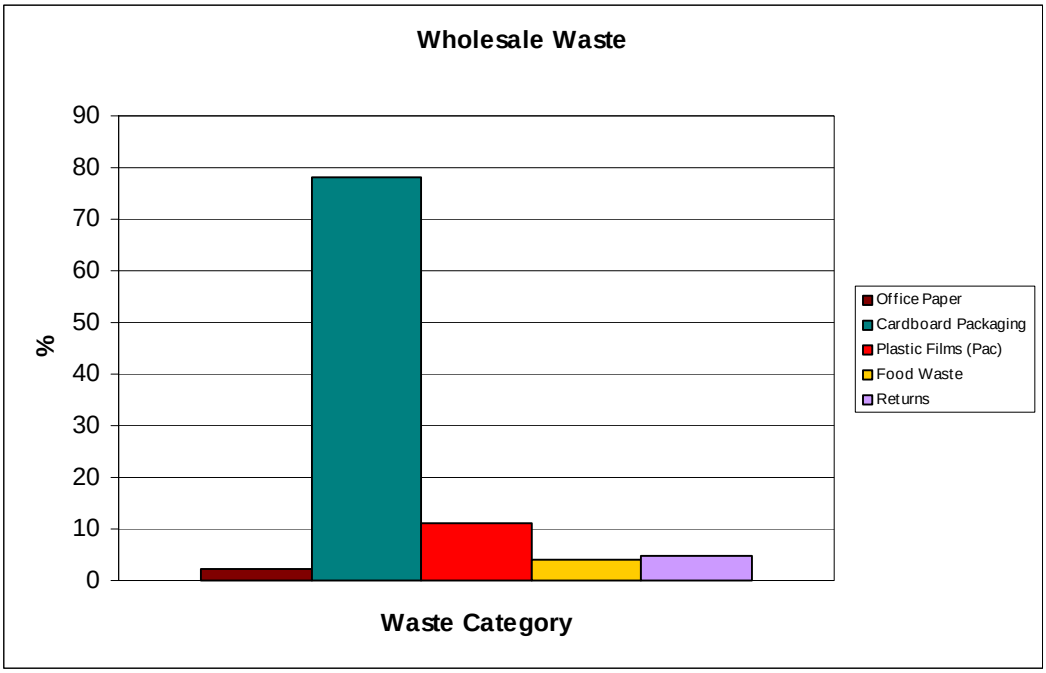


Figure 6.9 Waste Composition from Wholesale Outlet

Waste Category	%
Office Paper	2.10
Cardboard Packaging	78.00
Plastic Films (Pac)	11.00
Food Waste	4.00
Returns	4.90

Table 6.9 Waste Composition from Wholesale Outlet

6.10 The 'Other Retailers' Sector

6.10.1 NACE code.

The 'Other retailers' sector is a sub-sector of NACE code sector G which represents 'The Wholesale and Retail Trade'. For the purpose of this study 'Other retailers' are those retailers which do not fall into any of the other 9 sectors assigned to the wholesale and retail trade (See Chapter 5).

Analysis of data from IPODEC in Chapter 5 suggests that the 'Other retail' sector accounts for 7.1 % of commercial waste arisings in the Dublin region or 9.4 % of commercial waste arisings outside the Dublin region.

6.10.2 Waste Characterisation Study Results.

Characterisation data for the 'Other Retail' sector was based on a characterisation study carried out at Wilton Shopping Centre, Cork over a two- week period. This shopping complex hosts numerous restaurants and fifty other retailers which fall into the 'other retailer' category. Retailers surveyed included hairdressers, clothes shops, a DIY shop, music stores, telephone shops, chemists, a vegetable shop and a butcher.

Waste was characterised from the following 'waste sources'; fast food outlets and coffee shops, banks, butchers, newsagents and litterbins. Each source or group of retailer has its own particular waste character with food outlets having a high percentage of organic waste, news agents having a lot of paper waste and the litterbins having a high level of plastic packaging.

The character of waste from the entire shopping complex (excluding supermarkets) is typical of the 'other retailers' NACE sub sector and is illustrated in Figure 6.10. The most significant waste stream is cardboard packaging at 43.25%.

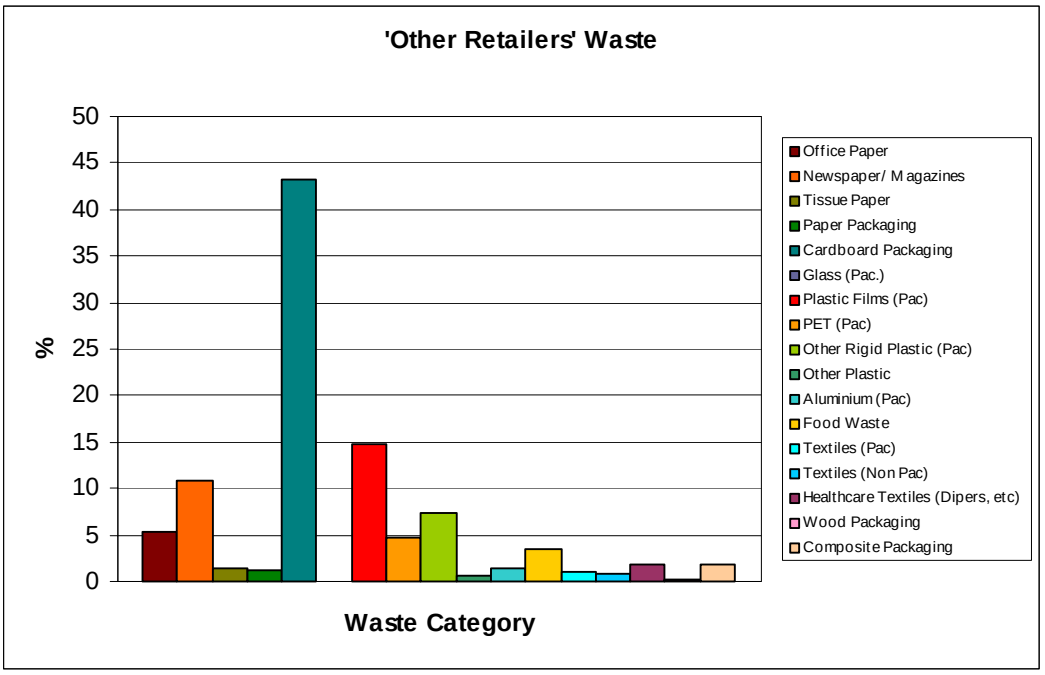


Figure 6.10 Waste Composition from 'Other Retailers'

Waste Category	%
Office Paper	5.24
Newspaper/ Magazines	10.92
Tissue Paper	1.38
Paper Packaging	1.17
Cardboard Packaging	43.25
Glass (Pac.)	0.03
Plastic Films (Pac)	14.76
PET (Pac)	4.79
Other Rigid Plastic (Pac)	7.34
Other Plastic	0.53
Aluminium (Pac)	1.39
Food Waste	3.42
Textiles (Pac)	1.03
Textiles (Non Pac)	0.90
Healthcare Textiles (Diapers, etc)	1.80
Wood Packaging	0.27
Composite Packaging	1.78

Table 6.10 Waste Composition from 'Other Retailers'

6.11 Summary of Waste Character Profile of Major Commercial Sectors

During the course of this study waste characterisation surveys were conducted on enterprises from all of the major commercial waste producing sectors:

- Hotels
- Supermarkets
- Transport & Communication
- Financial Services
- Colleges
- Restaurants
- Hospitals
- Public Offices
- Wholesale Distribution
- Other Retailers

The composition of waste from these surveys is summarised in Table 6.11. In the majority of cases the waste character of the sector is based on the characterisation study from one enterprise.

Waste Character of Major Commerical Waste Sectors										
Waste Category %	**Hotels**	**Supermarkets**	**Transport/ Communication**	**Financial Services**	**Colleges**	**Restaurants**	**Hospitals**	**Public Offices**	**Wholesale Distribution**	**Other Retailers**
PAPER AND CARDBOARD %										
Office Paper	2.70	4.62	8.84	82.28	34.62		5.61	54.55	2.18	5.24
Newspapers/ Magazines	2.22	1.75	21.98	5.72	1.37	1.91	8.13			10.92
Tissue Paper	4.91	2.88	5.25		2.75	7.32	15.63			1.38
Paper Packaging	0.42	0.12	2.35			8.95				1.17
Cardboard Packaging	7.81	35.75	10.22	1.12	7.65	18.82	16.34	14.18	78.08	43.25
Cardboard Non Packaging			1.57			1.62				
GLASS %										
Glass (Pac.)	12.81		8.57	0.12	1.85	8.38	6.63	0.60		8.03
Other Glass										
PLASTIC %										
Plastic Films (Pac)	2.12	6.97	1.37	3.24	1.32	3.94	2.76	1.73	11.08	14.76
PET (Pac)	0.57	1.77	6.46	0.99	6.30	4.88	3.69	1.26		4.79
Other Rigid Plastic (Pac)	1.23	1.62	4.31	1.37	1.32	3.91	4.03	1.87		7.34
Other Plastic			8.19		0.41		4.74			8.53
METAL %										
Aluminium (Pac)	0.40	0.28	1.38	0.06		1.85	0.22	0.19		1.39
Ferrous Metals (Pac)	2.13	0.29	8.51	0.37		4.02		1.33		
Non Ferrous (Pac)			8.27			8.16				
Other Ferrous Metals				0.25	24.82					
Other Non Ferrous Metals					3.51					
ORGANIC WASTE %										
Food Waste	53.45	38.96	22.10	4.48	18.92	36.82	15.00	23.63	4.08	3.42
Vegetable Oil	5.86	1.05	1.51		1.32	9.09	0.32			
Garden Waste										
TEXTILES %										
Textiles (Pac)										1.03
Textiles (Non Pac)	0.78									8.90
Healthcare Textiles (Diapers, etc)							5.76			1.88
WOOD %										
Wood Packaging	1.67				1.28					8.27
Other Wood					5.64					
COMPOSITES %										
Composite Packaging	0.67		2.91		6.88	4.38	0.79	0.66		1.78
Non Packaging			8.21				2.37			
SPECIAL/ IRREGULAR WASTE %										
WEEE										
Fluorescent Bulbs										
Batteries										
Waste Chemicals										
Waste Mineral Oil										
Crockery	1.85									
Shellfish					0.84					
Healthcare PPE							7.58			
Returns		4.58							4.58	
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Table 6.11 Waste Character of Major Commercial Sectors

CHAPTER SEVEN: Determination of National Commercial Waste Character

7.1 Waste Character Based on National Waste Arising Data

Waste characterisation data was generated in this project for ten of the most significant commercial waste producers, as provided in Chapter 6. These ten sectors were estimated to represent more than 80% of commercial waste arisings. The character of waste arising from these sectors is taken to represent the character of the entire national commercial waste arisings.

According to the 2001 National Waste Database Report (Table 4.4 of the NWDR) the quantity of NHMW landfilled was 737,193 tonnes and the quantity of NHMW recovered was 230,666 tonnes. Therefore, the total quantity of NHMW reported was 967,859 tonnes.

In the provision of information for this report, many waste contractors did not make a distinction between '*commercial waste*' and '*non-process industrial waste*'.

7.1.1 'Non-Process Industrial Waste' Arisings

'Non-process industrial waste' was not characterised in this study. In the future, the composition of this waste stream (according to EWC codes) may be estimated from returns made to the Environmental Protection Agency (EPA) from IPC and non-IPC companies. The usefulness of this data is discussed in Chapter 8.

In the 2001 EPA survey of industrial waste generators (represented by NACE codes C, D and E) data was obtained from 307 IPC licensed companies and 159 non-IPC licensed companies. 'Non-process industrial waste' was reported under EWC Chapter 20 and Chapter 15. A scale up methodology based on sectoral employee numbers was used to calculate the projected total industrial waste generation. Using data collected by the EPA it is estimated that 281,976 tonnes of waste was generated under EWC Chapter 20 and 231,576 tonnes was generated under EWC Chapter 15. This is a total of 495,552 tonnes of non-process industrial waste generated in 2001.

If 967,859 tonnes of NHMW was generated in 2001[22] and the industrial sector accounts for 495,552 tonnes, then it can be deduced that 472,307 tonnes of NHMW arose from the commercial sector represented by NACE codes G to O in that year.

7.1.2 National 'Commercial Waste' Arisings

The Dublin region is estimated to produce 35.8% of the 'commercial waste arising'.[23] Based on the calculated national commercial waste generation figure of 472,307 tonnes, this would suggest that an estimated 169,086 tonnes of waste arose from commercial sector in the Dublin region and an estimated 303,221 tonnes outside of the Dublin region in 2001. Waste tonnages produced per sector in the Dublin region / Outside the Dublin region were calculated using sectoral weightings calculated in Chapter 5. These tonnages are outlined in Table 7.1

[22] EPA National Waste Database 2001, Table 4.7.
[23] EPA National Waste Database 2001

Total Waste Arising Per Sector					
Sector	% Per Sector		Tonnes Per Sector		National Total (Tonnes)
	Dublin	Limk/Watd Average	Dublin	Outside Dublin	
Hotels	10.64%	14.75%	17,991	44,725	62,716
Supermarkets	11.40%	17.92%	19,276	54,337	73,613
Transport/Communication	5.78%	17.69%	9,773	53,640	63,413
Financial Services	19.91%	0.80%	33,665	2,426	36,091
Other Retailers	7.05%	9.38%	11,921	28,442	40,363
Colleges	9.47%	3.35%	16,012	10,158	26,170
Restaurants	10.54%	4.40%	17,822	13,342	31,163
Hospitals	3.16%	5.97%	5,343	18,102	23,445
Wholesale Distribution	7.72%	1.83%	13,053	5,549	18,602
Public Offices	5.71%	1.70%	9,655	5,155	14,810
Other Sectors	8.62%	22.21%	14,575	67,345	81,921
Total	**100.00%**	**100.00%**	**169,086**	**303,221**	**472,307**

Table 7.1 National Tonnages of Waste Arising from the Commercial Sectors

The waste characters of the main commercial sectors determined by this study are summarised in Table 6.11. Data from Table 6.11 combined with data on the national tonnages arising from these sectors (Table 7.1) allows for an estimation of the tonnages of all waste materials arising from the main commercial sectors. Therefore this study has characterised the waste character for 82.7% of the commercial sector or for 390,386 tonnes of commercial waste generated from these main sectors. The combined character of all these main sectors is taken as representative of the waste character of the entire commercial sector as determined in Table 7.2.

Estimated Annual Tonnages Arising From Major Commercial Sectors												
Waste Category	**Hotels**	**Supermarket**	**Transport/ Communication**	**Financial Services**	**Colleges**	**Restaurants**	**Hospitals**	**Public Offices**	**Wholesale Distribution**	**Other Retailers**	**Total Weights for Major Sectors**	**Waste Character of Major Sectors**
PAPER AND CARDBOARD (tonnes per annum)												
Office Paper	1,693	3,481	5,604	25,696	3,826		1,315	8,879	391	2,115	54,121	14.38%
Newspaper/ Magazines	1,392	1,288	13,938	2,864	359	595	1,908			4,468	25,851	6.65%
Tissue Paper	3,879	2,120	3,329		720	2,281	3,665			557	15,751	4.03%
Paper Packaging	263	88	1,498			296				472	2,618	0.67%
Cardboard Packaging	4,898	26,317	6,481	404	2,882	5,865	3,925	2,100	14,518	17,457	83,858	21.51%
Cardboard Non Packaging			996			585					1,580	0.38%
GLASS (tonnes per annum)												
Glass (Pac.)	7,532		5,434	43	275	93	1,554	89		12	15,034	3.85%
Other Glass												
PLASTIC (tonnes per annum)												
Plastic Films (Pac)	1,330	5,131	868	1,169	345	1,234	647	256	2,046	5,958	18,985	4.86%
PET (Pac)	357	1,383	4,098	357	1,649	1,521	865	187		1,933	12,269	3.14%
Other Rigid Plastic (Pac)	771	791	2,753	494	345	1,218	945	277		2,963	10,498	2.69%
Other Plastic			128		187		1,111			214	1,583	0.40%
METAL (tonnes per annum)												
Aluminium (Pac)	251	191	875	22		577	52	28		561	2,556	0.65%
Ferrous Metals (Pac)	1,336	213	323	134		1,253		197			3,456	0.89%
Non Ferrous (Pac)			171			50					221	0.06%
Other Ferrous Metals				93	6,495						6,588	1.69%
Other Non Ferrous Metals					919						919	0.24%
ORGANIC WASTE (tonnes per annum)												
Food Waste	33,522	28,688	14,014	1,617	4,951	11,474	3,517	3,500	744	1,388	103,399	26.49%
Vegetable Oil	1,875	773	958		345	2,833	75				8,669	2.22%
Garden waste												
TEXTILES (tonnes per annum)												
Textiles (Pac)										416	416	0.11%
Textiles (Non Pac)	489									363	852	0.22%
Healthcare Textiles (Diapers, etc)							1,350			727	2,077	0.53%
WOOD (tonnes per annum)												
Wood Packaging	1,847				335					109	1,491	0.38%
Other Wood					1,436						1,436	0.37%
COMPOSITES (tonnes per annum)												
Composite Packaging	420		1,845		1,881	1,368	185	98		718	6,436	1.65%
Non Packaging			133				556				689	0.18%
SPECIAL/ IRREGULAR WASTE (tonnes per annum)												
WEEE												
Florescent Bulbs												
Batteries												
Waste Chemicals												
Waste Mineral Oil												
Crockery	659										659	0.17%
Shellfish					220						220	0.06%
Healthcare PPE							1,777				1,777	0.46%
Returns		3,357							912		4,268	1.09%
Total	**62,716**	**73,613**	**63,413**	**36,091**	**26,170**	**31,163**	**23,445**	**14,510**	**18,612**	**40,363**	**390,386**	**100%**

Table 7.2 Estimated Tonnages /Character of Waste Arising from Major Commercial Sectors

The national waste character of the 'commercial sector' determined by this methodology identifies cardboard /paper as the most significant waste stream accounting for 47.62% of the commercial waste stream. Organic waste accounts for 28.7% of the total commercial waste stream. This is illustrated in Figure 7.1.

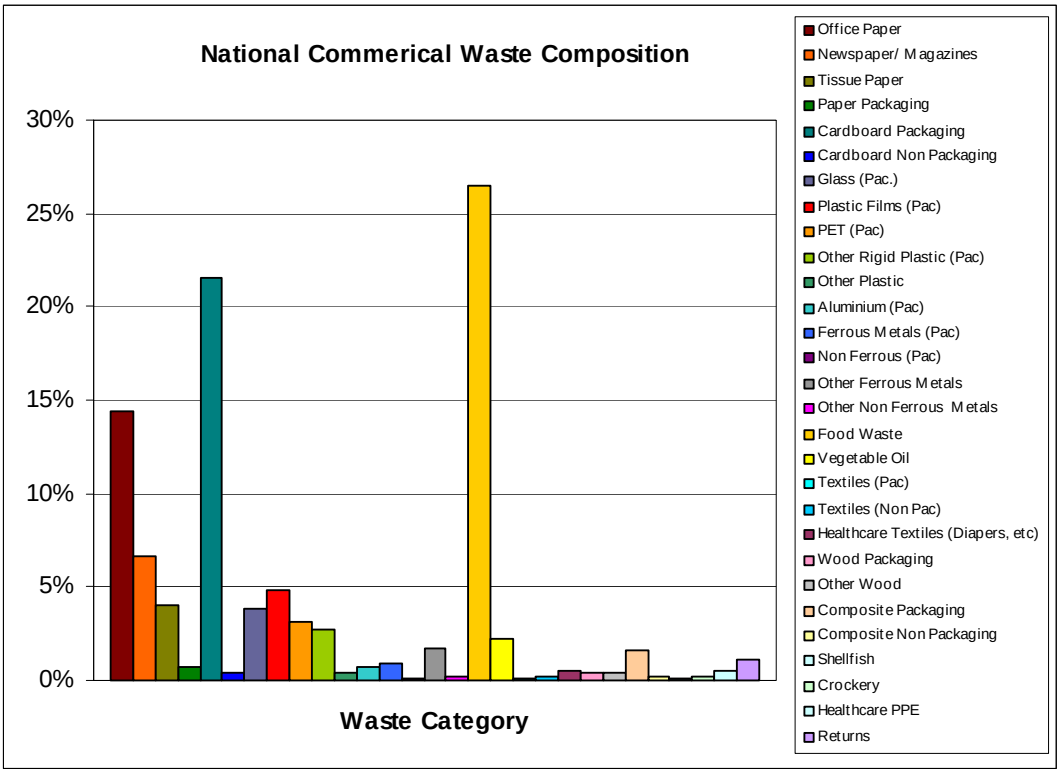


Figure 7.1 National Commercial Waste Composition

7.2 Comparison of Results from this Study with Previous Studies

The composition of commercial waste determined by this study is compared with previous composition of commercial waste arisings, published in the National Waste Database 1998 and 2001, as illustrated in Table 7.3.

A comparison of results shows variations which are to be expected due to different methodologies employed in the waste characterisation.

However there are similarities between the three compositions, with paper, organics and plastic being the most significant waste categories in all three studies.

Waste Category	Composition of Commercial Arisings		
	CTC 2001	NWD 2001[24]	NWD 1998[25]
Paper	47.62%	48.6 %	58.60%
Glass	3.85%	7.2 %	3.40%
Plastic	11.09%	10.3 %	10.60%
Aluminium	0.65%	1.6 %	0.60%
Ferrous Metals	2.57%	0.9 %	1.00%
Non Ferrous Metals	0.29%	0.1 %	0.10%
Organics	28.70%	20.6 %	15.10%
Textiles	0.86%	1.3 %	0.60%
Others	4.36%	9.4 %	9.90%

Table 7.3 Comparison of Commercial Waste Character Determined by this Study with 2001 and 1998 National Waste Databases

7.3 Scale-up based on Economic and Demographic Factors

7.3.1 National Waste Arisings Extrapolated from Sample Data

In the methodology outlined above, the national waste arisings for the various commercial sectors has been determined by a combination of:

(a) Determining the significance of commercial sectors (in terms of waste generation) in specific regions and

(b) Using published data on commercial waste arisings from these areas to determine the tonnage of waste arising from the various commercial sectors.

In order to verify the validity of this method a second methodology was used to determine the significance of commercial sectors, in terms of waste generation, by using a scale-up method based on economic and demographic factors.

Waste arisings for specific commercial sectors (hotel, hospital, third level institute, supermarket, bank, local authority office and airport) were determined by CTC during the course of this study. The results from similar surveys carried out by other researchers were also used for comparative purposes. Key waste generation indicators were chosen for each of the sectors studied. For example in the hospital sector waste generation was measured in terms of kg waste/bed-day. This waste generation indicator was then used to extrapolate national arisings from Central Statistics Office data on hospital occupancy.

The statistical data used in the calculations requires explanation on a case-by-case basis. It should be noted that this method has its limitations due to shortage of statistical data for a number of the commercial sectors.

[24] EPA National Waste Database 2001, Table 4.4
[25] EPA National Waste Database 1998, Table 3.6.

7.3.2 Hotels

There were 9.214 million bednights sold to overseas visitors in 2001 (www.cso.ie). This figure does not include Irish residents staying in hotels. Estimation was made from the % contribution of Irish residents to tourism in Ireland that year (www.bordfailte.ie). This percentage was factored in to estimate the total bednights sold in 2001 which arrived at 13,452,440 bednights.

The total waste arising from hotels was then calculated using a waste generation indicator of 4.7414 kg waste/room sold determined by the CTC survey of the Brandon Hotel in Tralee, Co. Kerry. This yielded a result of 63,765 tonnes per annum of waste from the hotel sector (Table 7.4).

HOTELS	
Bednights sold to overseas visitors (2001)	9,214,000
Factor to include Irish residents (2001)	1.46
Total bednights (2001)	*13,452,440*
WASTE INDICATOR	
Waste/room sold (kg) (2001)	4.74
Total bednights (2001)	13,452,440
TOTAL HOTEL WASTE GENERATED (tonnes) (2001)	**63,765**

Table 7.4 Quantity of Waste Generated by Hotels

7.3.3 Third Level Educational Establishments

An estimation of annual waste arisings from NUI and St. Patrick's College Maynooth and CIT were also used for comparative purposes in estimating the quantity of waste generated by third level educational establishments.

An indicator of waste produced per student was used for scale up purposes. Enrolment figures for the academic year 2000/2001 were used to determine student numbers in each college (www.hea.ie) Full-time and part-time student numbers were added to give a student total. Staff numbers were not considered nor were the use of full-time equivalents for part-time students (which are sometimes quoted in studies). These indicators and overall national student enrolment figures determined the total waste arisings from third level educational establishments

Scaling up using the CIT waste arising / student figure gives a total of 8,949 tonnes of waste in the third level sector per annum; while using the Maynooth colleges estimates, yields a total of 14,398 tonnes per annum (Table 7.5).

HEA figures do not include institutes such as the College of Commerce in Cork, St. John's College Cork, therefore using this data does produce an underestimate.

THIRD LEVEL EDUCATIONAL ESTABLISHMENTS	
CIT Full time (2000/2001)	5,615
CIT Part time (2000/2001)	3,244
Total CIT students (2000/2001)	*8,859*
NUI & St.Pat's full & part time (2000/2001)	*6,608*
National Full time (2000/2001)	126,300
National Part time (2000/2001)	32,265
Total National students (2000/2001)	*158,565*
WASTE INDICATOR	
Waste at CIT (tonnes) (2000/2001)	500
Waste/student at CIT (tonnes) (2000/2001)	0.0564
Total National students (2000/2001)	158,565
TOTAL THIRD LEVEL EDUCATION WASTE GENERATED (tonnes) (2001)	**8,949**
WASTE INDICATOR	
Waste at NUI & St.Pat's (tonnes) (2000/2001)	600
Waste/student at NUI & St.Pat's (tonnes) (2000/2001)	0.0908
Total National students (2000/2001)	158,565
TOTAL THIRD LEVEL EDUCATION WASTE GENERATED (tonnes) (2001)	**14,398**

Table 7.5 Quantity of Waste Generated by Third Level Educational Establishments

7.3.4 Hospitals

A waste survey of Waterford Regional Hospital was carried out by CTC in August 2002. Information from this study was used to determine waste produced/bed days used. The latest data available for bed days used dates to 2000 (www.doh.ie). This figure excludes long-stay patients in Inc. Orthopaedic, NRH, Peamount, Baldoyle and Manorhamilton hospitals.

Based on the information available a total of it was estimated that 10,576 tonnes of hospital waste is produced / annum nationally.

HOSPITALS	
Waterford Regional bed days used (80.8% occupancy) (2000)	*136,875*
All publicly funded acute hospital bed days (83.3% occupancy)(2000)*	*3,619,079*
WASTE INDICATOR	
Waste at Waterford Regional (tonnes) (2002)	400
Waste/bed day used at Waterford Regional (tonnes) (2002)	2.92E-03
All publicly funded acute hospital bed days (83.3% occupancy)*(2000)	3,619,079
TOTAL WASTE GENERATED (tonnes)	**10,576**
*Excludes Inc. Orthopaedic, NRH, Peamount, Baldoyle & Manorhamilton	

Table 7.6 Quantity of Waste Generated by Hospitals

7.3.5 Supermarkets

This waste generation indicator used for supermarkets is waste produced per unit of turnover. Total waste from Centra and Supervalu (www.musgrave.ie) and group turnover for Centra and Supervalu from 2001 was used to extrapolate. Using the national retail market for 2001 (est. at €9bn.) its is estimated that the national waste produced by supermarkets is 67,423 tonnes and 42,274 tonnes, using Supervalu and Centra data respectively (Table 7.7).

SUPERMARKETS	
Supervalu turnover € (2001)	*1.46E+09*
Centra turnover € (2001)	*6.52E+08*
National turnover € (2001)	*9.00E+09*
WASTE INDICATOR	
Waste @ Supervalu (tonnes) 2001	10937.50
Waste/€ Supervalu turnover (tonnes) 2001	7.49E-06
National turnover € (2001)	9.00E+09
TOTAL WASTE GENERATED (tonnes) (2001)	**67,423**
WASTE INDICATOR	
Waste @ Centra (tonnes) 2001	3,062.50
Waste/€ Centra turnover (tonnes) 2001	4.70E-06
National turnover € (2001)	9.00E+09
TOTAL WASTE GENERATED (tonnes) (2001)	**42,274**

Table 7.7 Quantity of Waste Generated by Supermarkets

7.3.6 Banking, Insurance and Building Societies

A waste survey of Bank of Ireland, Wilton, Cork was carried out in 2002 by the CTC. Data from this survey on waste arisings and information from a Central Bank Waste Audit (carried out by IPODEC, 2000) was used to generate indicators of waste produced/employee. Based on these indicators and a figure for the number of employees in the sector (www.cso.ie) total waste arisings of 12,543 tonnes per annum and 27,354 tonnes per annum were calculated based on Central Bank and BOI Wilton data respectively (Table 7.8).

The Banking, Insurance and Building Societies employee figures from the CSO do not include other financial areas such as credit unions, insurance companies or stockbroking that are also included in NACE sector codes.

BANKING, INSURANCE & BUILDING SOCIETIES	
Central Bank Employees (2001)	*773*
BOI Wilton Employees (2001)	*24*
National Banking Employees (2002)	31,900
National Insurance Employees (2002)	15,000
National Building Societies Employees (2002)	3,600
Total National Employees (2002)	*50,500*
WASTE INDICATOR	
Waste @ Central Bank (tonnes) (2002)	192
Waste/Central Bank employee (tonnes) (2002)	0.2484
Total National Employees (2002)	50,500
TOTAL WASTE GENERATED (tonnes) (2002)	**12,543**
WASTE INDICATOR	
Waste @ BOI Wilton (tonnes) (2001)	13
Waste/BOI Wilton employee (tonnes) (2001)	0.5417
Total National Employees (2002)	50,500
TOTAL WASTE GENERATED (tonnes) (2002)	**27,354**

Table 7.8 Quantity of Waste Generated by Banking, Insurance & Building Societies

7.3.7 Public Sector

Data from a CTC survey of Cork County Council offices at County Hall Cork was used to generate an indicator of waste produced/office employee. This was extrapolated using the number of national public sector employees (excluding health and education sectors) (www.cso.ie) to yield an annual waste arising from the public sector of 31,468 tonnes in 2002 (Table 7.9).

PUBLIC SECTOR excl HEALTH & EDUCATION	
Cork County Hall employees (2002)	*400*
National Public Sector employees (March 2002)	*153,500*
WASTE INDICATOR	
Waste @ Cork County Hall (tonnes) (2002)	82
Waste/Cork County Hall employee (tonnes) (2002)	0.205
National Public Sector employees (March 2002)	153,500
TOTAL WASTE GENERATED (tonnes) (2002)	**31,468**

Table 7.9 Quantity of Waste Generated by the Public Sector excl Health & Education

7.3.8 Transport – Air Travel

Information was available from waste surveys carried out by IPODEC on behalf of Aer Rianta at Dublin Airport and by the CTC at Cork Airport. Passenger figures for both airports were used to generate an indicator of waste produced/passenger (www.aerrianta.ie). Based on the total number of Aer Rianta passengers in 2000 extrapolation gives 3,443 tonnes per annum and 7,770 tonnes per annum using Dublin and Cork data respectively (Table 7.10).

TRANSPORT - AIR TRAVEL	
Passengers Dublin Airport (2000)	*13,816,000*
Passengers Cork Airport (2000)	*1,700,000*
Total Air Rianta Passengers (2001)	*18,500,000*
WASTE INDICATOR	
Waste @ Dublin Airport (tonnes) (2000)	2,571
Waste/Passenger Dublin Airport (tonnes) (2000)	1.86E-04
Total Air Rianta Passengers (2001)	18,500,000
TOTAL WASTE GENERATED (tonnes) (2000)	**3,443**
WASTE INDICATOR	
Waste @ Cork Airport (tonnes) (2000)	714
Waste/Passenger Cork Airport (tonnes) (2000)	0.00042
Total Air Rianta Passengers (2001)	18,500,000
TOTAL WASTE GENERATED (tonnes) (2000)	**7,770**

Table 7.10 Quantity of Waste Generated by the Transport – Air Travel

7.3.9 Comparison of Data Produced by 'Scale-Up Method' with that Produced by Estimation of 'Sector Significance+ NWD figures'

A comparison of data on waste tonnage arising from the main commercial sectors using the two methods outlined in this study indicates that figures obtained from the 'scale up method' are generally less than those obtained from the method based on 'sector significance + NWD figures'.

Correlation between the two methods for the Hotel and Supermarket sectors is good suggesting confidence in both methods for these sectors.

In general the 'scale up method' is limited by comprehensive statistical data available for scaling up in all of the various sectors. For example, data may be available from the HEA for student enrolment figures but the HEA figures do not include all third level institutes. In addition, while data was available from the Department of Health on bed days for short term patients, there is an unavailability of figures for long-stay patients at all hospitals.

For scale up on the transportation sectors a wide range of statistical data is required on the various forms of transport and the various quantities of unitary waste arising.

Sector	Source	Scale Up Factor	National Waste Generated (tonnes)	
			Based on scale -up	Based on national database and sector size
Hotels	*Bord Failte*	4.74 kg/room	63,765	62,172
Third Level Educational Establishments	*CIT*	0.0564 tonnes/student	8,949*	
	NUI & St.Pats	0.0935 tonnes/student	14,833*	26,980
Hospitals	*Waterford Regional*	2.93E-03 tonnes/bed day	10,576*	23,074
Supermarkets	*Supervalu*	7.49E-06 tonnes/turnover	67,423	
	Centra	4.70E-06 tonnes/turnover	42,274	72,751
Banking, Insurance & Building Societies	*Central Bank*	0.2484 tonnes/employee	12,543*	
	BOI Wilton	0.5417 tonnes/employee	27,354*	38,618
Public Sector excl Health & Education	*Cork County Hall*	0.205 tonnes/employee	31,468	61,838
Transport - Air Travel	*Dublin Airport*	1.86E-04 tonnes/passenger	3,443*	
	Cork Airport	0.00042 tonnes/passenger	7,770*	15,340

Table 7.11 National Waste Tonnages for Main Commercial Sectors based on Scale-Up Based On Economic And Demographic Factors Compared With Determination By National Database And Sector Size (Used In This Study).

**Limited by statistical data.*

As can be seen from Table 7.11 the 'scale up method' can produce varying results based on the unitary waste arising figures chosen. The figures obtained from the two universities vary considerably. This is problematic as waste generation figures vary from business to business in the same sector. It is therefore necessary for a number of unitary waste generation figures to be obtained and averaged from each sector for this method to be successful.

From this study it felt that the use of the 'scale up' method is complicated, is limited by sources of statistical information, and needs to account for the varied waste generation rates from similar businesses within the same sector.

It is felt that the method based on 'sector significance + NWD figures' relies on data which is already in the public domain (in the case if the NWD) and can be accurately generated in the case of the sector significant data.

CHAPTER EIGHT: Conclusions And Recommendations: Development Of A Proposed Methodology

8.1 Introduction

The methodology used in this project to determine the national commercial waste character appears to represent a viable approach. While the results obtained on this occasion cannot be regarded as totally accurate, considerably more information has been generated than was previously available. Similarly, shortcomings and gaps have been identified. Therefore, the study has laid the foundation for a national waste characterisation methodology, which can be progressed based on the findings of this project.

The methodology proposed can be enhanced by improving the accuracy of results at a number of levels. These include additional sampling per enterprise, and additional enterprises per sector. It should be noted that certain sectors, such as Transport and Communication, may be quite heterogeneous and could therefore require further segmentation.

8.2 The Nature of Municipal Waste

Municipal waste can be regarded as coming from three sources. These can be identified by NACE codes. The three sources are:

- Non Process Industrial Waste (mainly EWC Chapters 15 and 20 from NACE codes A-F)
- 'Commercial ' waste (NACE codes G-O)
- Household waste (NACE codes P and Q).

These three categories should be characterised and combined to give the total national characteristic for municipal waste. The main methods employed to date for the characterisations are:

- Non-process industrial waste: EPA questionnaire returns from IPC and non-IPC companies
- Commercial waste: characterisation studies
- Household waste: characterisation studies

This study was devoted to the characterisation of the 'commercial sector'. However, it is argued that the methodology can find use in the other two sectors.

8.3 Characterisation of Waste in the 'Commercial' Sector

This sector is taken as being represented by NACE codes G-O. These codes contain a large number of enterprise types, making complete classification an almost impossible task. Studies in other countries indicate that a representative selection is the preferred option – usually weighting the surveys towards larger companies (c.f. Chapter 2 for details). Even then, the number of samples may be large, with samples of over 1000 being reported. However, most of the studies suffered from limitations, e.g.

- Use of questionnaires as opposed to characterisation surveys (England and Wales)
- No distinction between paper and cardboard (Almeda County)
- Large quantities of 'Mixed Generator' categories (Seattle)

- Commercial waste being collected partly as municipal and partly as commercial/industrial (ETC/W report)
- Scale-up on economic/demographic factors

Results from the current study suggest that a large proportion of the waste arises from a limited number of sectors. This greatly assists in reducing the number of samples required.

The method recommended, based on the results of this study is as follows:

(l) Sub-contract a large enough sample of waste contractors to measure their waste collected per NACE sectors and sub-sectors.

(m) Based on their business share determine the estimated percentage that each NACE sector contributes as outlined in Chapter 5.

(n) Based on the information obtained in (a) and (b) select sectors for study. These should represent a large proportion of the waste (at least 80%-90%). Applying the Pareto principle (80:20) will result in a diminishing return on resource investment after this point.

(o) Identify enterprises and/or organisations within each sector, such that there is confidence that all major deviations are covered. For example at least one university and one Institute of Technology should be examined within the colleges sector.

(p) Where sectors are particularly diverse, consider breaking them into the major sub-sectors. Transport and Communications is one example of such a sector.

(q) Carry out a waste characterisation survey at the enterprise level following the methodology outlined in this report. Ensure that enough samples are taken to give a reasonable degree of confidence in the results. Unfortunately, where particular waste streams are small, this may imply more sampling than is feasible from a resource input point of view. In such cases, complete segregation of the smaller streams may be the only accurate method of determination.

(r) From the information gleaned in (f) produce a “Fingerprint” of the enterprise. Where more than one enterprise is surveyed, produce a “Fingerprint” of the sector – unless results are at variance, in which case it may be better to work in sub-sectors.

(s) From the “Fingerprint” of each sector scale up to a national level. This can be performed in two ways, as outlined in (i) And (j) below.

(t) Using national Waste database figures and the percentage contributions obtained from (a) and (b) above, determine the quantity of waste arising from each sector. Combine this with the various “Fingerprints” obtained in (g) above. The accuracy of this technique depends on the accuracy of both the ‘Total’ waste figure and the reliability of the sectoral contributions. The two sets of information must, at least, be consistent in their scope.

(u) Using statistical and demographic data deduce a scale-up parameter. The accuracy of this parameter will depend on the quality of statistical information available, and on the establishment of a good correlation between the scale-up parameter and waste produced. An example of a reliable scale-up parameter is found in the hotel sector, where waste arisings correlate very well with number of bedroom nights sold, and where the number of bedroom nights is known with a fair degree of accuracy. On the other hand scale-up on the basis of number of employees in the Financial Services sector may not be so reliable.

(v) Good correspondence between results obtained from the methods described under (i) and (j) above would lead to a high degree of confidence in the overall result.

It is strongly recommended that the method described under (i) above be the primary method. Waste contractors will generally keep precise records. From these records, it is

possible to obtain a good estimate of the total waste produced by a sector. Reliance on landfill records is not recommended at this point. Commercial contractors often do not distinguish between 'commercial' and non-process industrial wastes. Hence, landfill records are hampered. However, if the commercial contractor is given a precise request (in terms of NACE codes, for example), the information provided tends to be reliable.

8.4 Characterisation of Waste in the 'Industrial' Sector

The 'industrial' sector (taken here as being represented by NACE codes A-F), would appear to be too heterogeneous to facilitate detailed fingerprinting by third parties. Currently, 'industrial' companies submit returns on waste statistics to the EPA. The data is then scaled up using economic and demographic statistics.

It is recognised that it is difficult to be sure of the accuracy of the information. However, the following suggestions attempt to address this problem.

Companies should be asked to submit specific information relating to the waste categories outlined in Chapter 6 of this report. It is further suggested that companies be encouraged to develop 'fingerprints' of their municipal waste. This can be done in accordance with the methodology outlined in Chapter 4 of this report. Templates, spreadsheets, etc. can be supplied to companies for this purpose.

It would appear that, despite its reliability problems, scale-up based on employee numbers, etc. is the only realistic option due to the diversity of the enterprises.

8.5 Characterisation of Waste in the 'Household' Sector

Lessons learned in the course of this 'commercial' waste characterisation, suggest that certain guiding principles can lead to a more accurate determination. Primary among these is the maximisation of the degree of segregation. At the very least, organic materials of a wet nature should be kept separate from dry materials, as contamination by liquids (of, for example paper) can lead to overestimation.

It is suggested that a method similar to the fingerprinting of commercial sectors be applied to household waste. Ideally, this should be carried out on segregated wastes. The following steps are recommended.

- Perform characterisation fingerprinting on a sample of households.
- The selection criteria should include location, social category, and current collection practices.
- It is preferable to perform the studies in locations where some type of kerbside or multi-bin system is in place. Apart from the contamination issue, single bin householders may engage in a degree of recycling via bring banks, civic amenity sites, etc. This introduces an added variable, since these practices must somehow be accounted for. On the other hand, householders may be less inclined to 'manually' recycle if there is a pre-existing segregation scheme.
- Secure agreement of householders and explain the purpose of the scheme. Ensure that no external recycling activities are carried out during the sampling period.
- Work in conjunction with a waste contractor, who may have to provide additional receptacles, increase frequency of collection, etc. The objective is to inconvenience the householder as little as possible.
- Manually sort the segregated streams to produce a fingerprint.
- Waste categories should be in line with those outlined in Chapter 6.

- Scale-up should be based on population data, regional divide, urban/rural divide, etc.

By ensuring that no external recycling occurs during the sampling period, the total waste-stream can more easily be determined.

8.6 Amalgamation of Results: Production of Overall Municipal Waste Figures

As outlined in Section 8.1 the waste stream can be regarded as stemming from several source types. If the sub-division of the waste stream fractions is consistent across these source types, amalgamation can readily be achieved. Figure 8.1 illustrates how this might happen.

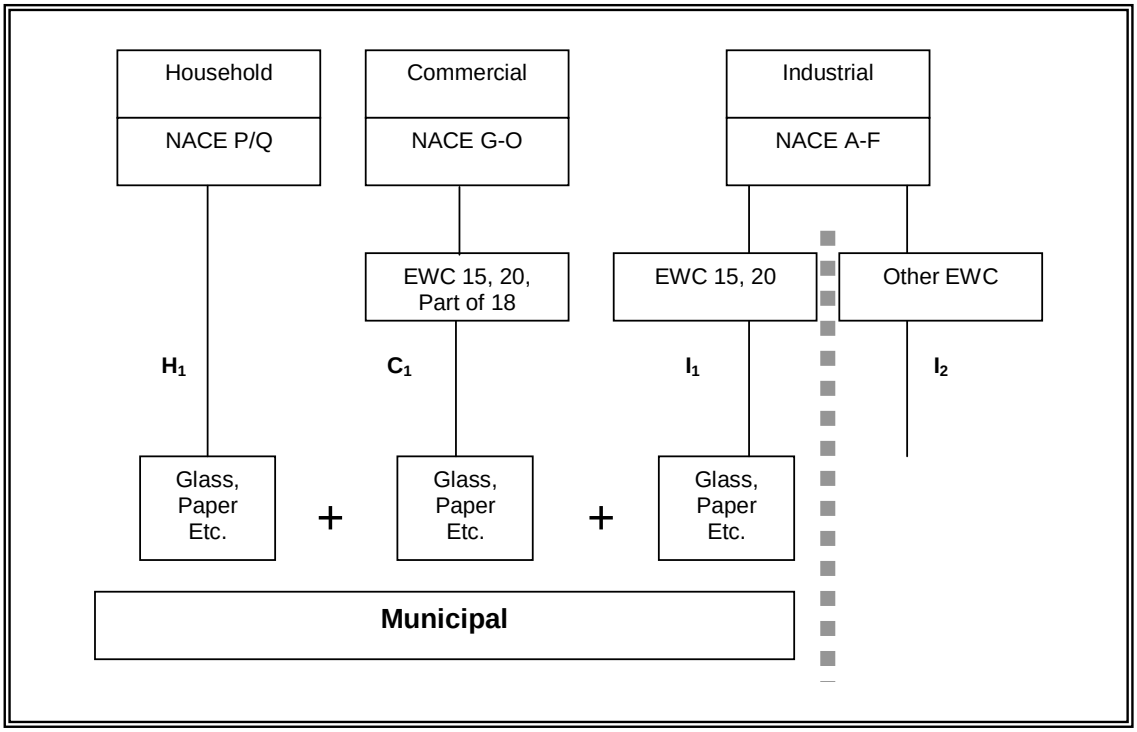


Figure 8.1 Definition of Municipal Waste

APPENDICES

Appendix A

Seattle Commercial Waste Stream

Composition Study (by weight)

Material	Overall Commercial	Construction, Demolition and Landclearing	Education	Health Care	Hotel/Motel	Manufacturing	Office	Other Services	Restaurant	Retail	Transportation	Wholesale	Mixed Commercial Generators
Paper	33.3%	4.4%	42.8%	46.6%	36.8%	23.6%	48.0%	41.0%	26.4%	33.4%	22.8%	40.9%	32.5%
Newspaper	2.7%	0.0%	5.0%	1.8%	11.0%	0.6%	3.4%	1.7%	1.7%	2.3%	1.7%	0.6%	3.2%
OCC/Kraft, unwaxed	6.7%	2.9%	4.9%	2.6%	2.8%	9.3%	4.0%	4.6%	8.8%	10.9%	8.3%	6.9%	6.6%
OCC/Kraft, waxed	1.8%	0.0%	0.5%	0.3%	2.4%	0.1%	0.0%	0.0%	1.5%	5.7%	0.0%	13.0%	0.8%
Office Paper	1.6%	0.0%	1.6%	3.3%	0.8%	1.0%	6.8%	2.1%	1.0%	1.0%	1.1%	1.1%	1.5%
Computer Paper	0.4%	0.0%	0.2%	0.5%	0.0%	0.3%	0.3%	0.5%	0.5%	0.1%	0.2%	0.6%	0.6%
Mixed Low Grade	9.8%	0.7%	10.5%	12.4%	9.2%	5.5%	18.6%	20.9%	6.3%	6.0%	4.1%	11.3%	9.3%
Phone Books	0.3%	0.0%	0.0%	0.3%	0.0%	0.0%	3.1%	0.2%	0.0%	0.0%	0.0%	0.1%	0.3%
Milk/Juice Polycoats	0.4%	0.0%	0.7%	0.4%	0.2%	2.2%	0.1%	1.2%	0.2%	0.3%	0.1%	0.0%	0.3%
Frozen Food Polycoats	0.1%	0.0%	0.1%	0.1%	0.0%	1.4%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%
Compostable/Soiled	7.0%	0.6%	17.3%	22.5%	10.2%	2.4%	9.4%	6.9%	3.8%	6.1%	5.8%	3.2%	7.0%
Paper/Other Materials	1.7%	0.1%	0.7%	1.3%	0.1%	0.5%	2.1%	1.5%	0.2%	0.8%	1.2%	3.8%	1.9%
Other Paper	0.7%	0.0%	1.3%	1.2%	0.0%	0.2%	0.3%	1.4%	2.5%	0.1%	0.2%	0.3%	0.8%
Plastic	11.0%	4.4%	11.3%	16.5%	10.1%	23.3%	9.1%	12.1%	18.4%	13.0%	5.6%	19.6%	7.7%
PER Pop & Liquor	0.2%	0.1%	0.3%	0.1%	0.1%	0.1%	0.2%	0.1%	0.2%	0.1%	0.1%	0.1%	0.2%
Other PET bottles	0.1%	0.0%	0.1%	0.1%	0.1%	0.0%	0.1%	0.1%	0.0%	0.1%	0.0%	0.0%	0.1%
HDPE Milk & Juice	0.2%	0.0%	0.5%	0.2%	0.1%	0.4%	0.1%	0.1%	0.1%	0.2%	0.1%	0.1%	0.2%
Other HDPE Bottles	0.2%	0.0%	0.3%	0.3%	0.1%	0.3%	0.5%	0.1%	0.1%	0.2%	0.1%	0.1%	0.3%
Other Plastic Bottles	0.1%	0.0%	0.1%	0.3%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%
Jars and Tubs	0.3%	0.0%	0.4%	0.3%	2.0%	1.2%	0.1%	0.1%	0.3%	0.2%	0.1%	0.1%	0.3%
Expanded Polystyrene	0.5%	0.1%	0.2%	0.7%	0.0%	0.4%	1.0%	0.4%	0.1%	0.6%	0.9%	0.8%	0.4%
Other Rigid Packaging	0.5%	0.3%	0.9%	0.8%	0.1%	0.4%	0.3%	1.3%	0.4%	0.6%	0.1%	0.3%	0.5%
Grocery/Bread Bags	0.5%	0.0%	0.4%	0.3%	0.9%	0.1%	0.1%	0.6%	0.2%	0.7%	0.7%	0.1%	0.5%
Garbage Bags	1.5%	0.0%	3.7%	5.0%	2.6%	0.8%	1.6%	1.6%	2.7%	2.0%	0.7%	0.3%	1.4%
Other Film	4.2%	3.3%	2.0%	7.3%	2.3%	7.0%	2.1%	3.9%	13.2%	5.9%	0.9%	15.1%	2.9%
Plastic Products	1.3%	0.7%	1.4%	0.9%	0.8%	4.5%	2.1%	1.7%	1.0%	1.2%	1.3%	1.0%	1.0%
Plastic/Other Materials	1.5%	0.0%	0.9%	0.3%	0.8%	8.2%	0.9%	1.9%	0.0%	1.3%	0.6%	1.7%	
Glass	2.5%	0.2%	3.6%	1.5%	4.1%	1.6%	4.3%	2.7%	2.1%	1.5%	4.9%	0.3%	2.6%
Clear Beverage	1.1%	0.1%	2.3%	1.2%	1.7%	0.5%	1.1%	1.7%	0.7%	0.9%	0.9%	0.2%	1.2%
Green Beverage	0.4%	0.0%	0.5%	0.2%	0.7%	0.1%	0.4%	0.2%	0.9%	0.3%	0.5%	0.0%	0.5%
Brown Beverage	0.4%	0.0%	0.4%	0.0%	0.2%	0.1%	0.2%	0.3%	0.5%	0.2%	0.7%	0.0%	0.6%
Container Glass	0.1%	0.0%	0.2%	0.0%	0.0%	0.1%	0.0%	0.1%	0.1%	0.1%	0.1%	0.0%	0.1%
Fluorescent Tubes	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Other Glass	0.4%	0.0%	0.2%	0.0%	1.5%	0.9%	2.5%	0.4%	0.0%	0.1%	2.7%	0.1%	0.2%
Metal	6.5%	8.4%	5.8%	2.8%	2.4%	9.5%	5.1%	8.3%	1.5%	3.9%	6.6%	5.1%	6.5%
Aluminium Cans	0.3%	0.0%	0.8%	0.3%	0.2%	0.2%	0.4%	0.3%	0.1%	0.2%	0.2%	0.1%	0.4%
Alum. Foil/Containers	0.1%	0.0%	0.2%	0.2%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%
Other Aluminium	0.1%	0.3%	0.1%	0.2%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.4%	0.4%	0.1%
Other Nonferrous	0.3%	2.5%	0.0%	0.3%	0.0%	0.6%	0.0%	0.0%	0.2%	0.3%	0.3%	0.0%	0.3%
Tin Food Cans	0.7%	0.1%	1.7%	0.3%	0.4%	1.1%	0.2%	1.0%	1.0%	0.4%	0.2%	0.6%	0.7%
Empty Aerosol Cans	0.1%	0.0%	0.1%	0.0%	0.4%	0.1%	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%	0.1%
Other Ferrous	3.1%	5.4%	1.7%	0.9%	0.5%	6.3%	1.5%	2.4%	0.0%	1.6%	2.0%	3.1%	2.8%
Mixed Metals/Materials	1.9%	0.1%	1.2%	0.6%	0.9%	1.2%	3.0%	4.4%	0.0%	1.2%	3.5%	0.9%	2.0%
Organics	28.1%	0.1%	23.4%	11.7%	43.3%	12.9%	13.2%	18.7%	50.8%	39.8%	28.1%	27.2%	30.6%
Pallets	2.3%	0.0%	0.0%	0.0%	0.0%	4.5%	1.6%	5.2%	0.0%	0.6%	11.2%	6.8%	1.6%
Crates/Boxes	1.0%	0.0%	0.0%	0.0%	0.6%	1.6%	0.0%	0.9%	0.0%	1.2%	10.8%	1.3%	0.7%
Leaves and Grass	2.1%	0.0%	0.3%	0.8%	0.0%	0.3%	3.3%	2.1%	0.0%	3.3%	0.0%	0.0%	2.9%
Prunings	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.7%	0.0%	0.5%	0.2%	0.0%	0.7%
Food	22.2%	0.1%	23.0%	10.9%	42.7%	6.6%	8.2%	9.9%	50.8%	34.1%	5.9%	19.2%	24.6%
Other Materials	8.2%	9.5%	5.2%	7.7%	2.7%	15.9%	12.1%	7.8%	0.7%	5.9%	7.5%	2.6%	9.0%
Textiles/Clothing	1.5%	0.2%	1.0%	1.2%	1.1%	3.9%	5.4%	1.4%	0.4%	1.3%	0.4%	0.2%	1.7%
Carpet/Upholstery	1.4%	5.7%	0.3%	1.1%	0.0%	3.3%	0.7%	0.6%	0.2%	0.7%	0.6%	0.4%	1.6%
Leather	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.5%	0.0%	0.0%	0.1%
Disposable Diapers	0.3%	0.0%	0.1%	1.8%	0.3%	0.2%	0.4%	0.6%	0.0%	0.3%	0.0%	0.0%	0.4%
Animal By-products	0.3%	0.0%	0.0%	0.0%	0.0%	0.3%	0.1%	0.4%	0.0%	0.2%	0.8%	0.1%	0.4%
Rubber Products	0.8%	0.4%	1.3%	1.7%	0.1%	0.5%	0.2%	0.8%	0.0%	0.1%	3.0%	0.0%	0.8%
Tires	0.1%	0.0%	0.0%	0.0%	0.0%	0.3%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%
Ash	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%
Furniture	0.4%	0.0%	0.0%	0.2%	0.0%	2.4%	2.5%	1.3%	0.0%	0.3%	0.0%	0.1%	0.3%
Mattresses	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.9%	0.0%	0.1%	0.0%	0.0%	0.2%
Small Appliances	0.5%	0.0%	0.3%	0.0%	0.0%	0.0%	0.3%	0.2%	0.0%	0.6%	0.8%	1.2%	0.6%
A/V Equipment	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.6%	0.1%	0.0%	0.7%	0.0%	0.0%	0.2%
Ceramics/Porcelain	0.3%	0.0%	0.2%	0.0%	0.0%	0.0%	1.0%	0.4%	0.1%	0.1%	0.0%	0.0%	0.4%
Non-distinct Fines	0.7%	0.0%	0.4%	0.8%	0.7%	0.6%	0.3%	0.6%	0.0%	0.4%	0.8%	0.4%	0.9%
Misc. Organics	0.9%	0.0%	1.6%	0.0%	0.3%	1.5%	0.1%	0.2%	0.0%	0.1%	0.4%	0.0%	1.1%
Misc. Inorganics	0.4%	3.2%	0.1%	0.9%	0.3%	3.0%	0.6%	0.1%	0.0%	0.3%	0.8%	0.3%	0.2%
CDL Wastes	9.9%	73.0%	7.8%	4.9%	0.2%	13.1%	7.2%	9.2%	0.0%	2.4%	24.4%	4.2%	9.6%
Dimension Lumber	1.7%	6.5%	1.1%	0.4%	0.0%	5.9%	1.2%	3.1%	0.0%	0.1%	0.7%	0.3%	1.5%
Other Untreated Wood	0.4%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.4%
Treated Wood	1.5%	0.1%	1.3%	0.2%	0.0%	2.0%	1.6%	2.3%	0.0%	1.4%	7.7%	0.7%	1.2%
Contaminated Wood	1.0%	1.4%	0.0%	0.5%	0.2%	0.3%	1.6%	1.5%	0.0%	0.3%	5.3%	0.2%	1.1%
New Gypsum Scrap	0.1%	7.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%
Demo Gypsum Scrap	1.5%	36.6%	1.0%	0.0%	0.0%	0.0%	1.3%	0.1%	0.0%	0.0%	0.0%	0.0%	1.6%
Fibreglass Insulation	0.1%	0.8%	0.0%	0.0%	0.0%	0.1%	0.3%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%
Rock/Concrete/Brick	0.7%	8.2%	1.0%	3.0%	0.0%	0.3%	0.0%	0.1%	0.0%	0.0%	1.2%	1.1%	0.7%
Asphaltic Roofing	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	1.2%	0.0%	0.0%	0.0%	0.0%	0.7%
Other Construction Debris	0.7%	3.1%	2.8%	0.7%	0.0%	0.0%	1.0%	0.1%	0.0%	0.1%	0.0%	0.0%	0.9%
Sand/Soil/Dirt	1.8%	8.3%	0.6%	0.1%	0.0%	4.5%	0.1%	0.6%	0.0%	0.3%	9.4%	1.8%	1.3%
Hazardous	0.5%	0.0%	0.1%	8.4%	0.4%	0.0%	0.9%	0.2%	0.0%	0.0%	0.1%	0.0%	0.5%
Latex Paints	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%
Hazardous Adhesives/Glues	0.0%	0.0%	0.1%	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Non-hazardous Adhesives/Glues	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Oil-based Paints/Solvents	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Cleaners	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Pesticides/Herbicides	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Dry-Cell Batteries	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.1%
Wet-Cell Batteries	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Gasoline/Kerosene	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Motor Oil/Diesel Oil	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Asbestos	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Explosives	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Other Hazardous Chemicals	0.2%	0.0%	0.0%	8.2%	0.0%	0.0%	0.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
Other Non-hazardous Chemicals	0.1%	0.0%	0.1%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
Sample Count	348	5	15	9	5	25	19	28	5	34	10	29	151
Total Sample	193,793.0	1,513.1	3,610.8	2,089.7	1,332.8	6,748.3	4,687.3	7,277.5	1,815.1	9,120.3	2,952.3	7,823.9	40,253.3

Appendix B

Composition of Commercial Waste – California

Results of Industry Group Surveys

Composition by Industry Group

The study called for 1,200 commercial generator samples, which were allocated to 26 industry groups organised according to Standard Industrial Classification (SIC) codes. The following industry groups were included:

A - Finance / Insurance / Real Estate / Legal	N - Public Administration
B - Retail Trade - Restaurants	O - Services - Hotels / Lodging
C - Retail Trade - Other	P - Trucking & Warehousing
D - Services - Other Misc.	Q - Wholesale Trade - Durable Goods
E - Wholesale Trade - Nondurable Goods	R - Manufacturing - Other
F - Retail Trade - Auto Dealers & Service Stations	S - Transportation - Other
G - Services - Other Professional	T - Manufacturing - Electronic Equipment
H - Retail Trade - Food Store	U - Manufacturing - Food / Kindred
I - Construction	V - Manufacturing - Lumber & Wood Products
J - Services - Medical / Health	W - Manufacturing - Transportation Equipment
K - Manufacturing - Printing / Publishing	X - Retail Trade - Building Material & Garden
L - Services - Business Services	Y - Manufacturing - Industrial / Machinery
M - Services – Education	Z - AM Lumped Group

The last grouping, “Z - AM Lumped Group” includes several industry groups, each of which contributes relatively little to the state’s commercial waste stream. The lumped group includes the following industries:

Z - Agriculture / Fisheries	AG - Manufacturing - Chemical / Allied
AA - Manufacturing - Instruments / Related	AH - Retail Trade - General Merchandise Store
AB - Communications	AI - Mining
AC - Manufacturing - Primary / Fabricated Metal	AJ - Transportation - Air
AD - Manufacturing - Apparel / Textile	AK - Utilities
AE - Manufacturing - Furniture / Fixtures	AL - Manufacturing - Paper / Allied
AF - Services - Motion Pictures	AM - Forestry

Samples were allocated to each industry group and then were allocated to each of the state’s five regions based on the relative contribution of each region to the employment in each industry group. Samples were further allocated to the selected waste sheds within each region based on the relative contribution of each waste shed to the employment in each industry group. This data summarised in Table B.1.

Sector (No. of Samples)	Paper	Other Organic	Plastic	C & D	Metal	Special Waste	Glass	Mixed Residue	Hazardous
Manufacturing - Printing/Publishing (46)	66.3%	7.0%	10.4%	7.4%	5.0%	2.2%	0.7%	0.4%	0.5%
Finance/Insurance/Real Estate/Legal (48)	50.4%	25.6%	6.7%	4.3%	3.8%	5.0%	2.7%	0.6%	1.0%
Services - Medical/Health (50)	47.5%	26.6%	8.1%	1.5%	3.4%	10.4%	2.1%	0.2%	0.2%
Transportation-Other (41)	44.6%	13.2%	12.7%	16.6%	6.4%	0.2%	4.2%	2.2%	0.1%
Manufacturing-Transportation Equipment (46)	43.0%	12.4%	13.1%	17.4%	8.0%	2.0%	1.3%	1.9%	1.0%
Manufacturing-Electronic Equipment (44)	41.9%	10.8%	17.0%	13.1%	11.5%	1.2%	3.5%	0.8%	0.3%
AM Lumped Group (60)	41.0%	15.5%	17.3%	12.7%	5.4%	5.8%	1.3%	1.0%	0.1%
Services - Other Professional (49)	40.8%	38.3%	7.4%	6.2%	2.8%	0.6%	3.0%	0.4%	0.4%
Services-Business Services (43)	40.8%	31.1%	11.0%	3.9%	7.3%	1.0%	3.1%	1.0%	0.7%
Retail Trade – Other (51)	39.8%	30.6%	10.0%	6.4%	7.7%	2.0%	2.4%	0.7%	0.3%
Public Administration (43)	39.4%	27.7%	10.9%	12.9%	4.8%	1.1%	2.8%	0.2%	0.2%
Wholesale Trade - Nondurable Goods (53)	38.2%	31.3%	13.7%	5.9%	3.3%	5.3%	2.0%	0.4%	0.0%
Services-Hotels/Lodging (41)	37.1%	37.1%	10.4%	1.2%	3.2%	0.4%	9.8%	0.7%	0.0%
Manufacturing-Industrial/Machinery (48)	36.9%	12.8%	13.7%	12.2%	15.9%	5.6%	1.4%	0.7%	0.8%
Manufacturing-Food/Kindred (41)	36.3%	28.6%	18.8%	7.9%	5.4%	1.7%	1.2%	0.2%	0.0%
Trucking & Warehousing (42)	34.9%	12.2%	6.4%	23.7%	12.4%	6.5%	2.8%	0.3%	0.9%
Retail Trade - Automotive Dealers & Service Stations (53)	33.9%	13.5%	10.4%	14.9%	13.2%	9.5%	3.9%	0.4%	0.2%
Wholesale Trade-Durable Goods (42)	33.3%	23.6%	15.3%	13.1%	9.9%	1.2%	2.4%	1.1%	0.1%
Services - Other Misc. (50)	33.2%	30.3%	10.1%	4.8%	14.5%	3.7%	2.5%	0.5%	0.5%
Services-Education (42)	30.7%	51.3%	9.8%	0.5%	5.1%	0.9%	1.3%	0.3%	0.1%
Manufacturing-Other (45)	28.5%	17.6%	17.5%	17.9%	6.4%	8.2%	2.3%	1.6%	0.0%
Retail Trade - Food Store (52)	27.5%	43.3%	11.3%	10.8%	4.7%	0.8%	1.6%	0.1%	0.0%
Retail Trade-Restaurants (51)	25.0%	56.8%	7.0%	4.4%	3.4%	0.0%	3.2%	0.2%	0.0%
Retail Trade-Building Material & Garden (41)	21.4%	15.0%	6.9%	38.5%	6.0%	0.5%	8.4%	3.2%	0.0%
Construction (45)	20.4%	17.0%	5.1%	39.5%	9.6%	4.2%	3.9%	0.1%	0.2%
Manufacturing-Lumber & Wood Products (40)	16.3%	22.3%	3.0%	44.1%	10.1%	1.8%	1.5%	0.6%	0.4%
Overall Composition (1,207)	**39.0%**	**31.3%**	**9.8%**	**6.4%**	**6.0%**	**4.1%**	**2.4%**	**0.5%**	**0.3%**

Table B.1: Summary of Sector Composition Study from California, 1999

Waste Disposal Rates for Business Types

The estimated average disposal volume, average waste density and average per-employee disposal rate for each industry group considered in the study was determined. These figures were calculated based on information collected about the waste density (sample weight per volume), dumpster volume, dumpster fullness, frequency of waste pick-up, and number of employees at each participating generator site.

During the 1999 Statewide Waste Characterization Study, 14 of the 39 separate industry groups were combined into a "lumped group" for sampling purposes. This was possible because each of these groups contributes relatively little to the state's waste stream. Together, their contribution is less than 5 percent. As a result, the disposal rate estimates for each of these groups is based on a limited number of samples. This limitation should be considered when using the data. The industries included in the "lumped group" are identified by an asterisk.

Figure B.1 and Table B.2 shows the relative contribution of each industry group to the state's entire commercial sector waste.

In addition, Table B.2 contains the values for waste disposal rates for the business groupings in the solid waste characterization database, as well as the typical density of waste disposed by each grouping. Each business type has its own disposal rate - restaurants dispose different amounts from offices, for example. Also, the larger the business, the more waste it usually disposes. The number of employees can be used to indicate business size. Number of employees is used in the disposal characterization database to develop waste disposal rates for businesses. The assumption of the database is that businesses of a certain type (say restaurants) dispose similar wastes at similar rates (per employee), regardless of the location or size of the business. The data was developed as part of the 1999 Statewide Waste Characterization Study. Disposal rates are affected by a number of factors. Thus, these rates should only be used for planning purposes to aid in the design and development of solid waste programs. They should not be used as a measurement tool.

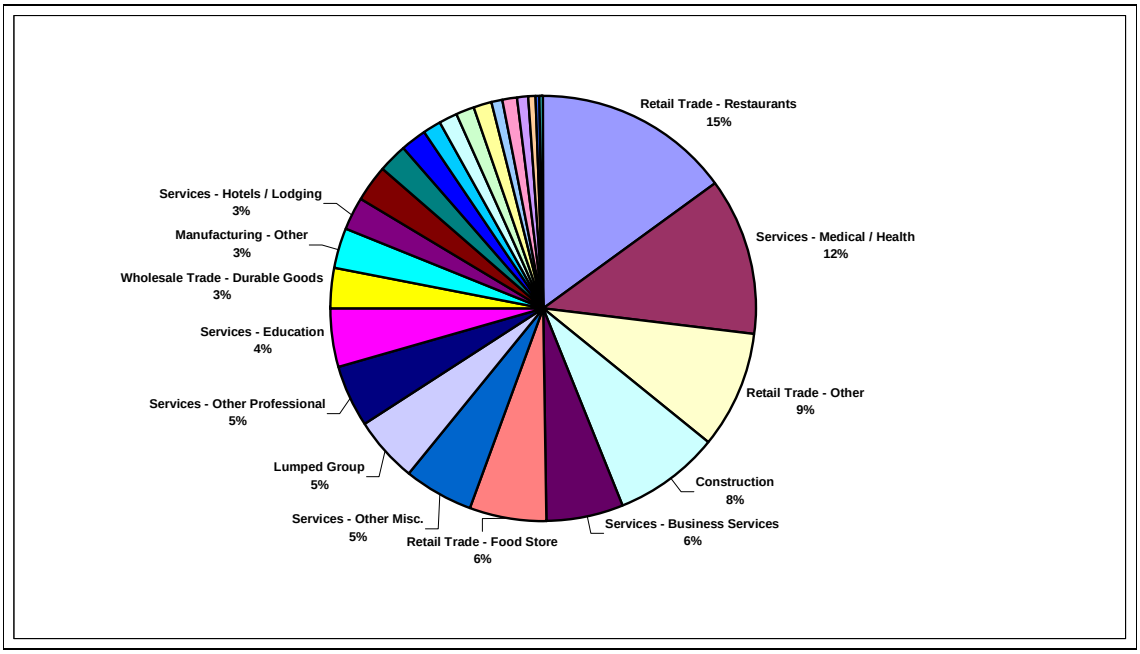


Figure B.1: Relative Contribution of Each Industry Group to Commercial Waste

Business SIC No.	Industry Group	Est. Percentage of Commercial Sector Waste	Est. Statewide Disposal (tons per year)	Disposal Rate (tons/employee /year)	Waste Density (lb/cubic yard)
29	B - Retail Trade - Restaurants	15.1%	2,622,515	3.1	109
35	J - Services - Medical / Health	11.8%	2,040,526	1.5	75
30	C - Retail Trade - Other	9.1%	1,577,262	1.9	72
4	I - Construction	8.0%	1,386,113	3	116
33	L - Services - Business Services	5.9%	1,015,819	1.7	87
27	H - Retail Trade - Food Store	5.8%	1,003,044	2.9	84
38	D - Services - Other Misc.	5.3%	919,135	0.9	90
	Z - AM Lumped Group:				
8 *	AE- Manufacturing--Furniture / Fixtures			2.4	145
3 *	AI- Mining			1.8	100
20 *	AB- Communications			1.5	98
16 *	AA- Manufacturing--Instruments / Related			1.2	121
34 *	AF- Services--Motion Pictures			1.1	169
19 *	AJ- Transportation--Air			1	82
1 *	Z- Agriculture / Fisheries	5.0%	868,681	0.9	107
6 *	AD- Manufacturing--Apparel / Textile			0.9	103
11 *	AG- Manufacturing--Chemical / Allied			0.9	135
12 *	AC- Manufacturing--Primary / Fabricated Metal			0.7	122
9 *	AL- Manufacturing--Paper / Allied			0.6	100
21 *	AK- Utilities			0.3	73
26 *	AH- Retail Trade--General Merchandise Stores			0.3	87
2 *	AM- Forestry			0.2	100

37	G - Services - Other Professional	4.7%	814,533	1.2	104
36	M - Services - Education	4.4%	763,817	0.8	73
23	Q - Wholesale Trade - Durable Goods	3.3%	566,863	0.9	65
17	R - Manufacturing - Other	3.0%	520,486	3.1	122
32	O - Services - Hotels / Lodging	2.6%	459,789	2.1	97
25	X - Retail Trade - Building Material & Garden	2.6%	446,541	3.3	121
24	E - Wholesale Trade - Nondurable Goods	2.2%	382,924	0.9	87
31	A - Finance / Insurance / Real Estate / Legal	1.9%	322,502	0.3	88
39	N - Public Administration	1.6%	278,112	0.4	89
18	P - Trucking & Warehousing	1.4%	245,569	1.9	95
5	U - Manufacturing - Food / Kindred	1.4%	238,668	1.6	74
22	S - Transportation - Other	1.2%	202,160	1.3	73
28	F - Retail Trade - Auto Dealers & Service Stations	1.0%	175,403	0.6	84
10	K - Manufacturing - Printing / Publishing	1.0%	165,594	0.8	88
14	T - Manufacturing - Electronic Equipment	0.8%	136,275	0.5	63
7	V - Manufacturing - Lumber & Wood Products	0.6%	107,251	3.1	134
15	W - Manufacturing - Transportation Equipment	0.3%	52,606	0.4	76
13	Y - Manufacturing - Industrial / Machinery	0.3%	46,172	0.2	69
	Total	**100.0%**	**17,358,359**	**-**	**-**

Table B.2: Waste Disposal Rates & Relative Contribution of Each Industry Group to Commercial Waste

Appendix C

Landfilled Waste Composition – Alameda County

Results of Four Quarterly Surveys

Material	Commercial Average Waste Composition (Weight Percent)
Paper	36.89
Corrugated	6.22
High Grade	4.61
Text Books	0.36
Newspaper	4.12
Magazines	1.67
Phone Books	0.48
Mixed Paper	5.22
Other Paper	14.21
Plastic	12.02
HDPE-narrow	0.51
HDPE-wide	0.37
PET-narrow	0.26
PET-wide	0.07
Film Plastics	4.75
Other Plastic	6.07
Glass	2.98
CRV Glass	0.88
Other Recyc - clear	1.19
Other Recyc - color	0.34
Other Non-recyclable	0.57
Metals	5.29
Aluminum Cans	0.31
Other Non-Ferrous	0.45
Steel Food & Bev Cans	0.67
Other Ferrous	3.48
White Goods	0.38
Yard Waste	4.92
Leaves & Grass	3.1
Branches & Brush	1.82
Organics	31.84
Food Waste	14.93
Tires	0.67
Other Rubber	1.03
Wood-unpainted	5.56
Wood-painted	2.06
Textiles & Leather	4.87
Diapers	1.28
Other Organics	1.43
Other Waste	6.07
Crushable Inerts	1.43
Other Inerts	1.27
Gypsum Wallboard	0.36
Asphalt Roofing	0.07
HHW	0.51
Brown Goods	1.48
Comp. Bulky Items	0.95
Total	100

Appendix D

Estimated Solid Waste Generation Rates for

Commercial Establishments, California

Waste Generation Source	Gen. Rate	Units of Measure	Source Date	Source	Notes
Commercial	10.53	lb/employee/day	May 1998	City of Los Angeles CEQA Thresholds Guide: Your Resource for Preparing CEQA Analyses in Los Angeles (DRAFT)	Does not include generation of construction debris
Commercial	5	lb/1000 sq ft /day	Aug. 1992	Co. of Los Angeles Dept. of Regional Planning, Vesting Tentative Tract No. 47905, etc.	EIR cites City of LA Dept. of City Planning doc "EIR Manual for Private Projects" as source
Commercial	13	lb/1000 sq ft /day	Apr. 1993	Draft Environmental Impact Report (EIR) for South Gate Commercial Corridors Redevelopment Project	EIR cites CIWMB Resource Manual, May 1989
Commercial	25	lb/gross sq ft /day	Jan. 1996	Draft Program EIR for Rye Canyon Business Part, Santa Clarita	EIR cites SWANA Tech. Bull. 85-6; Recovery Sciences, 1987; and Santa Clarita SRRE, 1990
Commercial retail	0.046	lb/sq ft/day	n/a	Draft EIR for the Central Commercial Redevelopment Project (Monterey Park Redevelopment Agency)	EIR cites Athens Disposal Co. and GRC Redevel. Consultants, 1992 as source
Commercial retail	0.006	lb/sq ft/day	Dec. 1991	Draft EIR for North Hills Development (Santa Clarita)	EIR cites City of LA Bureau of Solid Waste, 1989, as source
Commercial retail	2.5	lb/1000 sq ft /day	Apr. 1992	Stevenson Ranch Draft EIR (Phase IV) , LA County	EIR cites source as Ultrasystems
Office	6	lb/1000 sq ft /day	Apr. 1992	Stevenson Ranch Draft EIR (Phase IV) , LA County	EIR cites source as Ultrasystems
Office	0.006	lb/sq ft/day	Dec. 1991	Draft EIR for North Hills Development (Santa Clarita)	EIR cites City of LA Bureau of Solid Waste, 1989, as source
Office	100	lb/gross sq ft /day	Jan. 1996	Draft Program EIR for Rye Canyon Business Park, Santa Clarita	EIR cites SWANA Tech. Bull. 85-6; Recovery Sciences, 1987; and Santa Clarita SRRE, 1990

Office	0.0108	tons/sq ft/year	May 1998	Guidelines for Preparation of Environmental Assessments for Solid Waste Impacts (Ventura County Solid Waste Management Department)	Document states: "The Guidelines should not be construed as being a universal measuring tool for projects outside Ventura County."
Office	1.24	lb/employee /day	Jul. 1993	Final Report: 1992 Washington State Waste Characterisation Study, Volume 3: Generator Survey Approach (Washington State Department of Ecology)	
Offices	1 1.5	lb./100 sq ft /day lb/employee /day	May 1997	Guide to Solid Waste and Recycling Plans for Development Projects (Santa Barbara County Public Works Department)	Cites SWANA Tech. Bull. 85-6; Recovery Sciences, 1987; and Matrix Mgmt Group, "Best Management Practices Analysis for Solid Waste"
Professional office	0.084	lb/sq ft/day	n/a	Draft EIR for the Central Commercial Redevelopment Project and the Freeway ... (Monterey Park Redevel. Agency)	EIR cites Athens Disposal Co. and GRC Redevel. Consultants, 1992 as source
Commercial retail	0.0024	tons/sq ft/year	May 1998	Guidelines for Preparation of Environmental Assessments for Solid Waste Impacts (Ventura County Solid Waste Management Department)	Document states: "The Guidelines should not be construed as being a universal measuring tool for projects outside Ventura County."
Commercial retail (dry goods)	4.75	lb/emp/day	Jul. 1993	Final Report: 1992 Washington State Waste Characterisation Study: Volume 3: Generator Survey Approach (Washington State Department of Ecology)	
Auto dealer and service station	0.9	lb/100 sq ft/day	May 1997	Guide to Solid Waste and Recycling Plans for Development Projects (Santa Barbara County Public Works Department)	Cites SWANA Tech. Bull. 85-6; Recovery Sciences, 1987; and Matrix Mgmt Group, "Best Management Practices Analysis for Solid Waste"
Auto dealer, services, repair and service stations	0.0108	tons/sq ft/year	May 1998	Guidelines for Preparation of Environmental Assessments for Solid Waste Impacts (Ventura County Solid Waste Management Department)	Document states: "The Guidelines should not be construed as being a universal measuring tool for projects outside Ventura County."

Department store	3.12	lb/100 sq ft/day	May 1997	Guide to Solid Waste and Recycling Plans for Development Projects (Santa Barbara County Public Works Department)	Cites SWANA Tech. Bull. 85-6; Recovery Sciences, 1987; and Matrix Mgmt Group, "Best Management Practices Analysis for Solid Waste"
Food stores	0.0108	tons/sq ft/year	May 1998	Guidelines for Preparation of Environmental Assessments for Solid Waste Impacts (Ventura County Solid Waste Management Department)	Document states: "The Guidelines should not be construed as being a universal measuring tool for projects outside Ventura County."
Shopping center	2.5	lb/100 sq ft/day	May 1997	Guide to Solid Waste and Recycling Plans for Development Projects (Santa Barbara County Public Works Department)	Cites SWANA Tech. Bull. 85-6; Recovery Sciences, 1987; and Matrix Mgmt Group, "Best Management Practices Analysis for Solid Waste"
Supermarket	3.12	lb/100 sq ft/day	May 1997	Guide to Solid Waste and Recycling Plans for Development Projects (Santa Barbara County Public Works Department)	Cites SWANA Tech. Bull. 85-6; Recovery Sciences, 1987; and Matrix Mgmt Group, "Best Management Practices Analysis for Solid Waste"

Appendix E

International Waste Characterisation Methodologies

A. New Zealand

The Ministry for the Environment, New Zealand have devised a procedure for characterising solid waste that arrives at the disposal facility (transfer station, landfill, incineration plant or other bulk waste-handling facility) in bulk. The methodology for these studies is provided in '*Solid Waste Analysis Protocol*' (March 2002). This procedure entails:

- weighing all or most large vehicle loads entering the site and a proportion of smaller vehicle loads
- sampling a proportion of incoming loads in each category and sorting and weighing a sample of refuse from these into 12 primary categories
- statistical analysis and reporting.

There are two survey methods, sort-and-weigh and visual classification. The sort-and-weigh methodology has the advantage of greater accuracy and reliability in assessing the waste composition of each load of waste. However, it is time consuming and the number of waste loads able to be surveyed by this method is limited by the practicalities and costs of the method.

Visual classification is easier and quicker. It makes the results of the survey more representative of the overall waste stream by allowing a greater number of waste loads to be surveyed so that the data set is more extensive than is likely to be affordable using just a sort-and- weigh methodology. However, the method is less accurate in assessing the composition of each load of waste. Visual classification also potentially introduces a bias in the measurement of proportions for individual survey staff.

It is recommended that only the sort-and-weigh methodology be used for surveys at disposal facilities. These surveys can be designed to use both methods, but if visual classification is to be used then it must be in conjunction with sort-and-weigh methods, so that the accuracy of the visual classifications can be verified.

Sorting and Weighing

Ideally the sorting area should be covered and paved. Uncovered sorting areas can be used, but performance and data quality will be lower, and sorting may not be possible at all on days with continuous rain or strong wind. The sorting area needs to be at least 10 m x 10 m, with further areas available for storing refuse before and after sorting.

If visually classifying loads, this should be done before sort-and-weigh of a sample. Weights of each component are recorded, together with approximate volumes if volumetric data is also being gathered.

Tare weights only need to be measured once for vehicles that regularly haul loads to the landfill (if tare weights are not available, then reweigh the empty vehicle, record on form and retain form). When sorting and weighing the primary categories, the load must be weighed before sorting and the total after sorting checked against this. Weights should be recorded to the nearest 10 g. The simplest check on data entry are the totals before and after sorting. The system of double entry of data will identify most errors.

Visual Classification

Visual classification is a method whereby an observer estimates the proportions of refuse belonging to the primary waste classifications. The primary classifications are:

• Paper • Plastics • Purescibles • Ferrous metals • Non-ferrous metals • Glass	• Textiles • Nappies and sanitary • Rubble, concrete etc. • Timber • Rubber • Potentially hazardous

Visual classification yields far more data than sorting and weighing, but it is less precise. One person can visually classify 8 to 16 vehicle loads of refuse per hour; the limiting factor being the time to discharge loads. In comparison, a sort-and-weigh team of four people can process between one and three vehicle loads per hour.

Visual classification is a method for quickly collecting a large amount of data. Only one person will be visually classifying loads at a time. This person will make their assessment of the load as it is being unloaded from the vehicle, so that the entire load is seen. It is useful to estimate major components first, then note which categories are not present, and finally estimate minor components. It is essential to check that the sum of the estimates is 100%. Major components should be recorded to the nearest 5%, while components less than 10% should be recorded more accurately. To reduce the likelihood of bias, each member of the survey team should be rostered on the visual classification daily.

All loads that are sorted and weighed in detail should also have estimates of visual classification done by the remainder of the survey team. Separate working sheets should be provided to each team member, to avoid them subconsciously using the previous team member's estimate.

Following calculation of weights, immediate feedback should be given to each team member on an individual basis. This helps team members improve their visual classifications. Where there is some doubt about the ability of personnel to be sufficiently accurate in visual classification, the survey design should be initially based on sort-and-weigh only. During the initial stages of the sort-and-weigh survey, visual classification of the refuse can be trialed at little extra effort. If the visual classification proves to be reasonably consistent, it can be used to augment the data set and thereby improve precision. Different people will need different amounts of calibration against sort-and-weigh before they can undertake visual calibration duties. This can be evaluated by plotting calibration results for each individual. The visual assessment of loads to be sorted and weighed should, of course, be carried on throughout the survey, so that these loads may be considered a representative selection of the total that was visually assessed.

B. California

The California Integrated Waste Management Board (CIWMB) has devised a procedure for the characterization of waste. This procedure is outlined in 'Statewide Waste Characterisation Study: Results and Final Report' (December 1999). A summary of their methodology is provided below:

The objectives of this study were:

1. to estimate the composition of commercially collected waste that is disposed by commercial, industrial, and institutional generators in California and
2. to develop composition profiles for 26 types of generators, or industry groups.

The study called for a total of 1200 commercial generator samples. The first step in allocating these samples was to select the waste sheds where commercial waste samples would be collected. From the list of randomly selected disposal sites in each region, CIWMB staff randomly selected two to three disposal sites in each region, for a total of twelve sites throughout the state. Using Geographic Information System (GIS) mapping, CIWMB staff selected zip code areas as the boundaries around these disposal sites that roughly corresponded to a 20 mile radius around the site. Businesses located within these "waste sheds" were eligible for generator sampling.

Industry groups were designated based on the CIWMB's standard industry groupings by Standard Industrial Classification (SIC) code. Then the CIWMB allocated the number of samples to be collected from each industry group during each season according to the following process.

First, the number of samples to be collected throughout the state in each industry group were determined. Employment data for 1998 and previously determined business disposal rates (tons disposed per employee per year) were used to estimate total statewide disposal for each industry group, and the groups were ranked by disposal tonnage. A minimum of 40 samples was desired in each of the top 25 groups, each of which contribute at least 1% to the state's waste stream and in total account for an estimated 95% of the statewide waste disposed. To improve data for the industry groups that contribute the most waste, the minimum number of samples was increased to 50 for each of the top 10 groups. The remaining 13 groups, which together account for less than 5% of the waste, were lumped together and 60 samples (5% of the total number of samples) were assigned to this group as a whole.

Employment for each industry group in each region was used to distribute samples among the regions. For example, the Bay Area region accounts for 26% of statewide employment in Group A, therefore 26% of the samples for this group were allocated to that region. In the less populated regions, some of the groups account for much less than 1% of employment and would need less than one sample. However, to ensure that all of the top groups were represented in all regions, samples were assigned so that each region had at least 2 samples (one per season) in each of the top 25 industry groups. The sixty samples assigned to the lumped group were distributed so that these smaller industry groups were sampled in regions where they had significant employment.

Once the number of samples in each group in each region was determined, half the samples were assigned to each season. Where odd numbers of samples were assigned, the season to receive the extra sample was chosen randomly. For the lumped group, all seasonal assignments were done randomly.

Within each industry group in each waste shed, samples were distributed so that the majority of the samples were drawn from businesses who contribute large amounts of waste. This was accomplished using the 80/20 rule as a guide. This rule states that generally, 80% of the waste disposed by a group came from the largest businesses which make up about 20%

of the group, and 20% of the waste came from the remaining 80% of the (smaller) businesses. The procedure is described in detail below.

Random Selection of Business Sites

Specific businesses were selected randomly using NameFinders, a research organization that uses Dun and Bradstreet business data. For a region containing only one waste shed where generator sampling occurs, the process was as follows:

1. The business sites belonging to each industry grouping were segregated according to the range of numbers of employees at each site. A cut-off point was determined, going from larger business sites to smaller ones, such that business sites above the cut-off point represent approximately 80% of the total employment for all business sites of the industry grouping within the waste shed. The set of business sites that have more employees on site and that represent approximately 80% of the total employment was designated as "Tier 1" businesses. The set of smaller businesses was designated as "Tier 2."
2. Eighty percent of the required number of business sites for the SIC grouping were drawn randomly from the Tier 1 set, and 20% were drawn randomly from the Tier 2 set.[26]
3. Specific information about each business site was placed in a database and forwarded to SEWA and CIWMB staff, who contacted the businesses and determined if the business site met the criteria for sampling.

For a region containing two sampled waste sheds, NameFinders calculated the ratio of employment in each industry group that fell within one waste shed verses the employment that fell within the other waste shed. The ratio was used to determine how many business sites of each SIC grouping were required from each waste shed.

For example, if the waste shed surrounding the Bradley landfill contained x employees in the "Retail Trade – Other" category, and the region surrounding the Victorville landfill contained y employees in the same category, then $\frac{x}{x+y}$ percent of the required businesses was targeted from the Bradley waste shed, and $\frac{y}{x+y}$ percent was targeted from the Victorville waste shed. For each waste shed, the above numbered steps 1 through 3 were followed.

Since 1,200 business sites were required for the Study, the consultants obtained information for approximately 10,000 candidate business sites chosen randomly as described above. Extra business names were obtained to account for ones on the list from NameFinders which were no longer in existence, had recently moved, that could not be reached by phone, or were eliminated through the screening process described below. Each candidate site received a letter from the CIWMB explaining that they had been selected for generator sampling.

Final Screening of Business Sites

CIWMB staff and SEWA divided the list of candidate sites and contacted the sites to determine:

- the number and size of dumpsters at the site,

[26] In order to ensure that there was a large enough pool of candidate business sites to draw from, information on approximately 10,000 businesses was obtained NameFinders, using Dun and Bradstreet data on individual businesses. Specific arrangements were made with approximately 2,700 businesses, or 2.25 times the number of required sites.

- the frequency of pick-up,
- the type of service,
- the physical address, and
- the procedure for accessing the dumpsters.

These contacts proceeded until the required number of participating business sites were secured for each SIC grouping in each waste shed.

During the contact process, a business site was screened out of the study if it met any of the following conditions:

- It shared dumpster space with other businesses belonging to different SIC groupings or with any residences.
- It shared dumpster space with other businesses belonging to the same SIC grouping and it was impossible to obtain an estimate of the volume of waste generated in a given time frame by the selected business.
- Its dumpsters were not accessible to the sampling crew.
- It refused to permit sampling of its waste.
- SEWA or CIWMB staff were unable to obtain the required information on dumpster size, location, time and frequency of pick-up, or dumpster access procedures. However, this information was generally available from waste haulers.

If a business site was screened out, the next randomly selected business in that category was contacted, until the proper number of generators was identified for each industry group.

Contingency business sites were also obtained for use in sampling in case the Sky Valley Associates (SVA) crew was unable to access the dumpsters of a normal candidate business site in the field. Since it was impossible to determine ahead of time whether a contingency business site would stand in for a Tier 1 or Tier 2 business, contingency business sites were drawn from the Tier 1 set.

SEWA and CIWMB staff provided the final list of business sites to SVA along with maps showing how to get to each business site. SVA had copies of the letters that were sent to each business to show to any employee who questioned their activities. If the business denied permission to enter the property, or if the dumpsters were locked or inaccessible, SVA proceeded to the next site without a sample. SVA attempted to replace any missed samples with a sample from a contingency business site.

Obtaining Commercial Generator Samples

Samples were removed from dumpsters so that a vertical cross section “slice” was taken that included waste from the top to the bottom of the bin. The minimum sample size targeted was, in order of priority, either 125 pounds, 1.5 cubic yards, or all of the waste in the bin if less than either of these amounts was present. If there were multiple bins at a site, SVA pulled a sub-sample from each bin. A limited number of very large businesses were selected that had diverse waste streams generated at the sampling site. CIWMB staff determined, with the help of the site contact, what the main waste streams were and the best way to obtain one or more representative samples. Dumpsters were sampled so that each significant waste stream was represented by a sample, and an estimate of the amount of each sampled waste stream was made. Data from these “multi-bin” samples was combined to get the overall composition for the business site.

SVA confirmed the number and size of waste containers at the business site. SVA also estimated the volume of waste in each container. As SVA pulled each sample from the

containers, they attempted to maintain the relative density of the material as the sample was captured (e.g. they would not place heavy waste from the bottom of the container on the top of a sample). The sample volume was then measured (width, height and length).

The collected waste was segregated, labelled and transported to the disposal site where waste sorting operations were occurring. This waste was sorted by hand into 57 waste categories and then sorted again into 8 RPPC categories. The component weights were entered into a computerized database or recorded on field sheets for later entry.

Following the completion of each season of commercial generator sampling, subcontractor Veterans Assistance Network (VAN) contacted each of the sampled business sites to verify its SIC classification, and the number of employees working at the site.

C. Seattle

A total of 348 loads from the commercial substream were sampled from January to December, 1996. The drivers of sampled vehicles were asked to identify from which type of business they had collected the load. In cases where the driver could indicate that all of the load was from a single business type, that information was noted; otherwise, "mixed generator types" was recorded. Since commercial garbage trucks often haul waste from a variety of different business types, most samples (43%) are of the "mixed generator" type. The remaining generator-specific analyses are based on a very small number of samples and are thus subject to a relatively wide margin of error. These results provide rough estimates only. There was no intent to capture a certain number of samples from any particular generator type. The composition (by weight) was determined for 12 commercial generator types:

• Construction, Demolition & Landclearing • Education • Health Care • Hotel/Motel • Manufacturing • Office	• Other Services • Restaurant • Retail • Transportation • Wholesale • Mixed Commercial Generators

Appendix F

Irish Local Authorities Commercial Waste

Composition Survey Results

Cork County Council

Two samples from the commercial sector were characterised: one from a hotel and one from the retail sector. After consultation with the EPA, it was determined that sample sizes of approx. 1000 kg from each category would be utilised for each sort. Wastes were sorted as per the European Waste Catalogue (EWC) as described in the 1996 EPA document 'Municipal Waste Characterisation'. The methodology to determine an appropriate sample size was outlined in this document. However, the consultants reported that the quartering technique was onerous. Therefore, the full amount of waste from the representative sample was characterised. The characterisation was conducted in July 2001.

The results of the waste composition survey undertaken at the hotel (included a fine dining restaurant and a pub that served food) are presented in Table F.1. The highest percentage of wastes by weight included organic waste (44.17%) and glass (37.9%). This was followed by plastics (5.32%), cardboard (4.74%) and paper (3.4%). The amount of cardboard was lower than expected. The study team were not aware of any recycling of cardboard at the hotel.

Material	**Hotel**
Paper	3.41
Cardboard	4.74
Plastic	5.32
Glass	37.97
Metal	0.90
Textile	0.40
Organic	44.17
Composite	0.29
Unclassified Combustibles	0.73
Unclassified Incombustibles	2.04

Table F.1: Cork County Council Hotel Waste Composition (% weight)

The results of the waste composition survey undertaken in the retail sector (Bandon town) are presented in Table F.2. The majority of waste (56.3%) was paper. This can be attributed to the fact that the chosen retail outlets included a print shop and newsagents. The highest percentage of waste by weight was paper (56.3%). The remainder consisted of plastic (10.6%), unclassified combustibles (11.6%) and organic waste (8.2%).

Material	**Retail Sector**
Paper	56.27
Cardboard	4.26
Plastic	10.6
Glass	0.4
Metal	1.47
Textile	0.08
Organic	8.25
Composite	0.0
Unclassified Combustibles	11.57
Unclassified Incombustibles	7.1

Table F.2 Cork County Council Retail Sector Waste Composition (% weight)

Kildare County Council

Wastes from a sample of 7 businesses from the retail sector were characterised (including three pubs, three shops and a restaurant). After consultation with the EPA, it was determined that a sample size of approx. 1000 kg would be utilised. Wastes were sorted as per the European Waste Catalogue (EWC) as described in the 1996 EPA document 'Municipal Waste Characterisation'. The methodology to determine an appropriate sample size was outlined in this document. However, the consultants reported that the quartering technique was onerous. Therefore, the full amount of waste from the representative sample was characterised. The characterisation was conducted in December 2001 (close to Christmas).

The results of the waste composition survey undertaken from Ballymore Eustace are presented in Table F.3. The highest percentage of wastes by weight included organic waste (37.6%), papers (29.9%) and cardboards (7.3%). The unclassified combustibles (3.4%) consisted primarily of pieces of wood from the bottom of Christmas trees. The unclassified incombustibles (6.0%) consisted mainly of ashes.

Material	**Retail Sector**
Paper	29.9
Cardboard	7.3
Plastic	9.1
Glass	2.2
Metal	2.0
Textile	0.3
Organic	37.6
Composite	2.0
Unclassified Combustibles	3.4
Unclassified Incombustibles	6.0

Table F.3: Kildare County Council Retail Sector Waste Composition (% weight)

Clare County Council

The commercial waste survey was conducted on 57 retail outlets in Ennis town. The methodology used in this survey was obtained from the EPA document 'Municipal Waste Characterisation'. The waste was reduced to a more manageable size by repeated coning and quartering using a mechanical shovel. The analysed sample weight was 242.6kg. The characterisation was conducted in June 2001.

The results of the survey are presented in Table F.4. It should be noted that the majority of premises surveyed had a separate collection for cardboard waste. Further analysis of this waste was conducted to calculate the waste arising per employee. This results in a figure of 7.7kg of waste arising per employee (including cardboard for recycling).

Material	Retail Sector
Paper	33.6
Cardboard	11.2
Plastic	10.7
Glass	1.8
Metal	4.0
Textile	4.1
Organic	1.1
Composite	5.0
Unclassified Combustibles	20.6
Unclassified Incombustibles	2.1

Table F.4: Clare County Council Retail Sector Waste Composition (% weight)

Wicklow County Council

Wastes from a secondary school in Bray were characterised. The total number of pupils in this school was 990 and staff was 110. The sample size was approx. 110kg. The methodology used in this survey was obtained from the 1996 EPA document 'Municipal Waste Characterisation'. The process of coning and quartering the commercial sample was not necessary as the sample size, when collected in entirety, was of a manageable size. The characterisation was conducted in April 2002. The results of the waste composition survey undertaken are presented in Table F.5.

Material	Secondary School
Paper	25.2
Cardboard	7.6
Plastic	19.0
Glass	1.1
Metal	8.8
Textile	2.3
Organic	31.0
Composite	2.5
Unclassified Combustibles	0.0
Unclassified Incombustibles	0.0

Table F.5: Wicklow County Council School Waste Composition (% weight)

Offaly County Council

Wastes from three national schools were characterised (two in the Tullamore area and one in the Durrow area). After consultation with the EPA, it was determined that a sample size of approx. 600-1000 kg would be utilised. Wastes were sorted as per the European Waste Catalogue (EWC) as described in the 1996 EPA document 'Municipal Waste Characterisation'. The methodology to determine an appropriate sample size was outlined in this document. However, the consultants reported that the quartering technique was onerous. Therefore, the full amount of waste from the representative sample was characterised. The characterisation was conducted in April 2002.

There are no recycling schemes currently in place in any of the schools. A separate waste composition survey was conducted for each school. Approx. 208.25kg of waste was collected from 3 schools (one weeks waste). The highest percentages of wastes by weight included organic waste, paper, plastic and composites (i.e. drink cartons). The results of the waste composition surveys are presented in Table F.6

- Scoil Bride has 194 students and 14 teachers and generated 60.9kg (0.29kg per capita)
- Scoil Mhuire has 470 students and 24 teachers and generated 112.5kg (0.23kg per capita)
- Durrow School has 130 students and 4 teachers and generated 34.9kg (0.26kg per capita)

Material	Scoil Bride N.S.	Scoil Mhuire N.S.	Durrow N.S.	Average
Paper	27.4	19.6	41.3	29.4
Cardboard	7.0	1.5	4.2	4.2
Plastic	9.6	20.8	16.6	15.7
Glass	0.0	0.0	0.0	0.0
Metal	3.6	1.8	3.4	2.9
Textile	0.0	0.0	0.0	0.0
Organic	36.9	32.1	19.7	29.6
Composite	7.5	20.2	10.9	12.9
Unclassified Combustibles	8.0	2.4	2.9	4.4
Unclassified Incombustibles	0.0	1.5	0.0	0.5

Table F.6: Wicklow County Council Education Sector Waste Composition (% weight)

Appendix G

Data from Green Schools and

Green Flag Award Programme

Scoil Eoin N.S., Ballincollig

Scoil Eoin generates many types of waste. The composition of the waste is 48.46% paper, 18.71% cans, 17.42% plastic and 15.41% food waste.

Approx. 15.41% of the waste comes from lunches (mostly from the infant classes who don't eat their lunch. Some comes from Arts and Crafts.) This waste mainly consists of newspapers and cut up cardboard. This waste is fed to the school wormery to make compost.

The school generates about 16,200 kg per annum (1 wheelie bin per week).

Gaelscoil Thomais Daibhis N.S., Mallow

They collected the waste from one particular classroom for five consecutive days. On the fifth day, the contents of the refuse bags were removed and sorted into categories. The results of the survey were organic waste 10%, paper waste 50%, plastic waste 39% and metal/tin 1%.

This school generates five wheelie bins of waste per week.

Grattan Street N.S., Cork City

The school began waste auditing a week before their wormery arrived. Their waste was weighed for two weeks – then after six weeks further weighing was conducted. Every classroom has five bins – one each for paper, cardboard, plastic, metal and organics. From each classroom, each kind of waste was placed in plastic bags and weighed separately . As Table G.1 demonstrates, waste can vary considerably from classroom to classroom:

Waste Type	Junior Infants	Senior Infants	1st Class	2nd class	3rd Class	4th Class	5th Class	6th Class	Staff	Office	Total
Organic	3.3%	7.6%	4.0%	8.1%	4.8%	4.2%	5.1%	10.4%	6.4%	0.0%	53.7%
Paper	1.6%	2.0%	1.9%	1.9%	0.7%	1.0%	1.4%	1.6%	1.4%	2.5%	15.9%
Plastic	1.7%	1.8%	1.9%	1.6%	1.4%	1.0%	1.2%	1.7%	1.9%	0.0%	14.2%
Cardboard	0.9%	3.2%	1.2%	1.8%	0.5%	0.6%	0.7%	1.9%	0.9%	0.5%	12.2%
Metal	0.8%	1.1%	0.4%	0.4%	0.4%	0.1%	0.2%	0.3%	0.1%	0.0%	3.9%
Total	8.4%	15.8%	9.4%	13.8%	7.6%	7.0%	8.6%	15.9%	10.6%	2.9%	100.0%

Table G.1: Waste Composition, Grattan Street N.S.

After the schools waste (including the office and staff room) was measured, all paper was placed into one bag, all the plastic in another bag etc.

A summary of the waste composition results from the National Schools is presented in Table G.2:

Material	Scoil Eoin N.S.	Gaelscoil Thomais Daibhis N.S.	Grattan Street N.S.	Average
Paper/Cardboard	48.5%	50 %	28.1%	42.2%
Food	15.4%	10 %	53.7%	26.4%
Plastic	17.4%	39 %	14.2%	23.5%
Metals/Cans	18.7%	1 %	3.9%	7.9%
Glass	0 %	0 %	0 %	0%

Table G.2: Summary of National School Waste Composition

Appendix H

‘Waste Collection Area Worksheets’

MIXED WASTE SHEET (1 of 2)

DAY AND DATE: _____

MIXED WASTE ONLY: RECORD ALL MIXED WASTES			
	Day/Date/Time	**'Waste Source'**	**Weight (kg)**
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

Note: Several copies of this form may be used each day.

MIXED WASTE SHEET (2 of 2)

MIXED WASTE FROM:	*(Waste Source)*
DAY AND DATE:	

MIXED WASTE ONLY: Record ONLY SORTED Waste Samples					
	Sample 1	**Sample 2**	**Sample 3**	**Sample 4**	**Daily Total**
TOTAL SAMPLE WEIGHT (Kg)					
PAPER AND CARDBOARD					
Office Paper					
Newspaper/ Magazines					
Tissue Paper					
Paper Packaging					
Cardboard Packaging					
Cardboard Non Packaging					
GLASS					
Glass Packaging					
Other Glass					
PLASTIC					
Plastic Films Packaging					
PET Packaging					
Other Rigid Plastic Packaging					
Other Plastic					
METAL					
Aluminium Packaging					
Ferrous Metals Packaging					
Non Ferrous Packaging					
Other Ferrous Metals					
Other Non Ferrous Metals					
ORGANIC WASTE					
Food Waste					
Vegetable Oil					
Garden Waste					
TEXTILES					
Textiles Packaging					
Textiles (Non Packaging)					
Healthcare Textiles (Nappies, etc)					
WOOD					
Wood Packaging					
Other Wood					
COMPOSITES					
Composite Packaging					
Non Packaging					
SPECIAL/IRREGULAR WASTE					
Electrical & Electronic Equipment					
Fluorescent Bulbs					
Batteries					
Waste Chemicals					
Waste Mineral Oil					
Crockery					
Other (Please state)					
Other (Please state)					

Note 1: Total figures from each day are transferred into electronic spreadsheet
Note 2: A copy of this form must be completed daily for each 'waste source'

SEGREGATED WASTE SHEET (1 of 1)

DAY AND DATE: _____

SEGREGATED WASTE ONLY: Record ALL Wastes					
Total Weight (Kg)					**TOTAL**
PAPER AND CARDBOARD					
Office Paper					
Newspaper/ Magazines					
Tissue Paper					
Paper Packaging					
Cardboard Packaging					
Cardboard Non Packaging					
GLASS					
Glass Packaging					
Other Glass					
PLASTIC					
Plastic Films Packaging					
PET Packaging					
Other Rigid Plastic Packaging					
Other Plastic					
METAL					
Aluminium Packaging					
Ferrous Metals Packaging					
Non Ferrous Packaging					
Other Ferrous Metals					
Other Non Ferrous Metals					
ORGANIC WASTE					
Food Waste					
Vegetable Oil					
Garden Waste					
TEXTILES					
Textiles Packaging					
Textiles (Non Packaging)					
Healthcare Textiles (Nappies, etc)					
WOOD					
Wood Packaging					
Other Wood					
COMPOSITES					
Composite Packaging					
Non Packaging					
SPECIAL/IRREGULAR WASTE					
Electrical & Electronic Equipment					
Fluorescent Bulbs					
Batteries					
Waste Chemicals					
Waste Mineral Oil					
Crockery					
Other (Please state)					
Other (Please state)					

Note 1: Total figures from each day are transferred into electronic spreadsheet

Appendix I

Example of Blank Electronic Database:

(Summary Tab, Segregated Waste Tab & Mixed Waste Tab)

SEGREGATED WASTE & MIXED WASTE : Waste Characterisation Survey Summary				
Section A: Survey Details				
Business/Organisation Name:				
Survey conducted by:				
Start Date of Survey:				
End Date of Survey:				
Section B: Survey Results				
			Sampled Result	
Waste Material	Mixed Waste	Segregated Waste	(Kg)	(%)
PAPER AND CARDBOARD				
Office Paper				
Newspaper/ Magazines				
Tissue Paper				
Paper Packaging				
Cardboard Packaging				
Cardboard Non Packaging				
GLASS				
Glass Packaging				
Other Glass				
PLASTIC				
Plastic Films Packaging				
PET Packaging				
Other Rigid Plastic Packaging				
Other Plastic				
METAL				
Aluminium Packaging				
Ferrous Metals Packaging				
Non Ferrous Packaging				
Other Ferrous Metals				
Other Non Ferrous Metals				
ORGANIC WASTE				
Food Waste				
Vegetable Oil				
Garden Waste				
TEXTILES				
Textiles Packaging				
Textiles (Non Packaging)				
Healthcare Textiles (Nappies, etc)				
WOOD				
Wood Packaging				
Other Wood				
COMPOSITES				
Composite Packaging				
Non Packaging				
SPECIAL/IRREGULAR WASTE				
Waste Electrical and Electronic Equipment				
Fluorescent Bulbs				
Batteries				
Waste Chemicals				
Waste Mineral Oil				
Crockery				
Other (Please state)				
Other (Please state)				
Total				

SEGREGATED WASTE: Waste Characterisation Survey

ALL segregated waste should be recorded on this worksheet

Section A: Survey Details		
Business/Organisation Name:		
Survey conducted by:		
Start Date of Survey:		
End Date of Survey:		
Total Waste Sampled/Arising:	0.0	Kg

Section B: Survey Results									
	Characterised/Sampled Segregated Waste Results (kg)							Total Result	
Waste Material	Day 1 Total	Day 2 Total	Day 3 Total	Day 4 Total	Day 5 Total	Day 6 Total	Day 7 Total	(Kg)	(%)
PAPER AND CARDBOARD									
Office Paper								0.0	
Newspaper/ Magazines								0.0	
Tissue Paper								0.0	
Paper Packaging								0.0	
Cardboard Packaging								0.0	
Cardboard Non Packaging								0.0	
GLASS									
Glass Packaging								0.0	
Other Glass								0.0	
PLASTIC									
Plastic Films Packaging								0.0	
PET Packaging								0.0	
Other Rigid Plastic Packaging								0.0	
Other Plastic								0.0	
METAL									
Aluminium Packaging								0.0	
Ferrous Metals Packaging								0.0	
Non Ferrous Packaging								0.0	
Other Ferrous Metals								0.0	
Other Non Ferrous Metals								0.0	
ORGANIC WASTE									
Food Waste								0.0	
Vegetable Oil								0.0	
Garden Waste								0.0	
TEXTILES									
Textiles Packaging								0.0	
Textiles (Non Packaging)								0.0	
Healthcare Textiles (Nappies, etc)								0.0	
WOOD									
Wood Packaging								0.0	
Other Wood								0.0	
COMPOSITES									
Composite Packaging								0.0	
Non Packaging								0.0	
SPECIAL/IRREGULAR WASTE									
Waste Electrical and Electronic Equipment								0.0	
Fluorescent Bulbs								0.0	
Batteries								0.0	
Waste Chemicals								0.0	
Waste Mineral Oil								0.0	
Crockery								0.0	
Other (Please state)								0.0	
Other (Please state)								0.0	
Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%

MIXED WASTE : Waste Characterisation Survey

Complete ONE worksheet for mixed waste from EACH 'waste source'

Section A: Survey Details			
Waste Source' Area:			
Total Waste Arising (sampled & non-sampled):		Kg arising in	
Business/Organisation Name:			
Survey conducted by:			
Start Date of Survey:			
End Date of Survey:			
Total Waste Sampled:	0.0	Kg	
Is sample size sufficient?	No result		

Section B: Survey Results

	Characterised/Sampled Mixed Waste Results (kg)							Sampled Result		Scaled-Up Total
Waste Material	Day 1 Total	Day 2 Total	Day 3 Total	Day 4 Total	Day 5 Total	Day 6 Total	Day 7 Total	(Kg)	(%)	(kg)
PAPER AND CARDBOARD										
Office Paper								0.0		
Newspaper/ Magazines								0.0		
Tissue Paper								0.0		
Paper Packaging								0.0		
Cardboard Packaging								0.0		
Cardboard Non Packaging								0.0		
GLASS										
Glass Packaging								0.0		
Other Glass								0.0		
PLASTIC										
Plastic Films Packaging								0.0		
PET Packaging								0.0		
Other Rigid Plastic Packaging								0.0		
Other Plastic								0.0		
METAL										
Aluminium Packaging								0.0		
Ferrous Metals Packaging								0.0		
Non Ferrous Packaging								0.0		
Other Ferrous Metals								0.0		
Other Non Ferrous Metals								0.0		
ORGANIC WASTE										
Food Waste								0.0		
Vegetable Oil								0.0		
Garden Waste								0.0		
TEXTILES										
Textiles Packaging								0.0		
Textiles (Non Packaging)								0.0		
Healthcare Textiles (Nappies, etc)								0.0		
WOOD										
Wood Packaging								0.0		
Other Wood								0.0		
COMPOSITES										
Composite Packaging								0.0		
Non Packaging								0.0		
SPECIAL/IRREGULAR WASTE										
Waste Electrical and Electronic Equipment								0.0		
Fluorescent Bulbs								0.0		
Batteries								0.0		
Waste Chemicals								0.0		
Waste Mineral Oil								0.0		
Crockery								0.0		
Other (Please state)								0.0		
Other (Please state)								0.0		
Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%	0.0

Appendix J

Waste Character Fingerprints for

Main Commercial Sectors

Main Commercial Sectors

1.1 Hotels
1.2 Supermarkets
1.3 Transport & Communication
1.4 Financial Services
1.5 Colleges
1.6 Restaurants
1.7 Hospitals
1.8 Public Offices
1.9 Wholesale Distribution
1.10 Other Retailers

Organisation:	**Brandon Hotel**			
Sector:	**Hotels**			
Date of Survey:	**Sep-06**			
Project Manager:	**CTC**			

Waste Category	Mixed Waste for Disposal (average kg/day)	Segregated Waste for Recycling (average kg/day)	Total Waste Arising (kg/day)	% of Total Waste Arising
PAPER AND CARDBOARD				
Office Paper	16.13		16.13	2.70
Newspaper/ Magazines	13.24		13.24	2.22
Tissue Paper	29.34		29.34	4.91
Paper (Pac)*	2.51		2.51	0.42
Cardboard (Pac)	11.66	35	46.66	7.81
Cardboard (Non Pac)				
GLASS				
Glass (Pac)	1.72	70	71.72	12.01
Glass (Non Pac)				
PLASTIC				
Plastic Films (Pac)	12.66		12.66	2.12
PET (Pac)	3.43		3.43	0.57
Other Rigid Plastic (Pac)	6.35	1	7.35	1.23
Other Plastic (Non Pac)				
METAL				
Aluminium (Pac)	2.06	0.3	2.36	0.40
Ferrous Metals (Pac)	12.73		12.73	2.13
Non Ferrous (Pac)				
Ferrous Metals (Non Pac)				
Non Ferrous Metals (Non Pac)				
ORGANIC WASTE				
Food Waste	69.23	250	319.23	53.45
Vegetable Oil		35	35.00	5.86
Garden Waste				
TEXTILES				
Textiles (Pac)				
Textiles (Non Pac)	4.65		4.65	0.78
Healthcare Textiles (Dipers, etc)				
WOOD				
Wood (Pac)		10	10.00	1.67
Other Wood (Non Pac)				
COMPOSITES				
Composite (Pac)	4.02		4.02	0.67
Composite (Non Pac)				
SPECIAL/ IRREGULAR WASTE				
WEEE				
Florescent Bulbs				
Batteries				
Waste Chemicals				
Waste Mineral Oil				
Crocery	6.28		6.28	1.05
Other (Please state)				
Other (Please state)				
TOTAL	**196.00**	**401.3**	**597.30**	**100.00**

	% Recycled =	**67.19%**

* (Pac) = Packaging

Appendix 1.1 Brandon Hotel Survey Results

Organisation:	**SuperValu**			
Sector:	**Supermarket**			
Date of Survey:	**Sep-06**			
Project Manager:	**CTC**			

Waste Category	Mixed Waste for Disposal (average kg/day)	Segregated Waste for Recycling (average kg/day)	% of Total Waste Arising	Waste Category
PAPER AND CARDBOARD				
Office Paper	43.95		43.95	4.62
Newspaper/ Magazines		16.6	16.60	1.75
Tissue Paper	27.41		27.41	2.88
Paper (Pac)*	1.17		1.17	0.12
Cardboard (Pac)	6.70	333	339.70	35.74
Cardboard (Non Pac)				
GLASS				
Glass (Pac)				
Glass (Non Pac)				
PLASTIC				
Plastic Films (Pac)	46.30	20	66.30	6.97
PET (Pac)	16.82		16.82	1.77
Other Rigid Plastic (Pac)	9.73		9.73	1.02
Other Plastic (Non Pac)				
METAL				
Aluminium (Pac)	2.44		2.44	0.26
Ferrous Metals (Pac)	2.77		2.77	0.29
Non Ferrous (Pac)				
Ferrous Metals (Non Pac)				
Non Ferrous Metals (Non Pac)				
ORGANIC WASTE				
Food Waste	332.37	38	370.37	38.96
Vegetable Oil		10	10.00	1.05
Garden Waste				
TEXTILES				
Textiles (Pac)				
Textiles (Non Pac)				
WOOD				
Wood (Pac)				
Other Wood (Non Pac)				
COMPOSITES				
Composite (Pac)				
Composite (Non Pac)				
SPECIAL/ IRREGULAR WASTE				
WEEE				
Florescent Bulbs				
Batteries				
Waste Chemicals				
Waste Mineral Oil				
Returns	43.34		43.34	4.56
TOTAL	**533.00**	**417.6**	**950.60**	**100.00**

	% Recycled =	**43.93%**

* (Pac) = Packaging

Appendix 1.2 SuperValu Survey Results

Organisation:	**Cork Airport**			
Sector:	**Transport**			
Date of Survey:	**Nov-06**			
Project Manager:	**CTC**			

Waste Category	Mixed Waste for Disposal (average kg/day)	Segregated Waste for Recycling (average kg/day)	Total Waste Arising (kg/day)	% of Total Waste Arising
PAPER AND CARDBOARD				
Office Paper	175.73		175.73	8.84
Newspaper/ Magazines	436.78		436.78	21.98
Tissue Paper	104.25		104.25	5.25
Paper (Pac)*	46.60		46.60	2.35
Cardboard (Pac)	131.02	72	203.02	10.22
Cardboard (Non Pac)	31.20		31.20	1.57
GLASS				
Glass (Pac)	6.20	164	170.20	8.57
Glass (Non Pac)				
PLASTIC				
Plastic Films (Pac)	27.19		27.19	1.37
PET (Pac)	128.38		128.38	6.46
Other Rigid Plastic (Pac)	85.74		85.74	4.31
Other Plastic (Non Pac)	3.84		3.84	0.19
METAL				
Aluminium (Pac)	27.49		27.49	1.38
Ferrous Metals (Pac)	10.14		10.14	0.51
Non Ferrous (Pac)	5.34		5.34	0.27
Ferrous Metals (Non Pac)				
Non Ferrous Metals (Non Pac)				
ORGANIC WASTE				
Food Waste	439.14		439.14	22.10
Vegetable Oil		30	30.00	1.51
Garden Waste				
TEXTILES				
Textiles (Pac)				
Textiles (Non Pac)				
Healthcare Textiles (Dipers, etc)				
WOOD				
Wood (Pac)				
Other Wood (Non Pac)				
COMPOSITES				
Composite (Pac)	57.85		57.85	2.91
Composite (Non Pac)	4.10		4.10	0.21
SPECIAL/ IRREGULAR WASTE				
WEEE				
Florescent Bulbs				
Batteries				
Waste Chemicals				
Waste Mineral Oil				
Other (Please State)				
Other (Please state)				
Other (Please state)				
TOTAL	**1721.00**	**266**	**1987.00**	**100.00**

	% Recycled =	**13.39%**

* (Pac) = Packaging

Appendix 1.3 Cork Airport Survey Results

Organisation:	**Bank Of Ireland**			
Sector:	**Financial**			
Date of Survey:	**Oct-06**			
Project Manager:	**CTC**			

Waste Category	Mixed Waste for Disposal (average kg/day)	Segregated Waste for Recycling (average kg/day)	Total Waste Arising (kg/day)	% of Total Waste Arising
PAPER AND CARDBOARD				
Office Paper	10.67	17.8	28.47	82.28
Newspaper/ Magazines	1.98		1.98	5.72
Tissue Paper				
Paper (Pac)*				
Cardboard (Pac)	0.39		0.39	1.12
Cardboard (Non Pac)				
GLASS				
Glass (Pac)	0.04		0.04	0.12
Glass (Non Pac)				
PLASTIC				
Plastic Films (Pac)	1.12		1.12	3.23
PET (Pac)	0.34		0.34	0.99
Other Rigid Plastic (Pac)	0.47		0.47	1.37
Other Plastic (Non Pac)				
METAL				
Aluminium (Pac)	0.02		0.02	0.06
Ferrous Metals (Pac)	0.13		0.13	0.37
Non Ferrous (Pac)				
Ferrous Metals (Non Pac)	0.09		0.09	0.25
Non Ferrous Metals (Non Pac)				
ORGANIC WASTE				
Food Waste	1.55		1.55	4.48
Vegetable Oil				
Garden Waste				
TEXTILES				
Textiles (Pac)				
Textiles (Non Pac)				
Healthcare Textiles (Dipers, etc)				
WOOD				
Wood (Pac)				
Other Wood (Non Pac)				
COMPOSITES				
Composite (Pac)				
Composite (Non Pac)				
SPECIAL/ IRREGULAR WASTE				
WEEE				
Florescent Bulbs				
Batteries				
Waste Chemicals				
Waste Mineral Oil				
Other				
Other (Please state)				
Other (Please state)				
TOTAL	16.80	17.8	34.60	100.00

	% Recycled =	**51.45%**

* (Pac) = Packaging

Appendix 1.4 Bank of Ireland Survey Results

Organisation: **Cork Institute Of Technology**
Sector: **Colleges**
Date of Survey: **Apr-02**
Project Manager: **CTC**

Waste Category	Mixed Waste for Disposal (average kg/day)	Segregated Waste for Recycling (average kg/day)	Total Waste Arising (kg/day)	% of Total Waste Arising
PAPER AND CARDBOARD				
Office Paper	148.00	65	213.00	14.62
Newspaper/ Magazines	20.00		20.00	1.37
Tissue Paper	40.00		40.00	2.75
Paper (Pac)*				
Cardboard (Pac)	111.50		111.50	7.65
Cardboard (Non Pac)				
GLASS				
Glass (Pac)	13.70	1.4	15.10	1.04
Glass (Non Pac)				
PLASTIC				
Plastic Films (Pac)	19.20		19.20	1.32
PET (Pac)	91.80		91.80	6.30
Other Rigid Plastic (Pac)	19.20		19.20	1.32
Other Plastic (Non Pac)	6.00		6.00	0.41
METAL				
Aluminium (Pac)				
Ferrous Metals (Pac)				
Non Ferrous (Pac)				
Ferrous Metals (Non Pac)		361.6	361.60	24.82
Non Ferrous Metals (Non Pac)	40.00	11.2	51.20	3.51
ORGANIC WASTE				
Food Waste	275.60		275.60	18.92
Vegetable Oil		19.2	19.20	1.32
Garden Waste				
TEXTILES				
Textiles (Pac)				
Textiles (Non Pac)				
Healthcare Textiles (Dipers, etc)				
WOOD				
Wood (Pac)	18.60		18.60	1.28
Other Wood (Non Pac)		82.2	82.20	5.64
COMPOSITES				
Composite (Pac)	100.30		100.30	6.88
Composite (Non Pac)				
SPECIAL/ IRREGULAR WASTE				
WEEE				
Florescent Bulbs				
Batteries				
Waste Chemicals				
Waste Mineral Oil				
Shellfish	12.30		12.30	0.84
Other (Please state)				
Other (Please state)				
TOTAL	**916.2**	**540.6**	**1456.80**	**100.00**

% Recycled =	**37.11%**

* (Pac) = Packaging

Appendix 1.5 Cork Institute of Technology Survey Results

Organisation: **Combined Restaurants**
Sector: **Restuarants**
Date of Survey: **Oct-02**
Project Manager: **CTC**

Waste Category	Mixed Waste for Disposal (average kg/day)	Segregated Waste for Recycling (average kg/day)	Total Waste Arising (kg/day)	% of Total Waste Arising
PAPER AND CARDBOARD				
Office Paper				
Newspaper/ Magazines	3.14		3.14	1.91
Tissue Paper	12.08		12.08	7.32
Paper (Pac)*	1.57		1.57	0.95
Cardboard (Pac)	31.06		31.06	18.82
Cardboard (Non Pac)	2.68		2.68	1.62
GLASS				
Glass (Pac)	0.50		0.50	0.30
Glass (Non Pac)				
PLASTIC				
Plastic Films (Pac)	6.54		6.54	3.96
PET (Pac)	8.05		8.05	4.88
Other Rigid Plastic (Pac)	6.45		6.45	3.91
Other Plastic (Non Pac)				
METAL				
Aluminium (Pac)	3.05		3.05	1.85
Ferrous Metals (Pac)	6.63		6.63	4.02
Non Ferrous (Pac)	0.27		0.27	0.16
Ferrous Metals (Non Pac)				
Non Ferrous Metals (Non Pac)				
ORGANIC WASTE				
Food Waste	60.73		60.73	36.81
Vegetable Oil		15	15.00	9.09
Garden Waste				
TEXTILES				
Textiles (Pac)				
Textiles (Non Pac)				
Healthcare Textiles (Dipers, etc)				
WOOD				
Wood (Pac)				
Other Wood (Non Pac)				
COMPOSITES				
Composite (Pac)	7.24		7.24	4.39
Composite (Non Pac)				
SPECIAL/ IRREGULAR WASTE				
WEEE				
Florescent Bulbs				
Batteries				
Waste Chemicals				
Waste Mineral Oil				
Other (Please State)				
Other (Please state)				
Other (Please state)				
TOTAL	**150.00**	**15**	**165.00**	**100.00**

% Recycled =	**9.09%**

* (Pac) = Packaging

Appendix 1.6 Combined Restaurants Survey Results

Organisation: **Regional Hospital**
Sector: **Hospitals**
Date of Survey: **Aug-02**
Project Manager: **CTC**

Waste Category	Mixed Waste for Disposal (average kg/day)	Segregated Waste for Recycling (average kg/day)	Total Waste Arising (kg/day)	% of Total Waste Arising
PAPER AND CARDBOARD				
Office Paper	71.00		71.00	5.61
Newspaper/ Magazines	103.00		103.00	8.13
Tissue Paper	198.00		198.00	15.63
Paper (Pac)*				
Cardboard (Pac)	212.00		212.00	16.74
Cardboard (Non Pac)				
GLASS				
Glass (Pac)	14.00	70	84.00	6.63
Glass (Non Pac)				
PLASTIC				
Plastic Films (Pac)	35.00		35.00	2.76
PET (Pac)	46.80		46.80	3.69
Other Rigid Plastic (Pac)	50.00	1	51.00	4.03
Other Plastic (Non Pac)	60.00		60.00	4.74
METAL				
Aluminium (Pac)	2.50	0.3	2.80	0.22
Ferrous Metals (Pac)				
Non Ferrous (Pac)				
Ferrous Metals (Non Pac)				
Non Ferrous Metals (Non Pac)				
ORGANIC WASTE				
Food Waste	190.00		190.00	15.00
Vegetable Oil		4	4.00	0.32
Garden Waste				
TEXTILES				
Textiles (Pac)				
Textiles (Non Pac)				
Healthcare Textiles (Dipers, etc)	73.00		73.00	5.76
WOOD				
Wood (Pac)				
Other Wood (Non Pac)				
COMPOSITES				
Composite (Pac)	10.00		10.00	0.79
Composite (Non Pac)	30.00		30.00	2.37
SPECIAL/ IRREGULAR WASTE				
WEEE				
Florescent Bulbs				
Batteries				
Waste Chemicals				
Waste Mineral Oil				
Healthcare PPE	96.00		96.00	7.58
Other (Please state)				
Other (Please state)				
TOTAL	**1191.30**	**75.3**	**1266.60**	**100.00**

% Recycled = 5.95%

* (Pac) = Packaging

Appendix 1.7 Regional Hospital Survey Results

Organisation:	**Council Offices**			
Sector:	**Public Offices**			
Date of Survey:	**Aug-06**			
Project Manager:	**CTC**			

Waste Category	Mixed Waste for Disposal (average kg/day)	Segregated Waste for Recycling (average kg/day)	Total Waste Arising (kg/day)	% of Total Waste Arising
PAPER AND CARDBOARD				
Office Paper	117.00		117.00	54.56
Newspaper/ Magazines				
Tissue Paper				
Paper (Pac)*				
Cardboard (Pac)	30.40		30.40	14.18
Cardboard (Non Pac)				
GLASS				
Glass (Pac)	1.28		1.28	0.60
Glass (Non Pac)				
PLASTIC				
Plastic Films (Pac)	3.70		3.70	1.73
PET (Pac)	2.70		2.70	1.26
Other Rigid Plastic (Pac)	4.00		4.00	1.87
Other Plastic (Non Pac)				
METAL				
Aluminium (Pac)	0.40		0.40	0.19
Ferrous Metals (Pac)	2.85		2.85	1.33
Non Ferrous (Pac)				
Ferrous Metals (Non Pac)				
Non Ferrous Metals (Non Pac)				
ORGANIC WASTE				
Food Waste	50.70		50.70	23.64
Vegetable Oil				
Garden Waste				
TEXTILES				
Textiles (Pac)				
Textiles (Non Pac)				
Healthcare Textiles (Dipers, etc)				
WOOD				
Wood (Pac)				
Other Wood (Non Pac)				
COMPOSITES				
Composite (Pac)	1.42		1.42	0.66
Composite (Non Pac)				
SPECIAL/ IRREGULAR WASTE				
WEEE				
Florescent Bulbs				
Batteries				
Waste Chemicals				
Waste Mineral Oil				
Healthcare PPE				
Other (Please state)				
Other (Please state)				
TOTAL	**214.45**		**214.45**	**100.00**

	% Recycled =

* (Pac) = Packaging

Appendix 1.8 Council Offices Survey Results

Organisation: **Wilton Shopping Centre**
Sector: **Other Retailers**
Date of Survey: **Nov-02**
Project Manager: **CTC**

Waste Category	Mixed Waste for Disposal (average kg/day)	Segregated Waste for Recycling (average kg/day)	Total Waste Arising (kg/day)	% of Total Waste Arising
PAPER AND CARDBOARD				
Office Paper	24.63		24.63	5.24
Newspaper/ Magazines	6.33	45	51.33	10.92
Tissue Paper	6.47		6.47	1.38
Paper (Pac)*	5.48		5.48	1.17
Cardboard (Pac)	36.28	167	203.28	43.25
Cardboard (Non Pac)				
GLASS				
Glass (Pac)	0.12		0.12	0.03
Glass (Non Pac)				
PLASTIC				
Plastic Films (Pac)	69.37		69.37	14.76
PET (Pac)	22.52		22.52	4.79
Other Rigid Plastic (Pac)	34.52		34.52	7.34
Other Plastic (Non Pac)	2.49		2.49	0.53
METAL				
Aluminium (Pac)	6.54		6.54	1.39
Ferrous Metals (Pac)				
Non Ferrous (Pac)				
Ferrous Metals (Non Pac)				
Non Ferrous Metals (Non Pac)				
ORGANIC WASTE				
Food Waste	16.09		16.09	3.42
Vegetable Oil				
Garden Waste				
TEXTILES				
Textiles (Pac)	4.83		4.83	1.03
Textiles (Non Pac)	4.24		4.24	0.90
Healthcare Textiles (Dipers, etc)	8.45		8.45	1.80
WOOD				
Wood (Pac)	1.25		1.25	0.27
Other Wood (Non Pac)				
COMPOSITES				
Composite (Pac)	8.39		8.39	1.78
Composite (Non Pac)				
SPECIAL/ IRREGULAR WASTE				
WEEE				
Florescent Bulbs				
Batteries				
Waste Chemicals				
Waste Mineral Oil				
Other (Please state)				
Other (Please state)				
Other (Please state)				
TOTAL	**258.00**	**212**	**470.00**	**100.00**

% Recycled = 45.11%

* (Pac) = Packaging