

## Appendix 3: Mapping and evaluation of collated data

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This Appendix provides a summary of the data collated during this project and an overview of the different aspects of coverage of various municipal waste compositional data types.

An overriding consideration for all types of collated data is whether they should be selected for inclusion for subsequent project tasks, in particular for producing estimates of UK municipal waste composition. Whilst Appendix 3.1 provides an overview of *all* collated data, Appendix 3.2 describes the initial selection criteria that we have applied for determining which studies should be included. Appendices 3.3, 3.4 and 3.5 map the different types of collated data in greater detail and illustrate the distinction between datasets that result from either *all collated data* or from *applying the selection criteria* is made clear in these appendices.

The variability in the composition of the data meeting the selection criteria is considered at a local authority level in Appendix 4.1.2.

### 3.1 Overview of collated data

A large number of studies covering a wide range of UK local authorities and municipal waste streams have been collated, though with varying coverage of the different municipal waste streams. In fact, the amount of collated data greatly exceeds our initial expectations of what could be realistically collated during the project. The studies discussed in this Appendix are primary data gathering compositional studies carried out in the UK. Additionally, the vast majority are specific to one or more local authority area(s) and carried out in the past 5 to 6 years, with over half carried out from 2006 onwards.

Many of the collated studies have been carried out at county council or waste disposal authority level. For these studies, where district level results are available – particularly in relation to kerbside streams – it has been useful to consider data for each district as a separate dataset, due to the need to link district-level residual kerbside data with WasteDataFlow tonnage data (see Appendix 4). Furthermore, many studies address more than one municipal waste stream (i.e. different elements of kerbside, HWRC and sometimes other streams such as municipally collected trade waste). Since different municipal waste streams will have to be considered separately, it has also been useful to consider data for each separate waste stream from each study separately; though with the exception that most studies which analysed multiple kerbside streams (i.e. residual, dry recycling and garden waste), the kerbside waste streams have been considered to constitute a single dataset.

On this basis, therefore, the project has collated 535 different municipal waste compositional datasets in total. The numbers of datasets by contractor (carrying out the respective primary data gathering) are summarised in Table 3.1.

**Table 3.1: Number of UK municipal waste compositional datasets collated, by contractor**

Contractor	No. datasets collated
AEA Technology	18
Entec	33
MEL	171
Resource Futures (and subsidiaries)	268
RPS <sup>1</sup>	3
WastesWork	21
Other	21
<b>Total</b>	<b>535</b>

The numbers of datasets collated at the level of the different municipal waste streams are summarised in Table 3.2. The total number of datasets by waste stream (873) far exceeds the total number of datasets by contractor (535), since many of the datasets by contractor relate to analyses of more than one kerbside stream (i.e. residual, dry recycling, garden waste and/or organics).

**Table 3.2: Number of municipal waste streams covered by the 535 collated UK compositional datasets**

Waste stream	Total	2008	2007	2006	2005	2004	earlier
Kerbside residual	342	39	115	72	56	26	12
Kerbside dry recycling	229	35	83	53	32	9	2
Kerbside garden waste	114	21	36	34	14	1	2
Kerbside organics	21	7	8	4	1	1	0
Communal residual	19	0	6	3	2	7	0
Communal dry recycling	10	0	6	2	1	0	0
HWRC residual	53	4	13	15	5	11	2
HWRC other	9	1	1	5	5	2	2
Bulky waste collections	23	1	2	1	4	6	2
Commercial residual	17	0	4	5	4	3	2
Street sweepings & litter	13	0	4	1	5	3	1
Street recycling bins	3	0	2	0	0	1	0
Council office residual	8	0	3	0	3	2	0
Schools residual	6	0	2	0	3	0	1
Beach & caravan residual	2	0	1	0	0	1	0
Flytipping	2	0	0	0	1	1	0
Community skips	1	0	0	0	1	0	0
Bring site dry recycling	71	0	0	0	0	1	0
<b>Total</b>	<b>873</b>	<b>108</b>	<b>260</b>	<b>190</b>	<b>161</b>	<b>71</b>	<b>24</b>

Note: includes district level data sets and some non-disaggregated county level datasets.

<sup>1</sup> RPS data for Northern Ireland, available for two phases, has not been disaggregated as yet to unitary authority level, under-representing the number of datasets.

In Table 3.2, “kerbside organics” generally refers to mixed garden waste collections (ie garden waste with cardboard and/or food, etc).

### 3.1.1 Subsidiary compositional data within some datasets

Many of the collated datasets also include multiple compositional data, particularly in terms of:

- separate results per phase/season for many multi-phase studies;
- separate results per sampling category for many studies, where sampling stratification has been carried out; i.e. separate results for ACORN (A Classification of Residential Neighbourhoods) categories in many kerbside studies that applied ACORN stratification; or separate results for different commercial sectors in some studies where municipal commercial waste auditing has been stratified by sector / business type.

## 3.2 Evaluation and selection criteria

Following on from the collation of the large body of UK municipal waste compositional data, selection criteria were developed in order to distinguish datasets in terms of quality, so that they could be included in further analysis stages, leaving the weaker datasets to one side. The basic set of selection criteria needed to:

- be based on considerations of the datasets available;
- reflect differences in sampling strategies deployed in analysis of different municipal waste streams;
- identify issues of coverage, by municipal waste stream and region;
- consider the timeliness of the data, particularly in relation to kerbside and HWRC residual wastes
- consider the categorisation of waste materials.

Furthermore, one single set of criteria cannot be applied for all the analyses that the project will consider. For example, much kerbside data has been collated, in which case it may be fruitful to apply fairly demanding selection criteria, as this may result in a set of study data which is robust but nevertheless provides good coverage; (see Appendix 3.3). However for other municipal waste streams there is a dearth of data, and applying similarly strict criteria would likely result in excluding studies that should actually be included, if only because there is so little data available; (see Appendix 3.5).

General evaluation criteria have been developed for the project and are presented in Appendix 1. The criteria demonstrate the range of issues that have been (where appropriate) included in our considerations for establishing which studies should be included in various project tasks. Moreover these criteria map out the issues that should (where appropriate) be considered in assessing the robustness of analyses derived from a particular set of compositional data; and inform gap analyses in respect of UK municipal waste compositional evidence (see Appendix 6). However the selection criteria presented in Appendix 1 cannot be applied comprehensively and mechanically to any particular project task. For example, for the *selection* of kerbside residual data – for the purposes of producing estimates of overall UK municipal waste composition – it has been considered necessary to keep these criteria straightforward and reliant on a limited number of factors (Appendix 3.3.2).

## 3.3 Kerbside data

In this Appendix we review all collated kerbside compositional data (Appendix 3.3.1) and then review the kerbside datasets which have been selected for inclusion in the project for the purposes of further analysis (Appendix 3.3.2), including the production of estimates of national municipal waste composition (see Appendix 4).

### 3.3.1 Review of all collated kerbside compositional data

Kerbside data represents by far the most important municipal waste stream for many of the project tasks. This is particularly the case with regard to the aim of producing UK municipal waste compositional estimates (Appendix 4.1). Fortunately, a large body of kerbside data has been collated, consisting of 357 district level datasets<sup>2</sup>, plus some county / WDA level studies for which district level data is not available or disaggregation was not easily carried out from the data made available to the study. Approximately, 53% of the district level studies looked at more than one kerbside stream (i.e. residual plus dry recycling and/or organics). Of the remaining studies which looked at only one kerbside stream, most of them (82%) audited only kerbside residual waste. The numbers of kerbside compositional datasets collated for various kerbside streams are summarised in Table 3.3.

Summary details of the collated kerbside datasets, grouped by residual waste, dry recycling and organics (garden and/or food waste) are presented in Table 3.4, including the average sample weights per phase, number of households audited per phase and number of categories for each group of datasets. Although the average tonnage sorted per phase appears to be quite high across the kerbside studies, not all studies reported the weight of material sorted and of those that did, the majority sorted less than 5 tonnes. The mean values per phase were influenced by relatively few studies sorting 20 tonnes or more.

As mentioned, some of the collated datasets investigated only one kerbside stream (residual, dry recycling or organics), and summary details for these datasets are presented in Table 3.5. These studies give an indication to the differences in average sort weight for each of the three main kerbside streams compared with the data presented in Table 3.4.

**Table 3.3: Numbers of district level kerbside compositional datasets collated, by kerbside stream**

Waste stream	No.	%
Kerbside residual only	125	35.0%
Kerbside residual, dry & garden waste	87	24.4%
Kerbside residual & dry	50	14.0%
Kerbside dry only	44	12.3%
Kerbside garden waste only	15	4.2%
Kerbside & communal residual	10	2.8%
Kerbside residual, dry & organics	14	3.9%
Kerbside & communal dry	3	0.8%
Kerbside organics only	2	0.6%
Kerbside dry other	1	0.3%
Kerbside paper only	1	0.3%
Kerbside aerobic bin	1	0.3%
Kerbside dry & garden waste	1	0.3%
Kerbside residual & organics	1	0.3%
Kerbside residual, dry & food waste	1	0.3%
Kerbside, mansion blocks & estates residual	1	0.3%
<b>Total</b>	<b>357</b>	<b>100.0%</b>

Note: non-disaggregated county level data excluded.

<sup>2</sup> See Appendix 3.1 for definition of 'datasets'

**Table 3.4: Summary details for ALL collated kerbside datasets**

	Mean weight sorted/ study	Mean number of phases per study	Mean weight sorted/ phase	Mean number of households /phase	Mean number of sub-categories
Kerbside residual	6.1 tonnes	2.1	3.6 tonnes	201	46
Kerbside dry	4.7 tonnes	1.8	2.9 tonnes	244	49
Kerbside organics (FW/GW)	5.2 tonnes	2.2	3.0 tonnes	121	49

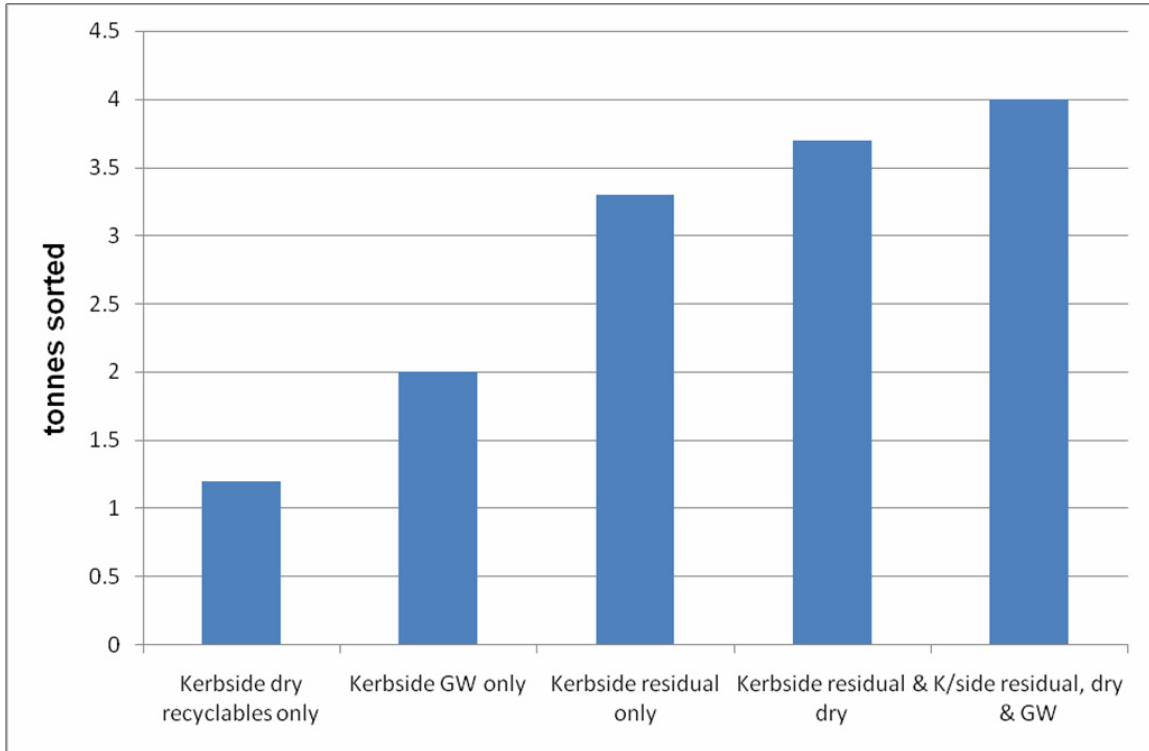
Note: "number of sub-categories" refers to total number of waste categories used to classify audited materials.

**Table 3.5: Summary details for SINGLE STREAM collated kerbside datasets**

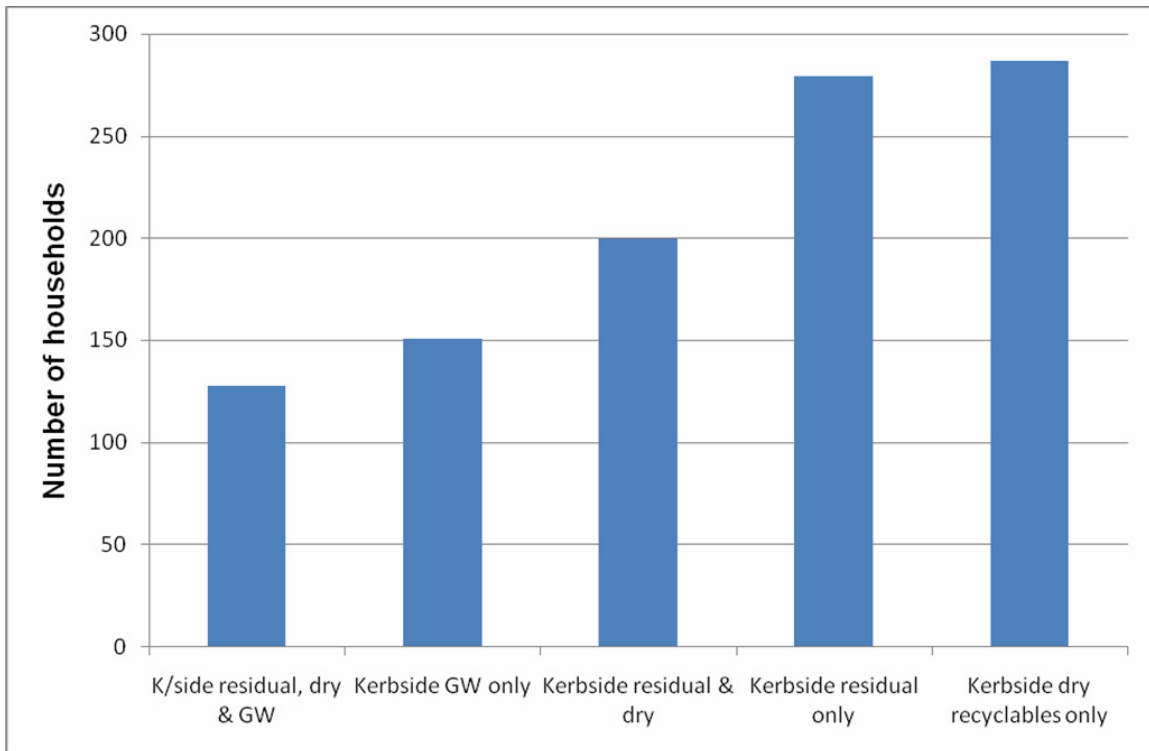
	Mean weight sorted/ study	Mean number of phases per study	Mean weight sorted/ phase	Mean number of households /phase	Mean number of sub-categories
Kerbside residual only	6.0 tonnes	1.8	3.3 tonnes	279	43
Kerbside dry only	2.5 tonnes	2.1	1.2 tonnes	287	49
Kerbside organics (FW/GW) only	2.6 tonnes	1.8	2.0 tonnes	151	26

The average tonnes of material sorted per dataset for different types of kerbside study are illustrated in Figure 3.1; and Figure 3.2 shows the average number of audited households sampled per phase for these studies.

**Figure 3.1: Average tonnes of material sorted per phase for main types of kerbside study**



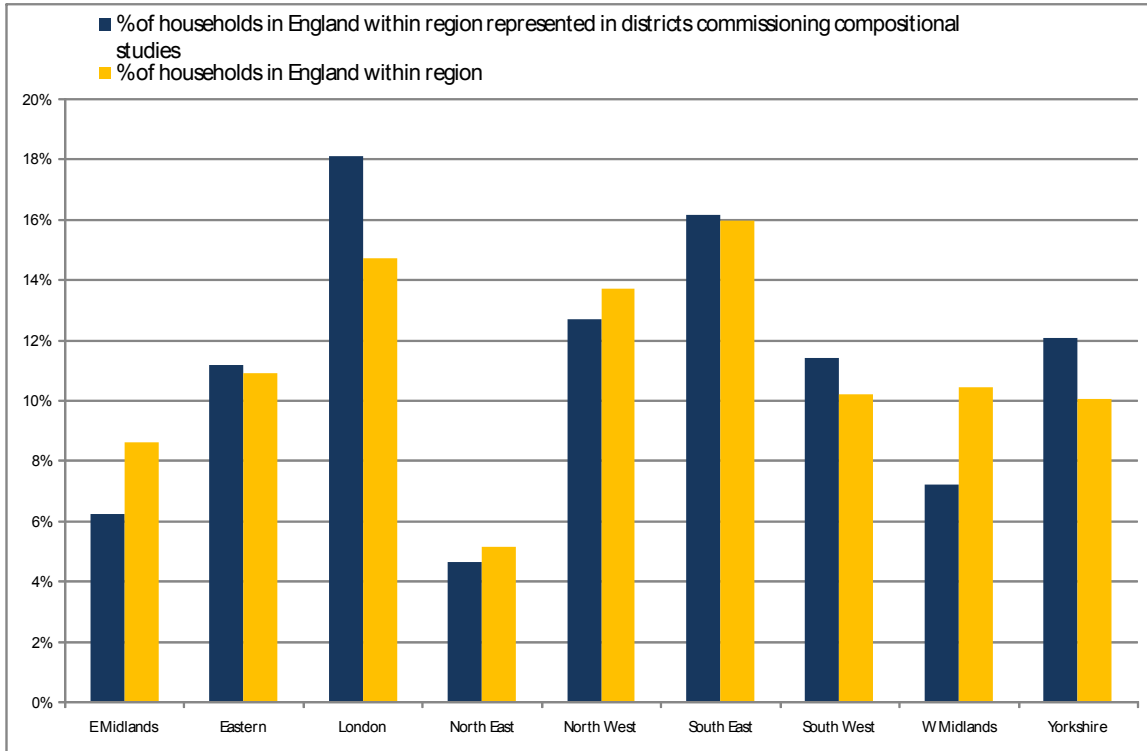
**Figure 3.2: Average no. households sampled per phase for main types of kerbside study**



The collated kerbside compositional datasets demonstrate an impressive coverage within England, with kerbside residual data of some description available for 63% authorities in England (at district/unitary level).

The coverage of collated kerbside residual datasets by different English regions is likewise impressive, with the proportion of collated studies by region matching fairly closely the proportions of households in the respective regions, as illustrated in Figure 3.3.

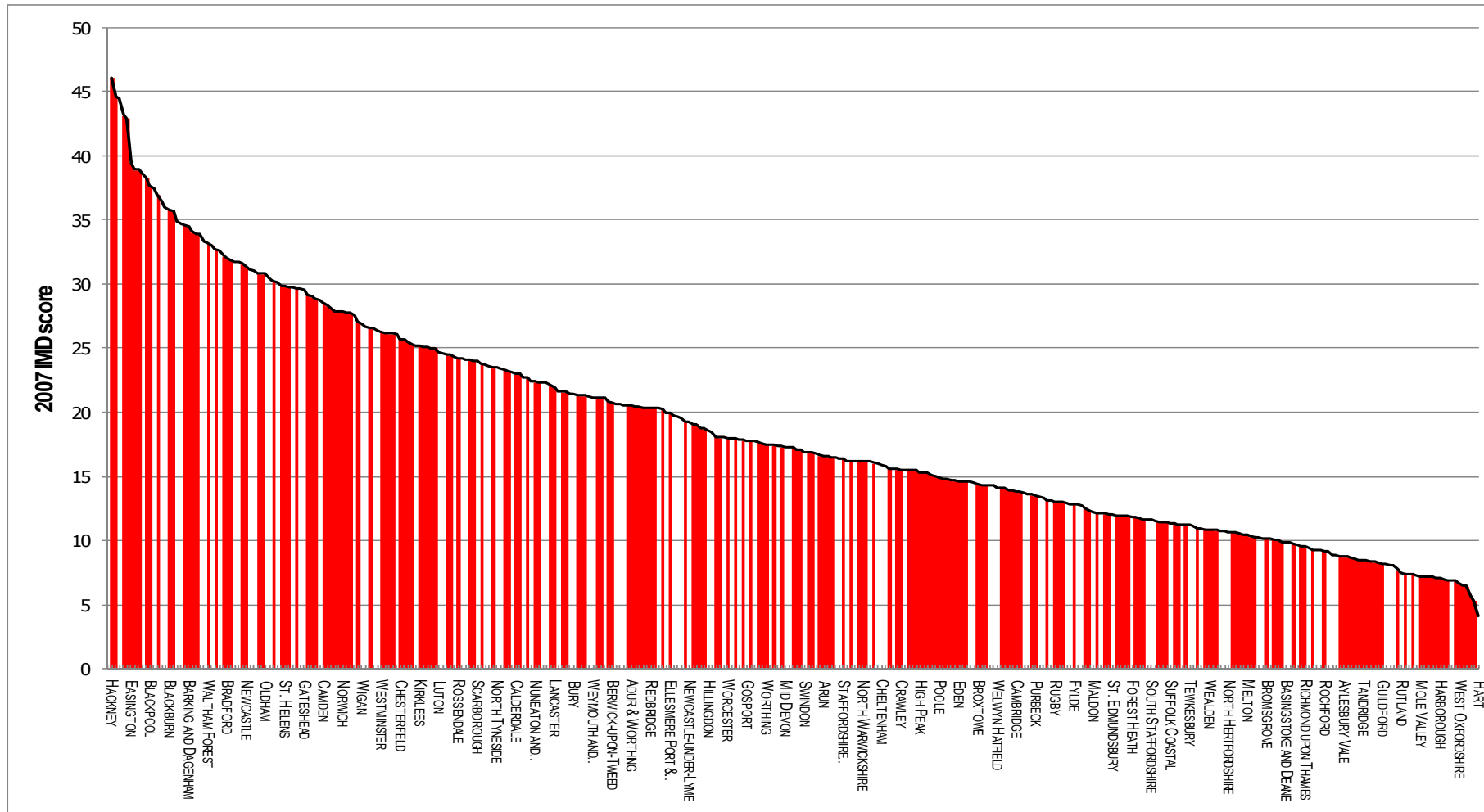
**Figure 3.3: Regional coverage of district-level kerbside residual studies collated in relation to proportions of households within regions: England**



Coverage in terms of levels of deprivation is also excellent, as demonstrated in Figure 3.4 below. This chart shows the spread of average deprivation scores<sup>3</sup> across England local authority areas (district/unitary authority level) – represented by the black line. Corresponding average deprivation scores for the 224 district/unitary level authorities for which kerbside residual compositional data has been collated are represented by the red bars. The y-axis in Figure 3.4 represents the 2007 Indices of Multiple Deprivation (IMD), with lower IMD scores indicating more affluent authorities, and higher IMD scores indicating less affluent authorities.

<sup>3</sup> Indices of Multiple Deprivation 2007

Figure 3.4: Coverage of collated kerbside residual datasets in terms of deprivation scores: England authorities, as of AUGUST 2008



Note: the names of some England districts are shown on the x-axis for illustrative purposes only – there is insufficient space to show the names of all districts.



UK municipal waste kerbside compositional data coverage is weaker outside England, with 10 datasets for Northern Ireland, 19 datasets for Scotland and 2 datasets for Wales. For Northern Ireland and Wales, these datasets are supplemented by studies held by Resource Futures relating to previous estimates of overall household waste composition in these devolved administrations, namely:

- RPS, Review of Municipal Waste Component Analysis (Northern Ireland), 2008;
- AEAT, Composition of Municipal Solid Waste in Wales, 2004.

For further comments on the coverage of collated data for the Devolved Administrations, refer to Appendix 4.5.

### 3.3.2 Evaluation of kerbside residual data and selected datasets

In evaluating the collated kerbside data, a set of selection criteria has been applied, for the purposes of using the selected data to produce estimates of overall UK municipal waste composition (Appendix 4). Due to the proliferation of kerbside residual waste composition available for England, it has been considered appropriate to apply reasonably restrictive selection criteria, for the purposes of producing updated overall municipal waste composition estimates, as follows:

- **Number of phases**, to account for seasonal variation and increase robustness of results through repeat auditing of sample areas;
- **Socio-demographic stratification**, to account for socio-demographic effects that can be expected to affect kerbside waste composition;
- **Timeliness of study**, such that more recent studies can be considered (to minimise effects of changing kerbside composition over time) and in order that kerbside residual data can be related to WasteDataFlow tonnage data (see Appendix 4).

Timeliness, in particular, is a crucial factor, in respect of (i) producing estimates which are not outdated; and (ii) integrating all kerbside residual waste composition estimates with a particular WasteDataFlow reporting year. The periods during which collated kerbside studies were carried out are summarised in Table 3.6, which indicates the numbers of studies for which sampling started and finished in each year.

**Table 3.6: Year of start and finish of sampling for collated kerbside compositional studies**

	2001	2002	2003	2004	2005	2006	2007	2008	Total
2001	1	0	0	0	0	0	0	0	1
2002	0	6	0	4	0	0	0	1	11
2003	0	0	3	7	0	0	1	1	12
2004	0	0	0	13	14	0	0	0	27
start year 2005	0	0	0	0	49	31	11	0	91
2006	0	0	0	0	0	39	26	5	70
2007	0	0	0	0	0	0	72	17	89
2008	0	0	0	0	0	0	0	16	16
Total	1	6	3	24	63	70	110	40	317

With these considerations in mind, the following selection criteria have been applied for the purposes of the specific project task of producing overall municipal waste composition estimates for England:

- 2 or more phases (some attempt to control for seasonality);
- ACORN, Council Tax band, or other socio-demographic stratification (some attempt to control for area types when generalising results for a district);
- start date of 2005 or more recent.

Applying these criteria results in over half of the collated kerbside studies being excluded, as shown in Table 3.7, illustrating the number of studies included and excluded, respectively by the contractor which carried out the studies.

**Table 3.7: Numbers of kerbside residual studies meeting selection criteria by contractor**

	Resource Futures	MEL	ENTEC	AEAT	WastesWork	Other
<b>Do not meet all criteria</b>	73	72	7	12	11	12
<b>Meet all criteria</b>	60	41	14	1	3	1
<b>% pass</b>	45.1%	36.3%	66.7%	7.7%	21.4%	7.7%
<b>Total</b>	133	113	21	13	14	13

The most important factor on which studies failed was the criterion that the study should have two or more phases. Of the 187 studies that failed, 76% failed on this criterion, with this being the only reason for failure in 58% of failed studies. The lack of area stratification (or the lack of a clear description in the study of how this was done) and studies pre-dating 2005 were less important disqualifiers. A small number of failed studies would also have failed due to their waste category lists being insufficiently detailed for the purposes of this study.

**Table 3.8: Analysis of failure rates by reason: kerbside residual studies**

	start year 2005 or more recent	2 or more phases	area type stratification	number of kerbside residual studies	% of all fails
fail on 3 counts				5	3%
fail on 2 counts				14	7%
fail on 2 counts				10	5%
fail on 2 counts				16	8%
fail on 1 count				9	5%
fail on 1 count				115	58%
fail on 1 count				28	14%
<b>pass on 3 counts</b>				<b>120</b>	
number of passes	258	167	279		
number of fails	59	150	38	<b>total fails</b>	<b>197</b>
% fail	19%	47%	12%		

The seasonal coverage for the 120 studies (kerbside residual) meeting the selection criteria is demonstrated in Table 3.9, which shows the total number of phases of auditing carried out in each season (assuming the commonly understood subdivision of four seasons of the year) across all the studies.

**Table 3.9: Number of phases of auditing per season across all kerbside residual studies meeting the selection criteria**

Winter: DEC, JAN, FEB	Spring: MAR, APR, MAY	Summer: JUN, JUL, AUG	Autumn: SEP, OCT, NOV
90	65	55	100

It is apparent that, amongst the studies meeting the selection criteria, there is a bias towards audits being carried out during autumn and winter months. This may possibly be linked to the financial spending cycles for local authorities and other clients that have commissioned waste auditing work.

The application of the selection criteria specified above has the great advantage that UK municipal waste compositional estimates derived from these studies can demonstrate that, insofar as kerbside residual waste is concerned, a serious attempt has been made to control for the relevant factors, namely:

- seasonality (and increased robustness through repeat sampling);
- socio-demographic factors affecting kerbside composition;
- use of reasonably current data, which can be integrated with WasteDataFlow tonnage data.

In relation to the latter point, it is important to choose a single WDF reporting year on which to perform the grossing-up calculations. The most appropriate period has been considered to be 2006/07, since this reporting year is the one which most closely matches the periods during which the selected residual kerbside studies were carried out. The grossing-up route for producing national municipal waste estimates involves integration of compositional data for the residual fraction around the operationally generated split of recycling tonnages (Appendix 4). Where compositional studies that meet the selection criteria relate to a sampling year other than the chosen WDF profile year for grossing-up, it is important to still weight the data using district level data from the target WDF reporting year; in order to build-up a picture of national arisings with reference to the chosen reporting year.

The selected studies maintain a good coverage by deprivation, as demonstrated by Figure 3.5, which shows the relative number of, respectively, *collated* and *selected* kerbside residual studies by quartile, in terms of deprivation scores.

**Figure 3.5: Collated and selected kerbside residual compositional studies by quartile of deprivation score**

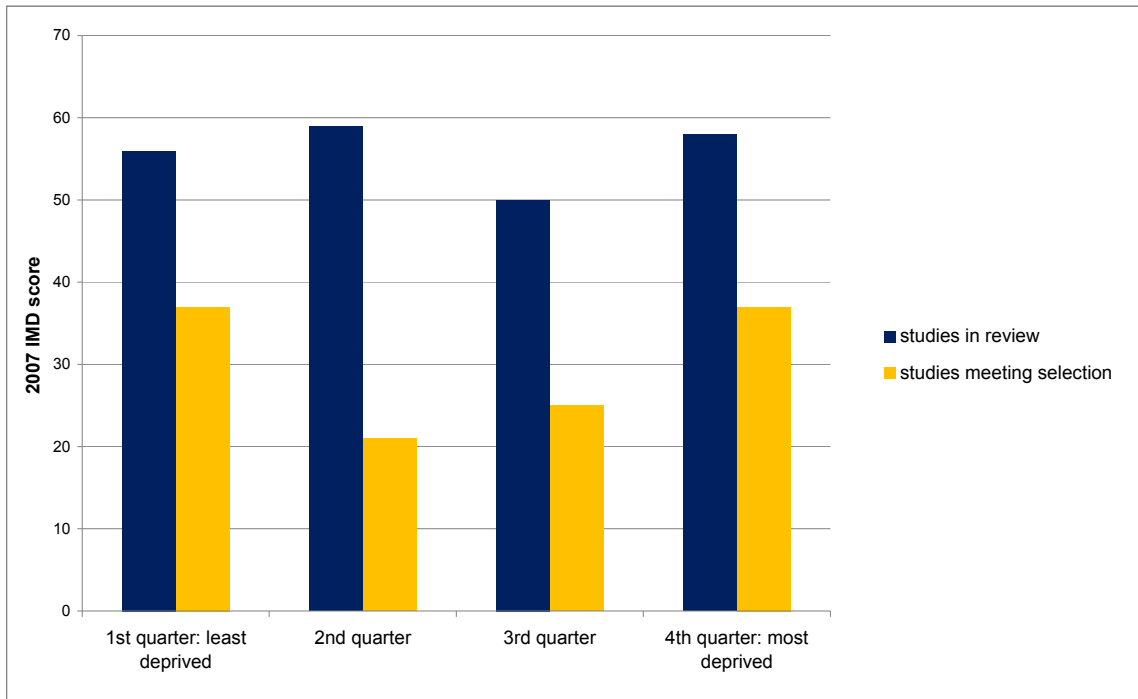
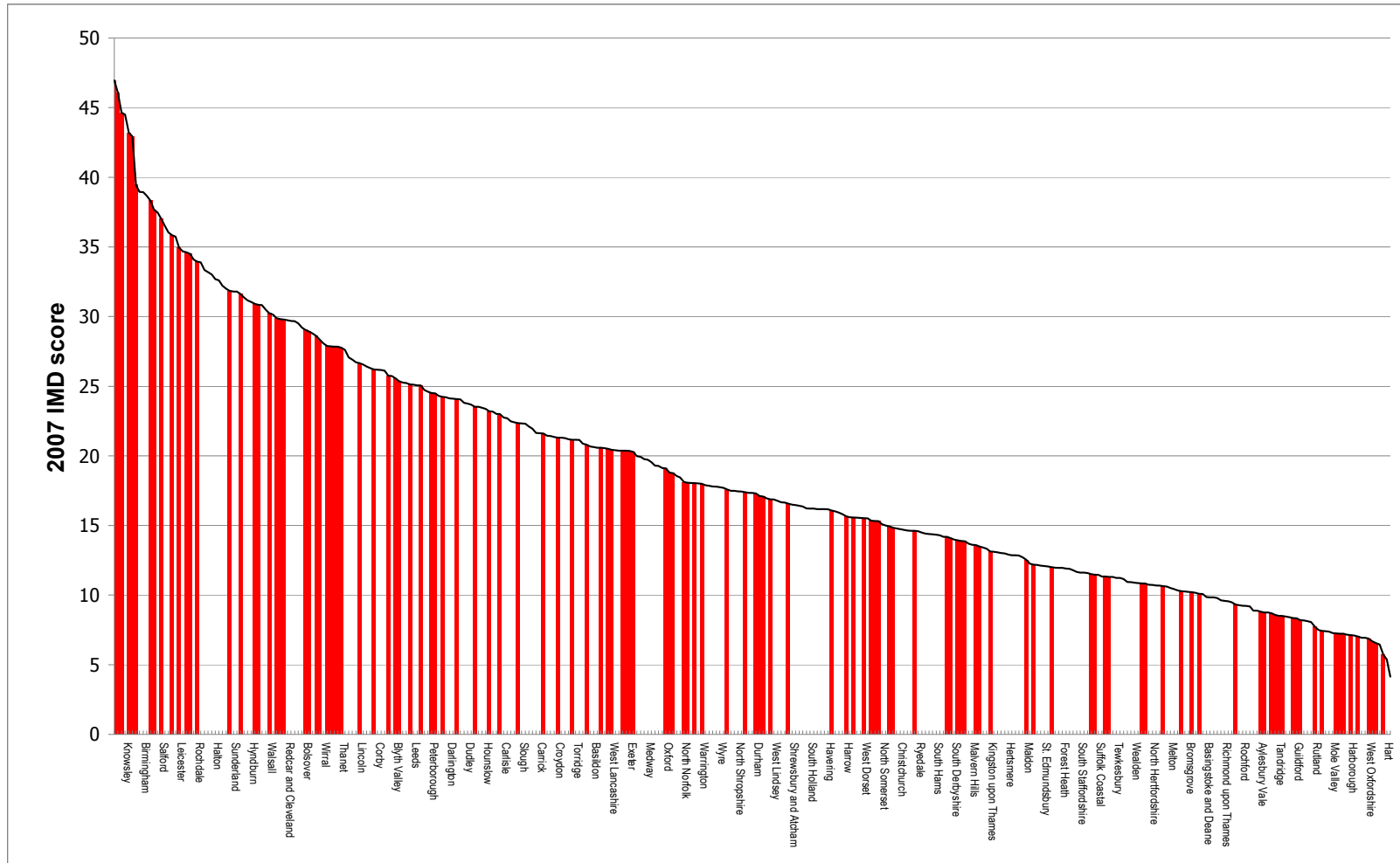


Figure 3.6 below illustrates the coverage of *selected* studies across local authorities (district and unitary authority level) by average deprivation score for each respective local authority. Although the coverage is not as dense as shown in Figure 3.4 for all *collated* studies, the coverage across ranges of deprivation scores for *selected* studies shown in Figure 3.6 is still excellent, albeit with a slight emphasis towards less affluent authorities; (which, interestingly, is in contrast to previous reviews of England municipal waste composition that have shown poorer coverage of these sorts of districts and an emphasis towards more affluent authorities).

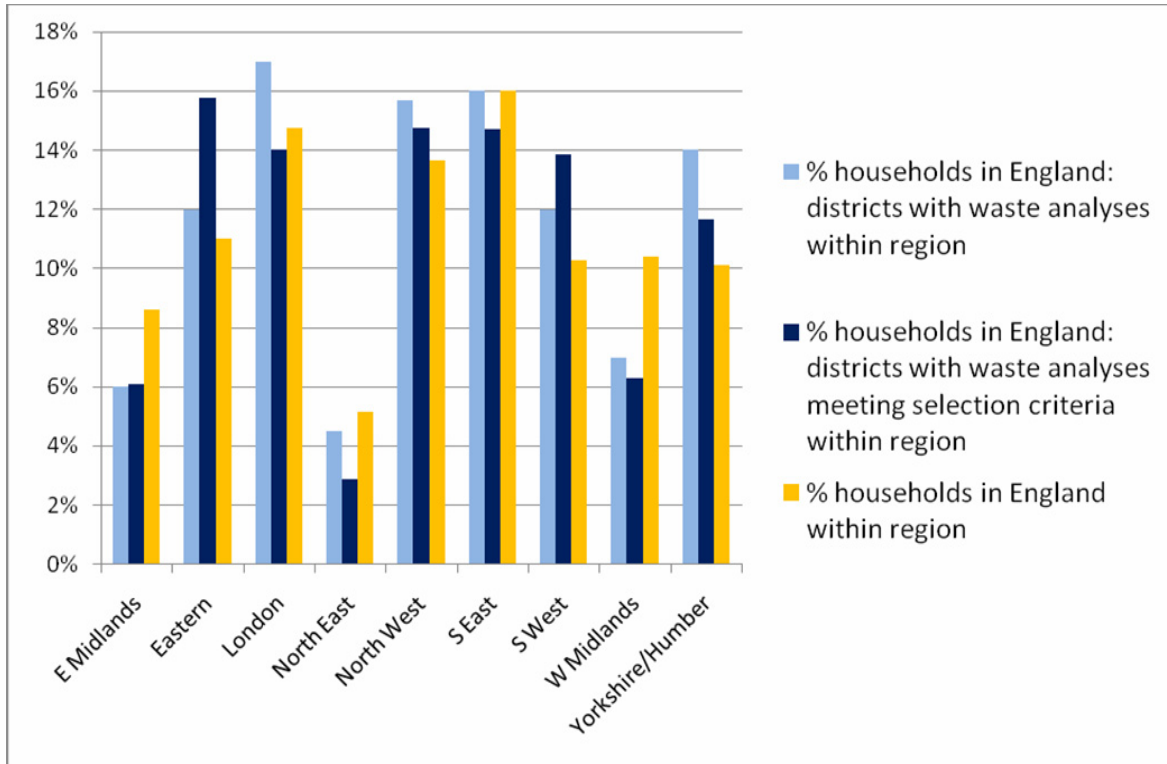
Figure 3.6: Coverage of selected kerbside residual datasets in terms of deprivation scores: England



Note: the names of some England districts are shown on the x-axis for illustrative purposes only – there is insufficient space to show the names of all districts.

Coverage for *selected* kerbside residual studies by England region is reasonable but contains some biases, as shown in Figure 3.7, which compares the proportions of *collated* and *selected* studies against the proportions of households in each respective region. The East of England and the South West are over-represented in terms of household numbers, whereas the Midlands (East and West) and the North East are under-represented.

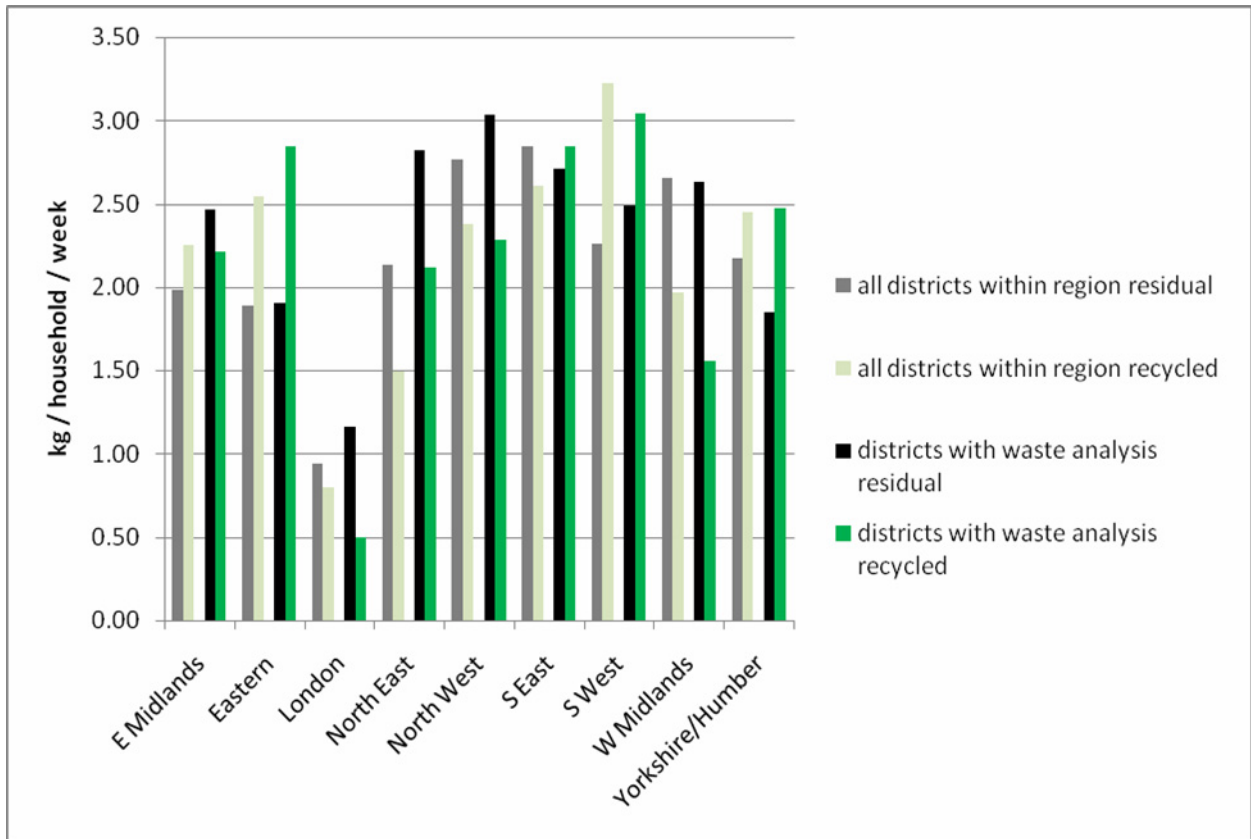
**Figure 3.7: Profile of kerbside residual studies and households by England region**



As a further assessment of the authorities represented within the selected compositional studies, a comparison was made between WasteDataFlow returns for these districts compared with regional mean values for kg/household/week for kerbside residual, kerbside recycling and for overall kerbside household weight.

Overall, no significant differences between represented and non-represented authorities were found. However, in the North West, West Midlands & Yorkshire and Humber the qualifying authorities had significantly lower recycling performance than other authorities within their region. In terms of overall weights: (kerbside residual + recycling), differences were narrower and were only statistically significant in the case of the West Midlands, where the 9 selected authorities reported less waste per household than the remaining 25 West Midlands authorities.

**Figure 3.8: Regional coverage of kerbside studies collated, comparison of WasteDataFlow mean arisings (residual and recycling kg/hhld/week) for districts with compositional data compared with all districts within region: England**



### 3.3.3 Kerbside non-residual datasets

In respect of compositional studies that audited non-residual kerbside streams, these can be broadly categorised into two groups:

- Dry recyclables
- Organics – garden waste and/or food waste.

With regard to organics, these compositional studies are of less relevance to the project key tasks, since the compositional breakdown of organic fractions represents fewer challenges in comparison to kerbside dry recycling. Moreover many compositional issues relating to kerbside organic waste can be addressed sufficiently through (i) WasteDataFlow or (ii) work commissioned recently by WRAP in relation to food waste arisings and composition; notably The Food We Waste project (2008) and the recently commissioned study in Scotland.

By contrast, assessing the overall composition of kerbside dry recyclables presents major challenges, in particular due to WasteDataFlow not able to provide the compositional breakdown of dry recyclables as it is primarily a vehicle for collecting operational tonnages (see Appendix 4). Therefore the focus of this Appendix is on kerbside dry recyclables compositional data.

For kerbside dry recyclables compositional datasets, 76% of collated studies analysed dry recyclables alongside either residual or residual and garden waste or organic waste. A summary of collated district-level datasets which included kerbside dry recyclables is presented in Table 3.10.

**Table 3.10: Summary of district-level collated kerbside dry recyclables datasets**

Collection configuration	Frequency	Percent
Kerbside residual, dry & garden waste	87	41.2%
Kerbside residual & dry	59	28.0%
Kerbside dry only	44	20.9%
Kerbside residual, dry & organics	14	6.6%
Kerbside & communal dry	3	1.4%
Kerbside dry other	1	0.5%
Kerbside paper only	1	0.5%
Kerbside dry & garden waste	1	0.5%
Kerbside residual, dry & food waste	1	0.5%
<b>Total</b>	<b>211</b>	<b>100.0%</b>

The same criteria for including kerbside residual datasets (Appendix 3.3.2) has been applied to kerbside dry recycling datasets; i.e. multi-phase, socio-demographic stratification and carried out since 2005. The kerbside dry recycling studies selected according to these criteria are summarised in Table 3.11.

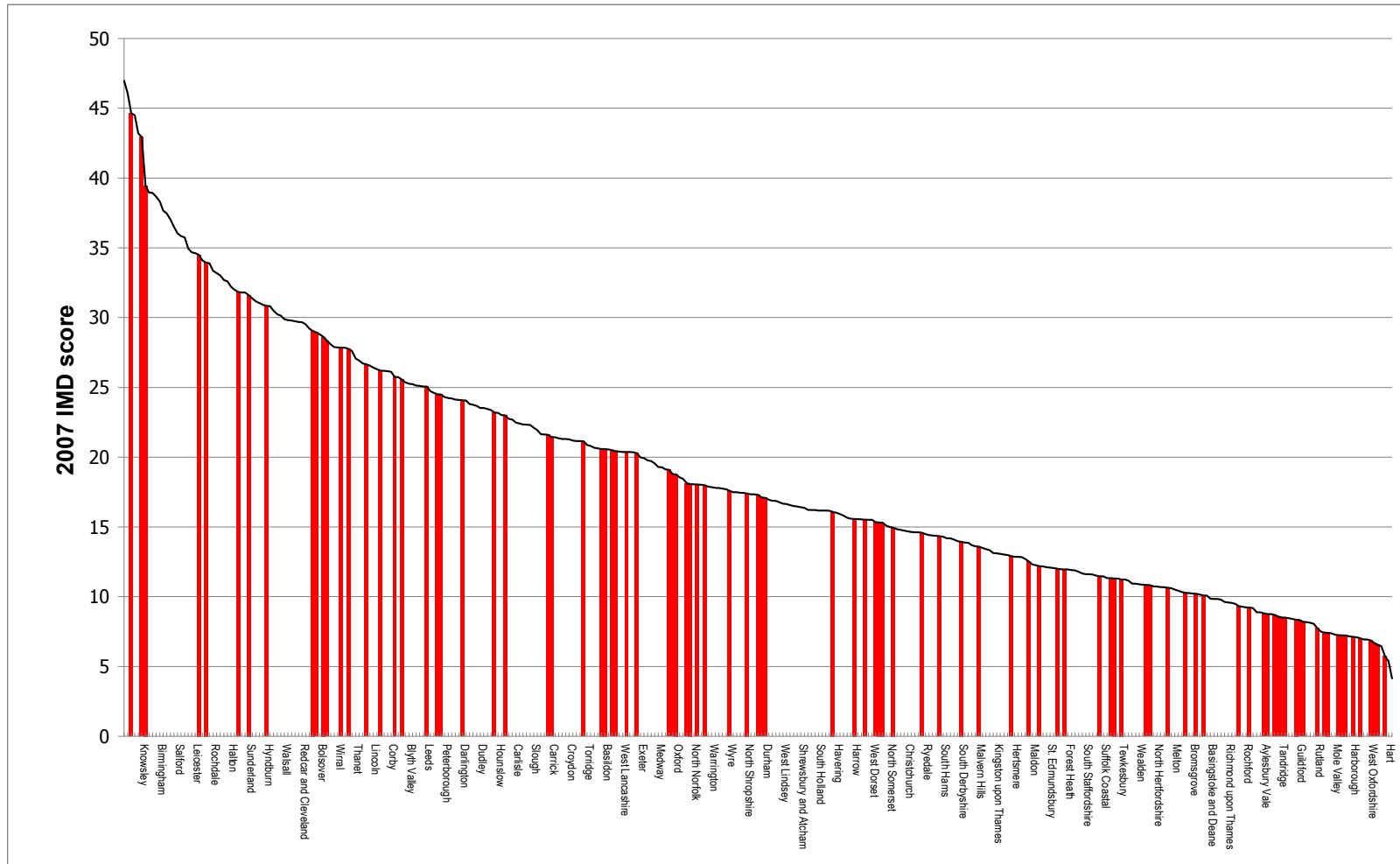
**Table 3.11: Summary of selected kerbside dry recyclables datasets**

Collection configuration	Frequency	Percent
Kerbside residual, dry & garden waste / organics	40	42.6%
Kerbside residual & dry	53	56.4%
Kerbside dry only	1	1.1%
<b>Total</b>	<b>94</b>	<b>100.0%</b>

The coverage of selected kerbside dry recyclables datasets in terms of average deprivation scores for England authorities is illustrated in Figure 3.9. Overall, there is some similarity to the outcome of the kerbside residual selection process (see Figure 3.6 above) as many of the selected dry recyclable studies were linked to residual studies that also met the three selection criteria. However there is considerably lower coverage for less deprived authorities.



Figure 3.9: Coverage of selected kerbside dry recyclables datasets in terms of deprivation scores



Note: the names of some England districts are shown on the x-axis for illustrative purposes only – there is insufficient space to show the names of all districts.

The coverage of selected kerbside dry recyclables datasets in terms of regional coverage in England is demonstrated in Figure 3.10, which compares the proportions of *collated* and *selected* studies against the proportions of households in each respective region.

**Figure 3.10: Profile of kerbside dry recyclables studies and households in England by region**

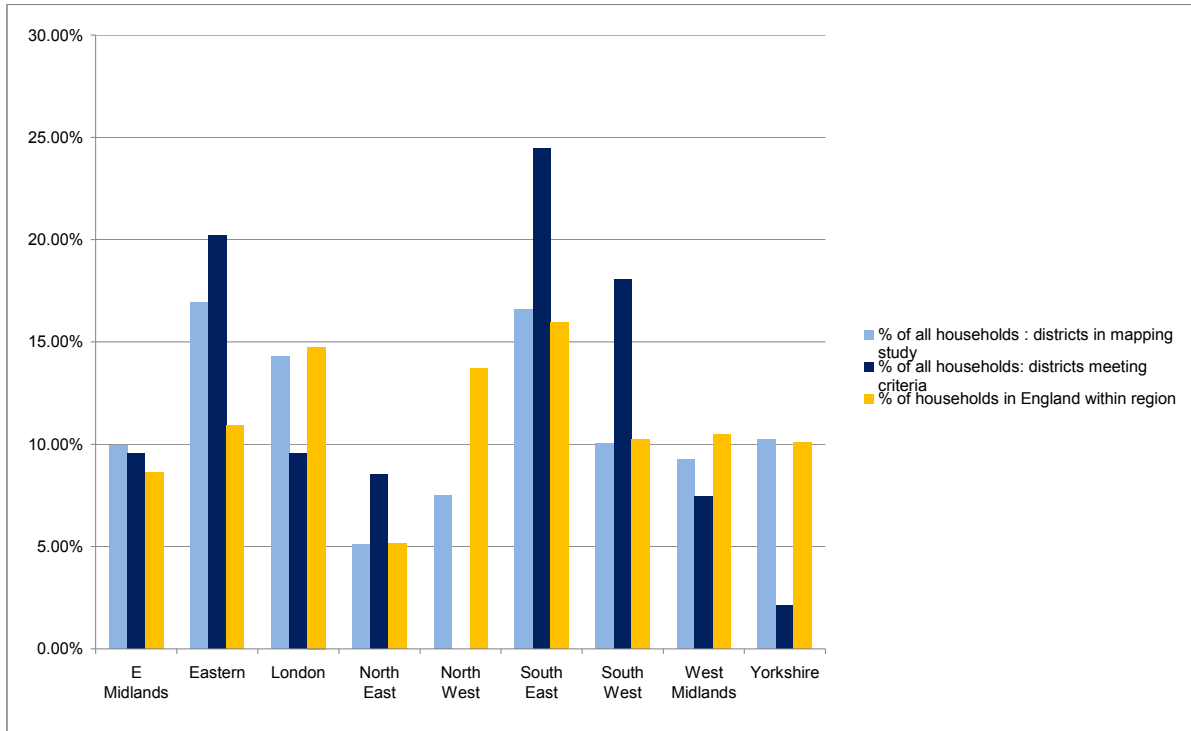
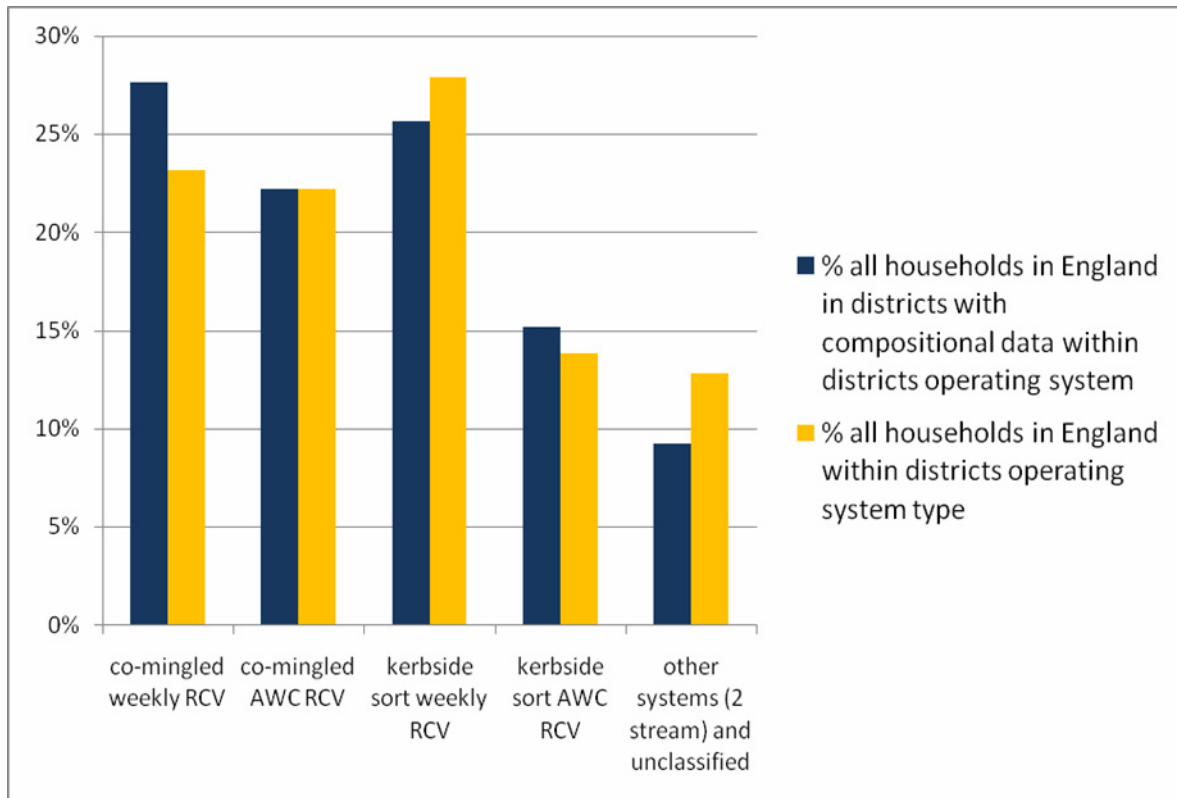


Figure 3.10 shows that for the selected studies, there is a dearth of qualifying data for the North West (with no selected studies) and Yorkshire due to the fact that most of the qualifying residual studies (Figure 3.8) did not include analysis of dry recyclables as well. Whether or not the North West and Yorkshire & Humber regions differ from other regions in terms of the composition of dry recyclables cannot be answered from the available data.

More importantly from the perspective of the proposed grossing-up methodology, there is good coverage by recycling system type (Figure 3.11). Districts with dry recyclable kerbside studies meeting the qualifying criteria broadly match the proportion of households covered by the different systems across England. For example, 20% of households in England live in districts operating co-mingled recycling collections in which the refuse is collected weekly. For districts with qualifying studies, 25% of households live in districts with these recycling systems. In view of the fact that co-mingled systems (and some kerbside sorted) report mixed waste tonnages to WasteDataFlow, good coverage of different collection system types allow compositional data on dry recyclables to be used to estimate compositional profiles for systems reporting co-mingled tonnages.

**Figure 3.11: Profile of kerbside dry recyclables studies and households in England by recycling collection system type**



### 3.4 HWRC data

Household Waste Recycling Centres (HWRCs) account for a significant proportion of municipal waste and are therefore an important municipal waste stream for this project to consider. Previous national municipal waste compositional reviews have had access to limited HWRC compositional data, but in general data for this municipal waste stream has been inadequate. This project has been successful in collating a reasonably large set of HWRC compositional data, with 56 studies in total. These studies have primarily been either:

- **Input audits:** visitor-based samples, used to estimate either overall HWRC waste composition or composition of wastes intended for disposal in residual waste skips;
- **Output audits:** audits of residual waste skips, used to estimate HWRC residual waste composition.

The numbers of different types of HWRC compositional studies collated are shown in Table 3.12, with the number of studies included for further analysis and those which were excluded. A total of 7 of the collated studies were repeat audits of sites which had been investigated in other studies; data from these studies have been linked into a single HWRC dataset where possible (4 out of these 7 studies). A total of 6 studies used limited category lists for HWRC waste which were insufficiently detailed for the purposes of this study while 4 of the collated studies identified mixed bagged waste as a substantial proportion of their sample, but did not sub-analyse this waste; therefore these studies were excluded from further analysis<sup>4</sup>.

34 HWRC residual waste were included in the analysis (6 input and 28 output studies of residual waste); refer to Table 3.12.

<sup>4</sup> In principle, the composition of bagged waste for these studies could have been estimated through applying an overall average estimate of black bin waste, derived from kerbside waste audits. However this relies on the assumption that all bagged waste delivered to HWRCs is similar in composition to kerbside residual waste; and the composition of kerbside residual waste also varies considerably between different areas and local authorities.

**Table 3.12: Numbers of collated HWRC compositional studies, by type of study**

Type of HWRC study	Input, all materials	Input, residual waste	Output, residual waste	Total
Included in analysis	5	6	28	<b>39</b>
Repeat study of same HWRCs	0	0	7	<b>7</b>
Excluded due to limited category lists	1	1	4	<b>6</b>
Excluded due to large fractions of unsorted bagged waste in samples	0	1	3	<b>4</b>
<b>Total</b>	<b>6</b>	<b>8</b>	<b>42</b>	<b>56</b>

A total of 50% of the selected input and output studies audited residual waste across two or more phases (i.e. attempted to control for compositional variations due to seasonality, an extremely important feature of HWRC operations). Furthermore, 85% of input and output studies carried out audits on both weekends and weekdays, attempting to control for compositional variations due to the day of the week. HWRC materials have generally been audited in a far greater degree of detail in terms of categorisation, with category lists for HWRC audits often being more extensive (maximum of 80 categories amongst collated studies) in comparison to kerbside audits (maximum of 66 categories amongst collated studies). However, the number of categories included in WDF for HWRC tonnages are generally fewer than those found in the collated compositional studies as there is usually a significant time lag in the addition of new materials to WDF to reflect the growing list of materials segregated at HWRCs.

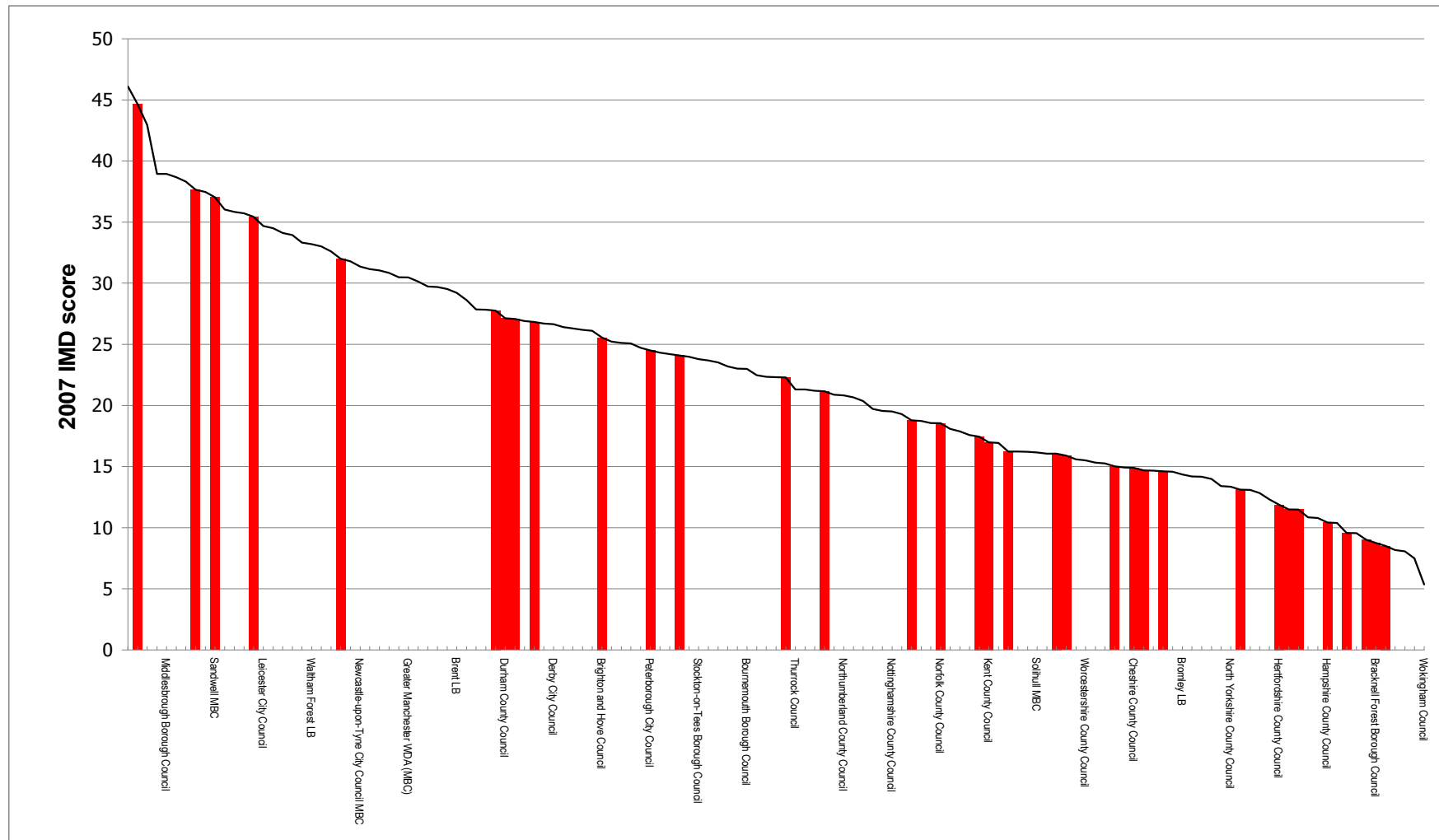
The overall coverage of the 34 HWRC residual waste datasets included in the analysis, in terms of deprivation score is good, as illustrated in Figure 3.11. However there are some biases, with a greater representation of authorities with deprivation scores which are average or below average (a bias towards more affluent districts).

Related to this bias, the coverage of collated HWRC studies in terms of English regions (Figure 3.12) shows a strong emphasis towards the South East and South West regions, and a relative lack of studies for East Midlands and Yorkshire and Humber regions. This pattern of commissioning may well reflect the regional biases in segregation efficiencies, with those regions in the southern half of the country generally separating a higher proportion of material inputs to HWRCs.

Comparison of WasteDataFlow HWRC arisings data (kg/household/week, residual and recycled/composted) shows no statistically significant difference between districts with and without compositional data. At a regional level, although numbers of compositional studies are low for some, differences between regional mean values and those of local authorities with compositional data are not significant (Figure 3.13).

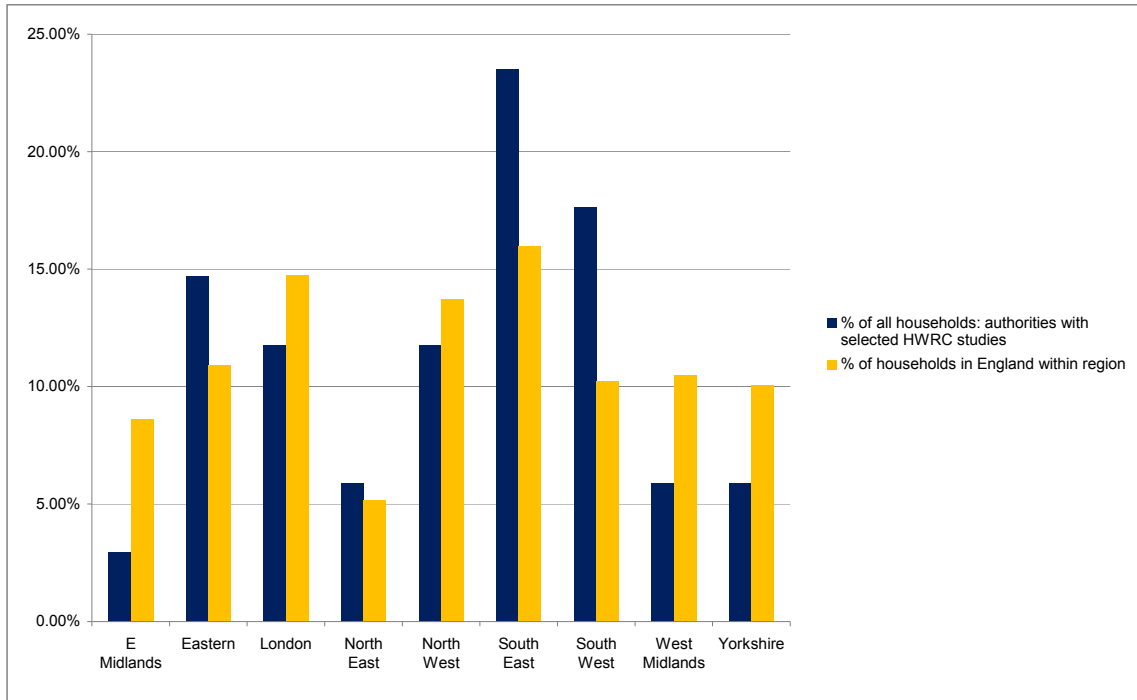
Overall, the HWRC compositional data collated for this project exceeds that available for previous national municipal waste compositional reviews.

Figure 3.11: Coverage of collated HWRC datasets in terms of deprivation scores: Unitaries and Waste Disposal Authorities in England

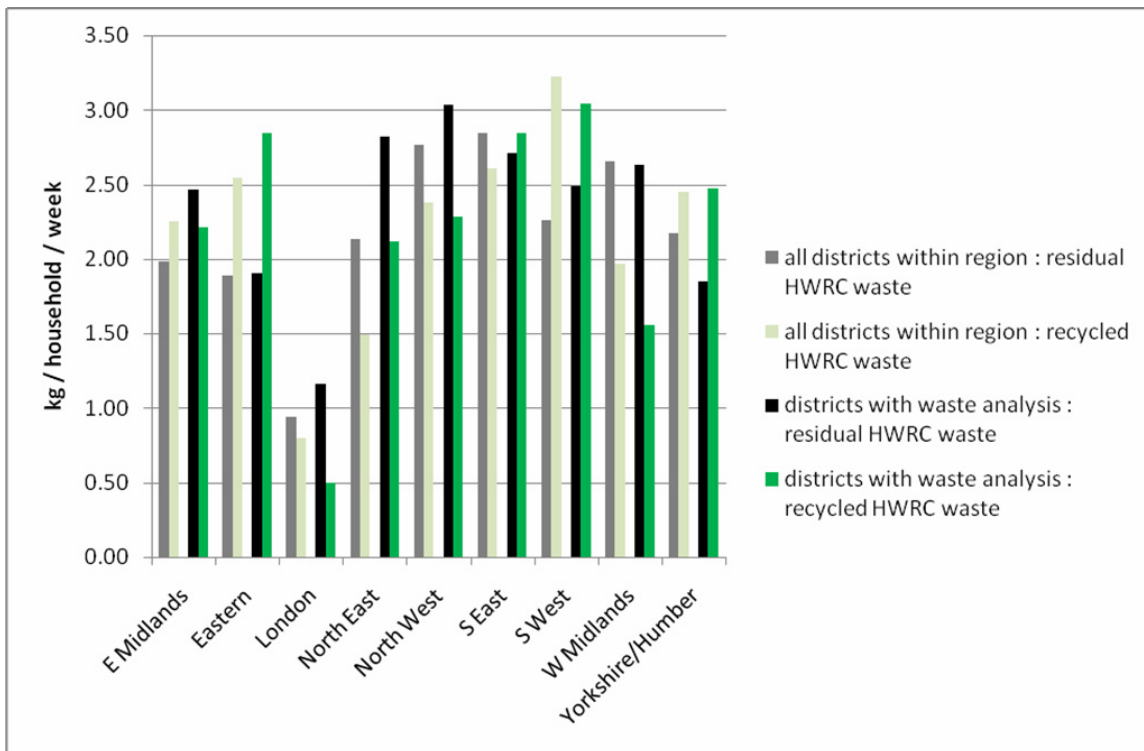


Note: the names of some England authorities are shown on the x-axis for illustrative purposes only – there is insufficient space to show the names of all authorities.

**Figure 3.12: Regional coverage of HWRC studies collated in relation to proportions of households within regions: England**



**Figure 3.13: Regional coverage of HWRC studies collated, comparison of WasteDataFlow mean arisings (residual and recycling kg/hhd/week) for districts with compositional data compared with all districts within region: England**



### 3.5 Data on other municipal waste streams

In common with previous reviews, few compositional studies were located for other municipal waste streams, as shown in Table 3.13. These other municipal waste streams included household waste streams that are not regular kerbside collections from households (other household waste collections, such as street cleansing/litter, bulky waste collections) and non-household streams. Of the 106 studies shown in Table 3.13, most related to 'other household waste' collections (litter, bulky waste, etc), with commercial municipal collections represented by 25 studies.

For these streams, no studies have been excluded for the purposes of producing UK municipal waste compositional estimates. The match between available studies and the most relevant WasteDataFlow reporting categories has required careful assessment within the grossing-up process. For further comments, refer to Appendix 4.1. A brief review of collated studies for different non-kerbside and non-HWRC municipal waste streams is presented below.

**Table 3.13: Numbers of collated municipal waste compositional studies, excluding household kerbside streams and HWRCs**

Waste stream	Total	2008	2007	2006	2005	2004	Earlier
Bulky waste collections	17	1	3	1	4	6	2
Communal residual	17	0	6	2	2	7	0
Communal dry	8	0	6	1	1	0	0
Commercial residual	25	0	1	18	2	3	1
Street cleansing, sweepings & litter	14	0	4	1	5	3	1
Street litter bins & recycling bins	3	0	2	0	0	1	0
Council offices	8	0	3	0	3	2	0
Schools residual	6	0	2	0	3	0	1
Beach & caravan residual	4	0	3	0	0	1	0
Flytipping	2	0	0	0	1	1	0
Community skips	1	0	0	0	1	0	0
Bring site dry	1	0	0	0	0	1	0
<b>Total</b>	<b>106</b>	<b>1</b>	<b>30</b>	<b>23</b>	<b>22</b>	<b>25</b>	<b>5</b>

#### 3.5.1 Communal residences

A total of 17 collated studies audited bins servicing communal residences (such as flats). Most studies included communal residual and dry recyclables. The numbers of phases ranged from 1 to a maximum of 4. The weight of material sorted per phase ranged from 1 to 2.5 tonnes.

### **3.5.2 Municipally collected commercial waste**

A total of 25 of the collated studies audited different types of municipally collected commercial, trade and market waste. Most studies attempted to stratify target samples by commercial sector or business type (SIC code). Some studies audited wastes presented by different business for municipal collection, whilst other studies audited samples from collection vehicles. Phases ranged from 1 to a maximum of 4, with weights sampled per phase ranging from 1 to 13 tonnes.

### **3.5.3 Street cleansing, sweepings and litter**

A total of 14 of the collated studies audited street sweepings and/or litter; 2 studies attempted to stratify urban and rural sample areas. Phases ranged from 1 to a maximum of 4, with weights samples per phase ranging from 60 kg to 5 tonnes.

Additionally 3 datasets relating to street bin litter and street bin recycling were collated; and 3 datasets relating to residual waste from beach cleansing/litter bins, and one dataset for caravan park residual waste.

### **3.5.4 Bulky Waste Collections**

A total of 17 of the collated studies audited bulky waste collections. All available studies were carried out by Resource Futures or MEL. These were all single phase studies, with weights sorted ranging from 1.7 to 9.5 tonnes.

### **3.5.5 Council Offices**

Eight of the collated studies audited waste from council offices or premises. Some of the studies also audited schools waste as part of the same audit. All collated studies were single phase and weights sorted ranged from 0.3 to 2.4 tonnes.

### **3.5.6 Schools**

Six of the collated studies audited school's waste. Study samples ranged from one school to 15 schools (a WRAP funded study). All studies were single phase and weights sorted ranged from 0.4 to 10.0 tonnes.

## **3.6 Coverage of data meeting selection criteria: conclusions**

The review has found a significant number of kerbside and HWRC studies and relatively few relating to other municipal waste streams. In view of the amount of data available for kerbside residual and dry recyclables, it has been possible to select-out studies that did not meet the basic qualifying criteria in order to concentrate the analysis on the higher quality datasets.

For other municipal waste streams, the number and coverage of studies is not as great. Despite this, it is important to compile compositional estimates for these waste streams as they have not before now featured in estimates of national waste composition in England. Elsewhere, only the 2003 WAG (Welsh Assembly Government) report 'Composition of Municipal Solid Waste in Wales' has provided any estimates for these waste streams.

Further comments on data coverage and gaps are provided in Appendix 6.