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Final report

The composition of municipal solid waste in Wales

A report that describes the composition of municipal solid waste in Wales. The information can be used by national and local governments to inform their waste management policy and practice decisions.

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Front cover photography: Handsorting a waste sample

Executive summary

Aims and objectives

The Welsh Assembly Government is committed to a more sustainable approach to waste management. Wales has increased its recycling rate for municipal waste from 7% in 2000/01 to 37% in 2008/09, and a new 'Zero Waste' plan for Wales was published in 2009. The plan sets out proposals for a challenging programme of change over the next 15 years which will continue to move Wales away from an over-reliance on landfill and maximise the use of unavoidable waste as a resource in order to derive the maximum environmental, social and economic benefit to Wales. It includes a target to recycle or compost 70% of municipal waste by 2025.

Municipal solid waste (MSW) is defined as all waste for which a local authority makes arrangements to collect or dispose of, with a few exceptions mainly being industrial waste taken for disposal or treatment separately. A study to determine the composition of MSW in Wales was conducted during 2002/03, and a number of local authorities in Wales have conducted analyses of a number of the waste streams that comprise municipal waste (e.g. normal or "residual" household collected waste and waste arising at household waste recycling centres) since then. However, the information is now dated and requires updating for use in national and local policy development. Outside of Wales other compositional analyses have been carried out in the UK since the 2002/03 Wales study including a 2008 study in an English Unitary Authority and 2009 study in 8 Scottish Local Authorities. These studies provide comparisons with the 2009 Wales MSW compositional analysis and will be referred to in this report as 'other studies.'

Individual local authorities will also require more up-to-date data for their own areas, and in particular the procurement groupings that have been formed for anaerobic digestion of collected food waste and treatment of residual waste arisings to secure appropriate infrastructure in the coming years. Consequently, the Welsh Assembly Government identified the need to commission a new full scale waste composition analysis of municipal solid waste (MSW) in Wales. The analysis will increase overall confidence in the available data which had been used in developing the waste strategy, and help underpin future service and policy decisions. A steering group, with representatives from the Welsh Assembly Government, the Welsh local government association (WLGA) and the WRAP (Waste & Resources Action Programme) was set up to oversee the project.

The work was commissioned for the Welsh Assembly Government by WRAP. It was delivered by WastesWork, supported by AEA, between May and December 2009.

What was done

Waste composition analysis was carried out in all of the 22 local authorities in Wales. Sampling areas within each local authority were selected using socio-economic profile data to identify groups of households which, between them, provided a suitably representative sample of both the overall Welsh population and the population of the local authority in which they were situated.

Compositional analyses were conducted in two seasons; summer (June/July) and winter (November/December) 2009. Analyses of the following MSW streams were conducted in all authorities; residual household collected waste, kerbside collected dry recyclables and organic waste, residual waste arisings at household waste recycling centre (HWRC) sites, litter, trade waste collected by local authorities and schools waste. The analysis data were then used to determine the overall composition of MSW in Wales and identify material that could be targeted for either recycling or composting in order to meet future recycling targets.

Composition of waste

The study analysed a total of 240 tonnes of municipal waste. The information derived from this work on the composition of each waste stream, together with an analysis of the overall composition of MSW in Wales, will provide local authorities in Wales with sufficiently robust information to enable them to further develop their recycling and composting strategies.

The three main waste streams (based on WasteDataFlow data for 2008/9) that comprised MSW in Wales were:

- residual household collected (dustbin) waste – 42% of MSW arisings;
- residual waste arisings at household waste recycling centre (HWRC) sites – 8% of MSW arisings; and
- trade waste collected by local authorities – 7% of MSW arisings.

Other waste streams, which include litter and bulky household waste, represented about 5% by weight of MSW arisings in Wales. The remainder (37%) was recycled.

Composition of residual waste streams

The residual waste streams that make up overall MSW are of particular interest as this is the material that is currently sent to landfill. Table E1 shows the composition of the main residual waste streams in Wales. Specific findings on the composition of each residual waste stream include:

- food waste represented about one third (by weight) of the residual household collected (dustbin waste) stream;
- residual waste arising at household waste recycling centre (HWRC) sites contained about 35% of the 'other combustible materials' category. This category includes wood;
- the main components of trade waste collected by local authorities were paper & card and food waste. There were differences in the composition of waste produced by different types of business; for example, the proportion of food waste was highest in waste from cafes/restaurants and care homes, and the proportion of cardboard was highest in waste from retail premises;
- the main components of bulky household waste were furniture and white goods; and
- the main components of waste from schools were paper & card and food waste.

Table E1: Composition (percentage by weight) of residual waste in Wales

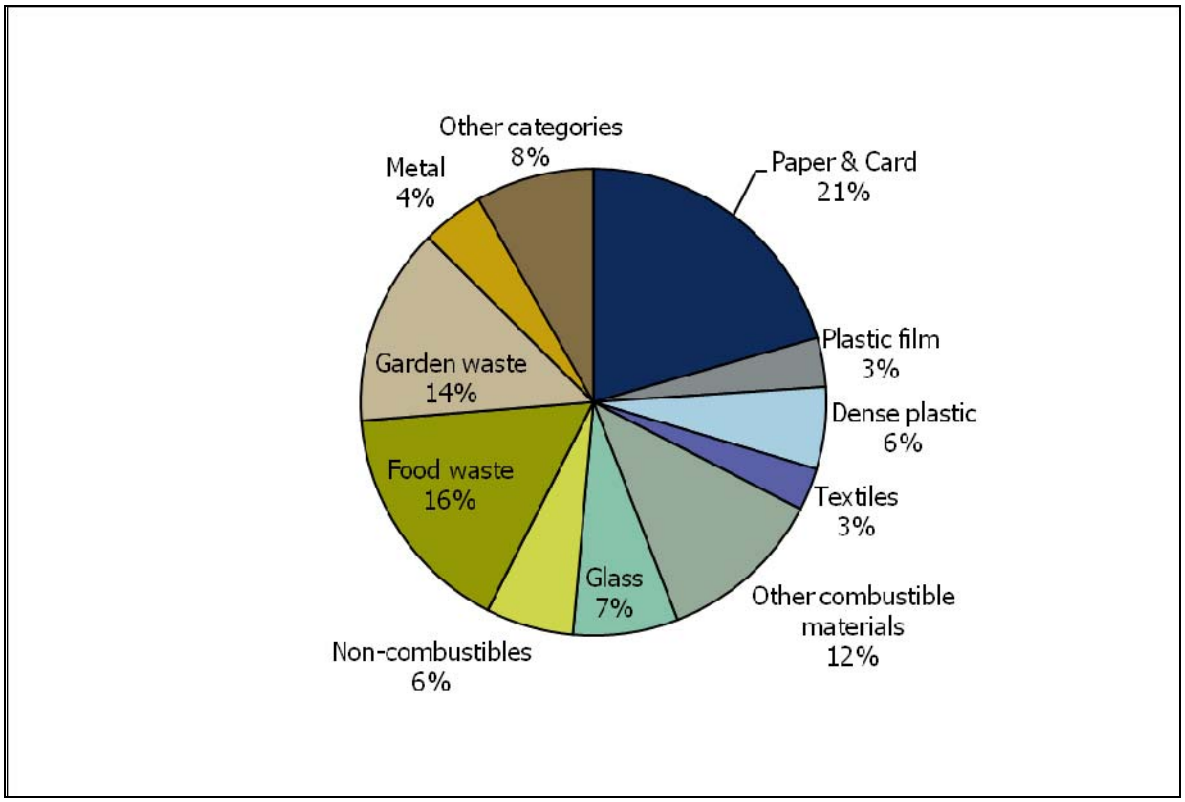
	Residual household collected waste	Residual waste arising at household waste recycling centres	Residual trade waste collected by local authorities
Paper & card	17.6	10.4	37.6
Plastic film	6.0	2.0	7.6
Dense plastic	6.8	9.2	7.8
Textiles	4.5	5.2	1.8
Other combustible materials	9.9	35.4	5.3
Glass	3.9	3.8	4.9
Other non-combustible materials	3.8	8.9	1.6
Food waste	30.0	5.5	20.8
Garden waste	3.3	7.2	0.9
Other organics	5.9	1.3	5.1
Metal	3.6	3.9	4.4
Hazardous items	0.7	1.3	0.8
Electrical items	1.2	5.3	0.8
Fines	2.6	0.6	0.5
Total	**100.0**	**100.0**	**100.0**

The overall findings for the composition of each MSW stream in Wales were similar to those determined in other studies, such as the study on MSW composition in Wales in 2002/03, the study on composition of MSW in Scotland conducted in 2009, and a recent Defra review of compositional analyses (mainly from England) conducted between 2004 and 2008. Thus the datasets used to determine the overall composition of MSW in Wales are considered to be robust.

Overall MSW composition

Figure E1 shows that the main components[1] of overall MSW in Wales were paper & card and food waste; which between them represented approximately 37% by weight of total MSW arisings. The third largest component was garden waste, which represented 14% by weight of the total MSW arisings in Wales. The overall composition of MSW in Wales was similar to that determined in other studies.

Figure E1: Composition (Weight %) of MSW in Wales



The overall biodegradable content of municipal solid waste in Wales was 60.0% if it is calculated using the values for biodegradable content of waste categories in the English and Scottish Regulations, and 64.1% if it is calculated using the values for biodegradable content of waste categories in current Environment Agency guidance (Appendix F shows how these values were determined). The Welsh Assembly Government will need to consider what the implications are for the current Regulations in Wales.

The 95% confidence interval for the biodegradable content of MSW in Wales was ±1.1percentage point. Thus, if the biodegradable content was calculated using the values in the current Environment Agency guidance, there is a 95% probability that the biodegradable content of MSW in Wales would be between 63.0% and 65.2%. If the biodegradable content was calculated using the values in the English and Scottish Regulations, then there is a 95% probability that that the biodegradable content of MSW in Wales would be between 58.9% and 61.1%.

Current recycling

Contamination of current recycling by non-targeted materials was low. The dry recyclables stream contained small amounts of a number of non-targeted but potentially recyclable materials such as wood, other (non-packaging) glass, food waste and Waste Electrical and Electronic Equipment (WEEE). The green waste stream contained less than 1% by weight of food waste in authorities which collected a green waste only stream. The food waste content of collections in authorities which collected a food waste only stream was over 95%.

[1] Composition of MSW determined from the composition and tonnage arisings of each MSW stream

The average capture rates that were achieved by the kerbside schemes in Wales in 2008/09 ranged from 73% for newspapers and magazines to 27% for other paper and card. The capture rates were comparable to those determined in other studies.

The overall recycling rate achieved at the HWRC sites in Wales in 2008/09 was 61%. Capture rates of over 80% were achieved for garden waste, wood and construction and demolition (C & D) waste, and capture rates of over 70% were achieved for glass and WEEE items. These were comparable to capture rates determined in other studies.

Opportunities for further recycling

One of the objectives of this study was to provide information on the occurrence of recyclable or compostable materials that are contained within municipal solid waste in Wales. Table E2 shows that 74% of MSW is comprised of recyclable or compostable material that currently could potentially be separated by households for recycling. There may also be carpet that is suitable for recycling within the "other combustibles" category. MSW arisings in Wales also contain about 2% by weight of furniture. Some of this, and also some of the waste electrical items, may be suitable for reuse.

Table E2: Arisings of potentially recyclable or compostable material in MSW in Wales

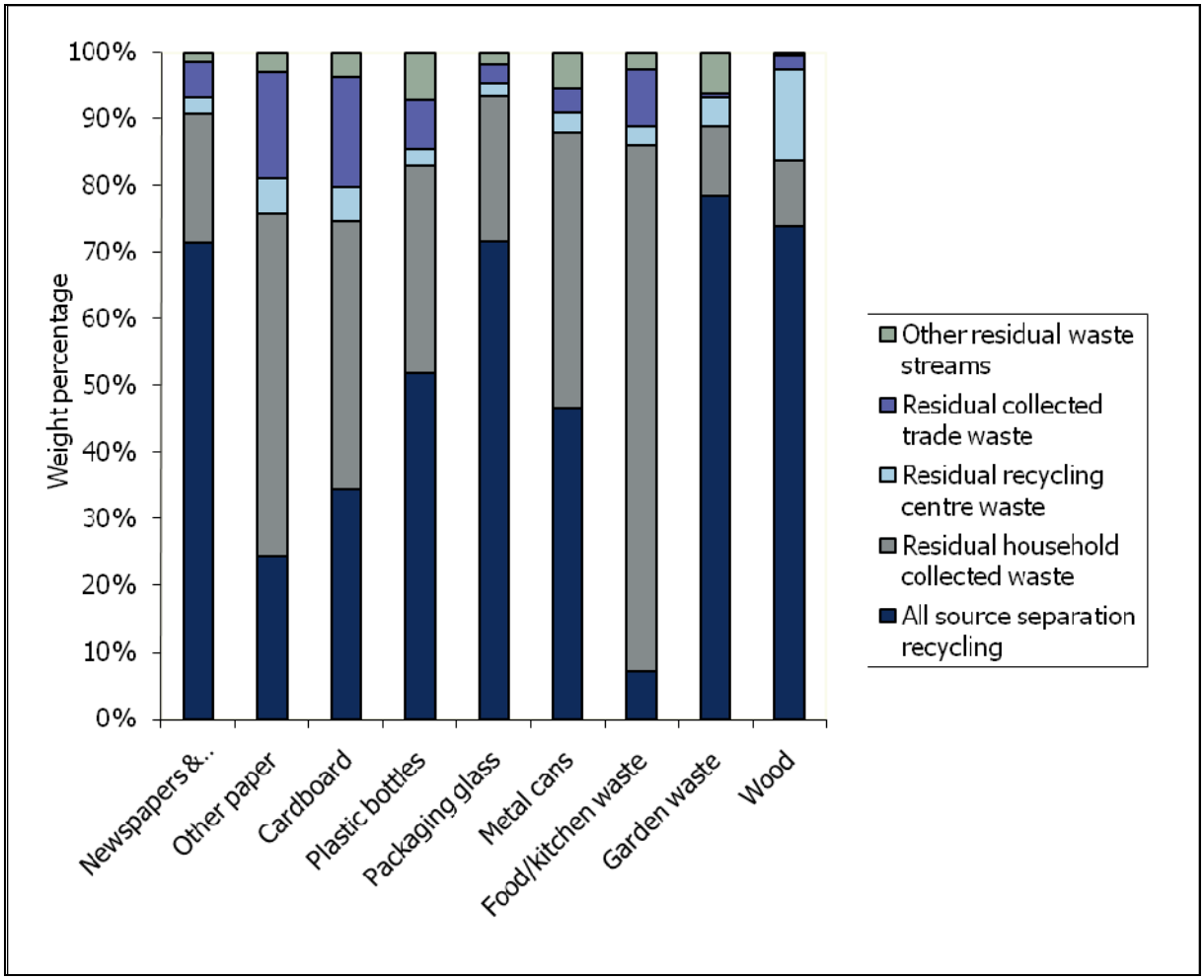
Category	Weight %
Newspapers & magazines	7
Recyclable paper	4
Cardboard boxes and containers	5
Dense plastic bottles	2
Other plastic packaging	2
Textiles and shoes	3
Wood	4
Packaging glass	6
C&D waste (rubble)	4
Metal	4
Food waste	16
Garden waste	14
Other (electrical items, oil, batteries)	3
Total	**74**

The 2009 draft of the Zero Waste Plan for Wales sets a target to collect and either recycle or compost 70% of MSW by 2025. The findings from this study suggest that approximately three quarters of MSW in Wales is made up of recyclable and compostable material. It is important to highlight that the 74% calculated from this study represents what is available for potential capture using recycling and composting collections. A recent report by Environment Agency in Wales for the Welsh Assembly Government identified that up to 90% of MSW in Wales could potentially be recycled. The 90% figure includes more paper, plastic film, disposable nappies, other glass, other organics and fines. Some of the other organics (such as wood based cat litter) and fines could be placed into an organics collection, but further developments in recycling technology, together with additional recycling infrastructure (particularly for disposable nappies) would be required in order for up to 90% of MSW to be classified as being potentially recyclable or compostable.

The actual amounts of material collected as a proportion of the total available in the waste stream will vary according to a wide range of technical and socio-economic factors. It is therefore useful to consider the current availability and capture of these materials in the different MSW streams. Figure E2 provides a breakdown (using WasteDataFlow data for 2008/09) of where the materials commonly targeted for recycling occur in the overall MSW stream, in order to highlight the opportunities for further capture and recycling. This shows that:

- 71% of newspapers & magazines were being recycled, and a further 19% were found in the residual household collected (dustbin) waste stream;
- 78% of food waste was in the residual household collected waste stream, and a further 8% was in the collected trade waste stream;
- 78% of garden waste was recycled;
- 14% of wood arose in the residual HWRC waste stream; and
- 16% of cardboard arose in the collected trade waste stream.

Figure E2: Distribution of common recycled material types between MSW streams



Local authorities will need to target the residual household collected waste stream, the residual household waste recycling centre (HWRC) stream and the trade waste stream if they wish to maximise the amount of material collected for recycling.

The average weight of residual household collected waste in Wales in 2008/09 was 10.3kg per household per week. As food waste represented 30% by weight of this stream, the typical arising of food waste was estimated to be 3.1kg/household per week from the current study. This figure was comparable with estimates from previous studies of household food waste arisings. The typical arisings for a number of other potentially recyclable materials were:

- newspapers and magazines – 0.3kg/household per week;
- other paper – 1.0kg/household per week (some of this currently can not be recycled);
- cardboard – 0.6kg/household per week;
- plastic bottles – 0.2kg/household per week;
- packaging glass – 0.4kg/household per week; and
- metal cans – 0.2kg/household per week.

This suggests that there is the potential to capture up to an additional 4kg/household per week of recyclable or compostable (including food waste) material from households through kerbside collection schemes.

Future work

The study has enabled a considerable amount of data on the current arisings and composition of MSW in Wales to be obtained. However, the introduction of new waste minimisation initiatives, such as the WRAP funded Love Food Hate Waste campaign, might influence a future reduction in the arisings of potentially recyclable and compostable materials that the authorities in Wales would need to collect in order to meet future recycling

targets. The introduction of more food waste collection schemes in Wales could also have an impact over time. This has been evident in WRAP funded food waste collections in England (up to 20% reduction in arisings after 12 months).

As it could be some years before the impacts of any waste minimisation campaign can be clearly identified, a further large-scale waste analysis programme could be conducted in about 5 years time to obtain updated information on the composition of MSW. This study could assess the impact of waste minimisation campaigns, the impact of the proposed food waste collections schemes, determine whether changes in packaging have any impacts for meeting future recycling targets, and identify any further changes that will be required to meet longer-term recycling targets.

Contents

Glossary

ACORN – A Classification of Residential Neighbourhoods
HHW – Household Hazardous Waste
HWRC – Household Waste Recycling Centre
MSW – Municipal Solid Waste
WEEE – Waste Electrical & Electronic Equipment
WLGA – Welsh Local Government Association
WRAP – Waste & Resources Action Programme

Acknowledgements

The authors would like to thank both the members of the Steering Group (Welsh Assembly Government, Welsh Local Government Association and WRAP) and all 22 local authorities in Wales for their help with completing the project. The authors would also like to thank the Wales Centre of Excellence for Anaerobic Digestion (based at the University of Glamorgan) for the assessment of the suitability for anaerobic digestion of samples of collected food waste.

1.0 Introduction

The Welsh Assembly Government is committed to a more sustainable approach to waste management. It published a waste strategy for Wales in 2002 which set a target to recycle or compost 40% of municipal[2] waste by 2009/10. The percentage of municipal waste in Wales which has been reused, recycled or composted has increased from 7% in 2000/01 to 37% in 2008/09, and the amount of municipal waste landfilled has reduced from 1.6 million tonnes in 2000/01 to 1.1 million tonnes in 2008/09. Wales has also met the 2009/10 target on reducing the amount of biodegradable municipal waste sent to landfill set by the EU Landfill Directive.

The 2009 draft of the Towards Zero Waste plan for Wales sets out proposals for a challenging programme of change which will continue to move Wales away from an over reliance on landfill and maximise the use of unavoidable waste as a resource in order to derive the maximum environmental, social and economic benefit to Wales. It aims to make Wales a 'zero waste' nation by 2050, and includes the following targets for municipal waste by 2025:

- 70% recycling/composting;
- treating no more than 30% of municipal waste in energy from waste facilities; and
- landfilling no more than 5% of municipal waste.

In developing the new waste plan, the Welsh Assembly Government has been looking in more detail at waste statistics in order to:

- ensure appropriate information is available to adequately assess the recycling, composting and treatment facilities required to meet the requirements set by the waste strategy;
- ensure that sufficient suitable facilities are provided to meet the requirements set by both the Landfill Directive and the new Waste Framework Directive; and
- develop more sustainable waste management practices.

A study to determine the composition of MSW in Wales was conducted during 2002/03, and a number of local authorities in Wales have conducted analyses of a number of the waste streams that comprise municipal waste (e.g. normal or "residual" household collected waste and waste arising at household waste recycling centres) since then. However, this information is now dated and requires updating for use in national and local policy development. Individual local authorities also require more up-to-date data for their own areas, and in particular for the procurement groupings that have been formed for the delivery of anaerobic digestion facilities for collected food waste and treatment of residual waste arisings. Consequently, the Welsh Assembly Government identified the need to commission a new full scale waste composition analysis of municipal solid waste (MSW) in Wales. A steering group, with representatives from Welsh Assembly Government, the Welsh Local Government Association (WLGA) and WRAP (Waste & Resources Action Programme) was set up to oversee the project. The five objectives of this project were to:

- estimate, by physical analysis, the composition of the 8 main waste streams that make up MSW;
- estimate the composition of municipal solid waste (MSW) arisings in Wales;
- provide data specific to each of the local authorities and local authority groupings in Wales;
- provide a more detailed assessment on the nature of packaging in the waste stream; and
- characterise the waste stream that is potentially available for anaerobic digestion.

The study was commissioned by WRAP on behalf of the Welsh Assembly Government, and a consortium of WastesWork and AEA was selected to deliver the study following WRAP's evaluation of competitively tender responses.

The work was managed by WastesWork, supported by AEA as the main subcontractor. WastesWork developed the sampling strategy and conducted the analysis work in all 22 local authorities in Wales, and AEA collated and reported the data.

[2] Municipal waste includes household and non-household waste that is collected and disposed of by local authorities. It includes regular household collections, specific recycling collections, special collections of bulky items, waste received at civic amenity sites and waste collected from non-household sources.

This report:

- describes how the methodology for obtaining the data was developed;
- presents the results from the analyses of each stream which were conducted and assesses the impacts of factors such as seasonal variation, which could affect waste arisings and composition;
- provides information on the overall composition of MSW in Wales, and
- assesses the opportunities for increasing the current MSW recycling rate in Wales.

The study was designed to provide information on the overall composition of MSW in Wales, and there was no intention to compare the performance of the local authorities. This report presents average results for Wales; more detailed information for each of the local authorities can be found in separate reports supplied to each local authority.

2.0 Development of the approach

The aim of the project was to conduct analyses in all 22 authorities in Wales. A number of authorities had originally indicated that they would commission their own studies (the Welsh Assembly Government would allocate funding to each authority which opted out, and the remaining budget would be allocated to WRAP to fund a study covering each of the remaining authorities). However, all 22 authorities decided to participate in this study.

The main areas which needed to be considered in developing the methodology to conduct the study were:

- selection of the sampling areas;
- development of a category classification system; and
- development of methodologies for sampling each waste stream.

The original plan for the study included the use of individual household questionnaires. However, as only limited information had been obtained from their use in the survey of MSW in Wales in 2002/03, the members of the Steering Group decided (following further discussions) that better value for money could be obtained by removing the requirement to conduct the questionnaire survey and increasing the number of analyses.

2.1 Selection of sampling areas

The selection of the sample areas needed to ensure that it was:

- representative of Wales;
- representative of each consortia[3] (see Table 1) for procurement of residual waste treatment; and
- representative of each local authority.

Table 1: Consortia for procurement of residual waste treatment capacity

Consortia	Local authority members
North Wales	Conwy, Denbighshire, Flintshire, Gwynedd, Isle of Anglesey, Wrexham
Mid Wales	Ceredigion, Powys
Eastern Valleys	Blaenau Gwent, Torfaen
Western Valleys	Merthyr Tydfil, Rhondda Cynon Taff
Prosiect Gwyrdd	Caerphilly, Cardiff, Monmouthshire, Newport, Vale of Glamorgan
South West Wales	Bridgend, Carmarthenshire, Neath Port Talbot, Pembrokeshire, Swansea

Residual household waste is the largest single stream of municipal waste, and so it is important that it is analysed to the highest levels of accuracy and reliability. The selection of areas where samples of this waste stream were to be obtained for analysis would usually be based on the premise that households of similar socio-economic characteristics are likely to have similar behavioural, purchasing and lifestyle characteristics, and this will be reflected in the quantity and composition of the waste that they produce. Although the original plan was to use

[3] The 22 local authorities in Wales have formed into six consortia for the procurement of residual waste treatment facilities

census data to select the areas in each authority for analysis, the members of the Steering Group decided that better value for money would be obtained if socio-economic profile data (which is based on census data) was used to identify the sample areas.

In the UK, the ACORN (A Classification of Residential Neighbourhoods) system has become the main method for profiling the socio-economic characteristics of households. The system was designed by CACI to reflect purchasing patterns, and uses 2001 census data to determine which of five categories (1 is the most affluent and 5 is the least affluent) each household is placed into. Purchasing patterns significantly influence waste composition, and thus as a tool, the profile very neatly differentiates between householder types in terms of their spending power, number and the age of the occupants. Thus it was used to select the households for the waste analysis.

Table 2 below shows the ACORN Category profile for Wales. This is the broadest level of profiling, and shows that the largest ACORN Categories are ACORN 1 (wealthy achievers) and ACORN 3 (comfortably off). About 40% of households in Wales were classified as 'more deprived' (in ACORN groups 4 or 5) according to the 2001 census.

Table 2: ACORN Category profile for Wales (based on 2001 census data)

ACORN Category profile		No. of households	Data as % for Wales	Number of samples
1	Wealthy Achievers	379,104	28.9	19
2	Urban Prosperity	56,273	4.3	3
3	Comfortably Off	343,952	26.2	17
4	Moderate Means	262,076	20.0	13
5	Hard-Pressed	268,237	20.4	14
	Unclassified	2,583	0.2	-
	Total	**1,309,642**	**100.0**	**66**

The funding for the study enabled household collected waste from three sample areas in each local authority to be analysed, which was a total of 66 samples. Table 2 shows the number of samples required in each ACORN group in order to ensure that the overall composition of this waste stream was representative of Wales.

The second level of sample selection needed to ensure that, as far as possible, the samples taken in each of the procurement consortia were representative of the consortia whilst ensuring that the overall sample was representative of Wales. Table 3 presents a more detailed ACORN profile for each of the procurement consortia.

The third level of sample selection needed to ensure that, as far as possible, the samples taken in each of the authority were representative of that authority, whilst ensuring that the samples were still representative of both Wales and the procurement consortia. The procedure used was to identify the dominant ACORN group in each local authority for inclusion, and then select two other ACORN sample areas which provided the required coverage of both households in Wales as a whole and households in each of the consortia. The three sample areas which were selected in each authority are presented (shaded in green) in Table 4. This shows that the overall sampling framework was representative of both Wales and each procurement consortia, and that the three dominant ACORN groups were sampled in 16 of the 22 authorities; the main reason for not sampling the three dominant groups in the other 6 authorities was the need to sample ACORN group 1 households in 19 of the 22 authorities. The sampling framework sampled ACORN groups which represented a minimum of 70% of households in 20 of the 22 authorities; the only exceptions were Cardiff (a minimum of 14% of households were represented in each of the 5 ACORN groups) and Swansea (due to the need to include an ACORN group A sample).

Table 3: ACORN profile (percentage of households) for each procurement consortia

ACORN group			North Wales	Mid Wales	Eastern Valleys	Western Valleys	Prosiect Gwyrdd	South West Wales	Wales
1 Wealthy Achievers	A	Wealthy Executives	6.8	3.5	2.6	3.7	10.1	6.3	6.4
	B	Affluent Greys	21.6	47.6	2.1	1.4	4.6	15.6	14.5
	C	Flourishing Families	9.6	4.1	6.6	6.2	8.3	8.8	8.0
2 Urban Prosperity	D	Prosperous Professionals	0.4	0.5	0.0	0.0	2.3	0.9	0.9
	E	Educated Urbanites	0.3	0.4	0.0	0.2	3.5	0.7	1.2
	F	Aspiring Singles	1.8	4.2	0.2	0.8	3.1	1.7	2.1
3 Comfortably Off	G	Starting Out	1.7	2.0	0.9	1.1	5.4	2.1	2.6
	H	Secure Families	13.8	8.0	14.1	12.1	13.4	13.4	12.8
	I	Settled Suburbia	11.0	9.0	5.4	3.9	4.6	9.9	7.9
	J	Prudent Pensioners	3.5	4.5	0.9	0.6	3.5	2.7	2.9
4 Moderate Means	K	Asian Communities	0.0	0.1	0.0	0.0	0.6	0.0	0.2
	L	Post-Industrial Families	1.5	1.0	11.3	12.2	6.8	3.2	5.0
	M	Blue-Collar Roots	8.9	5.3	25.5	36.2	12.1	14.8	14.8
5 Hard-Pressed	N	Struggling Families	14.7	7.4	24.0	16.3	16.0	14.9	15.5
	O	Burdened Singles	3.6	1.8	4.9	4.5	3.9	3.8	3.9
	P	High-Rise Hardship	0.9	0.3	1.3	0.5	1.5	1.2	1.1
	Q	Inner City Adversity	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Unclassified			0.1	0.3	0.1	0.1	0.3	0.1	0.2
Total			**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 4: Sample areas in each authority in Wales

Consortia	Authority	Percentage of households in each ACORN group				
		ACORN 1	ACORN 2	ACORN 3	ACORN 4[4]	ACORN 5
North Wales	Conwy	34	5	40	8	13
	Denbighshire	42	3	33	6	16
	Flintshire	40	-	34	7	19
	Gwynedd	40	3	23	19	15
	Isle of Anglesey	52	1	19	12	16
	Wrexham	30	2	26	10	32
Mid Wales	Ceredigion	58	10	19	5	7
	Powys	54	2	26	7	11
Eastern Valleys	Blaenau Gwent	6	-	9	49	36
	Torfaen	15	-	19	36	30
Western Valleys	Merthyr Tydfil	11	1	14	41	33
	Rhondda Cynon Taff	11	1	19	50	19
Prosiect Gwyrdd	Caerphilly	12	-	27	33	28
	Cardiff	18	19	28	14	21
	Monmouthshire	51	2	25	7	15
	Newport	20	3	26	24	27
	Vale of Glamorgan	35	7	26	18	14
South West Wales	Bridgend	23	1	32	24	20
	Carmarthenshire	41	1	28	14	16
	Neath Port Talbot	16	1	32	24	27
	Pembrokeshire	48	3	20	12	17
	Swansea	24	7	28	18	23
Total number of samples		**19**	**3**	**17**	**13**	**14**

Samples were taken from all types of properties, in the overall survey so that it was representative of household types in Wales. There was insufficient data to assess variations in arisings between housing types (but there is a well established link between number of people in the household and waste produced).

For each ACORN Group required, one street containing more than 32 households was identified by the local authority. The housing types were checked using postcode information that was then verified with CACI. In total, residual waste was collected from approximately 2,100 households in each season.

2.2 Development of the waste category classification system

The category classification system was based on the 37 categories of classification used in the 2002/03 study, but in order to develop the sub-category classification required for this study it was necessary to take account of both the level of detail required by the Welsh Assembly Government in reporting waste composition, and the cost

[4] Two samples taken in ACORN group 4 in both Blaenau Gwent and Merthyr Tydfil

implications of using a very detailed sub-classification system. Following discussion with the Steering Group, a 62 category classification was adopted for this study. This is shown in Table B1 in Appendix B.

This category listing enabled each of the following sub-classifications to be identified:

- **Recyclables** – as the 62 category classification was developed from a classification system designed to assess source separation schemes, it includes categories for all of the main materials collected by local authorities for recycling.
- **Compostables** – the 62 category classification separately identifies the sources of organic material, such as kitchen waste and garden waste contained in household collected waste.
- **Biodegradables** – There is a list of items in waste which are classified as being biodegradable as part of procedures for monitoring progress towards meeting the requirements of the Landfill Directive. All of these items are separately identified in the 62 category classification, and so an assessment of the biodegradability of each sample can be determined using the chosen calculation method.
- **Combustibles** – the 62 category classification identifies all combustible materials.

Although a "junk mail" category could also have been included as this is a category which could be targeted in a waste minimisation scheme, experience gained during other waste analysis studies identified the difficulties in positively identifying "junk mail" items. For this reason, these items were included in the "other recyclable paper" category.

Although this detailed category list provides information on a wide range of items, a less comprehensive breakdown using 24 categories (see Tables in Chapters 4 and 5) was used for the purposes of discussing the results.

2.3 Development of methodology for sampling each waste stream

The streams which were sampled were all of the main municipal waste streams:

- collected household waste;
- kerbside collected materials for recycling or composting;
- HWRC waste (the residual waste stream only);
- trade waste;
- litter and street sweepings;
- bulky uplift waste; and
- schools waste.

The project did not sample either gully emptyings or household clinical waste.

The methodologies used for sampling and subsequent analysis of each waste stream were based on the protocol for MSW streams developed for the analysis study conducted in Wales in 2002/03, and were the same as those used for the 2009 MSW survey in Scotland. They are described in more detail in Appendix C.

3.0 Practical work

This chapter of the report outlines the practical work that was conducted during the project. The practical work was conducted by WastesWork in two seasons; summer (June/July) and winter (November/December) 2009. In each season, the fieldwork was carried out over a six week period by seven teams of three analysts. Each team spent two weeks in each local authority; this enabled the fieldwork to cover both alternate weekly or fortnightly collection systems.

Table A1 in Appendix A shows the collection systems used in each of the authorities in April 2009, together with the types of dry recyclables and organics that are collected from the kerbside, and the number of HWRC sites. Table A2 lists the changes made to the recycling schemes in these authorities during 2009/10.

The typical amount of waste which were analysed in each season in each of the authorities was:

- household collected waste (residual, dry recyclables and compostables) - 800kg per sample area (total of 2,400kg per authority as 3 areas analysed in each authority);
- residual HWRC waste – 2,500kg;
- trade waste – 300kg; and
- other waste streams – 200kg.

The total amount of waste which was analysed was approximately 240 tonnes. As AEA were not involved in the operational procedures for acquiring or sorting samples of waste, they conducted an audit of a number of WastesWork's operations during the first season of the analysis work. This determined that all seven WastesWork teams were correctly following the analysis protocols agreed for this study.

3.1 Household collected waste

The household waste samples were collected on the normal collection day from 32 households in each of the selected sample areas. The teams arrived in their sampling street approximately 30 minutes before the normal collection time. A simple household survey was carried out; this involved noting how full each residual waste/recycling container was or the number of bags set out. All of the household waste which was set out for collection (either residual waste, recycling and green waste depending on the scheme in operation) was then transferred into bulk bags, and these were then loaded onto the back of a Luton van with tailgate.

Figure1: Collection of residual household waste

Once back at the sort site the samples were unloaded and the different materials were weighed on electronic platform scales to determine the total weights collected. The bulk waste, recycling and compost samples were all hand sorted separately. Samples for hand sorting were placed on a screen with 10mm apertures to remove fines (particles less than 10mm in any one dimension irrespective of composition) and initially sorted into the major material categories (e.g. dense plastics, metals, mixed textiles). Sorting at this level of definition continued until each of the samples had been screened. All particles falling through the screen were removed, weighed

separately and classified as fines. Secondary sorting was then undertaken. This involved the separation of materials into 59 specified sub-categories. Each sub-category was then weighed on electronic platform scales and the data recorded.

Figure 2: Sorting of household collected waste

3.2 Residual recycling centre waste

Each of the local authorities identified a HWRC site for inclusion in the study. The sampling and analysis at each site was conducted at a weekend as previous surveys had identified that there was no consistent overall difference between weekdays and weekends in the mean weight per visitor of waste brought to the site. Users were selected using the "next available visitor" approach. Further discussion of this methodology can be found in Appendix C. The supervisor selected the next visitor to the residual waste container when the analysis of the current sample had almost been completed. The typical number of samples which were analysed on any day was between 40 and 50.

Figure 3: Sorting of residual waste at a HWRC site

Each of those selected users who intended to throw rubbish into the residual skips was asked if they would participate in the survey. If they agreed, the waste they were going to throw into the residual skips was taken from them for hand sorting; they were asked to continue on with their recycling (if they did not want to take part in the survey then the next user was selected). Once the visitor had left the site the waste was hand sorted using the same procedures as those for the kerbside collected waste. Bagged waste that contained food was not tipped out and sorted on site, instead it was given its own sort category - 'black sack waste'. Ten of these sacks were later hand sorted back at the sort site to show a more detailed breakdown of their content including the potentially recyclable element.

3.3 Schools

Each local authority was asked to identify schools for inclusion in the survey. The Head teachers were telephoned prior to sampling to ask if the school would participate in the survey and to gain information on what time to arrive and who to meet. The samples (a total of 70 from primary schools and 34 from secondary schools over the two seasons) were collected on the normal waste collection day for the school. Each of the schools' bins - residual waste and recycling- were weighed, using a trolley jack with scales, and a note was made of the type of bin, size and the material the bin was made out of. As health and safety procedures meant that it was not

possible to empty bins over 660L manually, a sample of waste (approximately 200 litres) was removed from each bin. The analysis was conducted using the same procedure as that for household collected waste.

3.4 Trade waste

The location of each target business identified by each local authority was identified on a map and the day and time of normal collection was determined. A total of 1,015 samples were collected over the two seasons. As with the schools, many businesses used bins that are larger than 660 litres, which means they could not be manually emptied; instead the bins were weighed using trolley jack scales and a sample (approximately 200 litres) was then removed from each bin. The analysis of each collected sample was conducted using the same procedure as that for household collected waste.

Figure 4: Sorting of trade waste

3.5 Litter

Although street sweepings and litter vary much less across area types than other waste streams, it was still deemed useful to collect samples from all 22 local authorities. Samples were requested from different areas in each local authority representing:

- city/town centre area – near shops;
- a suburban area; and
- a rural area.

During the period that the fieldwork teams were working in each local authority, samples of litter and street sweepings were delivered by the LA to the sort team (a total of 93 samples were analysed during the two seasons). The samples were hand sorted using the sort categories used for household waste.

3.6 Bulky household waste

A number of local authorities in Wales provided detailed records of their bulky household collections (and data from other studies was also used). For each selected record, the typical weight listed in the FRN list[5] was allocated to each item. These were then summed to provide an overall composition for bulky household waste. No physical monitoring or analysis was undertaken.

[5] Typical weights for items potentially suitable for reuse. Furniture Reuse Network (www.frn.org.uk), 2009.

4.0 Composition of individual streams

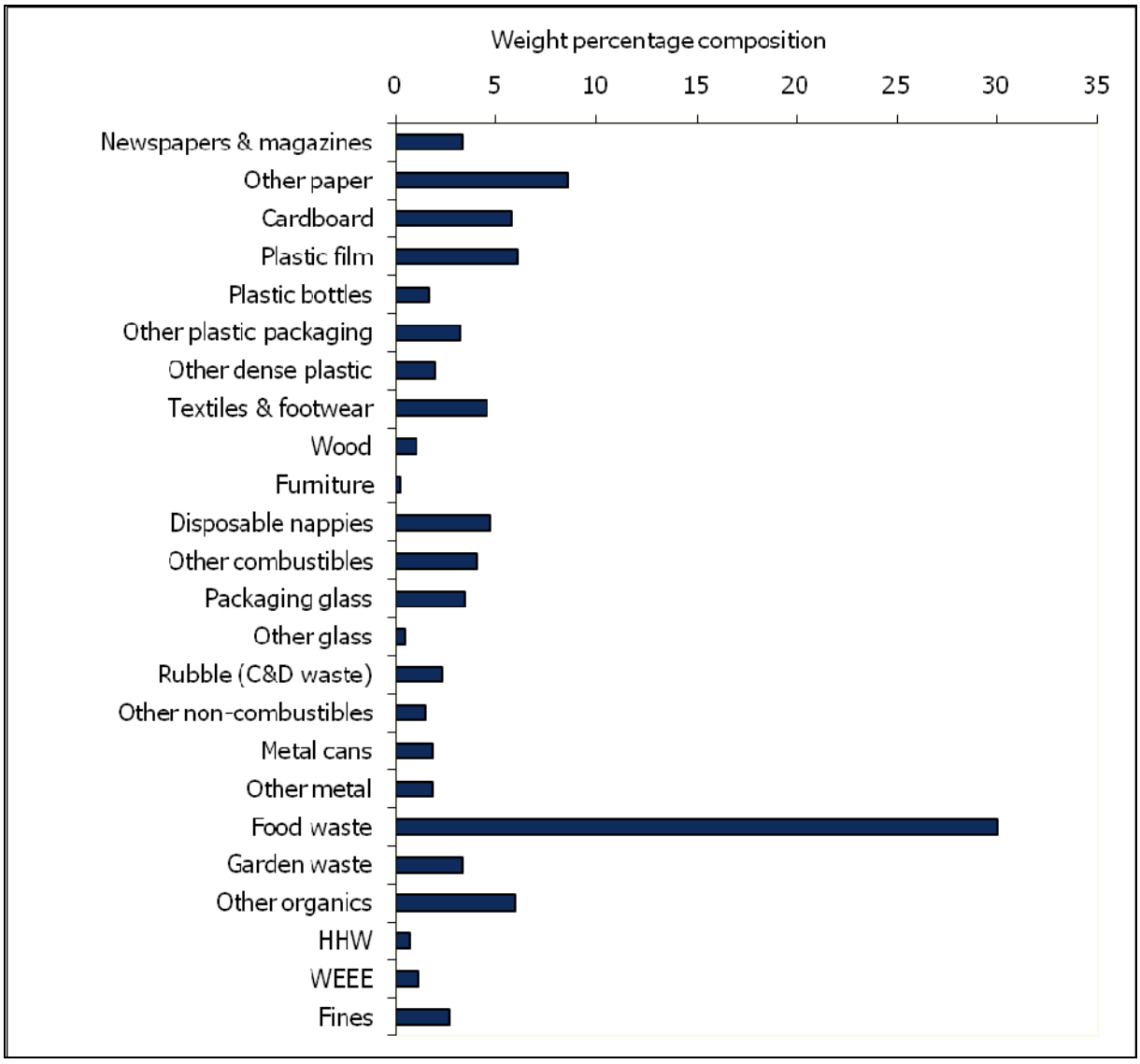
This chapter presents the results for the composition of each of the MSW waste streams which were analysed during the current study. The results for each local authority are presented in separate reports supplied to each local authority. A more detailed category breakdown for each stream is presented in Appendix D.

Chapter 5 presents information on the overall composition of MSW in Wales which was calculated using a combination of compositional data from this study and information from WasteDataFlow (2008/9). The compositional analysis results were compared with those from other studies, such as the analysis[6] of MSW in Wales conducted in 2002/03 in order to assess whether the data obtained was both sensible and robust.

4.1 Residual household collected waste

Figure 5 shows the average composition (% by weight) for residual household collected (dustbin) waste in Wales. The largest category was food waste, which represented almost one third (30%) by weight. The overall paper & card content was 18% by weight.

Figure 5: Composition (Wt %) of residual household collected waste in Wales



[6] The Composition of Municipal Solid Waste in Wales. Report by AEA for the Welsh Assembly Government, December 2003.

Table 5 compares the average results for Wales with those determined during analyses conducted in Scotland[7] in 2009, an English County[8] during 2008 (average of 55 samples from 11 districts – the range of collection systems for residual waste and recycling was similar to that for Wales). It also compares the findings with those from a review[9] of waste composition analyses[10] (most of the results are from English authorities) which has recently been published by Defra. This shows that the findings for Wales were similar to those determined for other studies; the two main categories were the food waste category, which represented about one third by weight of the residual household collected waste stream, and the overall paper & card content, which represented about 16-18% by weight of this waste stream.

Table 5: Composition (Wt %) of residual household collected waste

	Wales 2009	Scotland 2009	Undisclosed English County 2008	Defra review March 2009
Newspapers & magazines	3.3	4.1	3.9	13
Other paper	8.6	6.8	7.3	
Cardboard	5.7	5.0	4.8	5
Plastic film	6.0	4.5	5.5	14
Plastic bottles	1.7	3.3	1.9	
Other plastic packaging	3.2	4.0	2.4	
Other dense plastic	1.9	2.0	2.6	
Textiles & footwear	4.5	4.3	2.9	4
Wood	1.0	1.2	0.7	1
Furniture	0.2	0.4	0.4	-
Disposable nappies	4.7	4.8	6.3	5
Other Combustibles	4.0	6.6	2.7	3
Packaging glass	3.5	4.8	5.2	5
Other glass	0.4	0.7	0.5	
Rubble (C&D waste)	2.3	2.2	1.1	2
Other non-combustibles	1.5	1.0	0.6	
Metal cans	1.8	2.4	1.7	4
Other metal	1.8	1.7	1.6	
Food waste	30.0	31.5	34.4	32
Garden waste	3.3	2.6	2.6	6
Other organics	5.9	1.1	6.7	2
HHW	0.7	0.9	0.4	1
WEEE	1.2	1.5	1.1	1
Fines	2.6	2.6	2.6	2
Total	**100.0**	**100.0**	**100.0**	**100**

A comparison of the findings from this study and the previous studies mentioned above also show that the weight percentage of other types of recyclable materials were similar:

- glass bottles – about 4 to 5%; and
- metal cans – about 2%.

Residual household collected waste stream represented about 42% by weight[11] of overall arisings of MSW in Wales in 2008/09. Variability in the composition of this stream could have a significant impact on the estimates of

[7] The composition of municipal solid waste in Scotland. WRAP report (Project code EVA098-000), March 2010

[8] Unpublished report by WastesWork and AEA, 2009

[9] Municipal waste composition – A review of municipal waste component analyses. Report by Resource Futures for Defra for project WR0119 (available at www.defra.gov.uk)

[10] The English County results were not included in the Defra study as the data used was collected before this study was conducted

[11] *2008/09 WasteDataFlow data for Scotland*

overall composition of MSW in Wales. The 95% confidence intervals for the two main categories in the residual household collected waste stream were:

- food waste – 30% ± 2 percentage points; and
- total paper & card – 18% ± 1 percentage point.

These confidence limits are considered to be relatively low and suggest an acceptable level of variation in estimates of MSW in Wales from this study.

The average arising[12] of residual household collected waste in Wales in 2008/09 was 10.3kg per household per week. This was similar to a measured average value of 10.2kg/household per week determined in Scotland in 2009, but was higher than a measured average value of 9.3kg/household per week determined in the Undisclosed English County in 2008. As food waste (see Table 5) represented about 30% by weight of this stream, the typical arisings of food waste in this waste stream were estimated to be 3.1kg/household per week. Table 6 shows that this was comparable to both the value of 3.2kg/household per week determined in Scotland in 2009, and the value of 3.3kg/household per week determined for the study in the English County in 2008. All of these arisings were lower than a typical value of 4.0kg/household per week determined in a review[13] conducted in 2007.

Table 6: Weight arisings (kg/household per week) in residual household collected waste

	Wales 2009	Scotland 2009	Undisclosed English County 2008
Paper & card	1.9	1.6	1.5
Plastic bottles	0.2	0.3	0.2
Glass packaging	0.4	0.5	0.5
Metal cans	0.2	0.2	0.2
Food waste	3.1	3.2	3.3
Garden waste	0.3	0.3	0.2

Table 6 also shows that the arisings of paper & card (some of which cannot currently be recycled) in the residual household collected waste stream in Wales were higher than those determined in other recent studies. However, the arisings of other potentially recyclable materials in the residual household collected waste stream in Wales were similar to those determined in other recent studies. This suggests that there is the potential to capture up to an additional 4kg/household per week of recyclable or compostable (including food waste) material from households through kerbside collection schemes.

There are a number of factors which can influence waste generation:

- *Socio-economic profile of the households* - the potential impact of household socio-economic circumstances was used in the sampling design/strategy in order to try and obtain a more representative picture of national MSW composition in Wales, and thus it is therefore inappropriate to draw conclusions on the effects of this variable in isolation from the findings of this study. However, a survey on MSW arisings in Wales in 2002/03 identified that there was no identifiable relationship between socio-economic profile and amount of waste produced. A study[14] conducted in Newcastle reached a similar conclusion.
- *Urban or rural location* - The survey conducted on MSW arisings in Wales in 2002/03 determined that there was no statistically significant difference between waste arising in urban and rural areas.
- *Seasonal variation* - A comparison of the average summer and winter results for household residual waste indicated there was no evidence of any significant seasonal variation in composition. The survey conducted on MSW arisings in Wales in 2002/03, which covered all four seasons, determined that there was no statistically significant evidence of any seasonal variation in composition for all categories apart from garden waste.

[12] *Figure provided by Welsh Assembly Government based on WasteDataFlow returns for 2008/09*

[13] Dealing with food waste in the UK. Report by Eunomia Reseach & Consulting, March 2007

[14] *SWAT: A tool to enhance the precision and compatability of solid waste analysis data. T Bampatsis and G Dobson, Warmer Bulletin No. 94, March 2004.*

This survey has shown that there is some evidence that residual waste arisings were lower in authorities that operate fortnightly collection for this waste stream. The monitored average weekly arising of residual household collected waste was lower (8kg/household per week) in areas with fortnightly collection than in those with weekly collection (10kg/household per week). Although the monitored waste arising in some authorities with weekly collections were lower than in some of those that operated fortnightly collections, the four highest arisings were in authorities that operated a weekly collection for residual household waste.

4.2 Kerbside collected dry recyclables

Table 7 shows the average composition for the kerbside collected dry recyclables stream in Wales. Although not all of the local authorities collect the same dry recyclable materials (see Appendix A, Table A1), newspapers & magazines was the largest category (32% by weight) in the average dry recyclables stream, followed by 24% for packaging glass and 23% for other paper and card. Metal cans and plastic bottles each represented an average of about 7% by weight of the collected dry recyclables stream.

Table 7: Average composition (Wt %) of kerbside collected dry recyclables

	Dry recyclables
Newspapers & magazines	31.6
Other paper	10.8
Cardboard	11.7
Plastic film	1.9
Plastic bottles	6.9
Other plastic packaging	2.5
Other dense plastic	0.4
Textiles & footwear	0.5
Wood	0.1
Furniture	-
Disposable nappies	-
Other Combustibles	0.1
Packaging glass	23.9
Other glass	0.4
Rubble (C&D waste)	-
Other non-combustibles	0.2
Metal cans	6.9
Other metal	0.8
Food waste	0.3
Garden waste	0.4
Other organics	0.2
HHW	0.1
WEEE	0.2
Fines	0.1
Total	**100.0**

Table 7 shows that the dry recyclables stream contained 2.5% by weight of the 'other plastic packaging' category. Although some of this will be due to inclusion of non-targeted materials, a number of authorities (see Appendix A) are collecting all plastic packaging. It also shows that the dry recyclables stream contained small amounts of a number of non-targeted materials, such as wood, other (non-packaging) glass, food waste and WEEE. Plastic film represented about 2% by weight, but most of this was due to a number of authorities using plastic sacks to collect this stream.

Table 8 shows the average capture rates achieved[15] by the kerbside schemes for dry recyclable materials in Wales for a number of potentially recyclable materials. These recycling schemes captured 29% by weight of all household collected (residual waste, dry recyclables and organics) material.

Table 8: Capture rates (Wt %) for kerbside collected dry recyclable materials

Material	Capture rate (Wt %)
Newspapers and magazines	73
Other paper and card	27
Plastic bottles	55
Glass packaging	68
Metal cans	50

These capture rates were consistent with findings from other studies of kerbside separation schemes conducted over the past 15 years which show that capture rates for newspapers & magazines and glass packaging were higher than those for either metal cans or plastic bottles. The capture rates for newspapers & magazines and other paper and card were comparable to those determined in the MSW composition study in Scotland in 2009. However, the capture rates for glass packaging, plastic bottles and metal cans were higher than both those determined in the study in Scotland in 2009 and typical kerbside capture rates determined in the Defra review of MSW compositional analyses.

[15] Calculated using WasteDataFlow information on the arisings and composition of recyclable or compostable material recovered at the kerbside, WasteDataFlow information on arisings of residual household collected waste, and the average composition of residual household collected waste in Scotland shown in Table 5.

4.3 Kerbside collected organics

The local authorities in Wales operate a range of kerbside collection schemes for organic materials; for example, some authorities currently only collect garden waste, some collect garden waste and cardboard, some collect a separate food waste stream, and some collect a mixed food and garden waste stream. Table 9 presents the average composition for food waste only and garden waste only collections.

Table 9: Average composition (Wt %) of kerbside collected organic materials

	Food waste collection	Garden waste collection
Newspapers & magazines	0.9	-
Other paper	1.0	-
Cardboard	0.1	0.2
Plastic film	0.8	-
Plastic bottles	-	-
Other plastic packaging	-	-
Other dense plastic	-	-
Textiles & footwear	-	-
Wood	-	-
Furniture	-	-
Disposable nappies	-	-
Other Combustibles	0.1	-
Packaging glass	-	-
Other glass	-	-
Rubble (C&D waste)	-	-
Other non-combustibles	-	-
Metal cans	-	-
Other metal	-	-
Food waste	96.8	1.4
Garden waste	-	98.3
Other organics	-	-
HHW	-	-
WEEE	-	-
Fines	0.3	0.1
Total	**100.0**	**100.0**

This shows that:

- the garden waste only stream contained over 98% by weight of garden waste; the main non-targeted material was food waste; and
- the food waste only stream contained almost 97% by weight of food waste; the main non-targeted materials were newspapers & magazines, other paper, and cardboard (each of which was about 1% by weight of the collected material).

The average capture rate achieved for garden waste was 81%, which was comparable to that achieved in the study on MSW composition in Scotland in 2009. Only 2% of food waste was captured by the food waste kerbside schemes operating in Wales in 2008/09.

The arising of collected garden waste was higher in the summer. This is in keeping with the seasonal variation determined in other studies.

4.4 Household recycling centre waste

Figure 6 shows the average weight percentage composition for residual HWRC waste in Wales. This has been determined after including the results from the 'mixed bagged waste' category used during the hand sorting procedure for each sample that was analysed. The largest single category was the 'other combustibles' category (which includes carpet) which represented 20% by weight of the total stream. Wood, furniture and garden waste each represented about 7% by weight, and WEEE items represented about 5% by weight of this waste stream.

Figure 6: Composition (Wt %) of residual HWRC waste in Wales

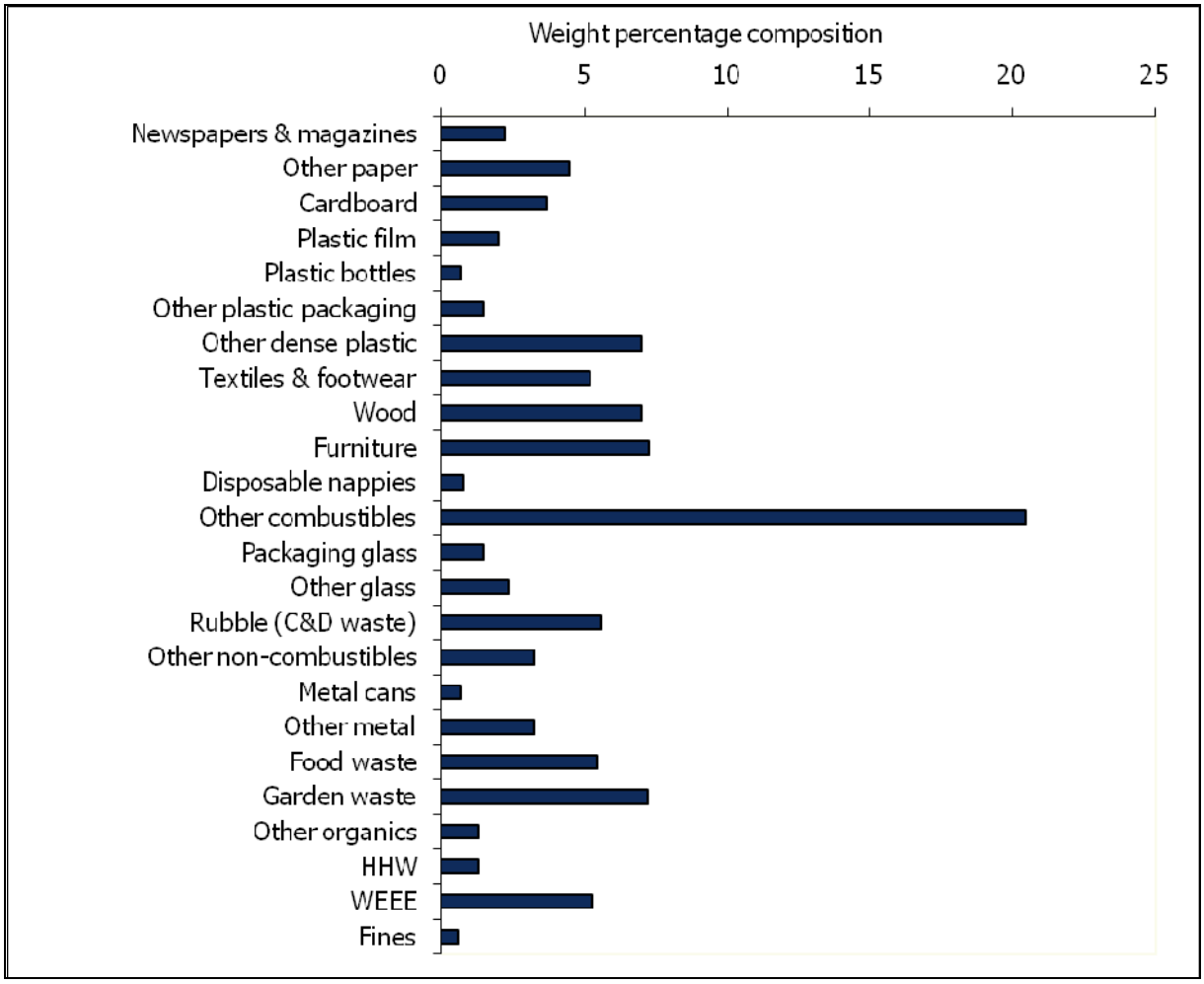


Table 10 compares the average results for Wales with those determined during analyses conducted in Scotland in 2009, an English County during 2008 and the average of those from the review of waste composition analyses (most of the results are from English authorities) which has recently been published by Defra (the analyses conducted on this stream in Wales in 2002/03 were on the waste brought to the site, and so can not be compared with these results). All of the results show that the largest category was the 'other combustible materials' (furniture, carpets and other combustible items) category, which represented between a quarter and a third by weight of this waste stream. The weight percentage of WEEE items was higher in Wales (and also in Scotland) than those determined in other studies.

Table 10: Composition (Wt %) of residual HWRC waste

	Wales 2009	Scotland 2009	Undisclosed English County 2008	Defra review March 2009
Paper	7	6	8	5
Cardboard	3	4	3	3
Plastic film	2	2	3	11
Dense plastic	9	8	12	
Textiles	5	6	5	5

Wood	7	10	7	15
Other combustible materials	28	30	33	27
Glass	4	3	4	3
C&D waste	6	9	5	15
Other non-combustibles	3	3	3	
Garden waste	7	5	6	10
Other organics	7	4	6	
Metal	4	4	2	2
Household hazardous	1	1	1	1
WEEE	5	4	1	2
Fines	1	1	1	1
Total	**100**	**100**	**100**	**100**

There are a number of factors which could affect the amount of residual waste arisings per visitor at the HWRC sites:

- *Collection method for residual waste* - The survey of MSW arisings in Wales in 2002/03 determined that there was no evidence of statistically significant differences between the waste collection method (sack or wheeled bin) in terms of the total amount of waste brought to the site by visitors, but as all of the authorities provided weekly collections for residual household waste, the potential impacts of differences in collection frequency could not be assessed. The findings from the survey in 2009 show that the average residual HWRC waste arising per visitor was higher (23kg per visitor) in authorities that operated a fortnightly collection for residual household waste than in authorities which operated a weekly collection for residual household waste (19kg per visitor). Although some authorities operating a fortnightly collection for residual household waste had lower monitored weights per visitor at the HWRC site than those operating a weekly collection, five of the seven highest monitored arisings (wt per visitor) at the HWRC sites were in authorities that operated a fortnightly collection for residual household waste.
- *Seasonal variation* - A comparison of the average summer and winter results showed that there was no evidence of any significant seasonal variation in composition. The survey conducted on MSW arisings in Wales in 2002/03, which covered all four seasons, determined that there was no statistically significant evidence of any seasonal variation in the HWRC residual stream composition for all categories apart from garden waste.
- *Weekday and weekend arisings* – Analyses were only conducted at the HWRC sites at weekends; this was because the MSW survey conducted in Wales in 2002/03 determined that there was no consistent overall difference between weekdays and weekends in the mean weight per visitor of waste brought to the site.

Table 11 shows the average capture rates for each category achieved by the HWRC sites in Wales. The overall recycling rate achieved at the HWRC sites was 61%, and capture rates for potentially recyclable or compostable materials ranged from over 80% for garden waste, C&D waste, and wood, to less than 50% for paper and cardboard. These capture rates were comparable to those determined for HWRC sites in the Defra 2009 review of MSW compositional analyses.

Table 11: Overall composition (Wt %) of waste brought to HWRC sites in Wales

	Average capture rate (Wt %) achieved for each category
Paper and cardboard	46
Cardboard	68
Wood	84
Glass	76
C&D waste	85
Garden waste	85
Metal	70
WEEE	72

4.5 Commercial waste collected by local authorities

Local authorities collect trade waste from a wide range of businesses. One of the aims of the study was to assess differences in the composition of residual waste produced by these different types of business. Table 12 shows the number of residual waste samples taken for each of the 10 business categories used in this study. A total of 1,015 samples of residual collected trade waste were analysed, but the sampling did not take account of whether a business recycled or not, as the primary goal of this part of the study was to characterise what remained in the residual waste stream.

Table 12: Number of residual waste samples

	Summer	Winter	Total
Retail premises	158	94	252
Food premises (cafes and restaurants)	135	103	238
Offices	110	69	179
Leisure facilities and social clubs	36	25	61
Hair & Beauty premises	31	15	46
Transport	30	16	46
Health (doctor, dentist, vet)	25	19	44
Manufacturing	25	18	43
Care	19	15	34
Other businesses	45	27	72
Total	**614**	**401**	**1,015**

Error! Reference source not found. presents the average composition of residual waste for each business type, and shows, for example, that:

- retail and office businesses produced a much higher weight percentage (up to 45%) of paper & card than businesses in the food (cafes and restaurants) sector (typical value of about 20%); and
- the food waste category represented over 40% by weight of waste produced by food and cafe businesses[16]. This was much higher than values produced by retail premises, hair & beauty, health, transport, manufacturing and other businesses (less than 15%).

Similar findings were determined for both the study conducted in Scotland in 2009 and the study conducted in Wales in 2002/03. This information can be used by local authorities to target their recycling collection schemes to the most appropriate businesses going forward.

[16] WRAP has commissioned a UK wide research project into the composition of waste from 4 specific sub-sectors of the hospitality sector (hotels, public houses and restaurants). The results from the hospitality work should compliment some of the findings for trade waste from the current study. The hospitality waste research is due to be published in summer 2010, please check http://www.wrap.org.uk/ for more details.

Table 13: Composition (weight %) of residual trade waste produced by the 10 business categories

	Food & Drink	Retail	Health	Manufacturing	Office	Hair & Beauty	Leisure	Transport	Care	Other businesses
Newspapers & magazines	2.9	5.5	12.6	6.9	6.0	7.9	3.4	7.1	7.1	6.9
Other paper	8.4	13.9	26.9	19.4	28.1	17.2	16.1	13.2	11.9	28.7
Cardboard	12.1	17.8	21.3	15.9	12.5	15.4	13.9	22.1	9.8	14.0
Plastic film	5.9	9.6	5.8	7.0	8.5	8.7	6.9	7.5	6.0	6.1
Plastic bottles	1.9	1.7	3.4	3.0	2.9	5.1	3.9	2.9	3.1	1.9
Other plastic packaging	2.4	3.6	2.3	2.9	3.7	3.5	3.0	4.6	2.8	2.0
Other dense plastic	0.5	3.6	2.0	1.6	2.1	0.6	1.3	8.3	2.7	1.1
Textiles & footwear	0.7	2.2	0.4	5.9	1.5	1.2	2.2	2.9	2.5	1.7
Wood	0.2	2.2	1.0	7.1	0.4	0.1	0.8	0.5	0.3	3.3
Furniture	0.1	0.5	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Disposable nappies	0.1	0.0	0.1	0.0	0.2	0.1	0.0	0.0	2.0	0.5
Other Combustibles	1.5	4.0	2.0	8.7	2.3	15.0	1.5	3.0	4.9	4.6
Packaging glass	5.5	1.6	1.1	1.0	1.3	0.6	9.3	1.4	0.7	1.8
Other glass	0.3	5.9	1.0	0.2	0.4	0.5	1.2	0.4	1.7	4.2
Rubble (C&D waste)	0.2	1.2	1.2	0.0	0.2	1.0	0.5	0.6	0.2	0.9
Other non-combustibles	1.6	1.1	0.9	0.9	0.5	0.2	1.4	0.1	0.5	0.5
Metal cans	1.9	0.5	0.7	0.5	0.9	1.0	1.5	0.8	1.0	0.3
Other metal	1.4	2.9	2.0	4.3	3.7	7.9	3.3	11.4	3.7	4.0
Food waste	41.3	13.8	10.9	9.2	16.3	11.3	20.0	10.4	30.4	11.2
Garden waste	0.1	1.7	0.0	0.0	0.7	0.0	3.3	0.1	0.3	2.0
Other organics	9.2	4.4	2.8	2.4	5.1	1.9	4.4	0.9	5.6	2.6
HHW	1.0	0.6	0.2	0.3	1.0	0.6	1.1	1.1	1.3	0.5
WEEE	0.1	1.2	0.5	2.3	1.2	0.1	0.5	0.5	1.2	0.7
Fines	0.5	0.6	0.7	0.4	0.4	0.2	0.4	0.1	0.3	0.6
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Although the analyses determined the typical composition of residual wastes produced by different types of businesses, the data needs to be grossed up in order to determine the overall composition of this waste stream for each local authority and for Wales as a whole. The method initially developed for grossing up the data was to:

- determine the typical composition of waste from each type of business; and
- determine the number of each type of business in each local authority that has a trade waste collection, and use this information to calculate the overall composition of this waste stream.

However, it was not possible to obtain robust data on the numbers[17] of each types of business whose waste was collected by the local authorities. Consequently the estimated composition of residual trade waste shown in Table 14 and Figure 7 was determined using the assumption that the number of samples for each business type shown in Table 12 were representative of the numbers of each types of business that local authorities collect trade waste from. The results show that:

- the food and 'other paper' categories each represented about a fifth of this waste stream; and
- the other paper and card categories (newspapers & magazines and card) represented about a fifth of this waste stream.

There are also 11 categories, such as rubble, which each represented less than 2% by weight of this waste stream.

Table 14: Overall composition (Wt %) of collected trade waste[18]

Category	Weight %
Newspapers & magazines	5.6
Other paper	17.1
Cardboard	14.9
Plastic film	7.6
Plastic bottles	2.5
Other plastic packaging	3.1
Other dense plastic	2.2
Textiles & footwear	1.8
Wood	1.3
Furniture	0.2
Disposable nappies	0.2
Other Combustibles	3.6
Packaging glass	2.8
Other glass	2.1
Rubble (C&D waste)	0.6
Other non-combustibles	1.0
Metal cans	1.0
Other metal	3.4
Food waste	20.8
Garden waste	0.9
Other organics	5.1
HHW	0.8
WEEE	0.8
Fines	0.5
Total	**100.0**

[17] *For example, the local authority record may not show what type of business it is*

[18] *Please note: these percentages have been determined using the assumption that the number of samples for each business type shown in Table 12 were representative of the numbers of each types of business that local authorities collect trade waste from*

Figure 7: Composition (Wt %) of collected trade waste[19]

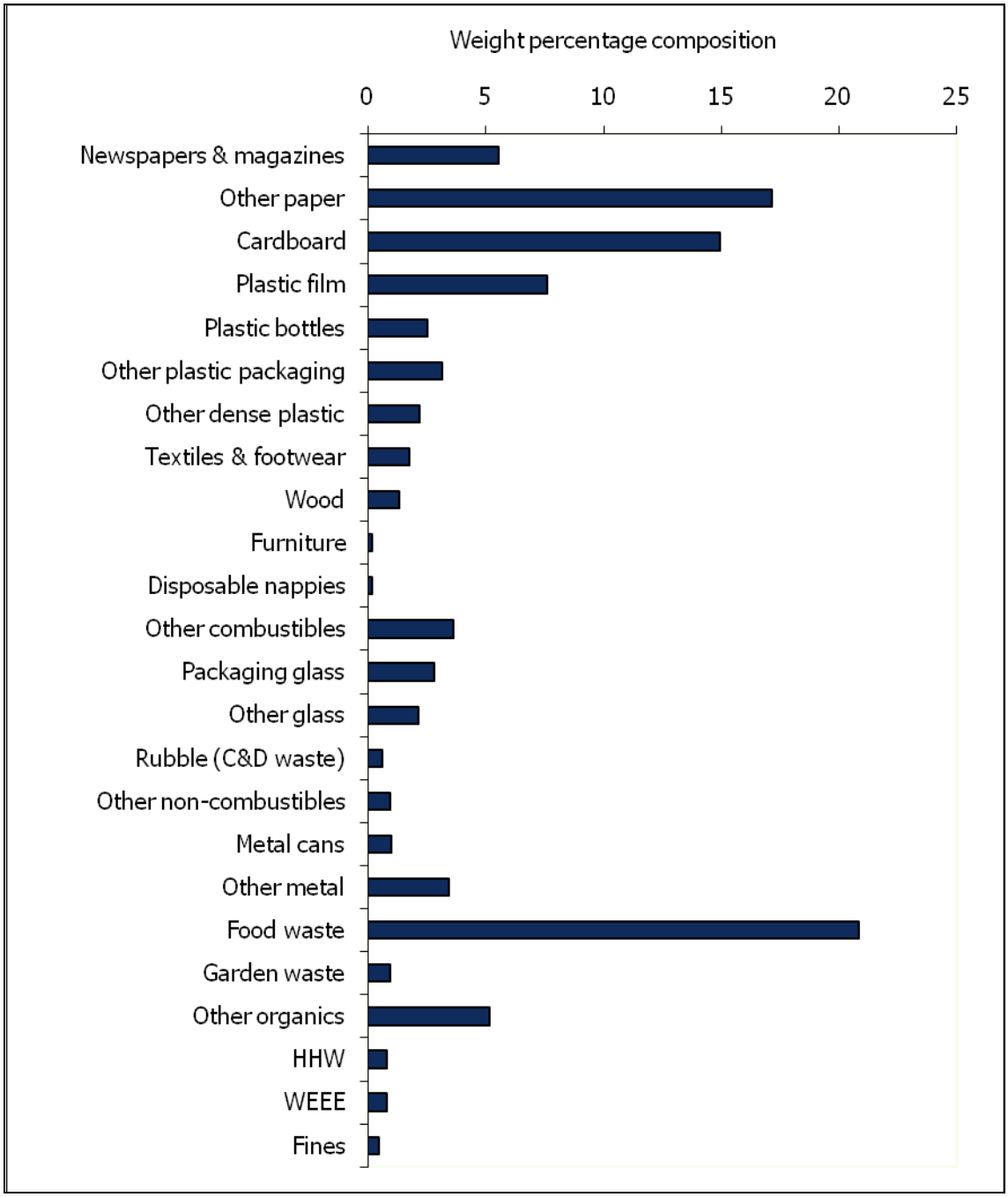


Table 15 compares these results with those for the composition of collected trade waste determined during the study of composition of MSW in Scotland in 2009, the study of composition of MSW in Wales in 2002/03 (Wales 2003), a study[20] conducted in a County in England during 2006, and an analysis of the mixed waste stream from commercial and industrial premises determined[21] in Wales in 2007 (Wales 2007). All of these studies only analysed the residual trade waste stream and therefore can be directly compared with this study.

[19] *Please note: this graph has been compiled using the assumption that the number of samples for each business type shown in Table 12 were representative of the numbers of each types of business that local authorities collect trade waste from*

[20] Unpublished report by AEA, 2006

[21] Determination of the Biodegradability of Mixed Industrial and Commercial Waste Landfilled in Wales. Report by SLR for Environment Agency Wales, November 2007

Table 15: Comparison of composition (Wt %) of trade waste stream

	Wales 2009	Scotland 2009	Wales 2003	Undisclosed English County 2006	Wales 2007
Paper and cardboard	38	40	41	35	32
Plastic film	8	8	4	7	7
Dense plastic	8	9	6	6	8
Textiles	2	1	2	1	2
Other combustibles	5	5	6	10	16
Glass	5	4	4	3	4
Other non-combustibles	2	1	1	2	6
Food waste	21	21	23	27	13
Other organics	6	3	4	3	2
Metal	4	5	5	4	4
Household hazardous	<1	<1	1	0	1
WEEE	<1	<1	1	1	1
Fines	<1	2	1	2	4
Total	**100**	**100**	**100**	**100**	**100**

This shows that there was very little difference in the composition, particularly in terms of the two main categories (paper & card and food waste) between the three surveys of trade waste collected by local authorities conducted in Wales and Scotland. However, the analyses of overall trade waste collected in an English County in 2006, and the analysis of the mixed waste stream conducted in Wales in 2007 both showed that these have a lower paper & card content. This was mainly due to the higher concentrations of other combustibles. However all five results show that the two main categories were paper & card and food waste, which was a similar finding to that for the residual collected household waste stream.

Less than 1% of businesses whose waste was sampled set out material for recycling on the day on which their residual waste was sampled for analysis. The materials which were set out were either paper, card or glass.

4.6 Litter

Figure 8 shows the average composition of litter in Wales in 2008/09. The weight percentage composition for 7 of the 24 categories (which include a number of categories that could be targeted for recycling) was over 5%, and the food waste category had the highest weight percentage (18%).

Figure 8: Composition (Wt %) of litter in Wales

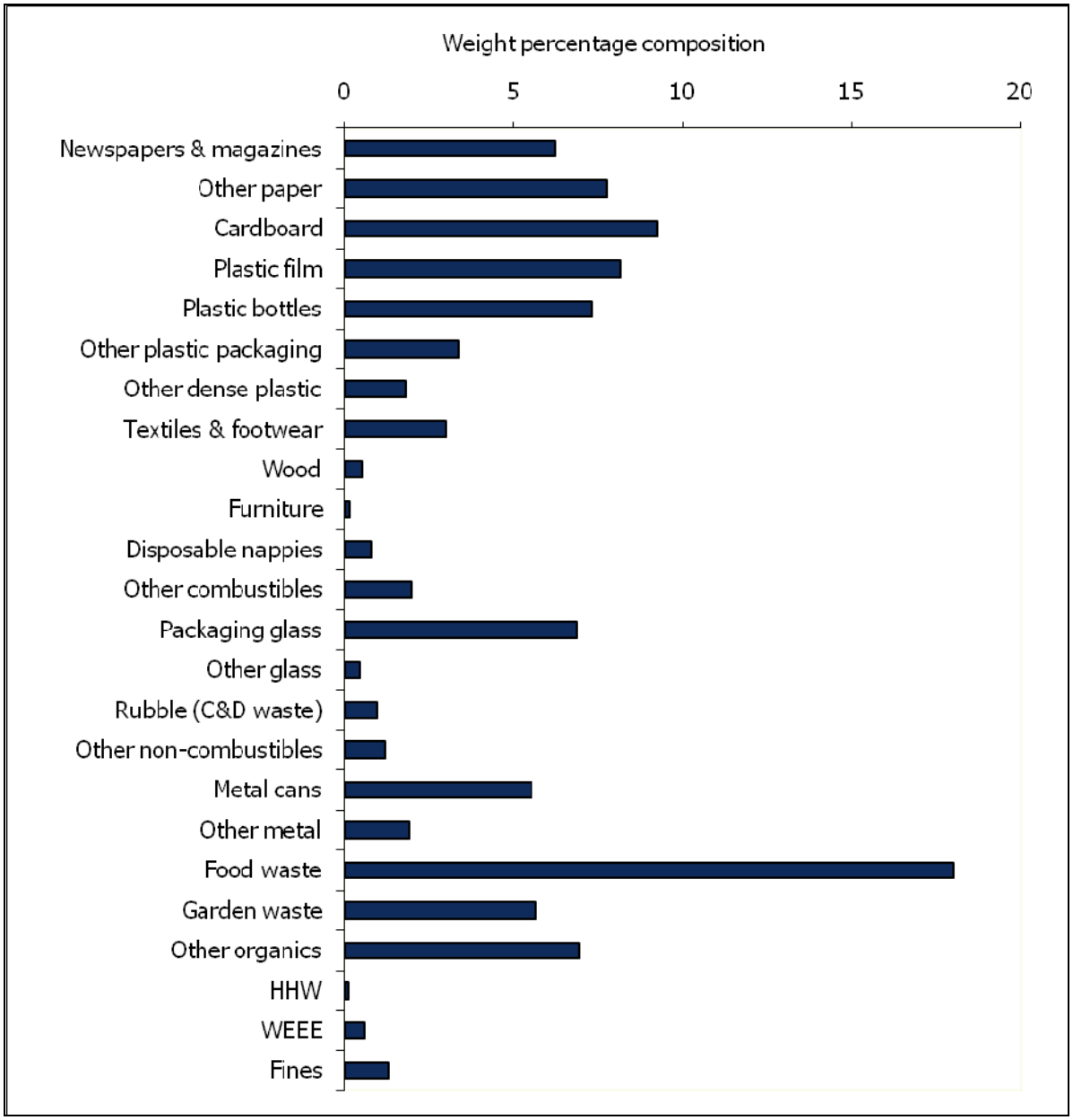


Table 16 compares these results for Wales with those for analyses conducted in Scotland in 2009, analyses conducted in Wales in 2002/03, analyses conducted[22] in an English Unitary Authority in 2005, and analyses conducted[23] in an English County in 2002. The results show that whilst there was a variation in composition, litter typically contains between 5 and 10% by weight of a number of common material types (newspapers & magazines, glass bottles and metal cans) that could be targeted for recycling.

[22] Unpublished report by AEA, 2005

[23] Unpublished report by AEA, 2002

The study showed that the average weight percentage of plastic bottles was higher in the summer. The survey conducted in Wales in 2002/03 also identified that the weight percentage of plastic bottles was higher during the summer. No other seasonal variations were identified.

Table 16: Composition (Wt %) of litter

	Wales 2009	Scotland 2009	Wales 2002/03	Undisclosed English Authority 2005	Undisclosed English County 2002	Average
Newspapers & magazines	6.2	7.6	9.7	6.8	10.2	8.1
Other paper	7.8	7.3	8.8	6.8	5.6	7.3
Cardboard	9.3	8.2	12.4	7.0	11.7	9.7
Plastic film	8.2	5.9	7.8	6.3	4.7	6.6
Plastic bottles	7.3	7.7	6.6	10.3	7.5	7.9
Other plastic packaging	3.4	3.6	3.4	2.1	3.4	3.2
Other dense plastic	1.8	1.1	2.5	1.8	1.8	1.8
Textiles & footwear	3.0	1.9	2.2	1.0	2.8	2.2
Wood	0.5	0.6	1.2	0.3	0.5	0.6
Furniture	0.2	0.5	0.0	0.0	0.0	0.1
Disposable nappies	0.8	1.4	1.1	1.1	0.6	1.0
Other Combustibles	2.0	10.0	1.5	3.8	3.7	4.2
Packaging glass	6.9	8.1	8.1	18.0	11.5	10.5
Other glass	0.4	0.3	0.3	0.5	1.2	0.5
Rubble (C&D waste)	1.0	0.2	0.3	1.2	0.3	0.6
Other non-combustibles	1.2	0.6	0.5	0.3	1.7	0.9
Metal cans	5.5	3.6	6.1	6.2	4.6	5.2
Other metal	1.9	2.6	1.8	1.1	1.2	1.7
Food waste	18.0	12.8	15.0	19.7	8.7	14.9
Garden waste	5.7	5.9	2.2	3.1	0.6	3.5
Other organics	6.9	5.1	6.3	1.3	12.6	6.5
HHW	0.1	0.1	0.3	0.8	0.1	0.3
WEEE	0.6	3.6	0.2	0.0	1.0	1.1
Fines	1.3	1.5	1.7	0.7	3.9	1.8
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

4.7 Schools waste

Table 17 shows the average composition of residual waste from both primary (70 samples) and secondary schools (34 samples) in Wales. The wastes had similar paper and card contents (30-35%) but the waste from primary schools contained a much higher percentage (35%) of food waste than that from secondary schools (21%). This may be due to a higher percentage of primary school children making use of the school dinner service, but may also reflect the fact that children at secondary schools may well eat their lunch outside the school. A similar trend was found in during the recent survey of MSW composition in Scotland.

The analyses indicate that the main categories which could be targeted for recycling or composting were paper & card and food waste.

A number of the schools had facilities for collecting recyclables; the materials which were being separated for recycling were paper, card, plastic bottles and cans (some of the schools with recycling facilities were not collecting all of these materials). None of these samples were handsorted.

Table 17: Composition (Wt %) of waste from schools

	Primary schools	Secondary schools
Newspapers & magazines	2.5	2.7
Other paper	18.3	22.4
Cardboard	9.1	11.0
Plastic film	6.4	8.6
Plastic bottles	2.7	6.5
Other plastic packaging	3.3	4.0
Other dense plastic	2.3	2.8
Textiles & footwear	2.4	1.2
Wood	0.6	2.0
Furniture	0.2	0.1
Disposable nappies	0.2	0.1
Other Combustibles	1.5	1.9
Packaging glass	0.5	0.7
Other glass	0.1	0.3
Rubble (C&D waste)	0.1	0.3
Other non-combustibles	0.4	0.7
Metal cans	1.4	2.3
Other metal	1.2	2.1
Food waste	40.2	25.8
Garden waste	2.2	0.7
Other organics	0.4	0.0
HHW	0.2	0.3
WEEE	1.0	1.1
Fines	2.8	2.6
Total	**100.0**	**100.0**

There was no WasteDataFlow data on the amount of waste from schools which was collected as it is normally included within the tonnage reported for household waste collections. Consequently, the results from the sample of schools in the current study were not used in the calculation of overall MSW composition.

WRAP's 2008 report *The nature and scale of waste produced by schools in England* presented the indicative findings of compositional analyses of waste produced in schools and the consequent implications for those planning to collect waste for recycling from schools. Within the 24 schools sampled for the study, average recycling rates were just 13% for primary schools and 20% for secondary schools. This highlights a significant gap between what could potentially be recycled and what is actually recycled in schools.

4.8 Bulky household waste

A number of local authorities in Wales provided detailed records of their bulky household collections. For each local authority which provided records, a minimum sample size of 500 records over a one year period were selected. For each selected record, the typical weight listed in the FRN list[24] was allocated to each item. These were then summed to provide an overall composition for bulky household waste. No physical monitoring or analysis was undertaken.

Table 18 compares the composition of bulky household waste in Wales in 2008/09 with those determined in other studies. All of the results show that the two main categories were furniture and WEEE items (nearly all of the WEEE items in bulky household waste were either white goods or televisions) which could be targeted for either reuse or recycling. The total arising of other recyclable categories, such as paper and food waste, was less than 3% by weight of this stream.

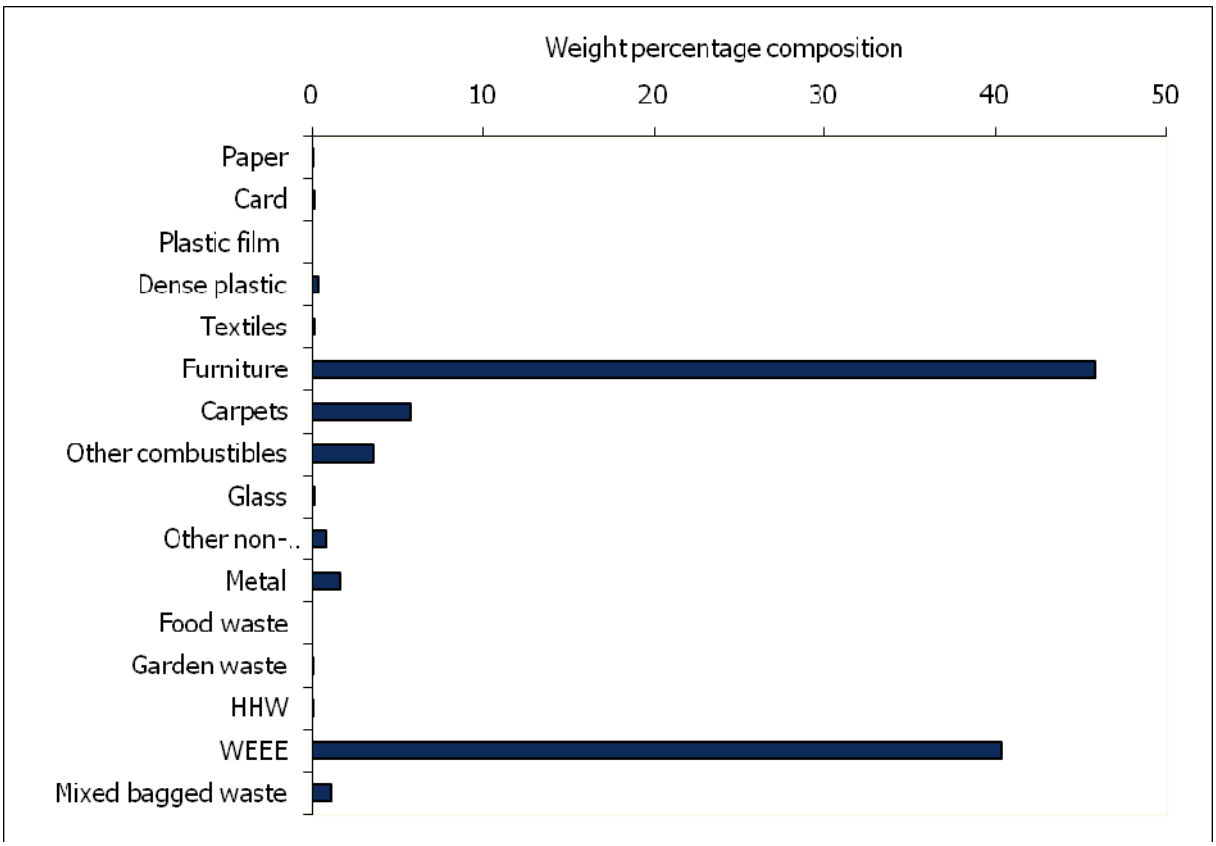
[24] Typical weights for items potentially suitable for reuse. Furniture Reuse Network (www.frn.org.uk), 2009.

Figure 9 shows the average composition of bulky household waste (determined from the analyses shown in Table 18). The two main categories, both of which represent over 40% by weight of the total arisings, were furniture and WEEE items.

Table 18: Composition (Wt %) of bulky household waste

	Wales 2009	Scotland 2009	Wales 2002/03	English County 2002	English Unitary Authority 2005/06
Paper	-	-	-	-	-
Card	-	-	<1	<1	-
Plastic film	-	-	-	-	-
Dense plastic	1	<1	1	<1	<1
Textiles	-	<1	<1	<1	<1
Furniture	58	45	37	41	49
Carpets	2	5	7	13	3
Other combustibles	2	2	14	<1	1
Glass	-	-	<1	<1	-
Other non-combustibles	1	1	2	<1	-
Metal	1	1	1	<1	2
Food waste	-	-	-	-	-
Garden waste	-	-	<1	-	-
HHW	-	-	<1	-	<1
WEEE	35	44	35	44	43
Mixed bagged waste	1	1	1	<1	1
Total	**100**	**100**	**100**	**100**	**100**

Figure 9: Composition (Wt %) of bulky household waste



5.0 Arisings and overall composition of municipal solid waste

The overall composition of MSW can be determined using the composition of each stream and data on the tonnage arisings of each of these waste streams. As analyses were conducted in all 22 authorities, the average composition of each stream was likely to be representative of the overall composition in Wales. Thus the average waste compositions for each stream shown in Chapter 4 were used for the calculation of the overall composition of MSW in Wales.

Table 19 shows the tonnage arisings of the waste streams that, between them, comprise the overall MSW stream. The tonnages in Table 18 were derived from the 2008/09 WasteDataFlow information collated by the Welsh Assembly Government.

Table 19: Tonnage arisings of MSW in Wales in 2008/09

	Weight ('000 tonnes)	Wt %
Materials recycled or composted	637	37.5
Collected residual household waste	725	42.6
Residual HWRC waste	145	8.5
Residual trade waste	113	6.7
Street cleansing waste[25]	52	3.0
Bulky waste	8	0.5
Other waste streams	20	1.2
Total	**1,699**	**100.0**

Table 20 shows the list of the MSW streams included in the 'Other waste streams' category in Table 19 (which represents 1.2% of the overall MSW stream). The tonnages for each of these streams were derived from WasteDataFlow information, and the overall composition of this stream was then determined using the assumed compositions for each waste stream shown in Table 20.

[25] Litter and mechanical sweepings each represent 50% of the street cleansing waste category

Table 20: Other waste streams

Stream	Categories	Wt %
Separately collected asbestos	100% non-combustible	3
Fly tipped waste	Other analyses[26]	30
Grounds waste	Similar to litter	3
Beach cleansing waste	Other analyses[27]	3
Other collected household waste	Similar to residual household waste	31
Healthcare	20% plastic, 80% HHW	4
Gulley emptyings	Other analyses[28]	10
Highways waste	100% C&D waste	10
Non-household C&D waste	100% C&D waste	6
Total		**100**

The overall composition (based on the 24 category list) of the recycling/composting stream was determined using WasteDataFlow information on reported tonnages of material collected through source separation schemes collated by the Welsh Assembly Government. The tonnages for paper and card were converted to tonnages of newspaper & magazines, etc, using the average composition data (see Table 7) for the kerbside collected dry recyclable stream instead. It was also assumed that all plastic which was recycled was plastic bottles.

Table 21 presents the composition of each of the waste streams that comprise MSW, together with the overall composition of MSW.

[26] AEA unpublished report

[27] Analyses determined in Scotland in 2009

[28] Analyses determined in Wales MSW study in 2002/03

Table 21: Composition (Wt %) of municipal solid waste in Wales in 2009

	Material recycled or composted	Residual household collected waste	Residual HWRC waste	Collected trade waste	Litter	Mechanical sweepings	Bulky waste	Other MSW waste streams	Municipal solid waste
Weight ('000 tonnes)	637	725	145	113	26	26	8	20	1,700
Wt %	37.5	42.6	8.5	6.7	1.5	1.5	0.5	1.2	100.0
Category									
Newspapers & magazines	14.0	3.3	2.2	5.6	6.2	0.3	0.0	1.0	7.3
Other paper	4.7	8.6	4.5	17.1	7.8	0.1	0.0	7.2	7.1
Cardboard	5.6	5.7	3.7	14.9	9.3	1.3	0.1	5.8	6.1
Plastic film	0.0	6.0	2.0	7.6	8.2	0.1	0.0	2.8	3.4
Plastic bottles	3.1	1.7	0.7	2.5	7.3	1.8	0.0	1.8	2.3
Other plastic packaging	0.0	3.2	1.5	3.1	3.4	0.3	0.0	2.2	1.8
Other dense plastic	0.0	1.9	7.0	2.2	1.8	0.2	0.4	2.0	1.6
Textiles & footwear	1.1	4.5	5.2	1.8	3.0	0.0	0.1	0.8	3.0
Wood	8.6	1.0	7.0	1.3	0.5	0.0	0.0	1.7	4.4
Furniture	0.5	0.2	7.2	0.2	0.2	0.0	45.9	0.9	1.1
Disposable nappies	0.0	4.7	0.8	0.2	0.8	0.0	0.0	0.1	2.1
Other Combustibles	0.0	4.0	20.4	3.6	2.0	0.0	10.5	14.0	3.9
Packaging glass	12.9	3.5	1.5	2.8	6.9	0.4	0.0	0.9	6.8
Other glass	0.0	0.4	2.3	2.1	0.4	0.0	0.2	0.1	0.5
Rubble (C&D waste)	8.8	2.3	5.6	0.6	1.0	0.0	0.4	17.9	5.0
Other non-combustibles	0.0	1.5	3.3	1.0	1.2	0.6	0.4	3.4	1.0
Metal cans	2.3	1.8	0.7	1.0	5.5	0.6	0.0	0.8	1.9
Other metal	2.9	1.8	3.2	3.4	1.9	0.0	1.6	2.0	2.4
Food waste	3.1	30.0	5.5	20.8	18.0	0.3	0.0	10.9	16.2
Garden waste	28.7	3.3	7.2	0.9	5.7	43.0	0.1	9.0	13.7
Other organics	0.0	5.9	1.3	5.1	6.9	0.8	0.0	0.5	3.1
HHW	0.2	0.7	1.3	0.8	0.1	0.0	0.1	3.2	0.6
WEEE	3.3	1.2	5.3	0.8	0.6	0.0	40.3	4.8	2.5
Fines	0.0	2.6	0.6	0.5	1.3	50.0	0.0	6.0	2.1
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Figure 10 shows the composition of MSW in Wales. The two largest categories (in weight percentage terms) were food waste (16%) and garden waste (14%). The total arisings of paper & card represented 21% by weight of MSW in Wales.

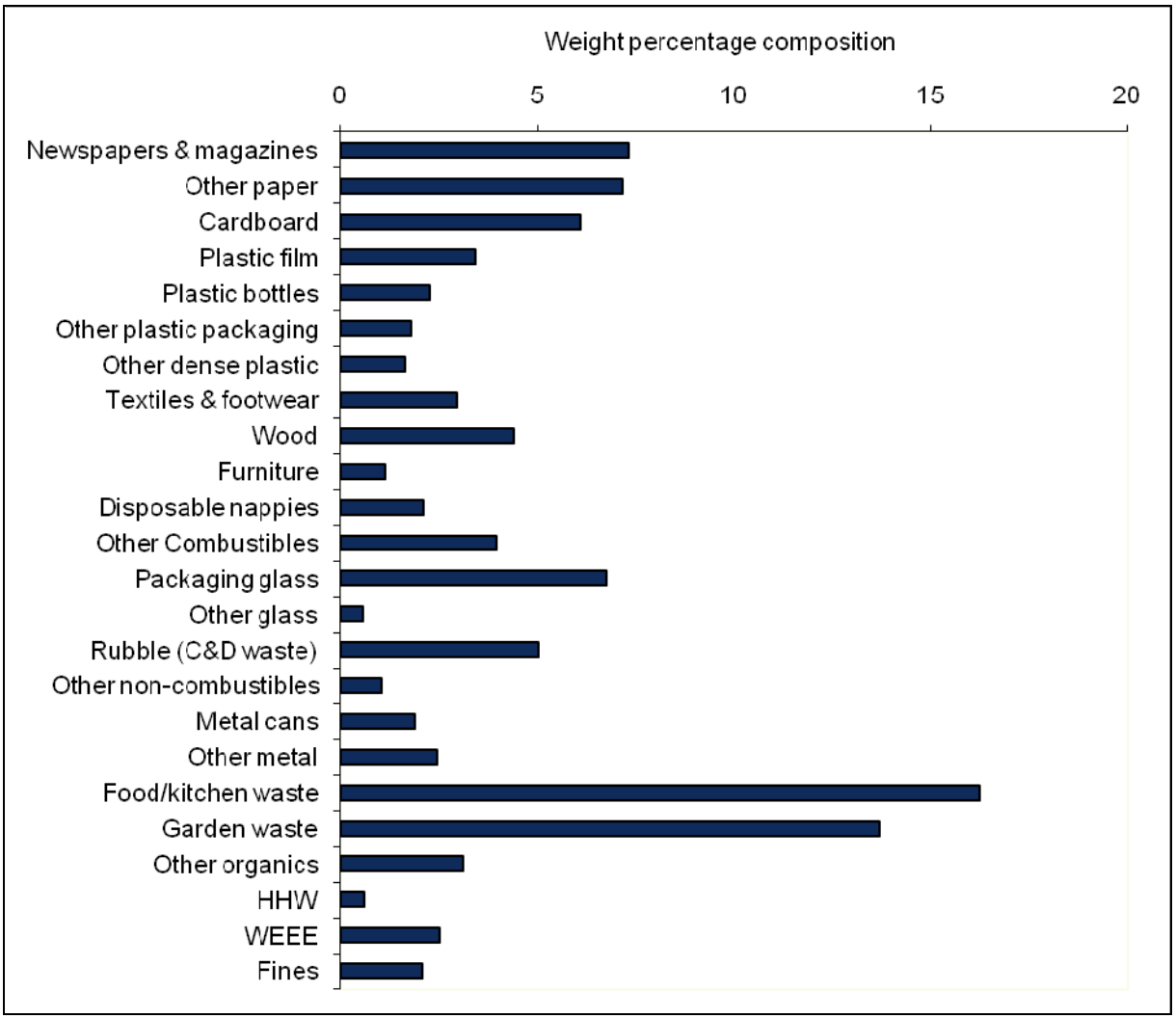


Table 22 compares the composition of MSW in Wales in 2009 with those determined in Scotland in 2009, Wales in 2002/03 and the composition determined by the Defra review of compositional analyses (most of these were conducted in England). The MSW compositions are largely similar.

Table 22: Composition of municipal solid waste

	Wales 2009	Scotland 2009	Wales 2003	Defra review March 2009
Paper & card	20.5	21.2	21.1	22
Plastic film	3.4	3.0	2.8	
Dense plastic	5.7	6.4	4.5	10
Textiles	3.0	3.1	2.2	3
Other combustibles	11.5	12.5	11.7	10
Glass	7.3	7.5	5.8	7
Other non-combustibles	6.1	5.3	8.0	5
Food waste	16.2	17.7	15.7	18
Garden waste	13.7	13.1	12.7	14
Other organics	3.1	0.8	2.1	2
Metal	4.3	4.0	5.6	4
HHW	0.6	0.5	0.8	1
WEEE	2.5	2.9	2.0	2
Fines	2.1	1.9	5.0	2
Total	**100.0**	**100.0**	**100.0**	**100**

The overall biodegradable content of municipal solid waste in Wales was 60.0 % if it was calculated using the values for biodegradable content of waste categories in the English and Scottish Regulations, and 64.1% if it was calculated using the values for biodegradable content of waste categories in current Environment Agency guidance (Appendix F shows how these values were determined). The Welsh Assembly Government will need to consider what the implications are for the current Regulations in Wales.

The 95% confidence interval for the biodegradable content of MSW in Wales was ±1.1percentage point. Thus, if the biodegradable content was calculated using the values in the current Environment Agency guidance, there is a 95% probability that the biodegradable content of MSW in Wales would be between 63.0% and 65.2%.%. If the biodegradable content was calculated using the values in the English and Scottish Regulations, then there is a 95% probability that that the biodegradable content of MSW in Wales would be between 58.9% and 61.1%.

6.0 Opportunities for further recycling

Table 23 shows that 74% of the arisings[29] of MSW in Wales were materials classified as recyclable or compostable that could potentially be separated by households for recycling. MSW in Wales also contained about 2% by weight of furniture. Some of this, and also some of the WEEE may be suitable for reuse. There may also be potential for additional recycling of carpet.

[29] The percentages of both "other paper" and "other plastic packaging" listed in Table 23 are lower than those shown in **Error! Reference source not found.**. This is because some of these materials are unsuitable for recycling.

Table 23: Potentially recyclable or compostable material in MSW in Wales (% of overall MSW)

Category	Weight %
Newspapers & magazines	7
Other paper	4
Cardboard boxes and containers	5
Dense plastic bottles	2
Other plastic packaging	2
Textiles and shoes	3
Wood	4
Packaging glass	6
C&D waste (rubble)	4
Metal	4
Food waste	16
Garden waste	14
Other (WEEE items, oil, batteries)	3
Total	**74**

The 2009 draft of the Zero Waste Plan for Wales sets a target to collect and either recycle or compost 70% of MSW by 2025. The findings from this study suggest that approximately three quarters of MSW in Wales is made up of recyclable and compostable material. It is important to highlight that the 74% calculated from this study represents what is available for potential capture using recycling and composting collections.

A recent report[30] by Environment Agency in Wales for the Welsh Assembly Government identified that up to 90% of MSW in Wales could potentially be recycled. The 90% figure includes more paper, plastic film, disposable nappies, other glass, other organics and fines. Some of the other organics (such as wood based cat litter) and fines could be placed into an organics collection, but further developments in recycling technology, together with additional recycling infrastructure (particularly for disposable nappies) would be required in order for up to 90% of MSW to be classified as being potentially recyclable or compostable.

Table 24 provides a breakdown by material types commonly targeted for recycling and their occurrence in the overall MSW stream. This shows, for example, that:

- 71% of newspapers & magazines were recycled, and 19% arose in the residual household collected (dustbin) waste stream;
- 79% of food waste was in the residual household collected waste stream, and a further 9% was in the collected trade waste stream;
- 78% of garden waste was recycled;
- 14% of wood arose in the residual HWRC waste stream; and
- 16% of cardboard arose in the collected trade waste stream.

Local authorities will need to target the residual household collected waste stream, the residual HWRC stream and the trade waste stream if they wish to maximise the amount of material collected for recycling.

[30] *Life Cycle Analysis of Municipal Recycling Targets for Wales – Headline Results. Report by Environment Agency Wales for Welsh Assembly Government, 2009.*

Table 24: Distribution (Wt %) of recyclable and compostable materials between waste streams

	Material recycled or composted	Residual household collected waste	Residual HWRC waste	Collected trade waste	Litter	Mechanical sweepings	Bulky waste	Other MSW waste streams	Municipal solid waste
Newspapers & magazines	71	19	3	5	1	-	-	0	**100**
Other paper	24	51	5	16	2	-	-	1	**100**
Cardboard	34	40	5	16	2	-	-	1	**100**
Plastic film	-	75	5	15	4	-	-	1	**100**
Plastic bottles	52	31	2	7	5	1	-	1	**100**
Other plastic packaging	-	77	7	12	3	-	-	1	**100**
Other dense plastic	-	51	37	9	2	-	-	1	**100**
Textiles & footwear	13	66	15	4	2	-	-	-	**100**
Wood	74	10	14	2	-	-	-	-	**100**
Furniture	17	7	55	1	-	-	19	1	**100**
Disposable nappies	-	96	3	1	1	-	-	-	**100**
Other Combustibles	-	43	44	6	1	-	1	4	**100**
Packaging glass	72	22	2	3	2	-	-	-	**100**
Other glass	-	35	37	26	1	-	-	-	**100**
Rubble (C&D waste)	66	20	10	1	-	-	-	4	**100**
Other non-combustibles	-	61	27	6	2	1	-	4	**100**
Metal cans	47	41	3	4	4	-	-	1	**100**
Other metal	45	32	11	9	1	-	-	1	**100**
Food waste	7	79	3	9	2	-	-	1	**100**
Garden waste	78	10	4	-	1	5	-	1	**100**
Other organics	-	81	4	11	3	-	-	-	**100**
HHW	14	50	20	9	-	-	-	7	**100**
WEEE	50	20	18	2	-	-	7	2	**100**
Fines	-	55	2	1	1	37	-	3	**100**

Appendix A - Collection systems in each authority

Table A1: Collection systems for household waste and recycling in each area and number of Household Waste and Recycling Centres - April 2009

Consortia	Local Authority	Residual waste	Dry recycling	Garden	Food	HWRC	Comments
North Wales	Gwynedd	240L green w/b AWC to garden waste/food in Dwyfor and Meirionnydd	Blue box collected weekly in Dwyfor and Meirionnydd same day as waste/compost. Includes paper, cans, aerosols, glass, foil, batteries, plastic bottles and card in Dwyfor	Brown w/b AWC to residual waste Dwyfor and Meirionnydd only		6 sites	Arfon on a weekly sack collection system for residual and no food collection
	Anglesey	240L black w/b AWC with Garden waste	Red and blue boxes weekly includes: paper, card, textiles, spectacles, cans, aerosols, foil, glass, plastic bottles, ink cartridges, batteries, mobile phones	240L green w/b AWC with residual waste	Mini Food Waste bin - weekly collection 6000 properties on trial	2 sites	-
	Conwy	240L w/b awc with recycling 120L bins provided within a trial area.	Box – cans and glass Bag – paper and thin card AWC with residual Plastics and batteries collected fortnightly in food waste collection areas	6 sacks per household per fortnight on same day as recycling	5L kitchen caddy and 23L external caddy for a weekly collection to 7000 households	2 sites	Households in food waste trial area can also recycle plastic bottles.
	Denbighshire	180L grey w/b AWC with garden [some areas will keep using sacks and have a weekly collection]	Blue and white sacks in some areas all other areas have blue 240L w/b. Includes: paper, card, tetrapaks, mixed plastics, glass, cans, foil & aerosols. Same day as refuse etc.	Green 140L w/b AWC with residual waste [in some areas white sacks can be purchased at 50p each	Orange Caddy collected weekly [scheme does not cover all areas] Liners provided FOC.	1 site	March 2010 roll-out used 140L grey bin for residual in place of 180L. Now 66% AWCs/bins/food, 34% weekly/sacks.
	Flintshire	Sacks weekly	Blue box for Glass. woven polypropylene sacks for plastic bottles and cans. Blue bags for	Fortnightly different day to waste and recycling	-	8 sites	-

Consortia	Local Authority	Residual waste	Dry recycling	Garden	Food	HWRC	Comments
			paper and cardboard. Fortnightly collections however not necessarily on the same day as refuse.				
	Wrexham	AWC with garden	Weekly green box and bag same day as waste or garden	AWC with residual waste	-	3 sites	AWC with garden
Mid Wales	Ceredigion	Weekly sack or w/b ban on garden waste	Clear recycling bag for around 89% of county. Accepts paper, card, plastic bottles and containers, mixed cans.	Pay as you throw 25p per sack	Kitchen caddy and 23 litre bin trial to around 5,000 in Aberystwyth	5 sites	Weekly sack or w/b ban on garden waste
	Powys	1 Roll of Black Sacks provided yearly, collected weekly	Sack 1 for plastic bottles, cans and carrier bags; sack 2 for paper and card, textiles, handbags, belts etc. Weekly same day as waste	Orange bags available for purchase at 90p/bag, landfilled. Other methods of disposal encouraged (Bring, HWRC etc.)	Scheme in Montgomeryshire by Cwm Harry which is expanding	6 sites	-
Eastern Valleys	Blaenau Gwent	Weekly black bag collections	55 litre kerbside boxes – source segregated.	On request	Weekly – using a 23 litre outdoor bin and a 5 litre indoor caddy. Currently trialling food waste liners	3 sites	
	Torfaen	240L black w/b AWC with garden OR weekly w/b and no garden/food service	Black box weekly same day as waste. Includes cans aerosols, paper, glass, textiles, shoes, plastic bottles	Green w/b for garden and food AWC with residual waste		1 site	-
Western Valleys	Rhondda Cynon Taff	Sacks weekly in Rhondda w/b weekly in Cynon Valley and Taff Ely	Sacks weekly. Includes glass, cans, all plastic containers, tetrapaks, paper, card same day as waste	Weekly same day as waste and recycling	Trial small brown bins collected weekly same daya s waste etc. Liners	5 sites	-

Consortia	Local Authority	Residual waste	Dry recycling	Garden	Food	HWRC	Comments
					allowed		
	Merthyr Tydfil	240L w/b weekly	Green box, weekly. Includes: paper, card, cans, glass, plastic containers, plastic bags, aerosols, foil, tetrapaks textiles	Sacks weekly	Blue bin weekly liners or newspaper can be used to wrap food	2 sites	All collections on the same day
Prosiect Gwyrdd	Cardiff	240 l Black wheeled bin or Black sack weekly	Green sack fortnightly – cans, plastic packaging, glass, paper, card	White sack or green bin collected weekly		4 sites	-
	Vale of Glamorgan	Weekly not always same day as recycling	Wk 1 card and plastic wk 2 cans, paper, glass	Fortnightly during summer same day as card and plastic	-	2 sites	-
	Newport	w/b AWC garden waste	Blue and green boxes collected weekly same day as either residual or garden waste	Includes card AWC residual waste	-	1 site	-
	Monmouthshire	Weekly sacks or dustbins	Weekly box, two box system being introduced, paper, cans, glass, textiles, shoes, directories	Weekly garden and food together		4 sites	-
	Caerphilly	Weekly black or green bin	Weekly brown w/b or green box: thin card, cans, paper, plastic packaging, glass	Fortnightly in reusable sacks	-	6 sites	-
South West Wales	Pembrokeshire	Black sacks weekly [sack provided by council on a roll extra can be purchased]	Orange sacks weekly. Includes paper, card, cans, plastic bottles. Same day as waste [sack provided by council on a roll extras are free]	Weekly green sacks same day as waste and recycling £5.50 for ten sacks paid in advance. Note that the green sacks are	-	6 sites	-

Consortia	Local Authority	Residual waste	Dry recycling	Garden	Food	HWRC	Comments
				collected along with residual waste (black sacks) and currently goes to landfill.			
	Carmarthenshire	Black sacks AWC with weekly food waste 4 black bag limit per household with certain exceptions	Blue sacks AWC with weekly food waste. Includes: paper, card, cans, rigid plastic packaging, aerosols, tetrapaks [additional rolls of sacks provided free by council]	Weekly with waste/recycling roll of 20 bags £3.50 paid in advance	Weekly 23½ litre green bin. No liners can wrap food in newspaper or kitchen roll	5 sites	Most collections on the same day in a split body RCV (70:30 split) with some exceptions. Rollout complete to over 90% of the authority
	Swansea	Black sacks weekly rolls delivered by the council additional bags cost 55p for ten	Fortnightly same day as waste. Includes: glass, paper, cans, card in separate sacks. Rolls of sacks delivered by council additional sacks can be requested and are free	Woven polypropylene reusable green sacks collected fortnightly same day as waste and recycling	Weekly bin	5 sites	-
	Neath Port Talbot	w/b or sacks weekly	Weekly same day as waste: Blue bag = plastic bottles; Green box = cans, aerosols and glass separate clear bags for textiles, paper and card	Green bag weekly	Food waste is collected weekly from 13,000 households.	3 sites	
	Bridgend	Blacks sacks delivered to hh by council in rolls collected weekly	Fortnightly collection same day as waste. Box 1 paper and thin card; Box 2 glass; carrier bag for textiles	Pre paid green sacks can be set out weekly same day as waste	Pilot for 9000 hh 4 different schemes being trialed	4 sites	-

Table A2: Changes made to collection systems for household waste since April 2009

Authority	Changes made
Blaenau Gwent	Fortnightly collection for residual waste, and wheeled bin for recyclables to be introduced. Food waste collections also introduced. Co-mingled collection system introduced for dry recycling.
Bridgend	New collection scheme to be introduced in June 2010 – fortnightly collection for residual waste, weekly collection for recyclables and food waste.
Caerphilly	fortnightly collection for residual waste; garden waste weekly; food waste collections started in October 2009 23l caddy
Cardiff	Households have either sacks or wheeled bins. No changes to collection system (weekly residual and food/garden, fortnightly for recyclables).
Carmarthenshire	No changes.
Ceredigion	Food waste collection (combined with garden waste) introduced in some areas during 2009.
Conwy	Full roll out of food waste, plastics and batteries planned for late 2010
Denbighshire	70% of houses now provided with alternate weekly collection. Number of houses provided with food waste collection increased.
Flintshire	Pilot area of 24,000 properties for food waste collection on a weekly basis on the same day as refuse. (Rolled out April 2010)
Gwynedd	Combined food & garden waste collection now provided to all households. Since January 2010 AWC rolled out County wide (wk 1- residual, wk 2- food and garden. Recycling weekly). Card included in blue box scheme.
Isle of Anglesey	Number of households provided with food waste collection increased.
Merthyr Tydfil	Food waste collection to be expanded to 95%+ of households by end of 2010.
Monmouthshire	Dry recycling collection has now been replaced with weekly co-mingled collection in sacks provided by the council.
Neath Port Talbot	Currently rolling out additional food waste collection service to a further 10,000 households. Use of coloured bags being phased out during 2010 so that clear bags are used for all recyclable waste inc green waste. Glass and cans will continue to be collected in a box.
Newport	Weekly food waste collections being introduced.
Pembrokeshire	Trial food waste collection scheme: weekly Collection - small bin for kitchen and large bin for collection. Liners provided for both bins. Began September 2009.
Rhondda Cynon Taff	Food waste collection now covers 20,000 households.
Swansea	Fortnightly segregated collection of plastics
Torfaen	Assessing options for collections from flats.
Vale of Glamorgan	Food waste collections introduced, and number of households with food waste collection increased in March 2010.
Wrexham	Food waste and cardboard now being collected with garden waste.

Appendix B - Detailed category classification

Table B1: Detailed category classification

Main Categories	Sub-categories
1. Paper and Card	Newspapers and magazines
	Directories, catalogues and books
	Wall paper
	Paper packaging
	Other recyclable paper
	Non-recyclable paper
	Liquid cartons
	Other non recyclable card
	Cardboard packaging; non-corrugated
	Cardboard packaging; corrugated
	Non-packaging cardboard
2. Plastic Film	Carrier bags
	Other packaging film
	Refuse sacks and other plastic film
3. Dense Plastic	PET bottles
	HDPE Bottles
	Other plastic bottles
	Expanded polystyrene (EPS)
	Other plastic packaging
	Other non packaging plastic
4. Textile	Man made fibres
	Natural fibres
	Shoes, bags, belts
5. Other Combustible	Wood and cork packaging
	Wood and cork non-packaging
	Chipboard, MDF
	Carpet
	Mattresses
	Kitchen units
	Other furniture
	lino/tiles flooring
	Disposable nappies
	Incontinence products
	Sanitary products
	Other combustible
6. Other Non Combustible	DIY rubble
	Other non combustible
7. Glass	Brown glass
	Green and Blue glass
	Clear glass
	Non packaging glass
8. Putrescibles	Garden waste soft
	Garden waste woody
	Soil
	Pet excrement and bedding
	Raw fruit and vegetable matter
	Raw meat and fish
	Cooked or prepared food
	Tea bags, coffee grinds, eggshells
	Bones
	Cooking oil and grease
	Food still in its packaging
9. Ferrous Metal	Food and beverage cans
	Aerosols
	Other ferrous metal
10. Non Ferrous Metal	Food and beverage cans
	Aerosols
	Foil
	Other non ferrous
11. WEEE	List
12. HHW	List
13. Fine Material	<10 mm Fines
Weight of bio bags [food sort only]	
Total	

Appendix C – Development of the methodology for sampling each waste stream

Household dustbin waste

Household waste is complex in its composition because of diverse factors such as geographical location, season, social and economic conditions and methods and frequency of collection. It is practically impossible, as well as physically undesirable; to separate, measure and analyse all the solid waste arisings generated in a local authority. However, the accuracy of waste data has been significantly improved over time with the use of socio economic profiling tools such as ACORN.

The sample collected for analysis must be sufficient to:

- ensure that the sample is representative of the population (waste stream) as a whole; and
- ensure that a specified precision is achieved.

It should be noted that the amount of sample needed to produce a required precision, reflecting abundance and particle size distribution in the waste stream, for a commonly found material (e.g. paper or glass) would be significantly smaller than that required for a less commonly found material (e.g. batteries). Thus the requirements of the project must be understood from the outset.

Data derived from the National Household Waste Analysis Programme[31] showed that, for a sample of household waste with a paper concentration of about 40% by weight, it was necessary to collect a sample weighing about 500kg (that arising from about 50 households per week, assuming a waste generation rate of 10kg per household). This would achieve a relative error of +/- 10%.

The introduction of kerbside recycling schemes has significantly reduced the weight of paper in household residual waste to approximately 20%. In addition, today the average household throws away, recycles or composts approximately 16kg per week. As such, a minimum of 32 households will provide a sample of about 500kg. This is considered a more than sufficient weight to determine the concentrations of common items e.g. newspaper and magazines, card packaging, plastic bottles, glass bottles and jars, cans, food and garden waste with a reduced relative error.

Residual Recycling Centre Waste

The analysis of waste brought to a HWRC is determined by selecting a number of visitors during a day, analysing each of the selected visitor's waste, and then summing these analyses to produce an overall estimate of HWRC waste composition.

The two approaches that can be used are either to analyse a representative sample of the total waste brought to the site (which will include any items that visitors planned to recycle), or to analyse a representative sample of the residual waste that visitors were planning to place in the 'landfill' container. The second approach was adopted for this study as the arisings of residual HWRC waste are reported by authorities through WasteDaFlow, and this information can then be used to determine the overall MSW composition.

The most suitable household waste recycling centre (HWRC) site in each of the 22 authorities was identified through liaison with the relevant local authority officers. Although the main aim of the site selection process was to identify sites which would be used by the households which were sampled at the kerbside, the selection process also had to consider the operational procedures for sampling at each site.

[31] *National household waste analysis project – report on composition and weight data. Department of the Environment report CWM 082/94, August 1994.*

A variety of approaches can be taken to the sampling of waste at HWRC sites. On purely statistical grounds, the most effective method is stratified random sampling, in which the sampling is based on predetermined factors (this approach is used for opinion poll surveys). However, for this to be successful for sampling at a HWRC site, information is needed on expected visitor types and arrival patterns, and this will seldom be available beforehand at a sufficient level of detail. Stratified random sampling is also likely to impose appreciable operational difficulties - a drawback that applies equally to simple random sampling. In practice, therefore, three main options are available:

1 systematic sampling of visitors (also termed sampling every 'n-th' vehicle);
2 systematic sampling through time; and
3 sampling the next available vehicle after the present sample has been completed.

Option 1 is statistically the most attractive as it provides an unbiased estimate of mean weight per vehicle. Consequently, the protocol states that the best approach is to sample every n'th visitor. However, there are operational difficulties with this approach as the limited space at most HWRC sites can make it difficult to both direct a number of visitors to an area where their waste will be unloaded, and to store the waste until it can be analysed. In addition, poor weather may significantly reduce the expected number of visitors, particularly on a weekday.

Option 2 largely reduces these operational problems, but it will introduce a potential bias. Furthermore, clustering problems can still arise as some vehicles may take substantially longer to sample and analyse than the allowed inter-sample time. Thus Option 3 is practically the most attractive, as by definition it avoids any necessity for holding vehicles in a queue or temporarily storing waste. It also makes the most efficient use of sampling effort, as there are no gaps waiting for the next scheduled vehicle or sampling time.

Although option 3 is the most operationally attractive option, it is more prone to bias, as it reduces the percentage of visitors which are sampled during busy periods. Thus it was necessary to consider whether the practical approach of sampling the next visitor after an analysis has been completed enables a representative sample of waste brought to a HWRC site over a day to be obtained. A simulation model developed as part of the development of the sampling protocol for Wales showed that whilst there is a risk of a modest degree of bias in adopting a sampling strategy based on sampling the "next available visitor", it enables the number of samples taken during the day to be maximised and will thus have an additional benefit in the form of improved precision. This is an important benefit as it outweighs the risk of a possible modest degree of bias. Consequently a sampling procedure based on "next available visitor" was chosen for this study.

Commercial waste collected by local authorities

Commercial waste collected by local authorities ('trade waste') tends to arise from small premises along with local authority operations, with the larger businesses tending to make use of private sector collection contractors. It is extremely difficult to generalise about the composition of trade waste because it is so heterogeneous. Waste from a bank is very different in nature to waste from a delicatessen or waste from a butcher for example. However, the waste from a bank in Flintshire should be fairly similar to the waste from a bank in Swansea.

For the 2002/03 Welsh Municipal Waste Analysis project, sampling of businesses was based on SIC [Standard Industrial Classification]. This method provides 20 business types for sampling as shown in the following Table.

SIC Group	Code	Types of businesses
Manufacturing	15-37	Small scale engineering
Printing and publishing	22	Newspaper offices, printers
Construction	45	Builders yard, Glaziers, Plumbers
Sale, maintenance and repair of motor vehicles; retail sale of automotive fuel	50	Vehicle repair garages
Retail; repair of household goods	52	Shops
Hotels and restaurants	55	Hotels, pubs, restaurants, take aways
Transport	60	Bus garages
Activities of travel agents	63	Travel agents
Post and telecommunications	64	Post offices
Financial services	65	Banks and building societies
Insurance and pension funding	66	Insurance offices
Real estate activities	70	Estate agents
Other business activities	74	Legal services, accountants, architects,
Public administration	75	Council offices
Renting	71	Video rental, tool hire
Education	80	Schools and colleges
Health and social work	85	Dentists, vets, doctors
Membership organisations	91	Clubs and societies
Recreational, cultural and sporting activities	92	Libraries, betting shops
Other service activities	93	Hairdressers, dry cleaners

Past experience has shown that office based businesses produce very similar types of waste – mainly paper and left over lunch. This means that it is possible to group together SIC codes: 63, 64, 65, 66, 74 and 75. An additional aim was to over sample businesses that have very different waste e.g. retail, manufacturing, construction and other services and take fewer samples for other businesses e.g. dentists, clubs and garages. Consequently, the businesses were grouped into nine principal business types:

- Retail premises
- Food premises (cafes and restaurants)
- Offices
- Leisure facilities and social clubs
- Hair & Beauty premises
- Transport
- Health (doctor, dentist, vet)
- Manufacturing
- Care
- Other businesses

The waste from schools was sampled separately.

Up to forty businesses in each authority were identified by council officers. Additional addresses for each business type were listed as fall backs so the total sample could be achieved on the collection day. Each business was identified on a map and the normal collection time determined. On that day, the fieldwork team drove to the premises, weighed the waste which was set out, and removed a sample of the waste for analysis. The waste was analysed using the same categories and general approach as used for collected household waste.

Bulky household waste

Records of bulky household collections are held by local authorities. As these cover all collections which are made over a year, they provide a better means for determining the composition of this waste stream than sampling one or two collections during the analysis periods.

Local authorities may well make over 5,000 collections (which may contain just one item or a number of items) per year. Although analysis of about 250 records in each authority would have enabled the frequencies of the main types of items in bulky household waste to be identified at an acceptable level of precision, a more

extensive analysis provides more information on the arisings of rarer items. Consequently, a minimum sample size of 500 records over a one year period was chosen for the analysis.

For each selected record, the typical weight listed in the FRN list[32] was allocated to each item. These were then summed to provide an overall composition for bulky household waste.

Litter

Litter was sampled using the protocol for Wales developed for the 2002/03 survey**.** Samples were requested from different areas in each local authority representing:

- city/town centre area – near shops;
- a suburban area; and
- a rural area.

During the period that the fieldwork teams were working in each local authority, samples of litter and street sweepings were delivered by the LA to the sort team. The samples were hand sorted using the sort categories used for household waste.

Schools waste

Schools waste was not included in the protocol developed for the 2002/03 survey, and thus the following methodology was developed.

Each local authority was asked to identify schools for inclusion in the survey. The Head teachers were telephoned prior to sampling to ask if the school would participate in the survey and to gain information on what time to arrive and who to meet. The samples were collected on the normal waste collection day for the school. Each of the schools' bins - residual waste and recycling- were weighed, using a trolley jack with scales, and a note was made of the type of bin, size and the material the bin was made out of. As health and safety procedures meant that it was not possible to empty bins over 660L manually, a sample of waste (approximately 200 litres) was removed from each bin. The analysis was conducted using the same procedure as that for household collected waste.

[32] Typical weights for items potentially suitable for reuse. Furniture Reuse Network (www.frn.org.uk), 2009.

Appendix D - Composition of MSW waste streams

Table D1: Composition (Wt %) of household collected waste

Main Category	Sub-categories	Residual	Dry recyclables	Food / kitchen waste	Garden waste
1. Paper and Card	Newspapers and magazines	3.32	31.57	0.88	0.01
	Directories, catalogues and books	0.94	4.83	0.00	0.00
	Wall paper	0.69	0.09	0.00	0.00
	Paper packaging	0.70	0.40	0.03	0.00
	Other recyclable paper	2.50	4.98	0.14	0.04
	Non-recyclable paper	3.72	0.45	0.36	0.00
	Liquid cartons	0.37	0.31	0.00	0.00
	Other non recyclable card	0.31	0.22	0.00	0.00
	Cardboard packaging; non-corrugated	3.06	5.44	0.06	0.10
	Cardboard packaging; corrugated	1.61	5.54	0.00	0.13
	Non-packaging cardboard	0.25	0.21	0.04	0.00
2. Plastic Film	Carrier bags	1.29	0.47	0.21	0.00
	Other packaging film	3.05	0.80	0.13	0.00
	Refuse sacks and other plastic film	1.70	0.62	0.47	0.01
3. Dense Plastic	PET bottles	0.88	3.56	0.00	0.00
	HDPE Bottles	0.63	3.13	0.00	0.00
	Other plastic bottles	0.14	0.26	0.00	0.00
	Expanded polystyrene (EPS)	0.29	0.10	0.00	0.00
	Other plastic packaging	2.87	2.37	0.02	0.00
	Other non packaging plastic	1.91	0.35	0.00	0.00
4. Textile	Man made fibres	2.01	0.17	0.00	0.00
	Natural fibres	1.41	0.21	0.00	0.00
	Shoes, bags, belts	1.18	0.13	0.00	0.00
5. Other Combustible	Wood and cork packaging	0.03	0.00	0.00	0.00
	Wood and cork non-packaging	0.91	0.07	0.00	0.00
	Carpet	0.75	0.00	0.00	0.00
	Mattresses	0.00	0.00	0.00	0.00
	Kitchen units	0.05	0.00	0.00	0.00
	Other furniture	0.19	0.07	0.00	0.00
	lino/tiles flooring	0.14	0.00	0.00	0.00
	Disposable nappies	4.71	0.04	0.00	0.00
	Incontinence products	0.57	0.00	0.00	0.00
	Sanitary products	0.49	0.02	0.00	0.00
	Other combustible	2.12	0.10	0.06	0.00
6. Other Non Combustible	DIY rubble	2.33	0.02	0.00	0.00
	Other non combustible	1.44	0.16	0.00	0.00
7. Glass	Brown glass	0.38	2.95	0.00	0.00
	Green and Blue glass	0.89	8.77	0.00	0.00
	Clear glass	2.20	12.20	0.00	0.00
	Non packaging glass	0.44	0.44	0.00	0.00
8. Putrescibles	Garden waste soft	2.06	0.39	0.01	56.77
	Garden waste woody	0.25	0.00	0.00	30.25
	Soil	1.05	0.00	0.00	11.13
	Pet excrement and bedding	5.92	0.16	0.00	0.00
	Raw fruit and vegetable matter	10.99	0.03	51.36	1.07
	Raw meat and fish	0.57	0.01	1.12	0.00
	Cooked or prepared food	9.09	0.16	30.14	0.36
	Tea bags, coffee grinds, eggshells	2.28	0.02	10.49	0.00
	Bones	0.64	0.01	3.27	0.00
	Cooking oil and grease	0.08	0.00	0.00	0.00
	Food still in its packaging	6.38	0.10	0.39	0.00
9. Ferrous Metal	Food and beverage cans	1.47	5.17	0.00	0.00
	Aerosols	0.18	0.34	0.00	0.00
	Other ferrous metal	0.94	0.10	0.00	0.00
10. Non Ferrous Metal	Food and beverage cans	0.38	1.78	0.00	0.00
	Aerosols	0.11	0.14	0.00	0.00
	Foil	0.46	0.15	0.02	0.00
	Other non ferrous	0.10	0.04	0.00	0.00
11. WEEE	List	1.18	0.23	0.00	0.02
12. HHW	List	0.69	0.07	0.00	0.00
13. Fine Material	<10 mm Fines	2.68	0.08	0.32	0.09
Weight of bio bags [food sort only]		-	-	0.46	-
Total		**100.00**	**100.00**	**100.00**	**100.00**

Table D2: Composition of residual waste from HWRC sites

Main category	Sub-category	**Residual HWRC waste**
Paper and card	Newspapers and magazines	2.30
	Directories, catalogues and books	1.26
	Wall paper	0.87
	Paper packaging	0.25
	Other recyclable paper	1.26
	Non-recyclable paper	0.94
	Liquid cartons	0.07
	Other non recyclable card	0.35
	Cardboard packaging; non corrugated	0.86
	Cardboard packaging; corrugated	1.97
	Non-packaging cardboard	0.36
Plastic film	Carrier bags	0.27
	Other packaging film	0.64
	Refuse sacks and other plastic film	1.15
Dense plastic	PET bottles	0.37
	HDPE Bottles	0.29
	Other plastic bottles	0.03
	Expanded polystyrene (EPS)	0.44
	Other plastic packaging	1.09
	Other non packaging plastic	7.13
Textiles	Man made fibres	2.84
	Natural fibres	1.37
	Shoes, bags, belts	1.12
Misc. combustible	Wood and cork packaging	0.14
	Wood and cork non-packaging	3.71
	Chipboard, MDF	1.46
	Carpet	12.76
	Mattresses	3.56
	Kitchen units	1.42
	Other furniture	7.16
	Lino/tiles flooring	1.81
	Disposable nappies	0.79
	Incontinence products	0.02
	Sanitary products	0.11
	Other combustible	2.35
Misc. non combustible	DIY rubble	5.23
	Other non combustible	3.40
Glass	Brown glass	0.30
	Green and blue glass	0.66
	Clear glass	0.59
	Non packaging glass	2.42
Putrescibles	Garden waste soft	3.91
	Garden waste woody	1.89
	Soil	1.39
	Pet excrement and bedding	1.27
	Raw fruit and vegetable matter	2.04
	Raw meat and fish	0.07
	Cooked or prepared food	1.68
	Tea bags, coffee grinds, eggshells	0.47
	Bones	0.07
	Cooking oil and grease	0.07
	Food still in its packaging	1.15
Ferrous metal	Food and beverage cans	0.34
	Aerosols	0.10
	Other ferrous metal	2.60
Non ferrous metal	Food and beverage cans	0.36
	Aerosols	0.04
	Foil	0.09
	Other non ferrous	0.31
WEEE	WEEE	5.18
HHW	HHW	1.29
Fines	<10mm Fines	0.60
Total		**100.00**

Table D3: Composition (Wt %) of other MSW streams

Main Categories	Sub-categories	Trade waste	Litter	Primary Schools	Secondary schools
1. Paper and Card	Newspapers and magazines	5.56	6.22	2.49	2.71
	Directories, catalogues and books	1.39	0.15	1.54	1.49
	Wall paper	0.02	0.01	0.03	0.00
	Paper packaging	1.67	2.56	0.82	0.88
	Other recyclable paper	8.11	1.99	7.29	12.28
	Non-recyclable paper	5.95	3.06	8.63	7.74
	Liquid cartons	0.28	0.45	2.45	0.82
	Other non recyclable card	0.72	1.22	0.54	1.02
	Cardboard packaging; non-corrugated	3.21	4.43	1.48	1.35
	Cardboard packaging; corrugated	9.88	2.64	3.86	5.91
	Non-packaging cardboard	0.83	0.54	0.76	1.85
2. Plastic Film	Carrier bags	0.72	2.14	0.48	0.56
	Other packaging film	4.20	3.94	3.20	3.90
	Refuse sacks and other plastic film	2.68	2.10	2.70	4.11
3. Dense Plastic	PET bottles	1.26	5.99	1.22	5.17
	HDPE Bottles	1.08	1.13	1.32	1.08
	Other plastic bottles	0.16	0.21	0.18	0.24
	Expanded polystyrene (EPS)	0.54	1.04	0.25	0.60
	Other plastic packaging	2.59	2.37	3.01	3.39
	Other non packaging plastic	2.19	1.80	2.30	2.83
4. Textile	Man made fibres	0.95	1.23	1.74	0.58
	Natural fibres	0.45	0.59	0.52	0.36
	Shoes, bags, belts	0.36	1.18	0.11	0.26
5. Other Combustible	Wood and cork packaging	0.10	0.07	0.14	0.12
	Wood and cork non-packaging	0.71	0.43	0.46	1.84
	Chipboard & MDF	0.30	0.00	0.00	0.00
	Carpet	0.64	0.00	0.06	0.02
	Mattresses	0.06	0.00	0.00	0.00
	Kitchen units	0.22	0.00	0.00	0.00
	Other furniture	0.16	0.15	0.20	0.08
	lino/tiles flooring	0.30	0.00	0.04	0.20
	Disposable nappies	0.17	0.80	0.24	0.07
	Incontinence products	0.14	0.00	0.00	0.00
	Sanitary products	1.64	0.24	0.08	0.06
	Other combustible	0.82	1.75	1.35	1.57
6. Other Non Combustible	DIY rubble	0.61	0.99	0.13	0.32
	Other non combustible	0.96	1.21	0.35	0.69
7. Glass	Brown glass	0.65	1.11	0.01	0.12
	Green and Blue glass	1.16	1.91	0.08	0.10
	Clear glass	1.00	3.86	0.47	0.53
	Non packaging glass	2.13	0.44	0.10	0.29
8. Putrescibles	Garden waste soft	0.42	5.16	1.35	0.54
	Garden waste woody	0.35	0.09	0.24	0.07
	Soil	0.16	0.41	0.60	0.07
	Pet excrement and bedding	5.14	6.95	0.43	0.03
	Raw fruit and vegetable matter	3.71	7.17	14.27	8.22
	Raw meat and fish	5.12	0.16	0.05	0.22
	Cooked or prepared food	6.23	6.99	21.88	13.91
	Tea bags, coffee grinds, eggshells	1.17	0.33	1.11	1.07
	Bones	0.31	0.46	0.05	0.05
	Cooking oil and grease	2.94	0.02	0.61	0.00
	Food still in its packaging	1.36	2.90	2.22	2.35
9. Ferrous Metal	Food and beverage cans	0.68	1.83	1.24	1.65
	Aerosols	0.72	0.16	0.08	0.06
	Other ferrous metal	0.95	1.07	0.52	1.44
10. Non Ferrous Metal	Food and beverage cans	0.32	3.69	0.19	0.68
	Aerosols	0.29	0.10	0.01	0.06
	Foil	0.50	0.37	0.53	0.39
	Other non ferrous	0.99	0.24	0.03	0.11
11. WEEE	List	0.81	0.58	1.02	1.07
12. HHW	List	0.81	0.11	0.20	0.30
13. Fine Material	<10 mm Fines	0.46	1.30	2.78	2.57
Total		**100.00**	**100.00**	**100.00**	**100.00**

Appendix E – Residual household waste in each waste treatment procurement consortium

Each treatment procurement consortium in Wales is planning to procure a waste treatment plant which will primarily treat the residual household collected waste stream. Table E1 presents the calculated[33] composition of overall residual household collected waste arisings in each of the procurement consortia, and shows that they were comparable to the estimated total arisings of this stream in Wales; for example, the overall paper and card content in each consortium ranges from 15 to 19%. There were differences in the food waste content (for example, both authorities in the Western Valleys consortium were operating food waste collection schemes, but the overall organic (food waste, garden waste and other organics) content in each consortium is between 38 and 40%.

Although the treatment plants will need to be designed to handle the arisings of this stream in each authority, the composition will change as additional recycling collections are introduced. This will have an impact on the calorific value of the waste, and could affect the operation of an energy recovery facility. In order to assess this, three scenarios were considered:

- Scenario 1 – No change to current recycling.
- Scenario 2 – No change to current recycling for dry recyclable materials, but 50% of food waste recycled.
- Scenario 3 – 50% of food waste recycled and 25% of both dry recyclable materials and garden waste recycled.

Table E2 shows the tonnage arisings and estimated fuel quality[34] for each scenario. Achieving scenario 3 would reduce the tonnage arisings of residual household collected waste by about 180,000 tonnes, and would increase the net calorific value from 8.8 to 9.6 MJ/kg (on an "as received" basis). The higher calorific value for both scenario 2 and scenario 3 is due to the reduction in moisture content resulting from the separate collection of the food waste (as this has a high moisture content).

Table E2: Fuel potential of residual household collected waste

	Scenario 1	Scenario 2	Scenario 3
Arisings ('000 tonnes)	725	616	546
Moisture content (Wt %)	38.0	33.8	34.8
Ash content (Wt %)	19.0	20.6	20.2
Gross calorific value (MJ/kg)	10.5	11.3	11.2
Net calorific value (MJ/kg)	8.8	9.7	9.6
Sulphur content (Wt %)	0.1	0.1	0.1
Chlorine content (Wt %)	0.3	0.4	0.4

[33] *Determined using the composition of the residual household waste stream in each authority in a consortium and the WasteDataFlow information for the tonnage arising of this stream in 2008/09.*

[34] *All figures are on an "as received" basis*

Table E1: Composition (Wt %) of residual household collected waste in each procurement consortium

	North Wales	Mid Wales	Eastern Valleys	Western Valleys	Prosiect Gwyrdd	South West Wales	Wales
Newspapers & magazines	3.2	3.6	3.3	2.9	3.0	3.5	3.3
Other paper	9.2	7.0	8.6	7.5	9.5	8.0	8.6
Cardboard	6.8	4.5	7.4	4.4	5.2	5.6	5.7
Plastic film	6.2	5.3	6.7	5.0	6.4	5.9	6.0
Plastic bottles	1.3	1.7	1.6	1.4	1.9	2.2	1.7
Other plastic packaging	3.6	2.5	3.0	2.4	3.7	3.0	3.2
Other dense plastic	2.5	1.8	1.7	1.9	1.9	1.6	1.9
Textiles & footwear	4.1	6.9	4.4	6.3	4.3	4.3	4.5
Wood	0.9	0.4	0.6	2.2	1.3	0.9	1.0
Furniture	0.3	0.0	0.4	0.2	0.1	0.0	0.2
Disposable nappies	4.4	4.4	6.5	3.7	5.3	4.1	4.7
Other Combustibles	3.9	3.7	3.4	4.7	3.7	4.7	4.0
Packaging glass	2.4	3.8	3.0	2.9	3.3	5.3	3.5
Other glass	0.4	0.5	0.6	0.6	0.5	0.4	0.4
Rubble (C&D waste)	3.0	3.4	1.2	5.5	0.9	0.8	2.3
Other non-combustibles	1.8	0.9	0.8	1.3	1.4	1.5	1.5
Metal cans	1.2	2.1	2.0	2.5	1.7	2.4	1.8
Other metal	1.7	1.5	1.5	2.4	1.9	1.7	1.8
Food waste	30.8	31.2	27.9	24.8	32.8	31.0	30.0
Garden waste	2.9	0.8	5.0	8.1	1.8	3.5	3.3
Other organics	5.8	8.3	6.7	4.6	4.3	5.9	5.9
HHW	0.4	0.7	0.7	0.8	0.8	0.8	0.7
WEEE	1.2	2.4	0.9	1.3	1.0	0.8	1.2
Fines	2.0	2.5	2.1	2.4	3.3	2.4	2.6
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Appendix F – Determination of biodegradable content of MSW

The biodegradable content of overall MSW in Wales can be calculated using data on the composition of the MSW stream and the assumed biodegradable content of each of the categories of MSW. However, the Welsh landfill allowances regulations do not specify an assumed biodegradable content for any category (such as paper) of MSW.

Two approaches that can be used to determine the biodegradable content of MSW in Wales are:

- use the biodegradable contents specified in both the English and Scottish landfill allowance regulations (2005), or
- use the assumed biodegradable content in Environment Agency guidance.

Table F1 shows these biodegradable contents; the English and Scottish Regulations do not specify an assumed biodegradable content for 5 of the waste categories (marked with a *) in Table F1, but the Environment Agency guidance provides a biodegradable content of 50% for three of these.

Table F1: Biodegradable contents

	English and Scottish legislation	Environment Agency guidance
Newspapers & magazines	100	100
Other paper	100	100
Cardboard	100	100
Plastic film	0	0
Plastic bottles	0	0
Other plastic packaging	0	0
Other dense plastic	0	0
Textiles & footwear	50	50
Wood	100	100
Furniture	50	50
Disposable nappies*	0	50
Other Combustibles*	0	50
Packaging glass	0	0
Other glass	0	0
Rubble (C&D waste)	0	0
Other non-combustibles*	0	0
Metal cans	0	0
Other metal	0	0
Food waste	100	100
Garden waste	100	100
Other organics	100	100
HHW*	0	0
WEEE	0	0
Fines*	0	50

Table F2 shows the biodegradable content of MSW in Wales determined using both the biodegradable contents in both the English and Scottish Regulations and the Environment Agency guidance. The biodegradable content is 60.0% if it is calculated using the values in the English and Scottish Regulations, and 64.1% if it is calculated using

the values in the Environment Agency guidance (the difference is due to the additional categories classified as having a biodegradable content of 50% in the Environment Agency guidance).

Table F2: Biodegradable content (Wt %) of MSW in Wales

	Composition (Wt %) of MSW in Wales	English and Scottish Regulations	Environment Agency guidance
Newspapers & magazines	7.3	7.3	7.3
Other paper	7.1	7.1	7.1
Cardboard	6.1	6.1	6.1
Plastic film	3.4	0.0	0.0
Plastic bottles	2.3	0.0	0.0
Other plastic packaging	1.8	0.0	0.0
Other dense plastic	1.6	0.0	0.0
Textiles & footwear	3.0	1.5	1.5
Wood	4.4	4.4	4.4
Furniture	1.1	0.6	0.6
Disposable nappies	2.1	0.0	1.1
Other Combustibles	3.9	0.0	2.0
Packaging glass	6.8	0.0	0.0
Other glass	0.5	0.0	0.0
Rubble (C&D waste)	5.0	0.0	0.0
Other non-combustibles	1.0	0.0	0.0
Metal cans	1.9	0.0	0.0
Other metal	2.4	0.0	0.0
Food waste	16.2	16.2	16.2
Garden waste	13.7	13.7	13.7
Other organics	3.1	3.1	3.1
HHW	0.6	0.0	0.0
WEEE	2.5	0.0	0.0
Fines	2.1	0.0	1.0
Total	**100.0**	**60.0**	**64.1**

The Welsh Assembly Government will need to consider what the implications are for the current Regulations in Wales. One factor which they will need to consider is the confidence intervals.

95% confidence intervals for the estimate of biodegradable content can be determined using the variability in composition of the residual waste streams. The biodegradable content was then determined using the assumed biodegradable contents for each category shown in Table F1. This showed that the 95% confidence interval for the biodegradable content of MSW in Wales was ±1.1percentage point, which means that if the Environment Agency guidelines were used, there is a 95% probability that the biodegradable content of MSW in Wales is between 63.0% and 65.2%. The 95% confidence intervals will be the same if the values in the English and Scottish Regulations are used.

As composition data was taken from a non-random sample frame (e.g. for residual household waste, ACORN categories were used) this variation only represents the error associated with sampling. It is recognised that the use of the highly stratified design in this study may have introduced additional non-sampling bias which cannot be accounted for. WasteDataFlow records were not used directly to calculate confidence intervals as the figures reported are absolute values.

Appendix G - Packaging in the waste stream

A more detailed analysis of packaging content was carried out in addition to the main compositional analysis project brief. The executive summary of this research can be found below.

Analyses of the packaging waste were carried out in both summer and winter 2009, with the aim of identifying any seasonal variation in the materials arising.

Samples were collected from households in two Welsh Local authorities – Caerphilly and Cardiff. The sample selection was based on the ACORN Classification system that groups householders by wealth and spending power, age of occupants and presence of children. In total five sample areas were identified, four in Caerphilly and one in Cardiff.

The results showed that on average households produced 16.3kg per week of residual waste and dry recycling. This weight includes a little over 5kg per household per week of packaging material, which is equivalent to 33% of the total weight. The weight of packaging found in the dry recycling was 3kg per household per week and 2.4kg per household per week in the residual waste.

The greatest weights of packaging for all households arise from food 2.16kg, and drink 1.78kg sources. The weights per household per week for each were 2.16kg of food packaging and 1.78kg of drink related packaging. Packaging from household care and personal care sources was also found for all households on a weekly basis, in both seasons, but with much lower weights. Households are less likely to have packaging from toys, DIY and electrical equipment on a weekly basis.

Food packaging was found to be varied and not all of it can be recycled at the kerbside or at bring banks. In addition containers that need to be rinsed of food before they can be recycled often do not make it into the recycling bins as this takes additional effort on the part of the recycler e.g. jam and sauce jars. It may be advisable to find alternative packaging materials for certain types of food to help the less enthusiastic recyclers.

Overall packaging was dominated, in terms of weight, by glass and card. The residual waste plus recycling from the average household contained 1.62kg of glass per week and 1.26kg of card. The majority of the glass was from drinks packaging 1.16kg per household per week whilst card came from all sources.

Glass has a large weight and volume, but capture rates for glass containers are usually fairly high. A good percentage of this material is already being recycled at the kerbside where it is included in the scheme. As mentioned above glass jars containing food are often not recycled.

Card is used to package all sources from food to DIY materials, smaller pieces of card can be over looked and those that contain a window of plastic will also often not get into the recycling bin. In addition card that is contaminated with food may also be rejected from the garden waste and card recycling schemes run by many local authorities.

By the time of the winter sampling the waste and recycling kerbside collection system in Caerphilly had changed to an alternate weekly collection system for the waste and recycling. The timescale only allowed for a week to be spent on the sampling, as such it was not possible to collect both waste and recycling from three of the four Caerphilly sample areas. This has limited the data.

There appeared to be very little seasonal variation for packaging materials, but as several of the residual samples were missed in the winter sampling, seasonal variation should not be completely disregarded.

This study has concentrated on weights of packaging and not volumes, a future study should also consider volumes as materials such as plastics have little weight but can represent large volumes.

The results from this compositional analysis of household packaging waste by material type and source can provide recommendations for WRAP's future working with consumers, manufacturers and retailers.

Appendix H - Suitability for anaerobic digestion of food waste

This appendix provides a summary of research conduced by the Wales Centre of Excellence for Anaerobic Digestion at the University of Glamorgan as part of a wider survey of the Wales's Municipal Waste Composition during the summer and winter of 2009. The full report is also publicly available on the WRAP website.

Anaerobic digestion has been defined by the Welsh Assembly Government as the preferred technology for treating food wastes due to the valuable renewable energy produced as well as the valuable and low carbon fertiliser and soil conditioner that can be generated. A number of local authorities are currently at the procurement stage for their food waste treatment plants and anaerobic digestion may be the technology employed for the treatment. Even if treatment of the food wastes will be conducted using other technologies, the results from the chemical analysis will also help support the design and operation of those processes.

With any waste treatment technology, feedstock characteristics are extremely important when defining design and operational parameters. Even more so when treatment efforts are conducted by living microorganisms, which interact actively within a food chain and are affected by environmental conditions such as in anaerobic digestion treatment processes.

A sample of 5kg in weight was received by the Wales Centre of Excellence for Anaerobic Digestion from each local authority of the food wastes collected by WastesWork from two survey sessions, one in summer 2009 and one in winter 2009. For some local authorities the food wastes had been source segregated, but for others a sample was segregated by the WastesWork team from the refuse waste stream or from a mixture of food waste and green waste stream. Each sample was collected from up to four socio-economic clusters of 35 houses each. During the summer season all the food waste collected from the clusters was mixed and a subsample collected for analysis. During the winter season an apportionment was made to allow different weight contributions from each socio-economic cluster to make up the overall contribution within each local authority.

The analytical testing was carried out in two stages. Initially, analyses took place for carbohydrate, lipid and protein content as well as for total solids, volatile solids and ion concentration (sodium and potassium). In a second stage, additional testing took place on stored frozen samples and the following parameters were then analysed: elemental analysis (carbon, hydrogen, nitrogen, sulphur and oxygen); metals (Al, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Mo, Ni and Zn) and nutrients (phosphorous (total); phosphorus oxide (P_2O_5); ammoniacal nitrogen and nitrogen (Kjeldahl)).

Although there are concerns over the small number of samples analysed, the results provide valuable information for the anaerobic digestion plant designers and operators. The concentrations of proteins and light metals (Na, K and Ca) are significant and therefore monitoring and control of the plant should be performed so that inhibition conditions or the onset of instability within the digestion process are avoided. Effective start-up and acclimation phases will be fundamental to support good plant performance. Also desulphurisation of the biogas will be required due to significant levels of sulphur in the wastes and effective precautionary measures for odour control should also be considered.

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