

Municipal Waste Characterisation Surveys 2008



Methodology Review

April 2008

RPS



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APPENDICES

APPENDIX A

WASTE CATEGORIES

APPENDIX B

EXCERPT FROM “EUROPEAN COMMISSION, METHODOLOGY FOR THE ANALYSIS OF SOLID WASTE (SWA - TOOL)” (ANNEX II, PART C)

APPENDIX C

BACKGROUND INFORMATION FOR HOUSEHOLD SAMPLING PLAN

1 INTRODUCTION

RPS and CTC have been commissioned to carry out waste characterisation surveys on the municipal waste stream, both household and non-household. The following waste streams are targeted:

- Mixed residual waste,
- Mixed dry recyclables,
- Mixed organic waste.

Strictly speaking these three categories don't apply to the non-household sector, as there are very few, if any, with 3 bin collection systems. However, because the methodology endeavours to remove organic waste at source, and because all samples are fully analysed (not coning and quartering), the results can be successfully aggregated with the domestic stream data.

The overall objective of the project is to create a national municipal waste composition/profile that can be applied to other national municipal waste statistics (both household and non-household). This will involve the generation of a set of factors that can be applied by the EPA to the aggregated waste data that is collected for landfilled waste, mixed dry recyclable and mixed organics, for the National Waste Report.

One requirement of the project brief is to ensure that the methodology employed to characterise household and non-household waste is up-to-date and reflects best practice. A review of the methodology employed in the 2004/2005¹ study has been undertaken, and is outlined in this report.

This report also includes a proposed methodology to measure contamination of packaging in the mixed residual and mixed dry recyclable waste streams, where applicable. The objective is to generate contamination correction factors for application to the quantities of packaging materials collected for landfill or recycling.

The sampling plan for the household surveys as well as the proposed waste categories were submitted to the EPA in advance of finalising this report. EPA feedback with respect to both of these sections have been included in this report.

¹ The methodologies can be found in "Programme for Municipal Waste Characterisation Surveys", (RPS/CTC,2005) for the non-household methodology and Household Waste Characterisation Survey Manual, (RPS, 2006) for the household methodology.

2 ELEMENTS OF METHODOLOGY COMMON TO HOUSEHOLD AND NON-HOUSEHOLD SURVEYS

2.1 WASTE CATEGORIES

The proposed full list of waste categories for use during manual sorting is attached in **Appendix A**. This was originally developed from the categories used in the EPA Municipal Waste Characterisation Manual, 1996. Alterations were made to this list during the 2004/05 campaign, and further alterations/improvements are proposed for the 2008 campaign; these are outlined below. The new list is made up of 13 primary categories, 61 secondary categories and 10 tertiary categories.

An important focus in the development of this list of categories is the requirement to be able to distinguish between the following:

- Packaging from non-packaging
- Recyclables from non-recyclables
- Hazardous waste from non-hazardous, where possible
- Biodegradable waste from non-biodegradable

For the purpose of this study, packaging is as defined in Section 5 of the Waste Management Act 1996, and means 'any material that is container or wrapping, used for or in conjunction with the containment, transport, handling, protection, promotion, marketing or sale of any product or substance, including such packaging as may be prescribed'.

Whilst it is important to maintain consistency between survey campaigns, to facilitate comparison, this should not rule out alterations that will give rise to improvements in the methodology. The revised list maintains the same primary categories as the previous 2004/05 campaign, with alterations made at the sub-category level.

Additional sub-categories added and removed are detailed in Table 2.1 and 2.2 below.

Table 2.1: Additional Categories

| Secondary Category | Tertiary Category | Comment |
|------------------------------------|---|---|
| Edible kitchen and canteen waste | Unused packaged food | To enable quantification of food that was unnecessarily wasted and could be prevented. Furthermore, to distinguish between the packaged and non-packaged elements of this category. |
| | Unused non-packaged food | |
| Inedible kitchen and canteen waste | - | To distinguish between food waste that could be prevented, and to quantify food waste that will necessarily arise and cannot therefore be prevented. |
| <i>Paper packaging*</i> | Recoverable paper packaging | To distinguish between paper packaging that is recoverable e.g egg cartons, and that which is contaminated by virtue of its use and is not recoverable e.g curried chips wrapping. This distinction will be used mainly for the non-household surveys. |
| | Unrecoverable paper packaging | |
| <i>Flat card packaging*</i> | Recoverable flat card packaging | To distinguish between flat card packaging that is recoverable e.g cereal boxes, and that which is contaminated by virtue of its use and is not recoverable e.g ready packed meats. This distinction will be used mainly for the non-household surveys. |
| | Unrecoverable flat card packaging | |
| <i>Corrugated card packaging*</i> | Recoverable corrugated card packaging | To distinguish between corrugated card packaging that is recoverable e.g household appliance packaging, and that which is contaminated by virtue of its use and is not recoverable e.g pizza boxes. This distinction will be used mainly for the non-household surveys. |
| | Unrecoverable corrugated card packaging | |

| Secondary Category | Tertiary Category | Comment |
|--|---------------------------------|--|
| Nappies | - | This is a significant proportion of the residual waste stream and is considered to warrant its own category. |
| PP Packaging | - | Not included previously, but it is needed as it is typically encountered in non-household waste |
| Other Plastic Packaging | Recoverable plastic packaging | To distinguish between other plastic packaging that is recoverable e.g crisp packets, and that which is contaminated by virtue of its use and is not recoverable e.g plastic film on meats/food. This distinction will be used mainly for the non-household surveys. |
| | Unrecoverable plastic packaging | |
| Aluminium tin foil | - | New category added to better quantify different types of aluminium waste. |
| Medicines and Drugs | - | To quantify this type of waste to inform waste policy. |
| Garden Chemicals | - | All three categories added to facilitate monitoring of the implementation of the National Hazardous Waste Management Plan. |
| Ink Cartridges and Toner | - | |
| Healthcare Risk Waste | - | |
| * Existing secondary category but new tertiary category. | | |

Table 2.2: Removed Categories

| Secondary Category | Comment |
|---|--|
| Biodegradable kitchen and canteen waste | Split into two categories, see Table 2.1 above. |
| Other Composite Non-Packaging | Any such items will be assigned to the category 'Unclassified combustible or incombustible' as this provides more information on how this waste can be treated. |
| PS Packaging | No longer warranted. |
| Other flexible plastic (Packaging) | These two categories have been combined into one - Other Plastic Packaging; separate categories are not warranted as they do not provide useful information. |
| Other rigid plastic (Packaging) | |
| Solvents | These three categories have been removed as not considered necessary; during the 2004/05 surveys, little to none of these items were encountered. If such items are encountered, a category will be created on site. |
| Photochemicals | |
| Pesticides | |

2.2 IMPORTANT POINTS OF CLARIFICATION FOR SORTING AND CLASSIFICATION

Some items within the municipal waste stream can potentially be categorised under more than one category. Since every item must be placed into one category or another, the following clarifications are given to explain the proposed methodology for classifying such items.

- Unused food items still in their packaging:
 1. where the contents can easily be removed, they shall be classified separately and placed into the appropriate category, and the packaging placed into its own appropriate category e.g half filled cola drink bottle or partially eaten microwavable meal.
 2. where the contents cannot easily be removed from its packaging e.g jar of honey, assign the item to the category 'Unused Packaged Food'. It should be noted that these items would only be assigned to this category if it is evident that the contents have only been partially used; a fully used jar of honey will still

contain traces of honey, but in this instance, the item would be assigned to the packaging category.

- Fines (< 20 mm) in bags such as vacuum bags, house sweepings, pet litter etc: The contents of such bags are often easy to classify exclusively as fines and as such, the full bags will be assigned to the 'Fines' category. The bags themselves form a relatively minor part of the waste stream, and it is preferable to avoid emptying these bags for hygiene reasons.
- Multi-material Items; i.e. objects consisting of more than one category e.g. metal brush with plastic handle, hole puncher, cardboard ring binder etc, shall be assigned to the category of its predominant component. Separation into its component parts would only be possible with substantial effort or not possible at all. If a predominant category is not obvious, the item should be assigned to an 'Unclassified' category.
- Refuse sacks are not packaging waste and shall be assigned to the categories 'Other Plastic Waste' as they do not satisfy the definition of packaging as outlined in Section 2.1 above.

2.3 PROPOSED ASSESSMENT OF CONTAMINATION

The brief required that adequate and statistically valid samples of household and non-household packaging waste from the mixed residual waste and mixed dry recyclables waste streams be take for contamination analysis.

The accuracy of the measurement of contamination levels will depend on:

- Number of waste categories for which contamination levels need to be calculated
- Number of samples to be subject to contamination analysis

2.3.1 Waste Categories for Contamination Assessment

In order to measure the level of contamination on packaging for the primary waste categories (e.g. paper, plastic) it is necessary to investigate each secondary subgroup presented. This is because of the multi-material nature of packaging (e.g. plastic packaging waste is composed of PET and PE containers, plastic films). Each of type of packaging may have different contamination levels based on their content (e.g. butter will adhere more to a container than will water).

In selecting the categories, consideration has been given to selecting categories accounting for more than 90% of packaging waste (based on results from the 2004-2005 surveys).

A total of 13 secondary categories were selected for assessment, see Table 2.3 below.

2.3.2 Number of samples

The coefficient of variation of contamination levels for the different waste categories from the 2004/05 surveys helped to determine the number of samples required for 2008. Details are presented in Table 2.3 below. The methodology for the selection of samples is based on Annex II, Part C of the "European Commission, Methodology for the Analysis of Solid Waste (SWA - Tool)" which is attached in **Appendix B**.

2.3.3 Methodology

The methodology developed below is based on the methodology used during the 2004-2005 surveys.

Table 2.3: Proposed Categories for Contamination Assessment

| Waste Packaging Category | MDR | | MRW | |
|---------------------------------|-----------------------|--------------|-----------------------|--------------|
| | Coefficient Variation | No. Samples* | Coefficient Variation | No. Samples* |
| Paper Packaging | 44.9% | 78 | 15% | 9 |
| Flat card packaging | 35.2% | 48 | 32% | 40 |
| Corrugated cardboard: packaging | 21.8% | 19 | 18% | 13 |
| PET packaging | 19.5% | 15 | 92% | 328 |
| PE packaging | 34.9% | 47 | 76% | 223 |
| Supermarkets bags & films | - | - | 43% | 71 |
| PP Packaging | - | - | 1.22% | 14 |
| Other plastic packaging | - | - | 29% | 32 |
| Green Glass packaging | - | - | 0% | 0 |
| Clear Glass packaging | - | - | 38% | 57 |
| Ferrous Metal Packaging | 20.9% | 17 | 65% | 161 |
| Aluminium Packaging | 21.8% | 19 | 101% | 391 |
| Beverage carton (packaging) | 46.8% | 85 | 109% | 459 |
| Total | - | 328 | - | 1798 |

Note: MRW - Mixed Residual Waste; MDR - Mixed Dry Recyclables
 * Based on 10% required accuracy, and 95% confidence level

The purpose of the contamination study is to determine the correction factors for the quantities of packaging waste collected and measured by weight. Contamination levels will be measured according to the following procedure:

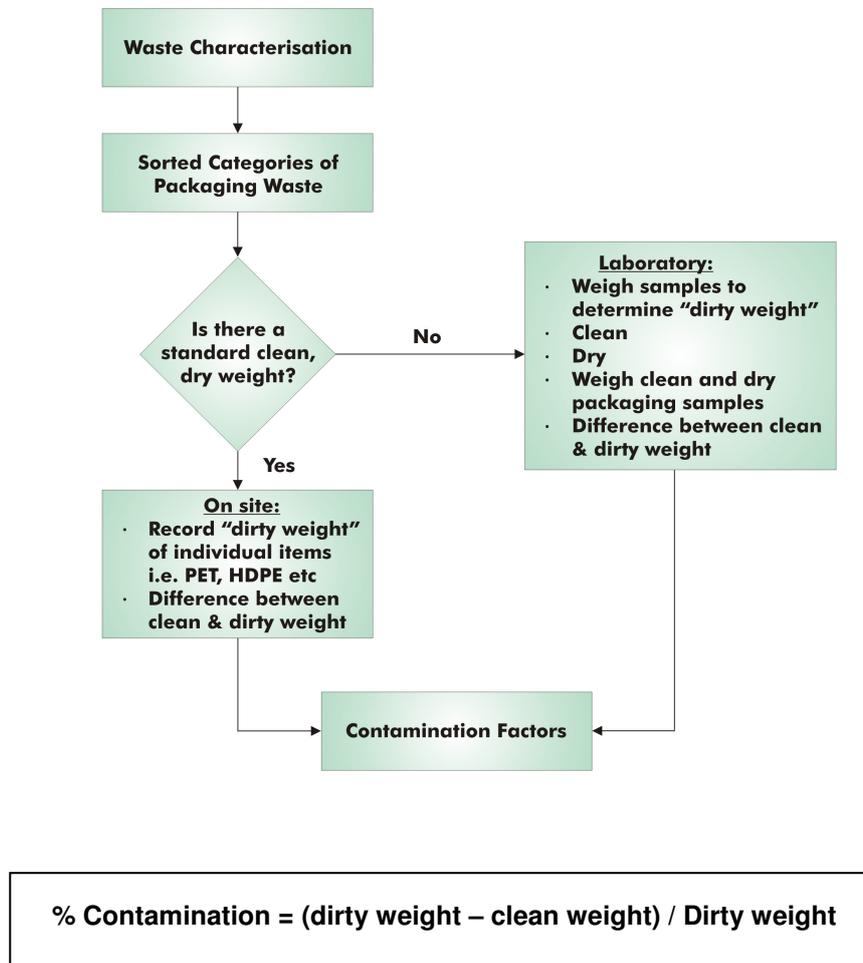
- a) Samples are collected during the waste characterisation process;
- b) The item is weighted while contaminated;
- c) Items of contamination are physically removed from the material being analysed - usually liquids or food residues. Where necessary containers or packaging are subsequently washed;
- d) Drying of the material (where appropriate) to remove any moisture contamination;
- e) Weighing of the clean dry test material and comparing this with the contaminated weight to generate the contamination correction factor.

A summary of the methodology is presented in Figure 2.1 below. Where a particular item is very common in the waste stream, it might be possible to determine in advance what its clean, dry weight is. In this case, the cleaning and drying step is not necessary.

Three differences arise in the methodologies employed in the contamination analyses for household and non-household packaging waste.

- Firstly, household waste composition will be carried out on collected waste, the non-household waste will be characterised at the point of generation, after segregation.
- The household waste contamination studies will be carried out after the majority of the samples have been through the waste characterisation process. As part of this, drinks bottles, i.e. PET and HDPE will have been emptied of their contents in cases where the weight of liquid is

estimated to be greater than the weight of the container. For the non-household waste, containers will be weighed 'as is' and then emptied; they will be allowed to drip dry and then the 'container only' is weighed.

Figure 2.1: Process Flow-chart for Calculation of Contamination

- Finally, in the contamination analysis of the non-household waste, an oven will be used to dry the samples after the initial weighing and cleaning of the samples (typical operating temperature was 70°C for 24 hours). The household waste will be drip dried for a period of 7 days.

2.4 CONSULTATION WITH REPAK

The following comments and concerns relating to the proposed methodology outlined in this report were raised by Repak:

- Repak would support the undertaking of composition survey(s) of materials accepted at Civic Amenities as this would provide greater confidence in the proportion of packaging reported from these facilities.
- With respect to the background data provided by the EPA for use in the sampling design, Repak would like to understand better the EPA's methodology for arriving at these figures in order to appreciate the degree of reliability of these figures.
- With respect to the non-household sampling, Repak's view is that 20 businesses will not provide a statistically representative sample for a national non-household waste profile. There is a high degree of variability between individual businesses, much more so that between individual households, and Repak feel that this won't be captured over 20 businesses.

- Repak are happy to provide their data on kerbside collected mixed dry recyclable waste composition data, subject to approval from their members. This data can be used to supplement the data generated from the household surveys.

With respect to the non-household sampling of 20 businesses, it is acknowledged that this is a low number in statistical terms. However, whilst the obvious alternative is to carry out more surveys, a balance has to be struck between the number of surveys and the cost. The non-household survey results gained from the 20 businesses can be supplemented by recent surveys carried out to provide a wider representation.

3 HOUSEHOLD SURVEYS METHODOLOGY

3.1 RECENT DEVELOPMENTS IN HOUSEHOLD WASTE CHARACTERISATION

This section provides a summary of changes that have occurred in the waste management sector in Ireland, or abroad, which may be pertinent to the methodology for undertaking a national waste composition survey campaign. A brief summary of recent campaigns carried out in Northern Ireland is also provided.

Waste Statistics and Waste Management Practices

Since the last campaign to create a national waste profile, carried out in 2004/2005, household waste generation has increased by 14.5%. From the EPA National Waste Report 2006, the quantity of household waste generated in 2004 was 1,728,154 tonnes compared to 1,978,716 tonnes in 2006. However, the recovery of household waste has also increased, with a recovery rate in 2004 of 19% compared to 22.2% in 2006. This is largely due to the introduction of a 'pay-by-use' charging system for waste collection services coupled with the expansion of kerbside collection of mixed dry recyclables.

The 'pay-by use' system was introduced in January 2005. This system charges householders either by volume or weight of residual waste collected, depending on the operator/Local Authority. This system encourages segregation of mixed dry recyclables. For areas where separate kerbside collection of recyclables was not provided, an increase in the use of civic amenities and bring banks was noted.

In 2008, the majority of households with a waste collection service are now provided with separate collection for mixed dry recyclables. Separate collection of organic waste has also expanded (e.g Fingal County and Dublin City Councils) but to a much lesser degree. 2008 will see further expansion of this service.

Local authorities have been transferring more and more of their household waste collection duties to private operators. This led to the situation of having, in some areas, multiple operators collecting in the same area, and less direct control by local authorities on waste collection and waste data. In 2005, 48% of household waste was collected by the private sector. This decreased slightly in 2006 to 47%.

CSO Census - 2002 v 2006

CSO data is used as the primary source of figures in relation to the Irish population and housing densities, social class and location. The following gives a brief comparison between data from the 2002 and the 2006 censuses.

Since 2002 the population has increased from 3,917,203 to 4,239,848. This increase in population has led to a corresponding increase in the population density from 56 people/km² to 60 people/km². Interestingly, the occupancy per household has decreased. In 2002, an average of 2.95 people inhabited each house whereas the 2006 figures give 2.81. This drop occurs in both the rural and urban figures.

As is expected, the CSO figures highlight the move of the population away from rural areas. The figures show a switch in the population, when before in 2002, 60% of the population lived in rural areas with the remaining 40% living in urban areas, now for 2006, these figures have switched with 60.7% of the population now living in urban areas with 39.3% of the population remaining in rural areas.

The total number of private households has increased over the four-year period from 1,287,958 to 1,627,404. In the number of total households, a drop in the percentage of total houses 89% down to 87.23% has been supplemented by an increase in total flat/apartment, 9% up to 11%. This highlights the migration of the population into urban areas.

Changes in the levels of the population that fall into each of the three social classes, also reflect the wealth in Irish economy. A drop in the percentage of the population that fall into social class C (-1.4%) from 2002 to 2006, has been supplemented by a small increase in percentage of Social Class B (0.3%) and a larger increase in Social Class A (1.1%).

It would probably be true to say that when comparisons are drawn between the 2002 and 2006 CSO data, the results reflect the changes in Ireland that have occurred as the direct result of the countries continuing economic prosperity and development.

Recent Northern Ireland Survey Campaigns

arc21

arc21 is a partnership of 11 District Councils from the eastern part of Northern Ireland. In 2007, arc 21 carried out a waste composition study of household waste in the arc21 region, in order to identify a composition profile for household waste within the region. This applied to residual waste, mixed dry recyclables and compostables. The methodology used for the arc21 study focused on selection of a representative sample which was based on European Commission guidance, and used a 'grouped household-based' approach. Other key elements of the methodology were - survey planning, survey execution and data analysis.

The study found that there was a considerable proportion of residual waste that was potentially recyclable through existing services, such as paper, card, dense plastic and glass. Furthermore, householders classified as Modest Means and Hard Pressed were not presenting their recyclable bins as frequently as other socio-economic categories. With respect to both of these findings, communication and awareness campaigns were considered key to ensuring that householders correctly use their existing recycling services.

The study also found that organic catering waste accounted for the largest component of the residual waste stream at 16.5%. In 2007, food waste was not collected in the organic separate collection in the arc21 region. However, the results of the study indicated that consideration should be given to extending the service to include this component of organic waste.

Northern Ireland Study

This project had two main aims; to determine the composition of municipal waste in Northern Ireland; and to review the percentage of municipal waste that is biodegradable. The project required waste to be collected and physically sorted from both kerbside collected household waste and also from Civic Amenity Sites including bring bank facilities from pre-selected District Councils within all three Waste management Groups (arc21, Southern Waste Management Partnership (SWaMP) and North West Region Waste Management Group (NWRWMG)).

Representative samples were chosen after the completion of background research and desktop studies. Once a representative sample was chosen, hand sorting was carried out on each sample, these results were then coupled with Waste Data Flow (WDF) figures for the 2006/2007 periods for each council district in Northern Ireland. The overall Composition of the total municipal waste in Northern Ireland was obtained by combining the results from the kerbside collections and from the civic amenity sites.

The study found that in Northern Ireland the percentage of biodegradable municipal waste generated was 64.01%. This is based on the waste analysed in the study via physical sorting and WDF operational analysis, which equates to 909,359.64 tonnes (85.45%) of the total waste arisings in Northern Ireland. The main components that make up the kerbside collected household waste are organic catering waste (25.57%), paper (23.29%) and organic non-catering waste (8.72%).

3.2 PROPOSED METHODOLOGY

It is proposed to apply the same overall methodology as for the previous campaign of surveys undertaken in 2004/2005, and to build on this methodology by identifying and addressing any weaknesses noted previously. The proposed methodology for undertaking the characterisation of household waste is based on the following guidance documents:

- EPA Municipal Waste Characterisation Manual, 1996.
- EPA Household Waste Characterisation Surveys Manual, 2006 (published under NWPP-2004-02), which provides an update on the 1996 manual.
- EPA Programme for Municipal Waste Characterisation Surveys, 2005

- European Commission SWA-Tool - Methodology for the Analysis of Solid Waste, March 2004. Whilst the EPA Manual sets out a useful methodology for undertaking individual characterisation surveys at local level, the SWA-Tool provides a methodology for arriving at a national waste profile i.e generation of a sampling plan that will provide nationally representative samples, and extrapolation of the results obtained to national level.
- European Commission - Development of a Methodological Tool to Enhance the Precision & Comparability of Solid Waste Analysis Data.
- European Standard EN 14899 - "Characterisation of waste - Sampling of waste materials - Framework for the preparation and application of a Sampling Plan".

The intended methodology, outlined in the EPA Household Waste Characterisation Surveys Manual 2006, identifies three main elements to a waste composition survey, namely Survey Planning, Survey Execution, plus Analysis and Reporting. There are a number of steps within each element. Each of these steps is reviewed individually in tabular format in the sections below with a view to identifying weaknesses and proposing improvements where possible. It should be noted that for some steps, no weaknesses have been identified.

In addition, existing constraints are also listed. Where relevant, suggested improvements for future survey campaigns, or improvements that can be made by the EPA, are listed. In some cases, constraints cannot necessarily be improved, and are included to illustrate inherent weaknesses in the study.

Figure 3.1: Overall Approach to the Household Methodology Development



3.3 SURVEY PLANNING

No weaknesses were identified under Survey Planning. Constraints are listed in Table 3.1.

Table 3.1: Constraints noted under Survey Planning

| Step | Constraint | Comment |
|-----------------------------|--|---|
| Step 1: Background Research | CSO data is published every four years. This may mean that for campaigns carried out 3/4 years after a census, areas sampled could have changed significantly as a result of new housing developments etc which are not reflected in the CSO data. | Limited scope for improvement as data collection is independent from the EPA and project team. This should not present a serious problem for this campaign as data from the census is relatively recent. For future surveys we propose as a mitigation to liaise with collection crews / supervisors to identify any significant recent changes in the area surveyed which may not have been reflected in the CSO data. |
| | There is no central database for the following data sets: - the total number of households i.e houses and apartments (individual units) within a Local Authority that are provided with a collection service. -the waste related charges for collection services provided by each Local Authority, - the type of collection in each Local Authority i.e 1,2 or 3 bin service, - the type of containers provided, in each Local Authority | All of this data is useful for the identification of sampling areas to ensure a representative sample e.g the type of charging mechanism can affect presentation rates, and as such, can affect the collection of a complete sample. For future survey campaigns, a readily available database of this information would be useful in sampling design. |
| Step 2: Sampling | The number of surveys required to give a | Due to budget and logistical constraints it is |

| Step | Constraint | Comment |
|--|--|--|
| Design | national profile was estimated as 68 in order to reach to reach an accuracy of 10% at 95% confidence level for Irish household waste. | not possible to carry out this level of surveying. However we recommend <ul style="list-style-type: none"> a) to continue to require surveys to be carried out by the biggest local authorities (urban areas). b) To collect where possible existing data (e.g. as part of the local authority questionnaire). c) To agree with REPAK on a common methodology to ensure that the results are compatible and accessible. |
| Step 3: Selection of a Representative Sample | It can be difficult to find a collection route within an Electoral Division that will provide enough households from all three social classes, plus match this with a suitable collection date. The increasingly fragmented nature of the collection market adds to this difficulty, as well as the number of samples that are to be collected within a specific period (i.e 18 in 8 weeks). | There is little that can be done to improve this situation; the existing constraints simply have to be considered in the survey planning process. It can result in a compromise between selecting the most suitable collection route to get the most representative sample, on the date when collection falls, or selecting a less suitable route on a more suitable date, in order to speed up the process. A number of electoral divisions can also be used to collect the sample. |
| Step 4: Survey Logistics Planning | Lack of communication by the waste collector from the top down. Staff may not be properly informed of their role in the sample collection. This can result in a lack of provision of the necessary equipment by the waste collector on the day of sampling e.g no separate collection vehicle provided, routine driver picking up the bins from the sample area before the sample truck gets to them, no machine available to mix and reduce the sample. | Emphasise to the waste collectors involved the need to communicate the procedure to their staff, and the need to provide the equipment on the day. Failure to do so could result in a number of weeks delay before the next collection in the chosen area rolls around. |

3.4 SURVEY EXECUTION

Table 3.2 Weaknesses identified under Survey Execution

| Step | Weakness | Proposed Improvements |
|---------------------------|--|---|
| Step 5: Sample Collection | The classification of households on a collection route into Social Class A, B or C is subjective and may not be consistent across samples. | Develop a guide for classifying households to improve consistency across samples. |
| Step 7: Sample Sorting | List of categories needs to be expanded. | See Section 2.1 |

Table 3.3 Constraints noted under Survey Execution

| Step | Constraint | Comment |
|---------------------------|--|--|
| Step 5: Sample Collection | The chosen level of sampling is at the at RCV (refuse collection vehicle) stage of collection. | Whilst sampling at RCV stage has the disadvantage of compaction and homogenisation of the waste, it has the advantage that householders are not aware of the survey and as such, do not have the opportunity to alter their behaviour which would impact on the results. Also, given the scale of this campaign and the number of samples to be collected, sampling from external waste containers would present too great a logistical challenge, whereas RCV sampling is feasible. |

| Step | Constraint | Comment |
|------------------------------------|--|--|
| | Low presentation rate of bins on the day of sample collection. | To guard against the risk of there being a lack of bins to obtain a full sample, contingency arrangements should be put in place at Step 3 to provide an alternative location on the collection route where additional bins can be obtained on the day, if possible. |
| Step 6: Reducing and Mixing Sample | There is a lack of hard evidence that 'Coning and Quartering' is the best way of mixing. | <p>The procedure of coning and quartering increases the extent of statistical sampling errors and may prevent the achievement of the required statistical standards. It presents the advantages to:</p> <ul style="list-style-type: none"> • Allow a quicker collection and a greater number of households to be included in the sample. • Be consistent with previous waste characterisation surveys in Ireland, therefore facilitate the comparison of results • Make it easier to repeat by local authorities / private collectors in the future |

3.5 ANALYSIS AND REPORTING

Table 3.4: Constraints noted under Analysis and Reporting

| Step | Constraint | Comment |
|--------------------------|--|---|
| Step 8: Results Analysis | Impact of Mechanical Biological Treatment on waste composition | Waste contamination factors are going to be applied by the EPA to the aggregated waste collection, landfill and recycling data to generate a national waste characterisation profile. This may lead to some inaccuracy in the case of waste which has been delivered to landfill from MBT plant(s). The output of an MBT plant is likely to be of a different composition than typical residual waste. For example, Mr Binman in Limerick extracts high calorific value materials for energy recovery and plastics / metals for material recovery. This results in only the undersized fraction (generally high in organic materials) being landfilled. The fraction landfilled differs in composition from the typical household and it is suggested that this fraction is not included in landfill data to be applied to municipal waste composition. |
| | Aggregation of results from Recycling Centres and Bring Banks | In 2006 17% of household waste was collected by Recycling Centres and Bring Banks. This will have an impact on the household waste composition profile. As kerbside waste composition results are combined with quantitative data on Recycling Centres and Bring Banks, we would recommend carrying out an assessment of the composition of the main waste streams collected. This will ensure that the assumptions used during the combination are accurate (e.g. glass is 100% packaging etc.). |
| | To date no local authorities have reported survey results for 2006/07 surveys. | In order to increase the database of surveys, it is recommended that the EPA issue a letter to local authorities requiring that results from surveys carried out in 2006 and 2007 be provided. |

4 NON-HOUSEHOLD SURVEYS METHODOLOGY

4.1 RECENT DEVELOPMENTS IN NON-HOUSEHOLD WASTE CHARACTERISATION

Since the last survey, conducted in 2004/2005, the commercial procedure developed during MS7 and refined during the last study, has been disseminated to various groups and local authorities as the recommended method for commercial waste audits in Ireland.

An examination of publications since 2005 shows little evolution from the coning and quartering method that was previously used in this country. Over 4000 periodicals were searched online and an extensive internet search was conducted. While a number of characterisation studies were found, they were predominantly American based and governed by the ASTM Standard Test Method for Determination of the Composition of Unprocessed Municipal Solid Waste². This document is a revised version of an earlier one which details characterisation methodology and sampling statistics. It is based on the coning and quartering technique, and a number of flaws have been found with the system. The Standard is briefly reviewed below. These flaws were also highlighted by another study into the methodology for solid waste characterisation based on diminishing returns³ – this is also discussed in more detail below.

A brief summary of any relevant recent studies is given here.

- ***Statewide Waste Characterisation Study of California***⁴. California did a comprehensive examination of their MSW. Their sampling procedure for the commercial sector was based on the following – “Samples of commercial waste were obtained from randomly selected vehicles at the landfills and transfer stations employed in this study. Composition percents and estimated tons for each material were derived by combining data at the regional level, with weighting proportionate to the estimated amount of commercial waste disposed in each region, as revealed by the vehicle surveys.” The breakdown of sectors was made based on interviews with the waste collectors entering the facilities and the overall commercial waste was generated on a generic basis rather than based on a sectoral approach.
- ***The Resource Recovery Fund Board Waste Audit Guide (Nova Scotia)***⁵ – this guide was generated in conjunction with the Halifax Regional Municipality for the Industrial, Commercial and Institutional sectors (IC&I). While the methodology employed is based on source separation, they consider municipal waste generated from only a number of commercial (office, retail and other) and institutional (medical and non-medical) sites. They do suggest that “*The stratification of the IC&I sector is more complex and a system such as the Standard Industrial Classification (SIC) or other similar organizational/classification systems are typically used*”. The Waste Audit guide is for use by individual businesses and does not suggest any scale up methodology for generating regional characterisation figures.
- ***ASTM Designation: D 5321 – 92 (Reapproved 2003)***²: This methodology allows determination of number of trucks to be sampled and gives instructions in how to conduct a survey. The method is based on diverting trucks entering the landfill site to a special analysis area. The trucks to be sampled are diverted randomly (e.g. using a random number generator), and dump their load in one contiguous pile. An approximately 1 m³ bucket loader removes material longitudinally along one entire side of the discharged load. Provided that it is large enough (visually estimated as 450 kg), this is used as the basis for coning and quartering.

The selected sample is mixed, coned and quartered. One quarter is selected randomly to be the sorting sample. Typically this will be between 90 kg and 136 kg. As can be seen, the US standard test method differs in several regards from the Irish methodology. Additionally,

² ASTM (American Society of Testing and Materials), 2003. Standard Test Method for Determination of the Composition of Unprocessed Municipal Solid Waste.

³ Sharma M, McBean E, *A methodology for solid waste characterisation based on diminishing returns*, Waste Management 27 (2007) 337 – 344.

⁴ Statewide Waste Characterisation Study, Cascadia Consulting Group on behalf of California Integrated Waste Management Board, December 2004.

⁵ Waste Audit Guide, The Resource Recovery Fund Board, Nova Scotia, www.rafb.com

instructions are given for dealing with single large items (weighed and noted), as well as for exceptions, such as many identical composite items (e.g. plastic-sheathed electrical conductor).

The method also outlines means for determining sample numbers. This is based on the student-t distribution and required confidence intervals and precision.

- **Sharma and McBean (2007)³** propose a way of determining the adequacy of sample numbers in-situ – i.e. on a running basis.

The Clean Technology Centre used a similar method during the 2005 study. In this method, CTC calculated the coefficient of variation (CV) of sample fractions as a running number. We sought to determine when CV converged. At this point, additional sampling, would mean very few gains for the extra effort expended. We would call this '*the Optimum Sample size (OSS)*'. Insufficient numbers were generated to feel confident about all the fractions (in particular the smaller fractions). However, the publication of Sharma and McBean in 2007 of a similar methodology, is encouraging, and we propose to expand this methodology in the current study.

This will mean some modification of the survey technique and data gathering, and development of additional spreadsheet material.

In essence, the Sharma and McBean method uses the coefficient of variation, but plots the absolute argument of the difference in squares of two consecutive Coefficients of Variation.

Thus

$$\Delta N_i = K[(CV_i^{j+1})^2 - (CV_i^j)^2]$$

Where N_i is the number of samples of fraction i , and j and $j+1$ are consecutive waste sortings.

Sharma and McBean found that, in general, CV decreases as the percentage of the waste in the i th category increases. This is exactly, what was found in the 2005 study.

For the absolute ΔN_i less than unity, additional waste sorts will not provide significant additional information. ΔN_i can, therefore be set at, say 0.99 (<1) to determine the convergence criterion. In this example:

$$[(CV_i^{j+1})^2 - (CV_i^j)^2] \leq 0.033$$

Other values of $[(CV_i^{j+1})^2 - (CV_i^j)^2]$ can be determined – depending on the required Confidence Interval.

4.2 REVIEW OF EXISTING METHODOLOGY

Commercial waste characterisation is, like anything that involves waste management, constantly evolving. While the methodology developed and used in Ireland is innovative and unique, it too should be subjected to critical review and improvement.

From experiences during the previous programmes, and having undertaken extensive commercial waste surveying since, it is clear that a number of areas need to be addressed. These are outlined below, along with potential improvement suggestions.

| Areas of Concern | Weaknesses | Solutions |
|--|---|---|
| Sectoral data used for Pareto Analysis | <ol style="list-style-type: none"> 1. The national sectoral breakdown previously used was based on information from a single contractor, although the information was generated for Dublin, Cork and Waterford. This is obviously limited and will be expanded for the current survey. 2. Absence of verification that the sectoral | Waste contractors from the main waste producing centres will be contacted. Information from a range of organisations will provide more reliable data. |

| | | |
|---|---|--|
| | information obtained was solely attributed to that sector. | This is an unavoidable issue, but through acquiring more contractor information, this issue will be addressed, and reliability improved. |
| Strict adherence to primary level NACE codes | For example, the Transport and Communication sector (NACE I) is too large and diverse to be treated as being homogenous, and needs to be sub-categorised. Conversely other sectors, e.g. the office sectors (NACE K - N) are relatively homogenous and can be taken as one. | The most recent version of NACE codes provides separation of Transport and Communication. This will be discussed in more detail in the next section. |
| Selection of sectors to be surveyed | When basing commercial characterisation on a sectoral approach, the selection of those sectors will always be an important issue. | While previous work as well as LAPD surveys will be considered in the current programme, the improvement in background information highlighted in the previous 2 points will ensure optimal sector choice. |
| Waste categories | These need to be amended to account for the issues such as serious contamination. As these surveys are designed to inform policy on areas for potential change, accurate material stream data is required. | A number of additional material streams will be included e.g. unrecoverable packaging (paper, plastic and cardboard). This will differentiate between material that is contaminated by virtue of its function, as opposed to that contaminated through its handling and management. |
| Lack of scientific statistical analysis during sampling | Waste data collected during the surveys is not subjected to in-situ statistical analysis. Such examination would determine whether sufficient sampling has been conducted at a location. | An additional in-situ step will now be included. This will involve more individual sampling and an in-situ statistical analysis of the data in order to determine if sufficient waste sorts have been conducted. (refer to section 4.1 above). |
| Contamination | The previous study used the traditional cleaning and weighing approach. This may not be appropriate for non-recoverable materials and needs investigation. | While the method previously used will again be employed, an additional examination technique will also be trialled. This will involve taking clean samples and contaminating them, in order to determine, typical, maximum, etc. contamination levels and to verify the accuracy of the 'weigh-wash-weigh' method. |

4.3 SURVEY PLANNING

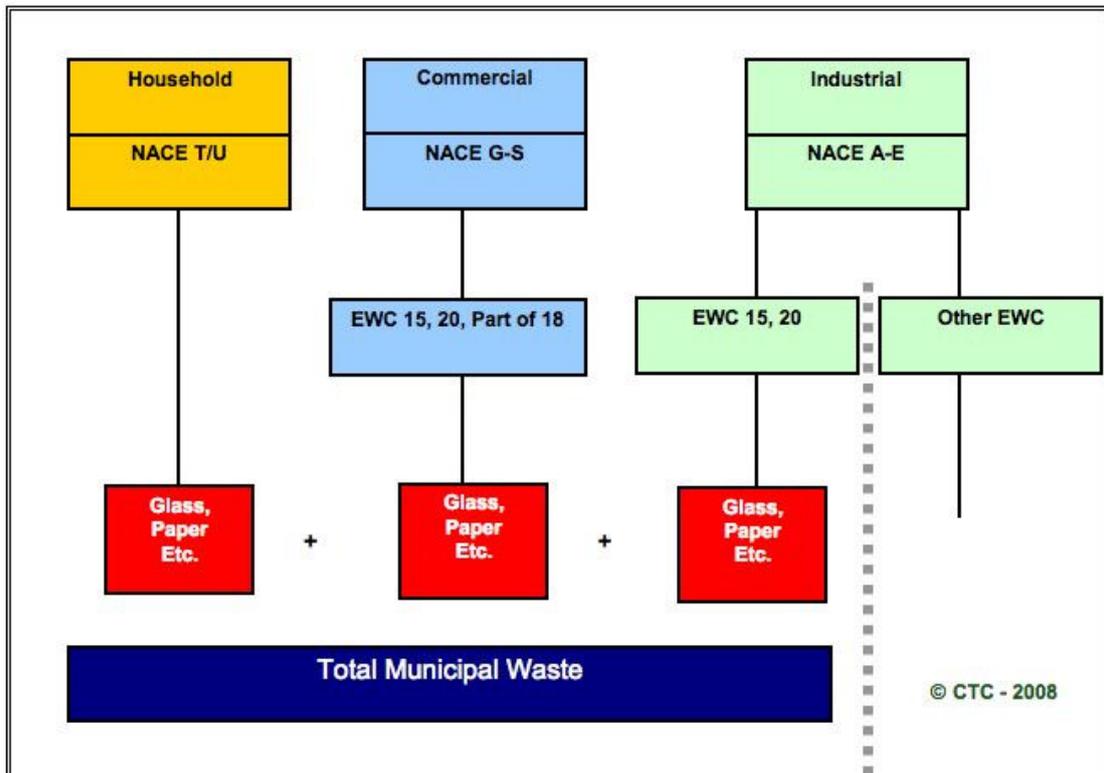
Recent changes in the NACE classification codes provide an improved breakdown within certain sectors that were identified as being too generic previously. For example, in the 2004 surveys Transport and Communication (NACE I) were taken as one category whereas in the new categories (www.CSO.ie) this has been split into H – Transport and Storage and J – Information and Communication. This is advantageous, since in the 2004 studies, NACE code I proved problematical, because of its size and diversity. This was one of the sectors earmarked for closer scrutiny and sub-division. The new classifications make this job easier.

The changes in NACE code are reflected in the updated definition diagram of the municipal waste streams under consideration in this programme.

The new NACE classifications will thus be used in the refining of potentially relevant and important sectors. With the assistance of the national waste contractors, the most relevant of these will be identified. A list of the major waste producing sectors has been sent to the contractors for them to assign relative percentages for specific areas (either through accurate data interpretation, or professional

estimation). The main waste producing centres nationally will be examined as well as a number of other non-urban commercially relevant areas.

Figure 4.1: Definition of Municipal Waste



Obviously, the results of previous waste characterisation studies will be revisited to provide a justifiable basis for specific sector selection. In addition, work conducted during the LAPD programme will be examined for potential inclusion. Much work has been done by the local authorities during this programme and all the waste characterisation studies have been done using the recognised EPA/CTC methodology. The following surveys have been conducted during this programme:

| Local Authority | Sector/Business Surveyed |
|------------------------|---|
| Kerry | Farranfore Airport |
| Wicklow | Statoil Service Station |
| Dun Laoghaire | Dundrum Shopping Mall (130 units) |
| Monaghan | 3 Hospitals National School Community Centre |
| Clare | Skycourt Shopping Centre (40 Units) |
| Cork County | Public Swimming Pool |
| Limerick | Residential Apartment Block (in progress) Public Office |
| Galway | 2 Hotels Supermarket Petrol Station Public Offices |

| | |
|---------------------|---|
| Roscommon | Public Office |
| Donegal | Hotel Public Offices Residential Surgery |
| South Tipperary | Small retail Units |
| Monaghan & Longford | Farms* |

* - These NACE codes are outside the scope of the current study.

In light of this work and through an examination of the revised NACE codes a number of potential areas that are considered to be important for the current surveys are highlighted in Table 4.1.

Table 4.1: Potentially relevant sectors within revised NACE classifications

| Sector | Comments |
|---|--|
| G WHOLESALE AND RETAIL TRADE;REPAIR OF MOTOR VEHICLES AND MOTORCYCLES | |
| 45 Wholesale and retail trade and repair of motor vehicles and motorcycles | May be an area that should be looked at – large garages etc. |
| 46 Wholesale trade, except of motor vehicles and motorcycles | Food wholesale previously examined. May need to revisit wholesale and/or distribution warehouses |
| 47 Retail trade, except of motor vehicles and motorcycles | Supermarkets and shopping malls done – may need to expand to different sectors but much LAPD work done |
| H TRANSPORT AND STORAGE | |
| 49 Land transport and transport via pipelines | Rail transport to be considered |
| 50 Water transport | Rosslare port |
| 51 Air transport | Have Kerry airport data but may want to re-examine deep burial materials |
| 52 Warehousing and support activities for transportation | NO |
| 53 Postal and courier activities | Maybe Post office sorting centres |
| I ACCOMMODATION AND FOOD SERVICE ACTIVITIES | |
| 55 Accommodation | Average hotel during summer season |
| 56 Food and beverage service activities | Sit down Fast food Food serving bar |
| J INFORMATION AND COMMUNICATION | |
| 58 Publishing activities | NO |
| 59 Motion picture, video and television programme production, sound recording and music publishing activities | Cinemas |
| 60 Programming and broadcasting activities | Done - RTE |
| 61 Telecommunications | Done – Eircom offices |
| 62 Computer programming, consultancy and related activities | NO |
| 63 Information service activities | NO |
| OFFICE BASED ACTIVITIES | |
| L Real estate activities | All of these are essentially office type environments and a large office block |
| M Professional, scientific and technical activities | |
| N Administrative and support service activities | |

| Sector | Comments |
|---|--|
| O Public administration and defence; compulsory social security | encompassing a number of sectors within this area will be examined |
| P EDUCATION | |
| 85.1 Pre-primary education | NO |
| 85.2 Primary education | Yes |
| 85.3 Secondary education | Yes |
| 85.4 Higher education | yes |
| 85.5 Other education | |
| 85.6 Educational support activities | |
| Q HUMAN HEALTH AND SOCIAL WORK ACTIVITIES | |
| 86 Human health activities | Hospitals done in LAPD |
| 87 Residential care activities | Maybe |
| 88 Social work activities without accommodation | NO |
| R ARTS, ENTERTAINMENT AND RECREATION | |
| 90 Creative, arts and entertainment activities | CCAD |
| 91 Libraries, archives, museums and other cultural activities | Maybe |
| 92 Gambling and betting activities | NO |
| 93 Sports activities and amusement and recreation activities | Possibly – GAA, etc |
| S OTHER SERVICE ACTIVITIES | |
| 94 Activities of membership organisations | Possibly Golf courses due to large number |
| 95 Repair of computers and personal and household goods | NO |
| 96 Other personal service activities | Hairdressers |
| OTHERS | |
| Extraordinary events | Concerts and festivals etc |

Until feedback information from the national waste contractors is received (3 are currently working on their figures), the sectors to be examined cannot be finally chosen. Once this information has been attained, and subject to discussion and agreement with the EPA, specific sectors will be selected.

In addition, Repak will be consulted in this regard due to their intimate knowledge of both the national waste contractors and of the most relevant waste producing commercial sectors nationally.

4.4 SURVEY EXECUTION

As with the household surveys planning is an essential step during the commercial surveys. Each sector identified as being relevant will require the engagement of a business in that sector. This can be a difficult and time consuming aspect of the commercial surveys. In addition once a suitable site has been chosen the on-site staff must be engaged and trained.

The main steps previously outlined in the 2004 methodology will be retained. While certain elements may be refined to overcome some of the perceived weaknesses the main steps of the methodology are deemed satisfactory. These steps are noted below and where changes are to be considered, or points need to be stressed, they will be noted. Otherwise they will just be listed.

Step 1: Meet with management and relevant on-site staff

Step 2: Schedule the Survey Period

Step 3: Identify Main Waste Producing Areas

Step 4: Select central collection area

Step 5: Inform and Organise On-site Staff

Step 6: Gather Necessary Equipment

Step 7: Procedure for Segregated Waste - this will be amended according to the new categories decided.

Step 8: Procedure for Mixed Waste - this will be altered slightly in order to obtain more data points in order to do statistical analysis during the surveys. Previously, a number of bags from a single area may have been examined at one time with the results aggregated. Now, each bag will be done individually until a statistically satisfactory have been done.

4.5 ANALYSIS AND REPORTING

Step 9: Determine Total Quantity of Segregated Waste

Step 10: Determine Waste Composition of Mixed Waste from each Source

Step 11: Data compilation and report to the EPA

5 SAMPLING PLAN FOR THE 2008 MUNICIPAL SURVEYS

5.1 OBJECTIVES OF THE BRIEF

The project brief requires the carrying out of waste characterisation surveys on both household and non-household municipal waste. The following municipal waste streams are to be characterised:

- Mixed residual waste,
- Mixed dry recyclables,
- Mixed organic waste.

The overall objective of the project is to create a national municipal waste composition/profile that can be applied to other national municipal waste statistics (both household and non-household). This will involve the generation of a set of factors that can be applied by the EPA to the aggregated waste data that is collected for landfilled waste, mixed dry recyclable and mixed organics, for the National Waste Report.

It is important that the national municipal waste profile generated by this project, is based on a statistically representative sample. The sampling design must define the boundaries and logistics of the sampling element in an unambiguous way, by providing specific and practical instruction to the sampler. The sampling plans for both the household and non-household municipal waste streams are outlined in Sections 5.2 and 5.3 below.

5.2 HOUSEHOLD SURVEYS

5.2.1 Background Research

Background information was collected from the EPA and CSO for each local authority in Ireland (Republic). The information comprised population statistics, waste management systems and existing information on waste composition. Results were input into a spreadsheet (**Appendix C**) and are summarised below.

Demographics:

| Total Population | Surface Area (km ²) | Density Pop/km ² | Urban % | Rural % | % Population per Social Class | | |
|------------------|---------------------------------|-----------------------------|---------|---------|-------------------------------|----|------|
| | | | | | A% | B% | C% |
| 4,239,848 | 70,182 | 60 | 60.7 | 39.3 | 38.8 | 40 | 21.2 |

Housing Types:

| Ave. no. of persons per private household | | | Total Households | Sub-total House % | Sub-total flats/Appt % |
|---|------------|-------|------------------|-------------------|------------------------|
| Agg. Rural | Agg. Urban | Total | | | |
| 2.95 | 2.72 | 2.81 | 1,627,404 | 87.23 | 10.11 |

Waste Arisings:

| Household Waste 2005 | kg/ hh /year | Household Waste 2006 | kg/hh /year | Recycling Centres (RC) | RC Tonnes Collected | Bring Banks (BB) | BB Tonnes Collected | % Waste Collected by RC+BB |
|----------------------|--------------|----------------------|-------------|------------------------|---------------------|------------------|---------------------|----------------------------|
| 1,633,266 | 385.2 | 1,672,213 | 394 | 86 | 191,398 | 1,919 | 96,725 | 17.2 |

Waste Collection:

| Kerbside | Kerbside Tonnes collected | Number of household serviced | Containers bags/ WB | Environmental Charges |
|------------|---------------------------|------------------------------|---------------------|-----------------------|
| Residual | 899,643 | ! | Wheelie Bin | ! |
| Recyclable | 194,367 | ! | Wheelie Bin | ! |
| Organic | 15,549 | ! | ! | ! |

! Data not available

5.2.2 Sampling Design

Using information on population from the Central Statistics Office and on waste collection systems from the EPA (see **Appendix C**) the total number of households for each cluster was calculated. The assumptions used, the number of households and the percentage of population in each cluster are shown in Tables 5.1, 5.2 and 5.3 respectively. This percentage excludes the categories “Caravan, mobile or other temporary structure” and “not stated” which accounts for 43,221 households or 2.7% of the total number of households.

Table 5.1: Description of Assumptions used to Allocate Households in each Cluster.

| | 1-bin | 2-bin | 3-bin |
|--------------------|---|---|--|
| Cities | Apartments with Residual waste collection only <ul style="list-style-type: none"> Part of DCC - 25,000* Limerick City Cork City Part of Galway City Part of Waterford City | Single unit dwellings and apartments provided with MRW + MDR collection <ul style="list-style-type: none"> Part of DCC - +25,000* - 15,000** Part of Limerick City Part of Cork City | Single unit dwellings and apartments provided with MRW + MDR + Organic collection <ul style="list-style-type: none"> Part of DCC +15,000** Part of Galway City Part of Waterford City |
| Towns | LAs with low recyclable collection rates (<10%) have a single bin in their rural areas <ul style="list-style-type: none"> Part of Carlow Part of Mayo Apartments in towns in other LAs | All single dwellings in towns are provided with 2 bin collection as a minimum | <ul style="list-style-type: none"> Ballinasloe Urban part of Co. Waterford |
| Rural areas | LAs with low recyclable collection rates (<10%) have their rural areas with single bin <ul style="list-style-type: none"> Part of Carlow Part of Mayo + Apartments in other LAs | LAs with recyclable collection rates >10% have their rural areas provided with 2 bin collection | <ul style="list-style-type: none"> Rural part of Co Waterford Rural parts of Co. Galway |

* 25,000 apartments are currently provided with a residual waste bin and a brown bin in the 4 Dublin local authorities
 ** 15,000 single unit dwellings are also provided with a brown bin in Dublin City Council and Fingal County Council areas.

Table 5.2: Number of Households in each Cluster

| | 1 bin kerbside collection system | 2 bins kerbside collection system | 3 bins kerbside collection system | Total |
|--------------------|----------------------------------|-----------------------------------|-----------------------------------|-----------|
| Cities | 77,065 | 384,296 | 54,627 | 515,988 |
| Towns | 42,418 | 318,924 | 60,422 | 421,763 |
| Rural areas | 70,176 | 428,509 | 147,840 | 646,526 |
| Total | 189,659 | 1,131,729 | 262,889 | 1,584,277 |

Table 5.3: Percentage of Population in each Cluster

| | 1 bin kerbside collection system | 2 bins kerbside collection system | 3 bins kerbside collection system | Total |
|--------------------|----------------------------------|-----------------------------------|-----------------------------------|-------|
| Cities | 5.0% | 25.2% | 3.6% | 33.8% |
| Towns | 1.5% | 21.4% | 4.0% | 26.8% |
| Rural areas | 4.0% | 25.7% | 9.7% | 39.4% |
| Total | 10.5% | 72.3% | 17.6% | 100% |

To calculate the above percentages, it was assumed that for 2 and 3 bin kerbside collection, the full population of the local authority is provided with the service, with the exception of flats and apartments in cities. This is not the case in Dublin where a significant proportion of flats and apartments (an estimated 25,000) are provided with mixed dry recyclables containers.

The areas with 3 bin kerbside collection are Galway City and County, and Waterford City and County, as reported in the 2006 EPA National Waste Report.

Single-bin (or traditional) systems in cities were calculated from the percentage of population living in flats/ apartments, as they are not generally provided with separate kerbside collection containers. Towns and rural areas are made up of counties Carlow and Mayo, as there is a limited quantity of recyclables collected in these areas (<10%).

All other counties were classified as 2 bin kerbside collection system.

The influence of drop-off on waste collection (i.e. Civic Amenity Sites and Bring Banks) needs to be investigated further. The information provided in the EPA National Waste Report 2006 demonstrates that they are playing an increasing role in the overall waste collection, with more than 17% of waste collected (3.4% being residual waste). They also have an important role for some specific waste streams such as glass.

Taking into account the evolution of the kerbside collection systems proposed in Regional Waste Management Plans (namely the increase of the 3-bin system - Dublin City and Fingal County Councils to be fully rolled out by the end of 2008), it was decided to select 7 clusters representing 99% of the Irish population; these are:

- Cities with 1 bin system (flats & apartments)
- Rural with 1 bin system
- Cities with 2 bin system
- Towns with 2 bin system
- Rural areas with 2 bin system
- Cities with 3 bin system
- Towns with 3 bin system
- Rural areas with 3 bin system

Initially it was planned to allocate the number of samples proportionally to the percentage of population. However, due to the evolution of the waste collection in Ireland towards a 3 bin collection system, it was decided to increase the number of samples collected in the 3-bin collection system group. This collection system was also judged to be less susceptible to having waste materials diverted towards civic amenities or bring banks. A minimum of 3 samples (mixed residual waste, mixed dry recyclables and separate organic kerbside) each collected on the same route, is necessary to assess household waste composition and arisings in 3 bin serviced areas. Similarly, a minimum of two samples (mixed residual waste, mixed dry recyclables) is necessary in 2 bin areas.

18 samples are proposed during April 2008 and again in October 2008, giving a combined total of 36 samples. The proposed samples to be analysed are summarised in Table 5.3.

Table 5.3: Proposed Survey Types for Household Waste Analysis

| | 1-bin kerbside collection system | 2-bin kerbside collection system | 3-bin kerbside collection system | Total |
|--------------------|----------------------------------|----------------------------------|----------------------------------|------------------|
| Cities | 2 (6%) | 4 (11%) | 6 (17%) | 12 (33%) |
| Towns | 0 | 4 (11%) | 6 (17%) | 10 (28%) |
| Rural areas | 0 | 8 (22%) | 6 (17%) | 14 (39%) |
| Total | 2 (6%) | 16 (44%) | 18 (50%) | 18 (100%) |

Note: the percentage in brackets represents the percentage of samples allocated to each individual cluster.

5.2.3 Selection of waste survey areas

Taking into account the requirements of the brief, it is proposed to carry out surveys in the locations shown in Table 5.4.

Table 5.4: Proposed Survey Locations

| Strata | 1 bin | 2 bins | 3 bins |
|--------------------|-----------------------|--|--------------------------|
| Cities | Fingal County Council | Cork City Council | Galway City Council |
| Towns | N/A | Limerick County Council | Waterford County Council |
| Rural areas | N/A | Limerick County Council Longford County Council | Waterford County Council |

Note: Even though the Dublin region represents 29% of Irish households, it is proposed to characterise only 1 sample from this region, as 4 black bin and 4 green bin surveys were carried out in Dublin in 2006 & 2007. The results of these surveys can be used to complement the low number of proposed surveys.

It is proposed to collect from a mix of households with an identical social class profile to the national social class profile.

5.3 NON-HOUSEHOLD SURVEYS

The sampling plan is not such a significant factor for the commercial studies. In general, and as discussed in section 4, a number of bags will be thoroughly examined, and an in-situ statistical analysis will be used to guide sample size. The EPA-CTC standard methodology already includes the sampling to be in proportion to the activities (e.g. canteen, office, stores, etc.).

Scale-up factors will be determined on a sector by sector basis - subject to the availability of information.

APPENDIX A

WASTE CATEGORIES

| MUNICIPAL WASTE COMPOSITION CATEGORIES & EXAMPLES | | | |
|---|---|---|--|
| EWC CODES | WASTE CATEGORIES | TYPICAL EXAMPLES | |
| ORGANIC WASTE | | | |
| 20 01 08 | Edible kitchen & canteen waste | Unused Packaged food | Unused or partially used packaged food, e.g. unopened biscuits, half used jams, etc |
| | | Unused non-packaged food | Vegetables, fruit, etc |
| 20 01 08 | Inedible kitchen & canteen waste | Vegetable peelings, tea bags, meat carcasses | |
| 21 01 08 | Liquid fit for human consumption | Liquid contained in drink and milk containers | |
| 20 02 01 | Biodegradable waste from garden & park | Grass and bush cutting, twigs, soil, flowers, leaves, tree branches, weeds | |
| 20 01 25 | Vegetable oil | Waste cooking oil | |
| PAPERS | | | |
| 15 01 01 | Paper Packaging | Recoverable paper packaging | Brown or white paper bags, wrapping paper, fast food wrapping, egg cartons |
| | | Unrecoverable paper packaging | Curried fast food packaging, meat wrapping |
| 20 01 01 | Newspapers | Local and national newspapers, newsprint-type advertising publications, other newsprint | |
| 20 01 01 | Magazines & glossy paper | Magazines and ads on glossy paper, shop catalogues | |
| 20 01 01 | Office papers | Envelopes, letters, print outs, | |
| 21 01 01 | Tissue Paper/ Kitchen Roll | Tissue Paper/ Kitchen Roll | |
| 20 01 01 | Other papers | Till receipts, books, telephone directories, golden pages, non-glossy junk mail, loose leaf paper, non-glossy brochures and catalogues | |
| CARDBOARDS | | | |
| 15 01 06 | Flat Card Packaging | Recoverable flat card packaging | Cereal packets, toy boxes, washing powder containers, food containers, cleaning product cartons |
| | | Unrecoverable flat card packaging | Ready packed meats |
| 15 01 06 | Corrugated Cardboard (Packaging) | Recoverable corrugated card packaging | Corrugated packaging cardboard used for household items packaging (TV, PC, furniture etc) |
| | | Unrecoverable corrugated card packaging | Contaminated pizza box |
| 20 01 | Other Cardboards (Non Packaging) | Birthday cards, postcards, files and folders, tickets | |
| COMPOSITES | | | |
| 15 01 05 | Beverage Carton (Packaging) | Beverage cartons (Tetrapak) | |
| 15 01 05 | Other Composite Packaging | Tablets packaging (blister packets), crisp packets | |
| TEXTILES | | | |
| 15 01 09 | Textiles Packaging | Nets for fruits and vegetables | |
| 20 01 11 | Textiles Non-Packaging | Rags, household soft furnishings and upholstery, blankets, towels, carpets, curtains | |
| 20 01 10 | Clothes | Clothes and canvas bags, | |
| | Nappies | Nappies | |
| 18 01 04 | Healthcare Textiles | Dressings, plasters, linen, disposable clothing, sanitary towels, bandages | |
| PLASTICS | | | |
| 20 01 39 | PET (Packaging)  | Soft drinks, soft drinks bottles, water bottles, some ice-cream cartons | |
| 20 01 39 | PE (Packaging)  | Milk, detergent, bottle caps, household/pet/garden products, laundry liquid containers | |
| 21 01 39 | PP (Packaging)  | Dessert containers, disposable drink cups, etc. | |
| 22 01 39 | Styrofoam (EPS) (Packaging) | EPS foam (Electronic goods packaging, burger boxes, some egg cartons), | |
| 15 01 02 | Other Plastic (Packaging)  | Recoverable plastic packaging | Crisp packaging, margarine tubs, toothpaste tubes, Yoghurt pots without lid, ice creams, CD covers |
| | | Unrecoverable plastic packaging | Meat containers, contaminated film packaging etc |
| 20 01 39 | Other Plastic Waste (Non Packaging) | Refuse bags, Clothes hangers, toys, air freshener holders, plant pots, seed trays, video cassettes, washing up bowls, racks, garden hoses, floor linoleum (lino), CDs, gardening equipment, hoses, lighters, rulers, shoes (plastic only), plastic frames | |
| GLASS | | | |
| 15 01 07 | Green Glass (Packaging) | Wine (red) bottles, beer bottles | |

| | | |
|---|---|---|
| 15 0107 | Clear Glass (Packaging) | White/Rosé wine and water bottles, jam jars |
| 15 0107 | Brown Glass (Packaging) | Beer Bottles (e.g. Budweiser), medicine bottles |
| 15 0107 | Glass Other Colours (Packaging) | Blue water Bottles, medicine bottles |
| 20 01 02 | Non Packaging Glass | Mirrors, plate glass, flat glass, cookware (Pyrex), mixed broken glass, drinking glasses |
| METALS | | |
| 15 01 04 | Ferrous Metal (Packaging) | Beverage and food cans, lids, biscuit containers |
| 20 01 40 | Other Ferrous Metal Waste | Keys, nails, cutlery, paper clips, building/DIY materials, screws, tools, safety pins, metal shelves, radiators, pots and pans, locks |
| 15 01 04 | Aluminium Cans(Packaging) | Beverage and food cans, foil sheets and trays, shoe polish cans, toothpaste tubes |
| | Aluminium Tin foil | Aluminium foil sheets and trays |
| 20 01 40 | Other Aluminium Waste | Cutlery, household wiring, crockery |
| 15 01 04 | Other Metal (Packaging) | Composite cans, tin containers etc |
| 20 01 40 | Other Metal Waste | Cast items (faucets, cooking pans), locks, building/DIY material, plumbing, bike parts |
| WOOD | | |
| 15 01 03 | Wood Packaging | Bottle corks, cork packaging, pallets |
| 20 01 37 | Non Packaging Natural Wood | Wood fencing, some wood from DIY |
| 20 01 37* / 20 01 38 | Treated/ composite woods (e.g. MDF/chipboard) | Kitchen units, particle wood (chipboard, plywood, mdf) |
| HAZARDOUS MUNICIPAL WASTE | | |
| 20 01 27* / 20 01 28 | Paint and associated products | Paint |
| 20 01 33*/34 | Batteries & Accumulators | Lead acid, nickel cadmium, other car and household batteries and accumulators (including rechargeable batteries) |
| 20 01 21* | Fluorescent tubes | Fluorescent tubes and other mercury containing wastes |
| 20 01 99 | Aerosols | Deodorant, perfume, hairspray |
| 21 01 35*/36 | Electronic equipment | Household appliances (toasters etc), toys, control instruments |
| 20 01 31*/32 | Medicines and drugs | out of date antibiotics, steroids, tablets, etc |
| 20 01 29*/30 | Detergents | Laundry detergents |
| 20 01 99 | Waste oil and oil filters | Automobile engine oil and filters |
| 20 02 03 | Garden chemicals | Sprays, feeds |
| 20 01 99 | Ink cartridges and toner | From office, household printers. |
| 20 01 99 | Healthcare risk waste | Sharps, vials |
| 20 03 99 | Other domestic waste | Any other items - Description to be provided during survey |
| 20 03 99 | Other domestic waste | Any other items - Description to be provided during survey |
| UNCLASSIFIED COMBUSTIBLES | | |
| 20 03 99 | Unclassified combustibles packaging | |
| 20 03 99 | Other unclassified combustibles | Animal hair, Item of furniture, appliance parts, non-mercury containing lightbulbs |
| UNCLASSIFIED INCOMBUSTIBLES | | |
| 20 03 99 | Unclassified incombustibles packaging | Ceramic box |
| 20 03 99 | Other unclassified incombustibles | Inert waste e.g. Ceramics, clay plant pots, crockery, stone/ceramic floor and wall tiles, vases, stones, bricks |
| COMPONENTS SMALLER THAN 20 MM ROUND MESH | | |
| 20 03 99 | Fines smaller than 20mm round | Any items going through the 20mm mesh |