

Commercial and Industrial Waste Survey 2009 Final Report

December 2010



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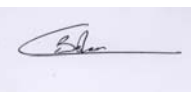




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Executive Summary

Survey context and approach

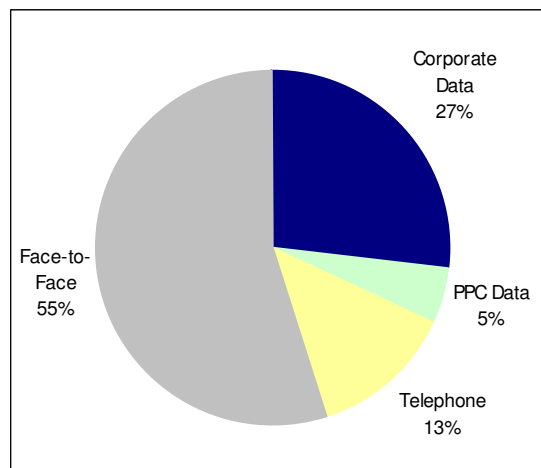
Jacobs supported by Halcrow were commissioned to undertake a national survey of Commercial and Industrial (C&I) waste arisings and management methods by the Department for Environment, Food and Rural Affairs (Defra). The survey was funded in partnership with the London Waste and Recycling Board (LW&RB) and the South West region.

The survey obtained data for the eight English regions, (at a NUTS 1 level) recognising that a separate survey had already been undertaken for the North West region¹. The project determined the total tonnage of C&I waste produced in England, in the calendar year 2009.

A random optimised stratified sampling methodology was adopted to derive a sample matrix to aim for an overall error on the total tonnage of C&I waste across the eight English regions surveyed of within +/-5% at a 95% confidence interval. The sample matrix was built up of 576 pools representing 12 industry and business sectors at 6 scales for each of the 8 regions covered within the survey. This approach yielded an optimal sample and in many cases this required the data from the whole population within a number of pools to be gathered. In delivering the survey the matrix was used to steer the data gathering to yield a sample that was as close to optimal as was practically achievable.

The results of this survey represent the most reliable and comprehensive set of national data on C&I waste for over 5 years. Data on waste arisings in 2009 from a total of 6,005 businesses was gathered between June and October 2010. The data was mainly collected through face-to-face and telephone interviews, additional data was gathered from the Environment Agency (EA) (PPC data) and from company head offices (corporate data), shown in Figure ES 1.

Figure ES 1: Breakdown of collected data



¹ Urban Mines, Commercial and Industrial Waste data analysis of the North West Region, December 2008

From the data collected, combined with data from the North West survey, the project outputs provide:

- The tonnage of waste produced from C&I businesses; split by:
 - waste type
 - business size including small/ medium enterprises (SMEs)
 - generating sector
 - region of arising
 - management method
- Information on the potential for further recycling/recovery of different wastes currently sent to landfill.

These outputs were replicated at Waste Planning Authority (WPA) level for the London and South West regions.

Sector, material and regional waste arisings

The total England C&I waste arisings in 2009, based on the survey results and North West data, is 48 million tonnes (mt), split evenly between commercial and industrial businesses as shown in Table ES 1. In addition to this, it is estimated that there are around 2.5mt of “non-wastes” not captured by the survey, specifically blast furnace slag and virgin timber.

Table ES 1: Waste arisings by sector ('000s tonnes)

	Sector	Total Arisings	Percentage
1	Food, drink & tobacco	4,756	10%
2	Textiles / wood / paper / publishing	3,449	7%
3	Power & utilities	5,719	12%
4	Chemicals / non-metallic minerals manufacture	3,848	8%
5	Metal manufacturing	4,236	9%
6	Machinery & equipment (other manufacture)	2,165	4%
Industry total		24,173	50%
7	Retail & wholesale	9,211	19%
8	Hotels & catering	2,671	6%
9	Public administration & social work	2,891	6%
10	Education	1,481	3%
11	Transport & storage	2,189	5%
12	Other services ²	5,401	11%
Commercial total		23,844	50%
Grand total		48,017	100%

The precision for the total waste arisings figure was 7.6% at a 95% confidence interval and at regional level the arisings were of a similar precision. The error is higher than that targeted for due to the optimal sample being unachievable in reality within a voluntary survey.

² Other services include a wide range of commercial business not covered by the other sectors including: arts, entertainment and recreation, administrative and support service activities, professional, scientific and technical activities, real estate activities, financial and insurance activities Information and communication. A full list of these is given in Appendix B..

The tables and figures below split the total waste arisings figure by broad material type (Table and Figure ES 2), region (Table and Figure ES 3) and by management method (Table ES 4).

Table ES 2: Waste arisings by material type ('000s tonnes)

Waste type	Total Arisings	Percentage
Animal & vegetable wastes	3,757	8%
Chemical wastes	5,380	11%
Common sludges	896	2%
Discarded equipment	759	2%
Healthcare wastes	1,856	4%
Metallic wastes	2,613	5%
Mineral wastes	8,896	19%
Mixed wastes	12,302	25%
Non-metallic wastes	11,554	24%
Non-Wastes	6	0%
Grand total	48,019	100%

Figure ES 2: Waste arisings by material type

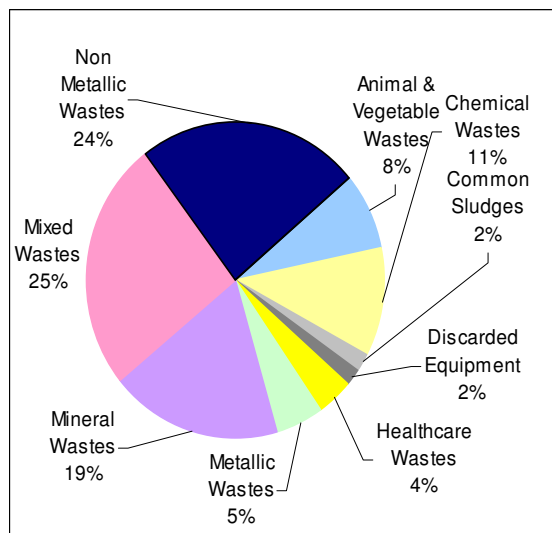


Table ES 3: Waste arisings by region ('000s tonnes)

Region	Total Arisings	Percentage
North East	2,357	5%
Yorkshire and The Humber	6,942	15%
East Midlands	6,308	13%
West Midlands	5,246	11%
East of England	4,506	9%
London	4,810	10%
South East	6,250	13%
South West	4,073	8%
North West	7,527	16%
Grand total	48,019	100%

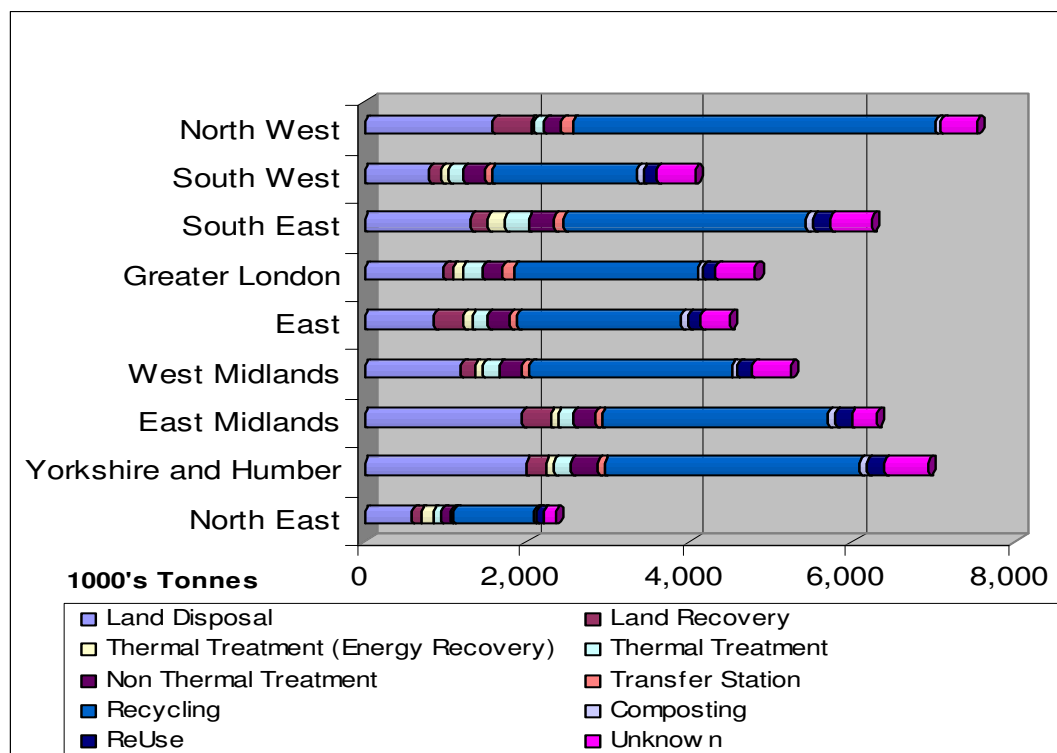
Table ES 4: Waste arisings by waste management method³ ('000s tonnes)

Waste management method	Total Arisings	Percentage
Landfill	11,259	23%
Land recovery ⁴	2,163	4%
Thermal treatment (energy recovery)	1,002	2%
Thermal treatment	1,720	4%
Non-thermal treatment	2,319	5%
Transfer station	825	2%
Recycling	22,974	48%
Composting	707	1%
Reuse	1,324	3%
Unknown	3,721	8%
Grand total	48,014	100%

³ Details of waste management methods are given in Appendix F

⁴ Land recovery - Some waste materials can be used for the reclamation, restoration or improvement of land as a substitute for virgin materials

Figure ES 3: Waste management method by region (tonnes)



Summary findings

Commercial and Industrial waste arisings in England have decreased by an estimated 19.9mt, from 67.9mt to 48.0mt between 2002/3 and 2009, a decrease of 29%. This is despite a rise in the total business population of 10% over the same period. The deregulation of blast furnace slags as by-products (non-wastes) removed 2.4mt (2009 value) from the estimate. The total arisings estimate has an estimated error of 7.6% at a 95% confidence interval.

Overall 13.4mt resulted from industry, approximately two thirds of the fall in arisings. Here the business population has fallen by 18% over the same period. The 6.5mt fall in commercial waste is set against a business population increase of 12% over the same period.

In a number of sectors, arisings fell by over 10%. Given the error within the estimate, these falls can be regarded as real. These sectors include: Food, drink & tobacco, Chemicals manufacture, Machinery & equipment manufacture, Retail & wholesale and Hotels & catering. In Education a 24% fall in waste was observed despite an increase in population of 16%. Waste from the Public administration & social work sector effectively doubled in line with a similar change in population but this in part reflects the nationalisation of some large banks in 2008, and a change in Standard Industry Classification of Economic Activities (SIC) code classification.

The data on management method provide evidence of the effect of fiscal and regulatory policy on waste arisings since 2002/3. The percentage proportion of waste landfilled by business has fallen from 41% to 23%, a drop of 16.4mt. This is reflected with an increase in the recycling rate of 15% to 48%. Reuse appears to have fallen although this is likely to be due to the reclassification of blast furnace

slags as non-wastes and hence their removal from the estimate. The amount of C&I waste undergoing treatment has increased by approximately 2mt, with 1.5mt of this going to thermal treatment.

Waste from SMEs fell to 16.6mt despite a 10% increase in SME population. This represents a 30% fall from 2002/03 values compared with a 20% fall observed for larger businesses.

1 Introduction

1.1 Context

The Department for Environment, Food and Rural Affairs (Defra) commissioned this study to obtain data from businesses in England on Commercial and Industrial (C&I) waste arisings and management methods in calendar year 2009. The survey was funded in partnership with the London Waste and Recycling Board (LW&RB) and the South West region.

There are few current comprehensive data sources concerned with the production and management of C&I waste. At present, other than PPC regulated businesses, there are no formal reporting requirements for businesses with respect to material flows or waste arisings.

Material resources and the embedded carbon within them represent a major contribution to business carbon footprints. Only a relatively small number of businesses characterise this to shape and monitor their efforts to reduce this footprint and improve their resource efficiency through minimisation, recycling and reuse. This performance data on resource efficiency was not gathered.

Other sources of information, for example waste transfer notes or regulatory returns from permitted waste management facilities, are not centrally collated and are not detailed or wide ranging enough to provide a reliable measure of the scale of C&I waste arisings or the waste management routes utilised.

1.2 Previous studies

Most current estimates of C&I waste are based on the EA 2002/3 C&I national waste survey. In the intervening period, significant government policy interventions and the adoption of environmental policies and practices by business organisations have aimed to reduce both the quantity of waste produced and the amount sent to landfill. However, if C&I waste generation mirrors municipal solid waste (MSW) arisings, then in the earlier years of this intervening period, overall C&I arisings may have grown.

Since the 2002/3 national survey, Urban Mines completed a survey in 2007 of C&I waste arisings in the North West region on behalf of the North West Regional Technical Advisory Body⁵. The Urban Mines North West survey provided detailed information on the production of C&I waste by businesses within the North West region (See Section 3.1.6 North West data for more details). This survey was subsequently repeated in 2009, covering the 2008/09 financial year.

ADAS were subsequently commissioned in 2009 to use the findings from the North West study to produce estimates of C&I waste arisings in 2006/07 for all regions in England⁶. ADAS used information from the Office for National Statistics (ONS) on the size of the regions and the demography of businesses within regions, to estimate the number of employees in each sector and at each scale. This was then coupled with the North West study to generate an estimate of current arisings

⁵ Urban Mines, Commercial and Industrial Waste data analysis of the North West Region, December 2008, <http://www.urbanmines.org.uk/?i=2138&s=1111>

⁶ ADAS, Study into Commercial and Industrial Waste Arisings, April 2009, <http://www.eera.gov.uk/publications-and-resources/studies/topic-based-studies/waste-studies/national-study-into-commercial-and-industrial-waste-arisings/>

across all regions in England. They then utilised East of England economic forecasts (provided by Oxford Economics) on future employment trends to derive 2020 forecasts for C&I waste arisings.

1.3 Survey need

While the study undertaken by Urban Mines gives sound results for the North West, there is limited evidence to show that the North West waste arisings can be extrapolated to all regions in England and provide reliable results. Therefore, the need remained to survey all English regions apart from the North West.

Specifically, work was required to:

- Inform future national policy on reducing the amount of waste produced by businesses, increasing the proportion reused or recycled and reducing the residual going to landfill;
- Establish realistic and meaningful baselines for use in monitoring and assessing the impact of policy on C&I waste arisings and management in the future;
- Improve the evidence base of the market for C&I waste infrastructure. This will help inform the review of waste policies announced by the new administration in June 2010.

LWaRB and the South West needed C&I waste information to:

- Underpin local and regional waste management and land-use planning direction;
- Aid local/regional business opportunity analysis and development by providing geographic information on the potential for further recovery of materials, not least in stimulating competition for waste infrastructure development.

The delivery of this project provides substantial benefits, including:

- A more robust evidence base to facilitate the development of future policies feeding into the review of waste policy announced in June 2010. More robust and reliable data to enable Defra and partners to target future action on C&I waste by identifying where the priorities lie on a sectoral, regional and specific material stream basis;
- More reliable data to enable national reporting under EU Regulation (EC) No 2150/2002 on waste statistics (the Waste Statistics Regulation);
- More effective targeting of business resource efficiency support via the Waste and Resources Action Programme (WRAP) and delivery partners providing business support from Government.

A specification was developed to capture these needs and put out to open tender in late 2009 and in February 2010, Jacobs supported by Halcrow were commissioned to undertake a national survey of C&I waste arisings. The survey obtained data for the eight English regions, recognising that a separate survey had already been undertaken for the North West.

The eight English regions (at a NUTS 1 level) covered in the survey were:

- North East
- Yorkshire and The Humber
- East Midlands
- West Midlands
- East of England
- London
- South East
- South West

1.4 Aims and objectives

The aim of this project was to determine the total tonnage of C&I waste produced in England, in the calendar year 2009, broken down by:

- Broad business sector,
- Material type, and
- Management method, for each waste stream.

The objectives of the project were to:

- Develop a sampling methodology to provide a representative basis for the survey that reflects each business sector and size. The sample was to be taken from the Inter-Departmental Business Register (IDBR) provided by the ONS.
- Develop a questionnaire to record the tonnage of individual waste streams, by material type, form, composition, and management method, for each individual site surveyed.
- Undertake face-to-face surveys at industrial sites and places of business as the primary method of data collection.
- Analyse data gathered, with appropriate application of estimators and conversion factors, to produce final data reports and comprehensive data tables at a national level.

From the data collected, combined with data from the North West survey, the project outputs provide:

- The tonnage of waste produced from C&I businesses; split by:
 - waste type
 - generating sector
 - region of arising
 - management method
- The potential for further recycling/recovery of different wastes currently sent to landfill.

These outputs were replicated at Waste Planning Authority (WPA) level for London and South West regions.

1.5 Project governance and structure

A steering group was convened by Defra to oversee the project and review survey outputs. The role of the steering group was to advise on methodological, logistical and analytical arrangements for the survey. This helped to ensure the survey proceeded effectively and delivered results that would satisfy the need for up to date and reliable evidence in this area of policy. The steering group comprised representatives from Defra, LWaRB, Government Office for the South West (GOSW), EA and WRAP, together with the Jacobs project management team. Members of the steering group were as follows:

Client internal project team

John Custance (Defra, SRO and primary budget holder for project)
 David Jagger (Defra Project Manager for the survey)
 David Lee (Defra, Environmental Statistics Service)
 Claire Coggan (Defra, ESS)
 Wayne Hubbard (LWaRB, representing partner region)
 Stuart Turner (GOSW, representing partner region)

Wider steering group

Louise Clark & Andrew Gregory (Defra, Commercial & Industrial Waste Policy)
 Serina Ng & Miriam Sachak (Defra, Environment Growth & Economics)
 Terry Coleman (EA)
 Barbara Leach & Fiona Coyne (WRAP)
 Gitty Ankers – (EA South West region representative)
 Ian Smith (EA, South West)

Jacobs project management team

Malcolm Caine, Project Manager
 Catrin Basham, Assistant Project and Program Manager

1.6 Survey caveats and limitations

The results of this survey represent the most reliable and comprehensive set of national data on C&I waste for over 5 years. Interim data were issued in November 2010 derived from 60% of the sample number with appropriate qualifications. The changes between the final estimate and the interim estimate are explained within Section 4.

However the results from all surveys are subject to limitations with respect to the quality of the estimates produced. As described above, the sample was designed primarily to produce national level results, with the exception of the two partner regions where sampling was intensified specifically to improve the quality of regional results. Confidence intervals for survey estimates are presented in Appendix L. The detailed approach, timing and economic landscape in the period surveyed also have a bearing on the results and their effective shelf life. Without extensive additional works, the impact of these limitations is impossible to estimate.

Whilst these factors do not change the results or the statistical data presented within this report, they should be borne in mind by users of the data as time passes between this publication and the application of the figures and/or forecasting based on the results. Some of the key limitations are summarised below, with a more detailed list including mitigations set out in Appendix A.

- The survey was entirely voluntary so only companies that were willing to participate were surveyed. It is likely that this is more likely to capture data from companies that are more progressive with respect to managing their wastes.
- The survey is for 2009 only, a year within the deepest recession since 1930s. This may be viewed as atypical and outside of the normal business cycle, so is likely to have affected business activity, and as a result C&I waste tonnages. It is also likely to have reduced willingness to participate.
- The data provided may be inaccurate or have failed to capture all material streams. The survey was not able to verify individual site returns with respect to their origin and accuracy. However, returns were sense checked and subject to

statistical checks against data from the same sub-population to detect unusual or absent data.

- The surveys may only give a one day picture of the overall waste arisings, where annual records are unavailable and estimations on waste arisings were made. This risk was minimised by the thorough training programme provided to the surveyors so they could gain an understanding of how the survey day fitted into the pattern of waste production throughout the year.
- A visual assessment of the composition of mixed waste streams may only give a one day picture of the overall waste arisings. Surveyor training included practical sessions on visual waste assessment to try to overcome any bias and ensure consistency.

2 Survey design and mobilisation

2.1 Business context

There are nearly 1.9 million businesses operating in England. These can be split using the 2007 SIC codes. There are 12 specified business sectors used in this study, six Industrial and six Commercial as shown in Table 1, with a full list provided in Appendix B. Business sectors covering Agriculture, Mining, Construction and Demolition were excluded from the study. These businesses generate large tonnages, much of which is inert (e.g. quarry spoil or rubble) and managed within the boundaries of the site in which they arise. They therefore present a relatively low impact and are insulated from the type of intervention that could be considered to drive material up the waste hierarchy⁷. The waste management industry was excluded to avoid potential double counting of waste arisings. This is consistent with previous C&I waste survey methodologies.

Table 1 Business sectors used for the stratification of business population (SIC codes)⁸

Business sector	Description	SIC range	Number of businesses	Percentage of total business population
Industrial sectors				
1	Food, drink & tobacco	10.1 – 12.0	7, 600	0.4%
2	Textiles / wood / paper / publishing	13.1 – 18.2	32, 795	1.7%
3	Power & utilities	19.1 – 19.2, 35.1 – 36.0	1, 965	0.1%
4	Chemicals / non-metallic minerals manufacture	20.1 – 23.9	14, 525	0.8%
5	Metal manufacturing	24.1 – 25.9	27, 160	1.4%
6	Machinery & equipment (other manufacture)	26.1 – 33.2	44, 310	2.4%
Total Industrial sector businesses			128, 355	6.8%
Commercial sectors				
7	Retail & wholesale	45.1 – 47.9	422, 995	22.5%
8	Hotels & catering	55.1 – 56.3	146, 480	7.8%
9	Public administration & social work	84.1 – 84.3, 86.1 – 88.9	133, 945	7.1%
10	Education	85.1 – 85.6	54, 430	2.9%
11	Transport & storage	49.1 – 53.2	73, 200	3.9%
12	Other services	58.1 – 82.9, 90.0 – 96.0	921, 900	49.0%
Total Commercial sector businesses			1, 752, 950	93.2%
Total number of businesses			1, 881, 305	100%

As can be seen from the table, over 90% of UK businesses arise in the Commercial sector, with 'Other services' capturing over 50% of the Commercial sector and Retail & wholesale occupying 24%. In the Industrial sector, 34% is captured by Machinery

⁷ <http://www.defra.gov.uk/environment/waste/topics/>

⁸ Other services include a wide range of commercial business not covered by the other sectors including: arts, entertainment and recreation, administrative and support service activities, professional, scientific and technical activities, real estate activities, financial and insurance activities Information and communication. A full list of these is given in Appendix B..

& equipment (other manufacture) and 26% is included within Textiles / wood / paper / publishing sector.

Business population data for 2009 from the ONS IDBR data was used to develop seven bands of business size as presented in Table 2. Reference is made to employees throughout the text of this report. For accuracy the estimate have been built up from employment which includes owners, Directors and others who may be considered employers as well as their employees.

Table 2 Bands of business size used for the stratification of business population

Band	No. of employees	Number of businesses	Percentage of businesses
0	1-4	1, 240, 470	65.9%
1	5-9	290, 970	15.5%
2	10-19	166, 520	8.9%
3	20-49	112, 950	6.0%
4	50-99	39, 225	2.1%
5	100-249	21, 340	1.1%
6	250 +	9, 830	0.5%

Nearly 66% of businesses within England are sized within 1-4 employees. This group were not surveyed but are included within the estimate. This was on the grounds that such companies, often with shared premises that may include other small businesses or even be part of a domestic residence, are difficult to survey accurately. Although these companies could aggregate to a significant waste stream, the individual arisings are likely to be small, often not requiring a dedicated waste collection service. As a result, despite the legal requirement to avoid disposing of business waste as household waste, a considerable proportion of the waste from this source is likely to find its way into the municipal waste stream.

This process meets the reporting requirements of the EU Regulation (EC) No. 2150/2002 on waste statistics⁹ and is also consistent and compatible with the business sectors studied in recent surveys, notably the surveys carried out for Wales and North West Region. Details of how the 1-4 employees business banding was incorporated are provided in section 3.4.3.

It should be noted that throughout the 2009 survey, as with previous investigations, the surveys were undertaken on a site, not a company, basis. Companies can occupy numerous sites, and to collect completely unbiased data a site basis was used. The survey may visit several of these sites or just one, depending on how they appear in the random sampling technique that was used for this survey.

2.2 Development of the sample matrix

A random optimised stratified sampling methodology was adopted to derive a sample matrix to aim for an overall error on the total tonnage of C&I waste across the eight English regions surveyed of within +/-5% at a 95% confidence interval. The sample matrix was built up of 576 pools representing 12 industry and business sectors at 6 scales for each of the 8 regions covered within the survey. This approach yielded an optimal sample and in many cases this required the data from

⁹ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:087:0157:0159:EN:PDF>

the whole population within a number of pools to be gathered. In delivering the survey the matrix was used to steer the data gathering to yield a sample that was as close to optimal as was practically achievable.

The matrix was stratified into the business sectors shown in Table 1 (excluding size band 0). The next stratification considered was size band, as presented in Table 2. This gave a basic matrix with 72 strata of sector and sizeband combinations. The basic matrix was further classified by the eight English regions covered in the survey. This regional classification developed the matrix into a total of 576 'pools' that were required to be sampled: combinations of sector, size band and region.

The 2002/3 data was re-compiled into SIC 2007 format using a correlation matrix which was agreed with Defra. The standard deviations of business waste arisings for the 72 strata were derived from the 2002/3 national survey data. The data for businesses with 3-9 employees in the 2002/3 national survey were used for size band 1 (5-9 employees).

The number of samples required in each of the 576 pools was allocated proportionally according to the waste arising within the stratum (defined by the business sector and size) and the stratum's population size in the region, with the following conditions:

- The minimum number of surveys per stratum in each region was set to two.
- The maximum number of surveys per stratum in each region was set to the population size of the stratum in the region.

This enabled the 'optimal' sample to be derived based on the 2002/3 variance. This sample was modified by Defra to reflect the additional resources provided by both the LWaRB and the South West region, whilst maintaining the overall statistical objectives for the national estimate.

A summary of the target sample matrix is shown in Table 3, with the full matrix given in Appendix C. This table also shows the estimated error at a 95% confidence interval (Note: this is based on the 2002/3 national survey data variance).

Where the sub-population of a population was small and the variance high, this naturally led to a situation where a large proportion of the sub-population was required within the sample to minimise the error and provide the level of confidence required. In a number of pools the sample matrix required a complete census of the sub-population for the target matrix to be met.

Table 3 Summary target sample matrix

Business sector	North East	Yorkshire and The Humber	East Midlands	West Midlands	East of England	London	South East	South West	Total	Est MoE at 95% C.I.
1	34	103	84	59	74	133	55	153	695	2.38
2	22	56	54	24	33	99	37	97	422	4.58
3	10	13	16	15	13	18	16	20	121	11.31
4	44	74	61	65	56	55	62	90	507	4.28
5	24	45	33	73	30	31	25	72	333	6.17
6	22	30	29	46	26	38	42	112	345	6.00
7	41	100	83	106	125	593	179	335	1,562	2.72
8	12	14	13	13	14	109	20	46	241	4.56
9	12	14	14	15	15	83	20	42	215	6.02
10	12	16	13	16	16	84	22	41	220	5.68
11	12	16	15	17	16	110	21	41	248	7.33
12	20	43	37	47	52	647	93	152	1,091	4.03
Total	265	524	452	496	470	2,000	592	1,201	6,000	4.02
Est MoE at 95% C.I.	3.43	3.36	3.63	4.02	3.54	3.86	3.78	3.04	4.02	

2.2.1 IDBR data

The ONS supplied data from the Inter Departmental Business Register (IDBR) for 118,329 companies on request – the data requirement was specified by and requested by Defra. This was based upon the target sample matrix, multiplied by a factor of 20 up to the population maximum. The factor was based on an assumed 5% response rate for companies approached to participate in the survey. Where the matrix defined a census for the sub-population in a pool, this demanded a 100% participation rate within the survey to fulfil the matrix.

2.2.2 Data preparation

Once received, the ONS database was ‘cleansed’ by the Database team. This ensured that the data fields were correctly aligned and any omissions were reported. From the outset it was evident that the data contained very few business telephone numbers (<<1%). Consequently, a telephone matching company was used to try and obtain further telephone numbers and this returned around 35% of the remaining numbers. So that more of the data could be used, internet searches were used to gain additional telephone numbers.

2.2.3 Data protection

Under the Deregulation and Contracting Out Act, 1994, for confidential information to be disclosed by Defra to its contractor, Jacobs were required to:

- Ensure the information was used only for the purposes in the specification;
- Provide the information only to their personnel as necessary;
- Inform their personnel of the confidential nature of the information;
- Ensure that they and their personnel do not communicate the information to any other person without the express written consent of Defra;
- Ensure that they and their personnel maintain the confidentiality and physical security of the information at all times.

The information provided to a contractor relating to businesses, including their identities, is confidential. Unlawful disclosure of the information is a criminal offence under Section 9 of the Statistics of Trade Act 1947 and Section 39 of the Statistics and Registration Service Act 2007.

Defra and its contractors have processed the data from this survey in compliance with the relevant code/legislation as listed below. Also, business contact details were deleted from the database at the end of the project (by Jacobs) and hence were not included in the data supplied to Defra.

The survey was undertaken and results produced in a manner compliant with the UK Statistics Authority's Code of Practice for Official Statistics, developed under The Statistics and Registration Service Act (2007).

The practicalities of compliance with data protection, regulation and guidance meant that rules and protocols for access to company information were defined for the project. Access to the data was limited within the project team, and secure areas for data storage were provided. In reporting the results on material and waste arisings and practices, Jacobs ensured that the information was not traceable to any company or individual to meet Principle 5 of the Code of Practice for Official Statistics.

2.3 Questionnaire

The survey questionnaire was developed by Jacobs and finalised following review by Defra and the project steering group. The survey was designed to meet both the needs of the project and European reporting requirements. It was developed in line with the previous 2002/3 C&I waste survey form, which has since been used as the basis of the 2007 Wales and North West survey forms, as well as the current 2009 North West form.

2.3.1 Questionnaire development

The first two parts of the survey form provided details regarding the nature of the company, its activities and its size. This information allows comparisons between data sets to identify patterns or anomalies, for example, does a small company manage their wastes differently to a large company. The location of the company was recorded to allow regional estimates to be compiled to inform needs assessment as part of Local Government strategies and plans.

Part three of the survey collected information regarding each individual waste stream generated on site. For example, wood waste, MSW, office waste etc. The data collected included:

- A description of the waste;
- The form and nature of the waste (i.e. liquid or solid, hazardous or non-hazardous);
- Whether the waste required any specialist treatment;
- Source of data (i.e. company records, waste transfer notes);
- The weight or volume of the waste and whether this was an actual or estimated value;
- The composition of any mixed waste streams;
- Who collected the waste (e.g. waste contractor, local authority);
- The waste management method (e.g. recycled, landfilled);
- The destination of the waste (if known);

It was also noted if the waste could be easily segregated for reuse/ recycling/ composting or could be further processed to reduce the quantity of C&I waste sent to landfill.

The composition of mixed waste streams was obtained from existing company records where possible. Where these were not available, an assessment of the composition of the waste was made by the surveyor. This comprised a visual assessment rather than a full, physical compositional analysis and did not involve any handling or weighing of the waste. General questions were also asked of each business site surveyed, to ascertain barriers to recycling and other related issues.

The last section of the form completed the survey with a signature from the surveyor and client to confirm that data has been entered accurately.

The survey questionnaire is shown in Appendix D.

2.3.2 Waste classification, weight estimation and management methods

Waste materials were classified in the survey using the Substance Oriented Classification (SOC) system. The headline SOC codes used were:

- Chemical wastes: solvents, acids/alkalis, used oil, catalysts, wastes from chemical preparation, residues and sludges
- Healthcare wastes
- Metallic Wastes
- Non-metallic wastes: glass, paper & card, rubber, plastic, wood, textiles
- Discarded equipment: End of Life Vehicles (ELV), batteries, waste electronics (WEEE) other discarded equipment
- Animal & vegetable wastes: food, manure, other animal & vegetable wastes
- Mixed (ordinary) wastes: household, undifferentiated wastes and sorting residues
- Common sludges and dredgings
- Mineral wastes: combustion residues, contaminated soils, solidified mineral wastes, other mineral wastes

The headline SOC groups were disaggregated into further sections. A full list of SOC codes is provided in Appendix E. A list of waste types and waste management methods is provided in Appendix F.

The two non-wastes, blast furnace slag and virgin timber, were added as separate lines so that these arisings could be separately accounted for and analysed from the main dataset. Information on how these waste streams were treated is provided in Appendix G.

It was anticipated that businesses would often be unable to provide accurate information on the weight or volume of their waste arisings, and surveyors would be required to estimate the volume of waste based on the container size used, container fullness and frequency of collection. The “standard” waste container size types used are provided in Appendix H.

Conversion factors were used to allow an appropriate volume to weight conversion and to accommodate a range of non-standard containers that could be encountered on the surveys. Conversion factors and assumptions were agreed with Defra, and these are provided in Appendix I.

2.4 Health & safety

A Health, Safety and Environmental (HSE) lead was appointed for the duration of the project. A HSE Plan was prepared by the HSE lead prior to the start of the project, accompanied by a method statement and project risk assessment. The key outputs from these documents were the identification of risks and appropriate controls for both travel and site survey work. The output of the risk assessment process was then used to develop mandatory survey rules.

Wherever practical, tele-conferencing was used for project progress meetings and other non-survey related meetings. For travelling to and from surveys, public transport (bus, tube, rail, tram) was used in preference to travel by car. All surveyors working on surveys were required to complete a travel Safe Plan of Action (SPA) for each week's work. The SPA identifies risks and mitigating steps necessary to ensure that travel was undertaken in a safe and effective manner. Each SPA for travelling to sites was signed off by the relevant Survey Team Leader in advance of the surveyor making the journey.

Businesses to be surveyed were categorised as low, medium or high risk based on the assumption of their size and typical operations, e.g. premises involving industrial processes are likely to increase exposure to risk. Additional controls were put in place to ensure these risks were mitigated e.g. ensuring only more experienced surveyors surveyed potentially high risk sites.

The completed HSE Plan, method statement and project risk assessment were reviewed and approved by the Defra steering group and were communicated to all members of the project team prior to the start of the project.

2.5 Contact centre

2.5.1 Organisation and operation of the contact centre

A contact centre was set up at Jacobs' Winnersh office to make the survey bookings. Staff with experience in telesales and the use of Excel and Word were recruited into the contact centre team.

A Team Leader was appointed to supervise the contact centre on a day-to-day basis. The contact centre staff were split into geographical regions, in proportion to the number of surveys to be carried out in each region. A team meeting was held at the beginning and end of each day with the remainder of the time structured to maximise survey bookings. Technical training was provided by Jacobs and Jacobs staff were on hand at all times to answer any technical queries from the contact centre staff or to resolve any issues that arose within the contact centre.

2.5.2 Training and performance management

The contact centre staff received bespoke telesales and database management training prior to beginning work. In addition the contact centre staff received HSE training appropriate for the Winnersh office along with technical training. The technical training covered:

- Why we were doing this survey and who are the stakeholders;
- Basic waste management training, e.g. why is waste important and the cost of waste to business;
- How the project and contact centre would be organised;

- Logistics and administration;
- Use of the database;
- Tips to get a successful survey appointment.

Training material and documents were produced for reference and were reviewed and approved by the Defra steering group prior to delivery of the training. Jacobs' staff were on hand to deal with any ongoing training issues or technical questions as they arose during the course of the project.

The daily team meetings were used as a forum to discuss any issues that had arisen, as a means of giving and receiving feedback and to provide any ongoing training as it was needed. The contact centre staff were monitored on a daily basis in terms of survey bookings and incentivised for completion of successful bookings.

2.5.3 Appointment booking system

A bespoke logistics system was set up to facilitate survey bookings. The business data was randomised before being assimilated into the booking database for access by the contact centre. The data was sorted by region in order to synchronise with the logistical set up of the contact centre. The sectoral composition of the sample on a regional basis was continually monitored to ensure that the sample remained representative of the C&I business population.

The system was designed to efficiently book surveys against resource availability, reducing the distances travelled and reducing travel expenses of the project. It was assumed that most face-to-face surveys would take between 30 minutes and 4 hours depending on the size and complexity of the business. After booking a survey, the survey details were entered onto the SPA form and the details were forwarded to the surveyor, team leader and logistics team. An information pack detailing what to expect from the survey was sent to the client.

2.6 Survey team

2.6.1 Set up of regional survey teams

A team of surveyors was set up in each of the regional survey areas. Each regional team was headed by a Team Leader, who was responsible for:

- Surveyor training
- Dealing with any issues or queries from the surveyors
- Quality assurance of the completed surveys.

Surveyors were selected based on their professional discipline, their experience in surveying/auditing and their knowledge of specific processes and industries. Contingency arrangements were put in place to ensure annual leave and sick leave were covered. The logistics team were responsible for ensuring there were appropriate travel arrangements for the surveyors and overnight accommodation if required.

2.6.2 PDA set up

Hand held Personal Digital Assistants (PDAs) were used to capture information during site surveys. These PDAs were light enough to be used all day on site, without the surveyor needing to return to an office to complete paperwork or carry a tablet PC. The PDAs were customised to fit the requirements of the survey.

The PDAs were set up to wirelessly upload details of the survey visits to the surveyor including the business location, contact details and health and safety requirements. Once completed, all survey data was wirelessly sent back to the main database. Data could then be accessed by the Survey Team Leader's and other members of the survey team through a secure online database for validation.

2.6.3 Training

All teams received training appropriate for their role within the project, i.e.:

- Team Leaders,
- Surveyors,
- Defra.

Training material was developed by the HSE Lead and Survey Team Lead in liaison with the rest of the Project Team. The training material and documents were reviewed and approved by the Defra steering group prior to delivery of the training.

Survey Team Leaders were trained initially by the Survey Lead and other members of the Project Team. The training was then rolled down to the regional teams of surveyors and delivered by the Team Leader and the Survey Lead. All the survey teams received the same training. The involvement of the Survey Lead and the Assistant Project Manager in all the training sessions ensured a consistent approach to the training of all the regional teams.

(a) HSE Training

All survey team members were given comprehensive HSE training bespoke for this project, assisted by a member of the corporate HSE team (see section 2.4, Health & safety). In addition all staff were required to undertake basic HSE training. Only those who complete the courses were allowed to work on the project.

(b) Technical Training

The technical training was provided to all the project team management, regional team leaders and individual surveyors and included receipt of training materials for future reference. It included:

- Background, objectives and context to the project;
- Who we were surveying;
- Training on the booking process;
- Survey training;
- Use of PDAs and software forms;
- Start up, data entry, checks, summary reports, business verification, uploading data to Survey Team Leaders;
- Where the data goes and how it will be used;
- SOC codes and conversion factors;
- How the data was going to be validated;
- Importance of recording information accurately;
- Approach to the site visits;
- Potential faced at each stage e.g. faulty PDA or missing data;

(c) Ongoing training

The Survey Team Leaders were the main point of contact for the surveyors for any questions or ongoing training issues during the course of the project. A weekly call was held between the Survey Lead and the Survey Team Leaders to discuss any issues and provide feedback. Training updates were provided as required to the Team Leaders to roll down to the regional surveyors.

2.7 Pilot survey

A pilot survey was essential for a project of this size and complexity. A number of pilot face-to-face surveys were conducted to test the survey process and PDA software in the field prior to the start of the full programme.

2.7.1 Feedback and amendments to the survey approach

Pilot surveys were carried out by Team Leaders and experienced surveyors. The businesses were selected at random and all those visited were receptive and provided data where requested. All businesses found receiving the initial information pack provided to be useful precursor to the survey. Feedback from the exercise was used to adjust and fine tune the software and approach to the surveys prior to the commencement of the main survey period. The main points highlighted are detailed in Table 4.

Table 4 Outcomes from the pilot surveys

Findings	Mitigation
Initial difficulty in entering data onto the PDA whilst continuing a conversation with the client.	It was envisaged that this would improve with practice and familiarity with the system.
The initial 10 waste streams provided on the PDA survey form were inadequate to account for all the waste streams generated by some companies. The waste collection frequencies needed to be increased on the PDA survey form to allow for all situations that were being encountered in the field (e.g. supermarkets that could have up to 50 containers collected twice daily).	Provision for 30 waste streams was made on the PDA survey form, and the collection frequency allowed was increased to allow for multiple daily collections of multiple bins. The PDAs were also reconfigured to make the process of data entry easier for the surveyors e.g. make it easier to scroll between waste streams. The PDAs were pre-loaded with some common data to save data entry time.
The process of inputting data into the PDA was initially time consuming. There were also some issues with slow upload of data and short battery life of the PDA during heavy use.	Surveyors were provided with a PDA user guide to assist them with the surveys. Problems with data upload and battery life were resolved by ensuring the PDAs were charged overnight and switched on to upload prior to the start of the survey. Surveyors were also provided with in-car chargers.
Although there was provision for a wide range of waste container sizes and types on the PDA survey form, it was found that the range of containers in use was too great to cater for every eventuality. Some waste streams were not stored in containers e.g. IT equipment, car tyres, fridges.	Surveyors were provided with further information regarding container types and sizes. Provision was made for an 'other' option for waste containers to cover items such as loose waste, bales, palletted waste, crates and other non-standard containers, together with the requirement to provide a container or waste volume (m ³).

3 Data gathering and management

3.1 Data Sources

The project originally aimed to complete the matrix through both face-to-face and telephone surveys. At the outset it was assumed that 84% of surveys would be conducted face-to-face and 16% of surveys would be conducted by telephone.

As fieldwork progressed it was recognised, with Defra, that completing the optimum sample across all 576 pools was not achievable through face-to-face and telephone interviews alone. This was due to three factors.

- The sample matrix was designed using variance data from the 2002/3 survey and where this resulted in the need to sample at or close a complete census for some pools. With an average positive response rate to calls of approximately one in ten, fulfilling the optimum sample for these pools was practically unachievable within a voluntary survey.
- The second was the requirement within many businesses to gather, manage and disseminate information on environmental and social performance at a corporate level and not a site by site basis. The adoption of the Corporate Social Responsibility (CSR) agenda led to many businesses declining to participate in the surveys either from the outset or after a number of visits. Instead, many offered to provide data gathered centrally for 2009. This became clear early on in the field work and as such a specific unit was identified within the project to engage with businesses at a corporate level and secure these 'corporate data'.
- The final factor was, despite best efforts, some businesses did not want to take part in the survey. A number of reasons for this were identified by the contact centre:
 - The work involved with getting the data prepared;
 - Lack of time;
 - Profit loss involved in doing something that didn't make money;
 - Staff shortages from sickness, holidays or staff cuts;
 - Although the initial person contacted was willing, their manager did not want the company to participate;
 - They felt the survey was a waste of time;
 - They couldn't believe we weren't 'selling' anything;
 - They claimed not to generate any waste;
 - They felt their waste streams were so inconsequential that a visit was unnecessary;
 - They just weren't interested in taking part.

Pools where the sample could not be fulfilled were identified as 'exhausted pools'. In general the exhausted pools comprised 'Size group 6' i.e. the larger companies and those in industry Sectors 1-5. Several of the exhausted pools are the same across all regions, e.g. size bands 4-6, therefore limited points were collected for these pools leading to a relatively large error for these strata.

The project has completed 3,273 site and 801 telephone surveys. In addition to this, a significant amount of data has been obtained from large companies who have supplied high quality corporate data. Data has also been secured from companies who have to submit data to the EA under Pollution Prevention and Control (PPC) requirements.

It was always envisaged that some PPC data would have to be incorporated into the survey results in order to ensure that they were not distorted by the omission of some major waste streams from certain large operations – paper mills, chemical plants, etc. These four data sources were used in a representative manner to populate the sample frame and produce results.

Details on the four methods used to collect data are given below, and in Appendix J.

3.1.1 Face-to-face surveys

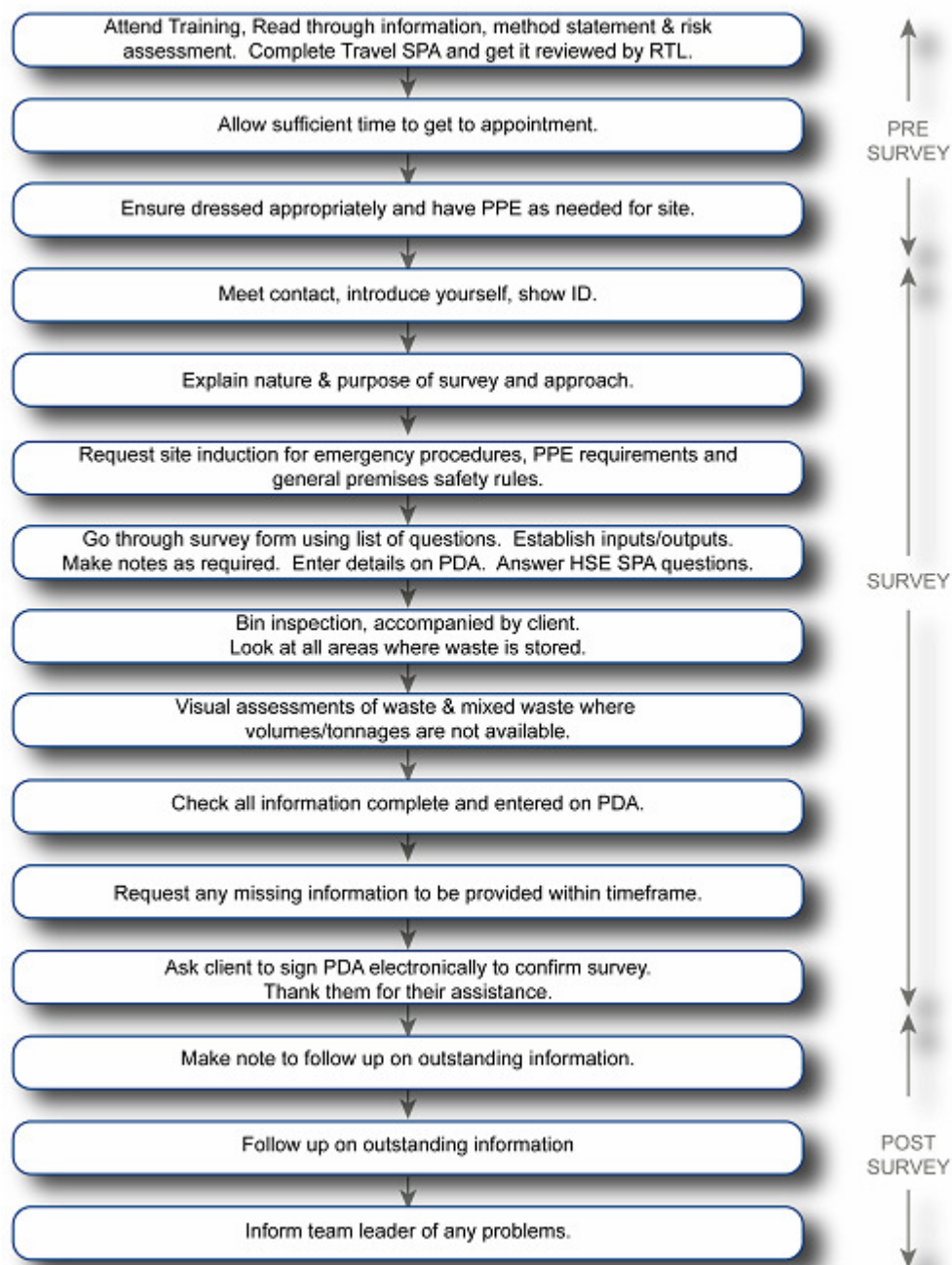
Data from face-to-face surveys was collected on site through the use of PDAs. The number of surveys completed face-to-face is shown in Table 5 below.

Table 5 *Number of face-to-face surveys completed*

Business sector	North East	Yorkshire and The Humber	East Midlands	West Midlands	East of England	London	South East	South West	Total
1	28	49	37	30	33	46	23	66	312
2	15	28	37	16	25	45	30	50	246
3	6	8	4	2	8	3	11	12	54
4	20	36	31	37	26	27	38	55	270
5	13	25	28	44	19	19	19	46	213
6	24	22	19	34	20	26	25	66	236
7	19	37	35	50	48	236	83	140	648
8	8	8	7	8	5	75	15	37	163
9	10	9	11	12	13	56	22	30	163
10	11	16	9	15	17	66	15	32	181
11	8	16	11	14	10	53	13	32	157
12	15	39	21	28	39	328	52	108	630
Total	177	293	250	290	263	980	346	674	3,273

The survey methodology is shown in the process flow diagram in Figure 1.

Figure 1 Survey methodology flow diagram



3.1.2 Telephone surveys

Telephone surveys were set up and booked by the contact centre in the same way as field surveys. They were carried out by field surveyors that had experience of carrying out site surveys on this project. The survey questionnaire and the questions asked were identical to those used on the field surveys. Information from telephone surveys was input directly onto a computer via an Excel spreadsheet, using an identical system to that used on the PDA. This ensured consistency with data gathering.

The telephone surveys were predominantly surveys where the client did not wish to have a surveyor visit, or could not have a face-to face survey due to, for example, health and safety or security reasons. Telephone surveys were not used for large or complex sites producing multiple complex waste streams.

The number of surveys completed via telephone appointments is shown in Table 6 below.

Table 6 *Number of telephone surveys completed*

Business sector	North East	Yorkshire and The Humber	East Midlands	West Midlands	East of England	London	South East	South West	Total
1	0	4	5	3	3	4	6	12	37
2	0	3	7	5	5	18	4	7	49
3	1	1	1	1	0	2	5	2	13
4	2	8	8	8	3	3	5	8	45
5	5	3	4	7	4	4	7	7	41
6	3	3	4	3	5	4	6	3	31
7	3	1	8	13	15	47	25	32	144
8	2	1	5	1	6	16	9	7	47
9	4	2	3	3	2	13	4	13	44
10	1	2	7	3	5	12	4	9	43
11	2	1	1	3	3	20	10	5	45
12	6	1	12	18	16	144	37	28	262
Total	29	30	65	68	67	287	122	133	801

3.1.3 PPC data

As many of the pools which were unable to be completed by face-to-face or telephone surveys lay in Size group 6 (250+ employees), a number of these organisations would be likely to have Pollution Prevention and Control (PPC) licences.

PPC is a regulatory regime for controlling pollution from certain industrial activities. Organisations operating under the PPC regime must provide a range of data on all waste materials generated. Some of these companies were contacted and many did not wish to provide additional data beyond their annual regulatory return. Companies within the PPC regime typically include industrial plants and this helped to address the issue of recruiting larger companies and thus the PPC data could be used in filling this gap. Many of these businesses are also the biggest producers of waste, and were the arisings estimates to be compiled without accounting for these sites, it would lead to underreporting of the overall amount of waste produced in England. All previous C&I surveys have included PPC data.

Given the nature of this data, i.e. its use for licensing, along with the annual requirement to report to the Environment Agency, the data was considered to be more reliable and representative than an ad hoc survey on site.

The addresses in the PPC data were compared to the addresses held within the sample received from the ONS. A manual check was then made of site names so that the matches between the PPC and IDBR data sources could be confirmed. Following this, a further check was made on those sites already visited as a field survey in order to avoid duplication within the database. Any sites that had received a survey were removed from the analysis.

The number of surveys completed with PPC data is shown in Table 7 below.

Table 7 *Number of surveys completed using PPC data*

Business sector	North East	Yorkshire and The Humber	East Midlands	West Midlands	East of England	London	South East	South West	Total
1	1	8	8	5	17	4	4	9	56
2	1	6	5	0	0	1	4	2	19
3	11	11	9	10	8	3	13	3	68
4	19	16	14	8	12	2	13	4	88
5	5	15	4	11	3	2	5	6	51
6	2	2	1	3	1	0	3	4	16
7	1	1	1	2	1	1	1	1	9
8	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0
12	0	0	0	3	3		4	2	12
Total	40	59	45	39	45	13	47	31	319

This table includes 21 data points added that were not in the original sample as mentioned section 4.1 and further detailed in Appendix J. This was to ensure that the largest producers of waste were included in the survey. A breakdown of these samples is provided in Table 8.

Table 8 *Number of addition PPC data used not in original sample*

Business sector	North East	Yorkshire and The Humber	East Midlands	West Midlands	East of England	London	South East	South West	Total
1	0	0	1	0	1	0	0	0	2
2	0	0	0	0	0	0	1	2	3
3	0	2	3	2	0	0	1	0	8
4	0	0	0	0	0	0	0	0	0
5	2	6	0	0	0	0	0	0	8
6	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0
Total	2	8	4	2	1	0	2	2	21

3.1.4 Corporate data

The contact centre found that a number of major companies did not wish to participate in the survey. Others were unwilling to be surveyed at a site level but were happy to provide data at a head office level. These companies were large organisations whose data is gathered proactively and systematically by central functions tasked with monitoring site and group performance. They are often based

on contractors' tonnage returns. These are invariably better than site collected data and other returns as their provenance is clear and they typically include contractor data from distribution and logistics centres that are often unavailable to site managers.

It was accepted by the steering group that this type of data was believed to increase the accuracy of the survey result. Additionally the incorporation of data from companies willing to provide it allows for the waste of those companies to be represented in the final results, leading to a more robust estimate of waste arisings. The alternative was to exclude these companies. However, this would have skewed the sample.

The corporate data collected covers a wide range of business sectors, from parcel delivery businesses to high street retailers and national organisations such as banks, power generators etc. It corresponds to several hundred data points within the sample frame.

A methodology was developed to ensure that corporate data was included in a way that did not distort the sample and minimised the error across each stratum. The methodology identified the number of data points (sites) from a particular company that could be imported without skewing the results towards the waste management practices of an individual company. It also maintained the appropriate representation of companies within each of the strata. Details of this methodology are provided in Appendix J.

The number of surveys completed with corporate data is shown in Table 9 below.

Table 9 Number of surveys completed using corporate data

Business sector	North East	Yorkshire and The Humber	East Midlands	West Midlands	East of England	London	South East	South West	Total
1	1	4	9	2	5	4	2	6	33
2	0	2	2	0	1	0	0	1	6
3	0	0	1	3	0	1	0	0	5
4	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0
7	28	75	68	91	104	443	124	337	1,270
8	0	0	0	0	0	82	0	0	82
9	0	0	1	0	0	4	0	4	8
10	0	0	0	0	0	0	0	1	1
11	1	1	3	0	2	33	1	5	46
12	1	3	1	4	1	140	1	10	161
Total	31	85	85	100	113	707	128	363	1,612

This table includes 947 data points added that were not in the original sample as mentioned in section 4.1 and further detailed in Appendix J. This was to ensure that the sampled matrix was completed to minimise the error. A breakdown of these samples is provided in Table 10.

Table 10 Number of additional corporate data points used

Business sector	North East	Yorkshire and The Humber	East Midlands	West Midlands	East of England	London	South East	South West	Total
1	0	0	0	0	0	1	0	0	1
2	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0
7	10	18	20	48	25	339	60	247	767
8	0	0	0	0	0	76	0	0	76
9	0	0	1	0	0	0	0	0	1
10	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	14	0	0	14
12	0	0	0	0	0	79	0	9	88
Total	10	18	21	48	25	509	60	256	947

3.1.5 2009 Competed Survey Matrix

The total number of surveys completed within the 2009 survey is shown in Table 11 below.

Table 11 Total number of surveys completed in the 2009 survey

Business sector	North East	Yorkshire and The Humber	East Midlands	West Midlands	East of England	London	South East	South West	Total
1	30	65	59	40	58	58	35	93	438
2	16	39	51	21	31	64	38	60	320
3	18	20	15	16	16	9	29	17	140
4	41	60	53	53	41	32	56	67	403
5	23	43	36	62	26	25	31	59	305
6	29	27	24	40	26	30	34	73	283
7	51	114	112	156	168	727	233	510	2,071
8	10	9	12	9	11	173	24	44	292
9	14	11	15	15	15	73	26	46	215
10	12	18	16	18	22	78	19	42	225
11	11	18	15	17	15	106	24	42	248
12	22	43	37	50	59	612	94	148	1,065
Total	277	467	445	497	488	1,987	643	1,201	6,005

3.1.6 North West data

The 2008/9 North West survey dataset was used to produce updated 2009 calendar year estimates which could be combined with the results produced from this survey to produce England national estimates.

Defra was provided with the raw anonymised dataset from the 2009 North West Survey. This dataset was manipulated in order to be able to produce the best possible comparable estimate. Primarily this involved adjustments in five stages:

1. The original survey covered 2008/9. Updated business populations for 2009 were used to generate new grossing factors which were applied to the raw observed tonnages.
2. Data for the fourteen companies in the original survey where PPC data was used was updated to 2009 PPC data.
3. Estimates for businesses of size band 1-4 were updated. These companies were not surveyed in 2009. These were recalculated, as in previous surveys, by applying the average weight per employee from the 5-9 size band from the updated data from step 1 and applying this to the 1-4 business population employment figures.
4. The effect of a move from SIC 2003 to SIC 2007 sector definitions was reconciled. The North West survey used the SIC 2003 whereas this survey uses the latest SIC 2007 classifications. Analysis of the same national business population data classified both ways yielded a correlation matrix which shows changes in sector populations purely as a result of the change in SIC (Table 12). This is particularly important to map changes between the 'other services' and 'public administration' sectors. The relative changes were used to adjust sector estimates to take account of this.
5. Finally, the nine North West business sectors were converted into the twelve used for this project (Table 13). This only affected the North West 'public administration' and 'other services' classifications. These two North West sectors have been split into five using the relative proportional arisings results in this survey.

The updated raw data and adjustments for SIC and sector differences were used to produce updated North West estimates for all the tables in this report. These tables have been added to the survey output tables to produce the England overall estimates in this report.

As noted in Section 2.2, in the design phase it was decided to omit the North West from this survey. This decision was taken in recognition that recent survey data was available, to maximise the resources available for surveying the rest of England, and to avoid the possibility of resampling businesses who had been approached only a short time before. Set against this is the fact that the North West survey covered a slightly different time period (2008/09) and had slightly different sectoral and business sector classifications. The North West survey, and subsequent report, remains the most up to date cohesive study of this area. However, the process described above has produced revised estimates suitable for inclusion in England estimates for this survey.

Table 12 Comparative sector changes in the North West business population, using SIC 2003 and SIC 2007 classification

Sector	SIC 2003 population	SIC 2007 population	% change
Food, drink & tobacco	1,285	1,286	0.1%
Textiles / wood / paper / publishing	4,025	4,035	0.2%
Power & utilities	355	346	-2.5%
Chemicals / non-metallic minerals manufacturing	2,265	2,255	-0.4%
Metal manufacturing	3,465	3,374	-2.7%
Machinery & equipment (other manufacturing)	5,335	5,353	0.3%
Retail & wholesale	56,605	55,870	-1.3%
Other services	134,395	126,489	-6.3%
Public administration	17,575	24,497	28.3%
Excluded businesses	39,785	41,584	4.3%
Total	265,090	265,090	0.0%

Table 13 Comparison of sector definitions, North West survey 2009, and Defra survey 2009

North West 2009			Defra 2009			
Sector No	Description	SIC 2003	Sector no.	Description	SIC 2003 groups	SIC 2007 groups
1	Food, drink and tobacco	150-160	1	Food, drink & tobacco	150-160	10.1 - 12.0
2	Textiles/wood/paper/publishing	170-193, 200,205, 210-212, 220-223	2	Textiles / wood / paper / publishing	170-193, 200,205, 210-212, 220-223	13.1 - 18.2
3	Power & Utilities	230-233, 400-410	3	Power & utilities	230-233, 400-410	19.1 - 19.2, 35.1 - 36.0
4	Chemical/non-metallic minerals manufacturing	240-252, 260,268	4	Chemicals / non-metallic minerals manufacturing	240-252, 260,268	20.1 - 23.9
5	Metal manufacturing	270-275, 280-287	5	Metal manufacturing	270-275, 280-287	24.1 - 25.9
6	Machinery & equipment (other manufacturing)	290-297, 300-335, 340-355, 360-366	6	Machinery & equipment (other manufacturing)	290-297, 300-335, 340-355, 360-366	26.1 - 33.2
7	Retail & wholesale	500-527	7	Retail & wholesale	500-527	45.1 - 47.9
8	Other services	550-555, 600-632, 640-642, 633-634, 650-726, 740-748, 910-930, 730-732, 850-852	8	Hotels & catering	550-555	55.1 - 56.3
			11	Transport & storage	600-632, 640-642	49.1 - 53.2
			12	Other services	633-634, 650-726, 740-748, 910-930, 730-732, 850-852	58.1 - 82.9, 90.0 - 96.0
9	Public sector	750-753, 853, 800-804	9	Public administration & social work	750-753, 853	84.1 - 84.3, 86.1 - 88.9
			10	Education	800-804	85.1 - 85.6

3.2 Survey database

A Microsoft Access (2007) database was prepared to hold and manage the survey data collected. The database was designed to produce the outputs required for the interim and final output tables. The database used the grossing method described in Appendix K.

The design of the database was scrutinized and relationships and functions were checked before it was populated with data. It was additionally sense checked once the data was incorporated to ensure that the results it provided were final.

3.3 Data validation and quality assurance of raw data

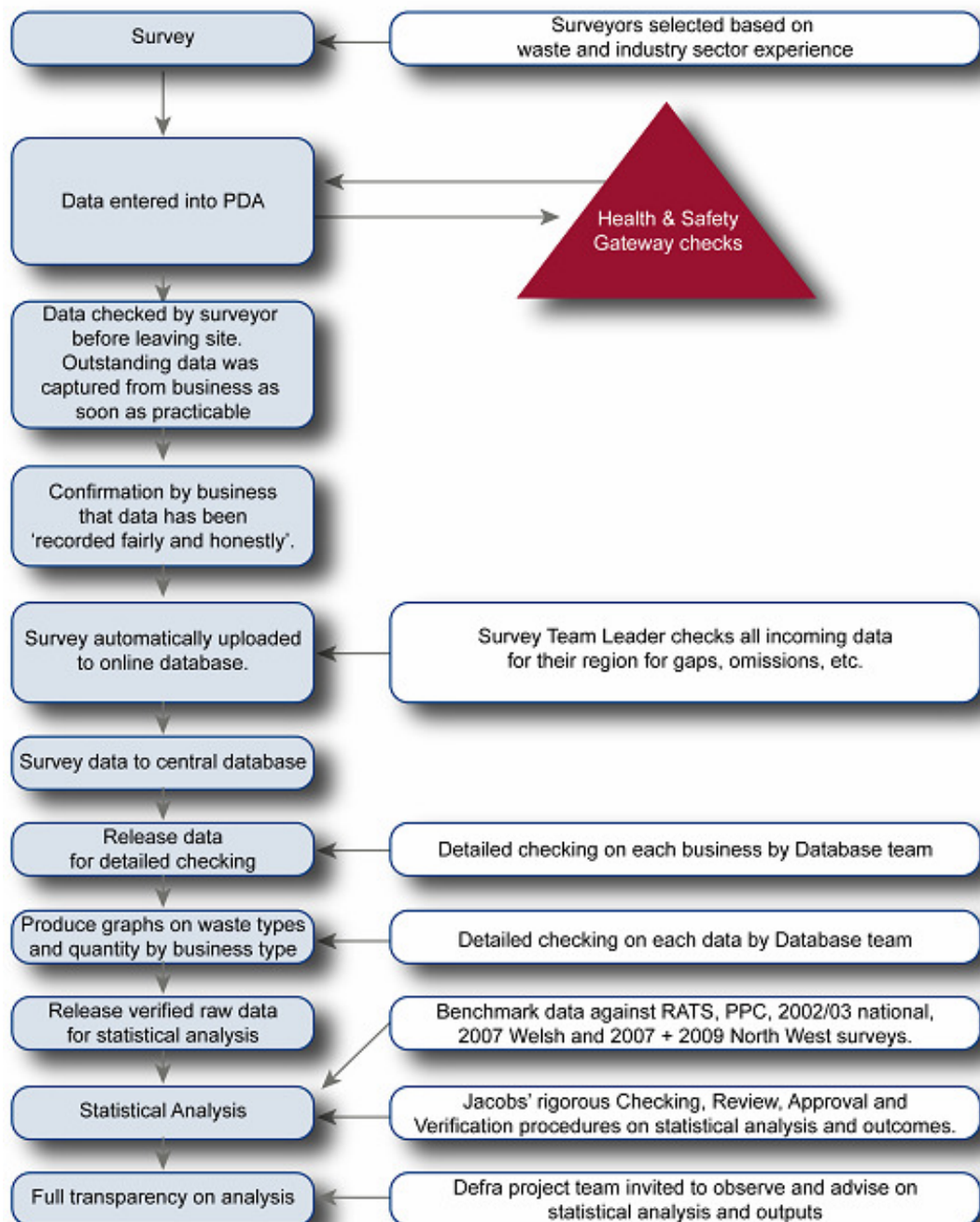
The total England C&I waste arisings estimate is built from the sample of 6,005 data points through grossing and so any errors at this stage are amplified and have the potential to have major impacts on the quality of the final estimate. A rigorous approach was applied to data validation based on comprehensive checking, reviewing, verification and approval of databases and models.

The checks can be broken down into the following categories, described below:

- Surveyor checks;
- Team leader reviews;
- Line by line data checks;
- Sense checks;
- Outlier checks.

A multi-layered data validation process was used, and this is illustrated in Figure 2.

Figure 2 Jacobs data validation process



3.3.1 Surveyor checks

Some possible sources of error in the surveying process included:

- Data may have been provided inaccurately by businesses (unintentionally and perhaps intentionally);
- Data may be missing altogether;
- Businesses may have requested that certain data was provided at a later date (which may not have been sent and therefore be excluded from the survey);
- The data collected during the site walkover will only record a snapshot in time;
- The commitment and attitude taken by individual surveyors.

To counteract these potential sources of error, the training package delivered to all surveyors included detailed instructions on how to conduct the survey and how their actions in the field could minimise the errors in the final results. On completing the entry of data, surveyors were requested to:

- Check all mandatory fields were complete;
- Check that the list of activities that produce waste was correct;
- Check that the environmental information regarding the site was complete;
- Check for typographical errors.

3.3.2 Team Leader review

PDAs were used to record the information during the site surveys. The data collected by the PDAs was then accessed by the Team Leaders for inclusion in the grossing database. As part of the Quality Assurance (QA) procedure, the Team Leaders undertook a high level review that:

- Ensured mandatory fields were complete, and
- Ensured that quantities of waste produced and waste types were appropriate/ reasonable for the type of activity and scale of business.

Any errors spotted here were referred back to the surveyor for correction before data was included in the grossing database.

3.3.3 Line by line checks

It was apparent that due to the developments in waste collection equipment, the extensive list of waste containers used within the PDA and telephone survey form was not inclusive. This meant that the 'other' classification had been used on a large number of occasions. To ensure that these data were correct, a line by line check was undertaken of all material lines where "other" had been used. This was completed by surveyors with a good level of site survey and waste experience. In addition, a list of standard weights and volumes were developed for materials that appeared frequently.

These checks highlighted a number of irregularities:

- Percentage fullness of container missing;
- Non-standard container size used;
- Individual item or number of items used.

Any inaccuracies spotted here were corrected and updated in the grossing database.

3.3.4 Sense checks

Two sense checks were run on the data following the line by line checks. The first looked at the typical waste streams expected in each pool and assessed this against the waste streams collected. A number of samples were identified and extracted to be investigated to ensure that the waste type had been correctly identified.

The second more detailed sense check looked at the data on a business type and size basis to ensure the arisings per material type were reasonable in relation to data from other businesses in that sector. This looked at any high or low tonnages in each sector.

Any inaccuracies identified in these sectors were updated in the database.

3.3.5 Outlier checks

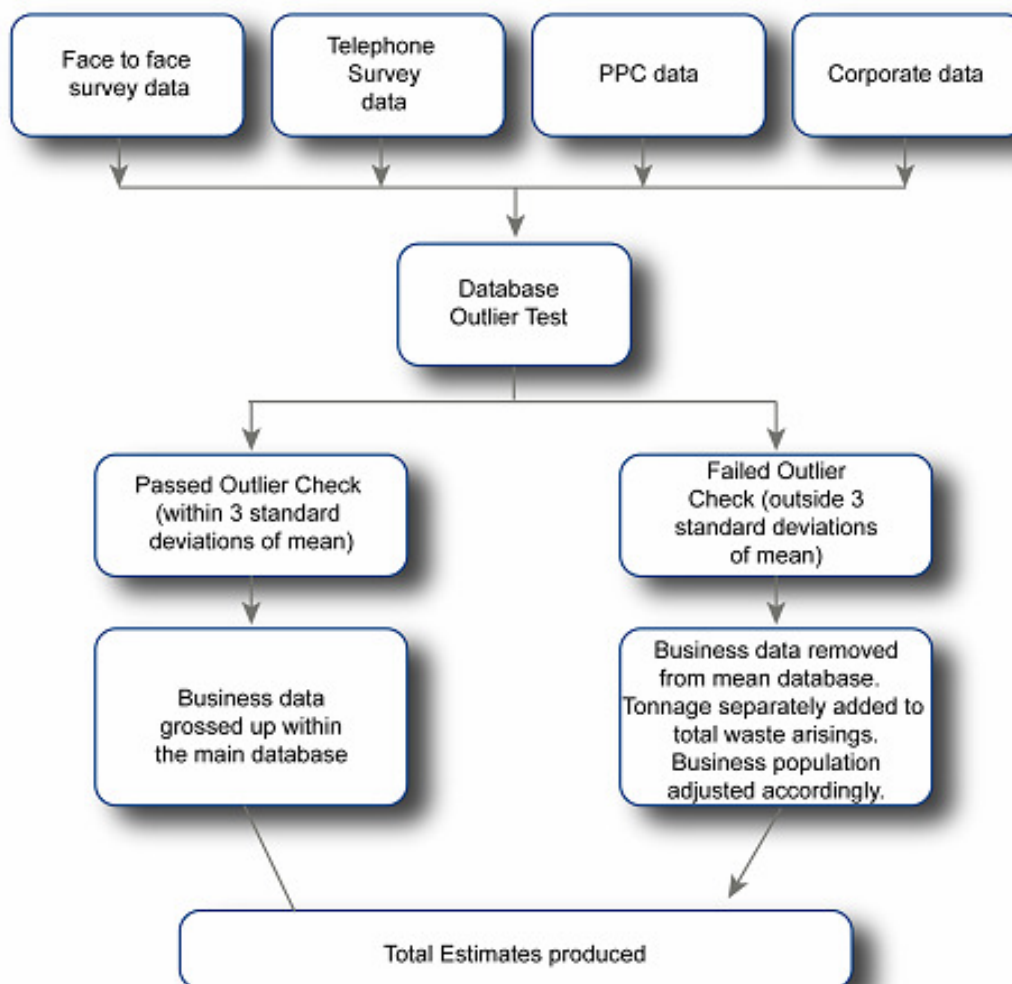
The data was screened for outliers. Assuming a normal distribution for each strata, any total business weight that was outside of two times the standard deviation of the mean weight for that strata, was extracted.

Each one of the extracted entries was screened to ensure that the data was reliable. Any inaccuracies identified in these outliers were updated in the database.

3.4 Grossing of survey results

A statistically sound grossing methodology was used to generate national results. A diagram illustrating the grossing process is provided in Figure 3.

Figure 3 Grossing process



3.4.1 Grossing methodology

The same overall grossing methodology was used as in previous surveys (e.g. the 2002/3 national survey, the 2007 surveys for Wales and the North West Region) in order to ensure compatibility and consistency with past studies. The methodology allowed for the comparison of results of this survey with those of the previous surveys at a high level. The outputs were also compatible with the requirements of the EU Regulations (EC) No. 2150/2002 on waste statistics.

The datasets were reviewed to assess if they could be used for grossing up. For example, data that had been flagged up as unreliable during data validation were excluded from the datasets used for grossing up to give national waste arisings estimates. The data was then checked and validated for consistency. For example, the total of the grossed-up weights of waste streams for a business sector were checked to ensure they were equal to the total of grossed-up weights by management method for the business sector.

Any business that might produce considerably more waste than a comparable business was treated separately. The test for this was based on assuming a normal distribution for each strata, any total business weight that was outside of three times the standard deviation of the mean weight for that strata, was highlighted.

In these cases the outlier businesses would be added into the estimate outside the grossing and the business population adjusted accordingly.

Data that was included within the grossing up exercise were those that were within an agreed range for the total tonnage by strata. Those outside this range were added to the grossed up figure separately. The variance and error data within this report refer to the grossed data only.

The same grossing methodology was used for all types of data collected, regardless of source. The detailed grossing methodology is provided in Appendix K. Error and confidence intervals are provided in Appendix L.

3.4.2 Benchmarking

The survey data collected was benchmarked against a number of sources to check consistency and identify reasons for significant discrepancy.

The 2009 survey was validated against a range of benchmarking data sources including:

- National C&I Waste Survey 2002/3 (EA);
- 2007 Survey of Industrial & Commercial Waste Arisings in Wales, For Environment Agency Wales;
- 2006/7 Study to fill Evidence Gaps for Commercial & Industrial Waste Streams in the North West Region of England, For the North West Regional Technical Advisory Board;
- Study into Commercial and Industrial Waste Arisings for the East of England Regional Assembly (ADAS, April 2009).

The benchmarking exercise was used to raise questions but not to direct the answer. It was recognised that if the data were consistent with previous studies this does not in itself make the data 'right' nor does it make it 'wrong' if the data is markedly different.

3.4.3 Businesses with fewer than five employees

Businesses with fewer than five employees were not surveyed. Waste arisings from these businesses were estimated. They were calculated from the sample results for businesses with 5-9 employees (size band 1).

The 2002/3 national survey determined the mean business waste arisings for businesses with 1-2 and 3-9 employees by sector. The ratios of the mean waste arisings of businesses with 1-2 employees were calculated to that of businesses with 3-9 employees from the 2002/3 data. The ratios are shown in Table 14 for each of the 12 business sectors surveyed.

Table 14 Ratios of businesses with 1-2 employees against businesses with 3-9 employees in terms of mean waste arisings

Business sector no.	Ratio
1	0.04
2	0.09
3	0.03
4	0.01
5	0.29
6	0.26
7	0.15
8	0.10
9	0.16
10	0.09
11	0.05
12	0.21

It was assumed that the ratios in Table 14 were applicable to the relationships between the mean waste arisings for businesses with 1-4 and 5-9 employees in 2009. The mean waste arisings for businesses with 1-4 employees in a business sector were estimated by multiplying the mean waste arisings for businesses with 5-9 employees by the relevant ratio given in Table 14 to yield the sector estimate for size band 0 (1-4 employees) for 2009.

4.1 Interim Results

Interim results for this survey were published on the 10th November 2010. Estimates were based on data from businesses amounting to around 60% of a planned total sample size of 6,000.

Estimates for England were based on the combination of interim results from the Survey of Commercial and Industrial Waste Arisings for 2009 (hereafter referred to as the Defra survey) with data from the North West of England Commercial and Industrial Waste Survey for 2008/09 published in March 2010.

A comparison of the interim and final results are given below:

Table 15 Comparison of interim and final estimate

	Interim results	Final results
Total arisings (England)	55.8 million tonnes	48.0 million tonnes
Industrial sector arisings	20.5 million	24.2 million tonnes
Commercial sector arisings	35.3 million tonnes	23.8 million tonnes
Error at 95% confidence	11%	7.62%

Several changes have been made since the interim results were issued that have changed the overall results. The details of these are given below, with the effect on the final results.

Table 16 Changes applied to interim data

Change	Effect on results
Sample numbers – The interim results were based on 60% of the results, whereas the final results were based on 6005 sample points.	This has improved the accuracy of the estimate.
The proportion of Face to face, telephone, PPC data and corporate data has changed between the interim and the final results.	The corporate data has shown a reduction in arisings in the commercial sector.
The main change is the use of more corporate data.	The use of addition PPC data has increased arisings in the industrial sector.

Change	Effect on results
The North West survey raw data was re-analysed by Defra to generate 2009 estimates for the region in a way best comparable with the Defra survey methodology. This will allow the tabulation of England estimates broken down by sector, material type, waste management method and region in the final reporting.	The results from the North West have been reduced by 0.1 million tonnes .
Some of the larger power producers and other large sites were not included in the sample. To ensure these sites were captured, data gathered directly from the EA were inserted.	<p>This has increased and improved the estimates within certain sectors. The screening for outliers resulted in these data being added in outside the grossing.</p> <p>In addition this has increased the proportion of waste generated by the industrial sector.</p>
<p>The PPC sites were all excluded from the grossing method and added in but outside the grossing in the interim. In the final report they were only excluded from the grossing if they did not pass the outlier test.</p> <p>Many of these sites were included in the grossing in the final results as they passed the outlier test.</p>	This has increased the grossing factors used where there were PPC data points. This has mainly affected the industrial sector, increasing the proportion of waste generated by the industrial sector.
The interim results were grossed without carrying out the outlier test. As a result the means generated as the basis for grossing were skewed by larger sites. This was understood and reflected in the commentary attached to the interim results.	This is the most significant factor driving the reduction of the final estimate compared to the interim.

The overall changes with the method and sample has allowed the error at a 95% confidence interval to reduce from 11.0% to 7.6%. The difference in the survey data and estimate are shown below.

Table 17 Interim and final survey data types

	Interim	Final report
Face-to-face	2,810	3,273
Telephone	406	801
Corporate	42	665
Corporate - Completion of survey	0	947
PPC	298	298
PPC - Completion of survey	0	21
Total data points	3,556	6,005
% error	11.0	7.6
Overall waste estimate (mt)	55.8	48.0

4.2 National C&I survey results

The total England C&I waste arisings in 2009, based on the survey results as detailed in section 3 is 48 million tonnes, split evenly between commercial and industrial businesses. In addition to the non-wastes identified in the tables below, it is estimated that there are around 2.5 million tonnes of further non-wastes not captured by the survey, specifically blast furnace slag and virgin timber.

The precision for the total waste arisings figure was 7.6% at a 95% confidence interval and at regional level the arisings were of a similar precision. The error compares with that targeted within the optimal survey design of $\pm 5\%$ at 95% confidence interval as is considered to be a very positive outcome. The difference reflect the data achieved from the businesses which participated i.e the variance within the 2009 data as opposed to the optimal sample matrix which was based on 2002/3 variance and the fact that it is not possible sample at or close to census for a number of pools within a voluntary survey. Appendix L shows the breakdown of this error by sector.

The following tables are estimates of national waste arisings based upon the grossing up of the data collected in this survey, including data collected through all methods (face-to-face and telephone surveys, PPC data, corporate data and North West survey data).

The data is presented with totals for all C&I waste arisings for industrial and commercial sectors. Results are shown by:

- Business sector and:
 - Company size band
 - Waste type - including mixed waste as a column heading
 - Waste type - mixed wastes only split by all other SOC group
 - Waste type - excluding the mixed waste column and with mixed waste redistributed across the other SOC groups
 - Waste management method
 - Region
- Region and:
 - Waste type - including Waste type - mixed wastes only split by all other SOC groups

- Waste type - excluding the mixed waste column and with mixed waste redistributed across the other SOC groups
- Waste management method
- Waste management and:
 - Waste type - including mixed waste as a column heading
 - Waste type - Mixed wastes only – split across other SOC groups
 - Waste type - excluding mixed waste column heading & redistribute mixed across other SOC groups
 - Mixed waste as a column heading

The tables quote tonnages in 1000 tonnes reflecting in part the accuracy of the estimate and to make the figures easier to consider. However it should be noted that this rounding leads to slight variations in the total waste tonnage between tables.

4.2.1 Detailed data tables

Table 18 Waste arisings by sector and company size band ('000s tonnes)

	Business sector	1-4	5-9	10-19	20-49	50-99	100-249	250+	Grand total
1	Food, drink & tobacco	2	14	57	303	582	928	2,870	4,756
2	Textiles / wood / paper / publishing	24	61	228	255	480	1,149	1,252	3,449
3	Power & utilities	1	41	19	53	91	1,511	4,003	5,719
4	Chemicals / non-metallic minerals manufacture	7	93	190	729	307	1,576	946	3,848
5	Metal manufacturing	106	100	152	251	636	719	2,272	4,236
6	Machinery & equipment (other manufacture)	51	50	174	222	236	494	938	2,165
7	Retail & wholesale	974	1,763	1,305	1,481	997	1,032	1,659	9,211
8	Hotels & catering	138	667	561	756	296	99	154	2,671
9	Public administration & social work	38	109	733	502	354	412	743	2,891
10	Education	26	80	42	316	259	447	311	1,481
11	Transport & storage	17	55	642	471	115	473	416	2,189
12	Other services	901	548	425	881	783	307	1,556	5,401
	Grand total	2,285	3,581	4,528	6,220	5,136	9,147	17,120	48,017

Table 19 Waste arisings by sector and waste type, including the mixed wastes column ('000s tonnes)

	Business sector	Animal & vegetable wastes	Chemical wastes	Common sludges	Discarded equipment	Healthcare wastes	Metallic wastes	Mineral wastes	Mixed wastes	Non-metallic wastes	Non-wastes	Grand total
1	Food, drink & tobacco	2,400	753	611	6	1	37	61	580	307	0	4,756
2	Textiles / wood / paper / publishing	17	1,044	58	28	<0.5	76	95	448	1,683	1	3,450
3	Power & utilities	278	366	26	2	1	48	4,815	154	30	0	5,720
4	Chemicals / non-metallic minerals manufacture	40	1,627	71	7	14	103	923	526	536	0	3,847
5	Metal manufacturing	74	683	21	6	2	895	1,972	462	121	0	4,236
6	Machinery & equipment (other manufacture)	12	195	35	30	22	902	20	541	402	5	2,164
7	Retail & wholesale	328	291	2	308	402	169	57	3,543	4,112	0	9,212
8	Hotels & catering	106	49	36	13	68	15	19	1,364	1,078	0	2,748
9	Public administration & social work	31	54	0	44	1,104	26	128	1,071	415	0	2,873
10	Education	82	3	<0.5	53	46	4	32	944	335	0	1,499
11	Transport & storage	215	113	27	132	58	246	13	706	754	0	2,264
12	Other services	171	203	8	130	137	92	762	1,965	1,780	0	5,248
	Grand total	3,754	5,381	895	759	1,855	2,613	8,897	12,304	11,553	6	48,017

<means less than the lowest digit shown

Table 20 Mixed waste arisings only, by sector and waste type ('000s tonnes)

	Business sector	Animal & vegetable wastes	Chemical wastes	Common sludges	Discarded equipment	Healthcare wastes	Metallic wastes	Mineral wastes	Non-metallic wastes	Non-wastes	Grand total
1	Food, drink & tobacco	257	44	6	<0.5	<0.5	26	4	243	0	580
2	Textiles / wood / paper / publishing	15	35	4	<0.5	<0.5	12	3	378	0	447
3	Power & utilities	9	31	<0.5	<0.5	0	5	28	81	0	154
4	Chemicals / non-metallic minerals manufacture	22	77	6	<0.5	<0.5	30	33	357	0	525
5	Metal manufacturing	22	6	0	<0.5	<0.5	88	168	177	0	461
6	Machinery & equipment (other manufacture)	42	17	<0.5	1	<0.5	120	6	353	0	539
7	Retail & wholesale	347	11	<0.5	81	<0.5	649	22	2,433	0	3,543
8	Hotels & catering	333	7	30	1	6	55	<0.5	934	0	1,366
9	Public administration & social work	168	1	0	29	151	35	11	676	0	1,071
10	Education	165	<0.5	0	27	13	32	19	689	0	945
11	Transport & storage	85	8	11	1	3	87	6	504	1	706
12	Other services	217	26	6	7	21	80	140	1,468	<0.5	1,965
	Grand total	1,682	263	63	147	194	1,219	440	8,293	1	12,302

Table 21 Waste arisings by sector and waste type, with mixed wastes allocated across the remaining waste types ('000s tonnes)

	Business sector	Animal & vegetable wastes	Chemical wastes	Common sludges	Discarded equipment	Healthcare wastes	Metallic wastes	Mineral wastes	Non-metallic wastes	Non-wastes	Grand total
1	Food, drink & tobacco	2,657	796	616	6	1	63	66	551	0	4,756
2	Textiles / wood / paper / publishing	32	1,079	62	28	1	88	98	2,061	1	3,450
3	Power & utilities	287	397	26	2	1	53	4,843	111	0	5,720
4	Chemicals / non-metallic minerals manufacture	62	1,704	77	7	15	134	956	893	0	3,848
5	Metal manufacturing	96	689	21	6	2	983	2,140	298	0	4,235
6	Machinery & equipment (other manufacture)	55	212	35	31	22	1,022	26	756	5	2,164
7	Retail & wholesale	675	302	2	389	403	817	79	6,544	0	9,211
8	Hotels & catering	463	97	15	17	81	99	47	2,183	0	3,002
9	Public administration & social work	241	68	64	55	955	63	120	1,170	0	2,736
10	Education	297	28	37	48	45	109	44	900	0	1,508
11	Transport & storage	233	96	1	149	363	264	37	1,327	1	2,471
12	Other services	339	173	<0.5	167	162	139	881	3,053	0	4,914
	Grand total	5,437	5,641	956	905	2,051	3,834	9,337	19,847	7	48,015

Table 22 Waste arisings by sector and management type ('000s tonnes)

	Business sector	Land disposal	Land recovery	Thermal treatment (energy recovery)	Thermal treatment	Non-thermal Treatment	Transfer station	Recycling	Com-posting	Reuse	Unknown	Grand total
1	Food, drink & tobacco	385	1,140	118	149	331	7	1,731	279	373	242	4,755
2	Textiles / wood / paper / publishing	395	516	120	18	221	24	1,879	15	140	123	3,451
3	Power & utilities	2,408	155	136	21	31	2	2,515	9	127	317	5,721
4	Chemicals / non-metallic minerals manufacture	938	146	120	178	518	52	1,297	156	163	281	3,849
5	Metal manufacturing	1,413	145	23	9	166	47	2,204	1	45	182	4,235
6	Machinery & equipment (other manufacture)	317	35	26	7	106	150	1,380	14	23	106	2,164
7	Retail & wholesale	1,956	4	146	170	615	247	5,240	35	213	586	9,212
8	Hotels & catering	894	0	43	47	52	47	1,429	24	41	525	3,102
9	Public administration & social work	555	2	64	828	80	11	719	25	64	349	2,697
10	Education	449	3	19	24	23	8	571	44	9	296	1,446
11	Transport & storage	368	6	98	143	59	87	1,462	1	77	173	2,474
12	Other services	1,201	5	93	146	118	159	2,496	102	49	543	4,912
	Grand total	11,279	2,157	1,006	1,740	2,320	841	22,923	705	1,324	3,723	48,018

Table 23 Waste arisings by sector and region ('000s tonnes)

	Business sector	North East	Yorkshire and The Humber	East Midlands	West Midlands	East of England	London	South East	South West	North West	Grand total
1	Food, drink & tobacco	168	688	757	558	736	388	312	533	616	4,756
2	Textiles / wood / paper / publishing	167	583	504	169	294	216	576	305	637	3,451
3	Power & utilities	221	2,064	1,602	481	112	91	708	151	289	5,719
4	Chemicals / non-metallic minerals manufacture	368	571	493	485	458	123	430	314	605	3,847
5	Metal manufacturing	414	772	485	1,116	363	53	269	324	440	4,236
6	Machinery & equipment (other manufacture)	100	268	175	282	200	108	293	230	509	2,165
7	Retail & wholesale	340	814	700	887	981	1,246	1,444	869	1,931	9,212
8	Hotels & catering	124	237	190	230	250	506	445	314	859	3,155
9	Public administration & social work	148	265	251	266	259	386	421	288	376	2,660
10	Education	59	122	103	144	146	194	219	140	305	1,432
11	Transport & storage	90	211	202	234	257	350	332	208	606	2,490
12	Other services	159	347	843	394	451	1,150	800	399	354	4,897
	Grand total	2,358	6,942	6,305	5,246	4,507	4,811	6,249	4,075	7,527	48,020

Table 24 Waste arisings by region and waste type, including the mixed wastes column ('000s tonnes)

Region	Animal & vegetable wastes	Chemical wastes	Common sludges	Discarded equipment	Healthcare wastes	Metallic wastes	Mineral wastes	Mixed wastes	Non-metallic wastes	Non-wastes	Grand total
North East	159	483	60	33	94	145	374	537	472	0	2,357
Yorkshire and The Humber	491	750	91	76	190	347	2,648	1,220	1,129	0	6,942
East Midlands	576	639	76	68	168	241	2,484	1,039	1,017	0	6,308
West Midlands	484	678	57	81	196	403	1,075	1,248	1,024	0	5,246
East of England	394	512	299	86	198	217	452	1,231	1,117	0	4,506
London	367	334	41	120	299	140	183	1,773	1,553	0	4,810
South East	368	774	58	136	315	281	848	1,829	1,641	0	6,250
South West	357	632	54	80	209	212	285	1,180	1,064	0	4,073
North West	561	578	160	79	187	627	547	2,245	2,537	6	7,527
Grand Total	3,757	5,380	896	759	1,856	2,613	8,896	12,302	11,554	6	48,019

Table 25 Mixed wastes arisings only by region and waste type ('000s tonnes)

Region	Animal & vegetable wastes	Chemical wastes	Common sludges	Discarded equipment	Healthcare wastes	Metallic wastes	Mineral wastes	Non-metallic wastes	Non-wastes	Grand total
North East	81	8	<0.5	5	1	52	26	365	<0.5	538
Yorkshire and The Humber	189	17	<0.5	11	2	122	47	831	<0.5	1,219
East Midlands	161	13	<0.5	9	2	102	33	717	<0.5	1,037
West Midlands	180	17	<0.5	12	3	129	58	849	<0.5	1,248
East of England	186	12	<0.5	12	3	128	36	855	<0.5	1,232
London	272	11	<0.5	16	5	170	43	1,256	<0.5	1,773
South East	267	18	<0.5	18	5	186	45	1,290	<0.5	1,829
South West	184	13	<0.5	11	3	122	28	818	<0.5	1,179
North West	239	246	68	34	79	267	233	1,079	0	2,245
Grand Total	1,759	355	68	128	103	1,278	549	8,060	0	12,300

Table 26 Waste arisings by region and waste type, with mixed wastes allocated across the remaining waste types ('000s tonnes)

Region	Animal & vegetable wastes	Chemical wastes	Common sludges	Discarded equipment	Healthcare wastes	Metallic wastes	Mineral wastes	Non-metallic wastes	Non-wastes	Grand total
North East	239	492	60	38	95	196	400	837	<0.5	2,357
Yorkshire and The Humber	680	768	91	87	192	469	2,695	1,960	<0.5	6,942
East Midlands	738	652	76	76	170	343	2,517	1,734	<0.5	6,306
West Midlands	664	695	57	93	199	532	1,134	1,874	<0.5	5,248
East of England	580	524	299	98	201	344	488	1,972	<0.5	4,506
London	639	345	41	135	304	310	226	2,809	<0.5	4,809
South East	635	792	58	154	320	467	892	2,931	<0.5	6,249
South West	541	645	54	91	212	334	313	1,882	<0.5	4,072
North West	800	824	228	113	266	894	779	3,616	6	7,526
Grand Total	5,516	5,737	964	885	1,959	3,889	9,444	19,615	6	48,015

Table 27 Waste arisings by region and management type ('000s tonnes)

Region	Land disposal	Land recovery	Thermal treatment (energy recovery)	Thermal treatment	Non-thermal treatment	Transfer station	Recycling	Com-posting	Reuse	Unknown	Grand total
North East	595	106	147	98	131	35	976	36	75	156	2,355
Yorkshire and The Humber	1,997	238	107	205	332	78	3,142	92	211	539	6,941
East Midlands	1,948	343	94	185	287	70	2,775	106	192	308	6,308
West Midlands	1,202	161	100	195	287	94	2,483	82	173	470	5,247
East of England	858	373	94	194	275	85	2,028	88	158	354	4,507
London	986	101	123	253	234	140	2,260	85	153	474	4,809
South East	1,308	225	199	289	313	125	2,991	86	201	512	6,249
South West	801	145	88	198	256	79	1,799	72	159	477	4,074
North West	1,584	466	54	124	206	135	4,468	59	0	433	7,529
Grand Total	11,279	2,158	1,006	1,741	2,321	841	22,922	706	1,322	3,723	48,019

Table 28 Waste arisings by management and waste type, including the mixed wastes column ('000s tonnes)

Management type	Animal & vegetable wastes	Chemical wastes	Common sludges	Discarded equipment	Healthcare wastes	Metallic wastes	Mineral wastes	Mixed wastes	Non-metallic wastes	Non-wastes	Grand total
Landfill	83	369	13	3	61	4	4,007	6,549	170	0	11,259
Land recovery	391	759	618	0	<0.5	0	301	64	30	0	2,163
Thermal treatment (energy recovery)	157	345	<0.5	<0.5	71	<0.5	28	293	108	0	1,002
Thermal treatment	222	275	11	<0.5	998	1	2	184	27	0	1,720
Non-thermal treatment	229	1,360	27	32	584	14	15	44	14	0	2,319
Transfer station	11	33	0	5	<0.5	31	11	583	151	0	825
Recycling	1,725	1,426	97	594	<0.5	2,426	3,692	2,668	10,340	6	22,974
Composting	374	225	33	5	0	<0.5	6	33	31	0	707
Reuse	361	81	4	26	<0.5	72	363	56	361	0	1,324
Unknown	214	517	97	90	106	80	484	1,785	348	0	3,721
Grand Total	3,767	5,390	900	755	1,820	2,628	8,909	12,259	11,580	6	48,014

NB Due to the differences between the North West and National Survey, the North West data was manipulated to be more compatible with National survey. Due to the nature of these manipulations, the North West totals included in table above were slightly different to those in other tables. Therefore there may be slight differences in the total tonnage estimates from other tables presented in this report. More detail on the North West results included in this report is in section 3.1.6.

Table 29 Mixed waste arisings only by management and waste type ('000s tonnes)

Region	Animal & vegetable wastes	Chemical wastes	Common sludges	Discarded equipment	Healthcare wastes	Metallic wastes	Mineral wastes	Non-metallic wastes	Non-wastes	Grand total
Landfill	865	400	30	57	29	598	837	3,732	1	6,549
Land recovery	21	8	<0.5	<0.5	<0.5	3	1	32	0	65
Thermal treatment (energy recovery)	47	7	<0.5	1	5	13	7	213	<0.5	293
Thermal treatment	32	1	<0.5	2	1	12	3	133	<0.5	184
Non-thermal treatment	7	2	<0.5	<0.5	<0.5	2	1	31	0	43
Transfer station	61	14	<0.5	3	1	48	14	442	<0.5	583
Recycling	347	32	2	29	3	299	80	1,875	<0.5	2,667
Composting	10	2	0	<0.5	<0.5	2	<0.5	19	0	33
Reuse	6	1	0	5	<0.5	7	1	37	0	57
Unknown	254	38	153	11	35	105	82	1,107	<0.5	1,785
Grand Total	1,650	505	185	108	74	1,089	1,026	7,621	1	12,259

NB Due to the differences between the North West and National Survey, the North West data was manipulated to be more compatible with National survey. Due to the nature of these manipulations, the North West totals included in table above were slightly different to those in other tables. Therefore there may be slight differences in the total tonnage estimates from other tables presented in this report. More detail on the North West results included in this report is in section 3.1.6.

Table 30 Waste arisings by management and waste type with mixed wastes allocated across the remaining waste types ('000s tonnes)

Region	Animal & vegetable wastes	Chemical wastes	Common sludges	Discarded equipment	Healthcare wastes	Metallic wastes	Mineral wastes	Non Metallic wastes	Non-wastes	Grand total
Landfill	948	770	43	60	90	602	4,844	3,902	1	11,260
Land recovery	412	767	619	<0.5	<0.5	3	301	62	0	2,164
Thermal treatment (energy recovery)	204	352	<0.5	1	76	13	36	321	<0.5	1,003
Thermal treatment	254	276	11	2	999	13	5	160	<0.5	1,720
Non-thermal treatment	236	1,362	27	32	585	16	16	44	0	2,318
Transfer station	72	47	<0.5	8	1	79	26	593	<0.5	826
Recycling	2,072	1,459	100	622	4	2,725	3,772	12,215	6	22,975
Composting	383	227	33	5	<0.5	2	6	51	0	707
Reuse	366	82	4	30	<0.5	79	364	398	0	1,323
Unknown	469	555	250	102	141	185	566	1,455	<0.5	3,723
Grand total	5,416	5,897	1,087	862	1,896	3,717	9,936	19,201	7	48,019

NB Due to the differences between the North West and National Survey, the North West data was manipulated to be more compatible with National survey. Due to the nature of these manipulations, the North West totals included in table above were slightly different to those in other tables. Therefore there may be slight differences in the total tonnage estimates from other tables presented in this report. More detail on the North West results included in this report is in section 3.1.6.

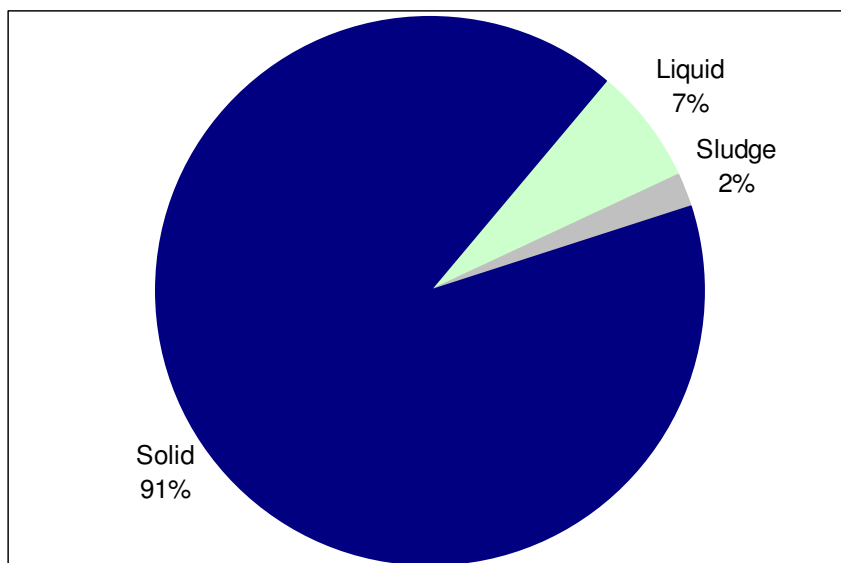
4.2.2 Additional Survey data

In addition to the tables provided above, the following information was also gathered in the surveys.

a) Physical form: Solid / liquid / sludge

The physical form of each material stream recorded was collected by the surveyors. This was based upon information provided by the business or a visual inspection. Figure 4 shows these results.

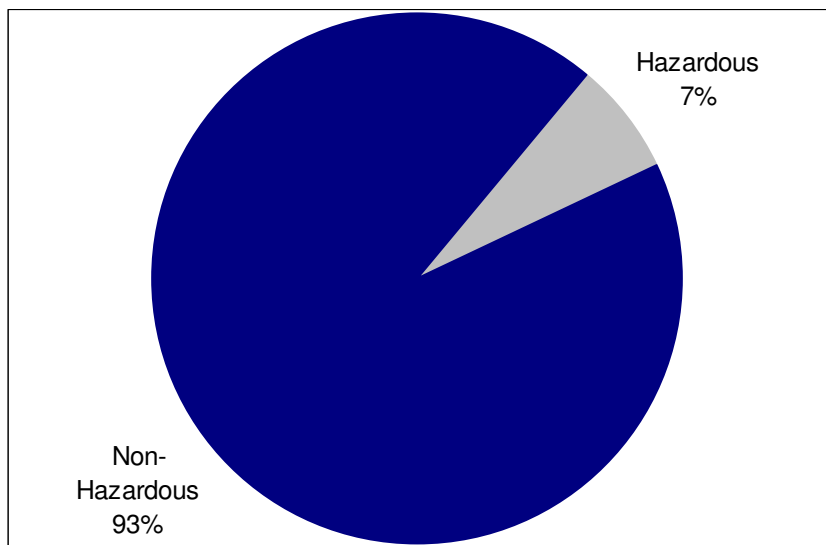
Figure 4 *Physical form of recorded waste streams*



b) Nature: Hazardous / Non-hazardous

Each waste stream recorded was assessed to determine whether it was hazardous or non-hazardous waste. This was based upon information supplied by the business. Figure 5 shows the percentage of hazardous and non-hazardous wastes.

Figure 5 Nature of recorded waste streams

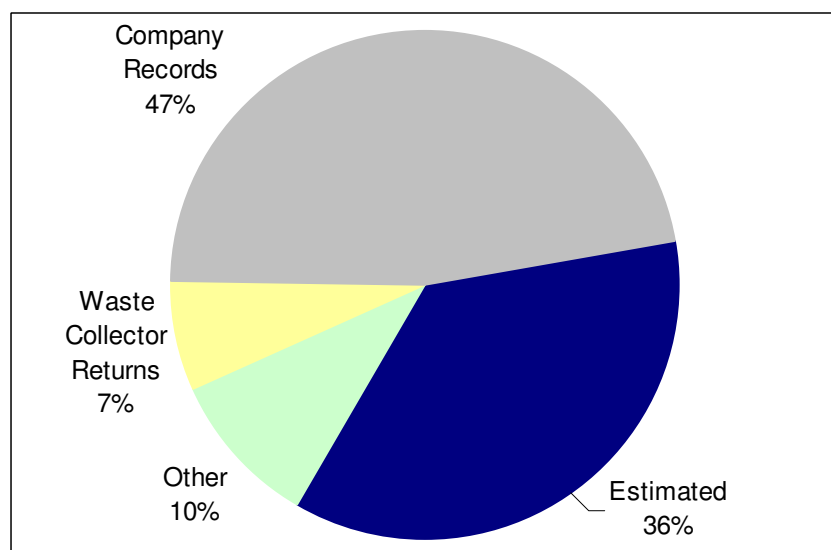


c) Data source

A variety of steps were taken to ensure the quality of the data collected. For the face-to-face interviews, surveyors were given tools to estimate waste tonnages from containers, but were encouraged to either take quantities from the company's written records (invoices, transfer notes etc) or if not available, to take estimates provided by the company themselves, and agreed with the surveyor.

The final data set showed that 54% of the data came from written records or company records. The chart in Figure 6 shows these results. 36% of data is based on estimates undertaken on site by surveyor.

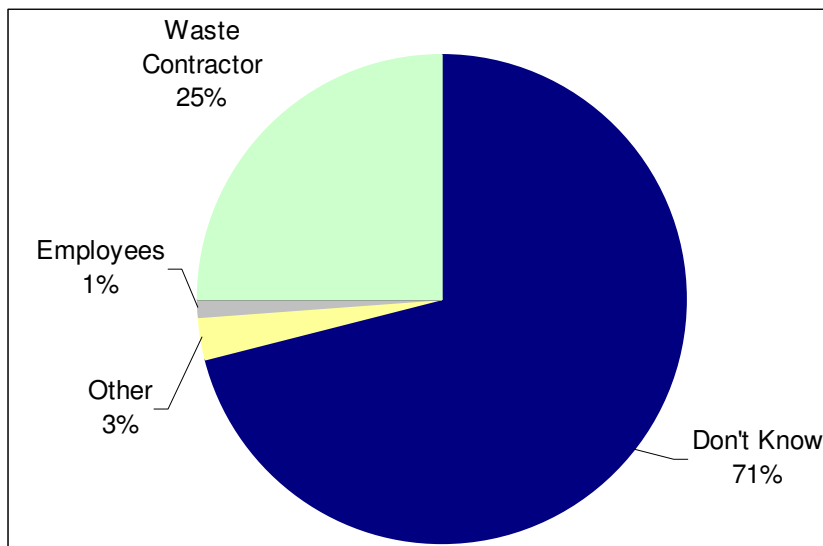
Figure 6 Data source



d) Waste collector

For each waste stream, the type of organisation who collected and either treated or disposed of the waste concerned was recorded, where the information was available. The results are shown in Figure 7.

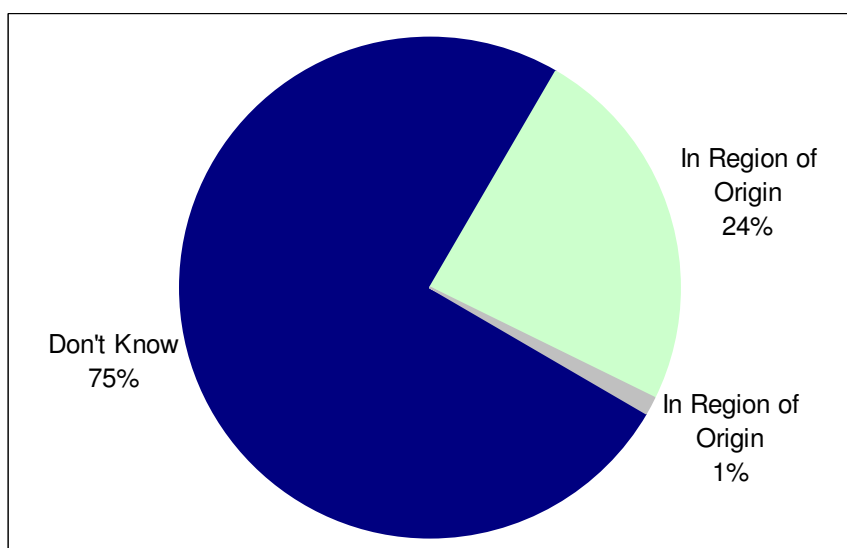
Figure 7 *Type of collection contract*



e) Waste destination

For each waste stream the destination of the waste was recorded i.e. was the waste destined to go to a treatment, recovery or disposal facility inside the region in which the business was based or within another region. This was based upon the knowledge of the business, but in many cases this was not known. The results are shown in Figure 8.

Figure 8 *Destination of waste for treatment in region or outside*



4.3 Commentary

4.3.1 Statistical analysis of data

Table 31 shows the completed sample matrix and the precision for the waste arisings estimated at a 95% confidence interval, at a national and regional level. The estimated margin of error of the national total, at the 95% confidence interval, is 7.62%. The estimate was built from site survey data gathered through face-to-face and telephone interviews. This was augmented by data from PPC regulated businesses and with data provided for companies at a corporate level. The grossing of the sample was based on an adjusted population of 5,887 sample points. The total sample population numbered 6005 samples. Data that were over 3 standard deviations beyond the mean for the 72 business strata were removed and added to estimate outside of the grossing. A total of 118 data points were added to the estimate in this way.

Table 31 Completed sample matrix and statistical confidence

Business sector	North East	Yorkshire and The Humber	East Midlands	West Midlands	East of England	London	South East	South West	Total	Est MoE at 95% C.I.
1	28	62	55	38	58	57	33	93	424	3.4
2	15	37	50	19	30	64	38	58	311	7.6
3	16	20	15	16	16	9	29	15	136	19.8
4	41	58	53	53	39	27	55	63	389	5.98
5	23	42	36	61	26	15	26	55	284	10.91
6	29	27	24	39	26	29	33	72	279	6.51
7	51	113	111	156	168	727	233	507	2,066	3.2
8	10	9	12	8	9	172	24	43	287	5.74
9	13	9	13	15	14	67	24	44	199	19.01
10	12	16	14	18	22	72	18	41	213	6.81
11	9	16	12	16	15	106	23	42	239	10.47
12	21	42	36	50	58	612	93	148	1,060	7.38
Total	268	451	431	489	481	1,957	629	1,181	5,887	7.62
Est MoE at 95% C.I.	6.47	6.7	5.85	8.01	6.98	7.14	6.65	7.23	7.62	

4.3.2 Benchmarking

The data were compared with the 2002/3 survey and other more recent work as part of the benchmarking and quality assurance processes. It was recognised that with only one national dataset of a similar size in 6 years, and with changes in the classification schemes used there was only so far this comparative work could be taken. The process did serve to highlight areas for further analysis within the checking and verification process as well as providing the basis for comment on changes that were well beyond the confidence interval. A number of these could be readily rationalised with reference to business populations.

The data reveal a drop in the national estimate of C&I waste of 19.9mt to 48.0mt. This is a fall of 29% from the 2002/3 value of 67.9mt, despite a rise in business population of 10% over the same period. The deregulation of blast furnace slags as by-products (or non-wastes) removed 2.4mt (2009 value) from the estimate.

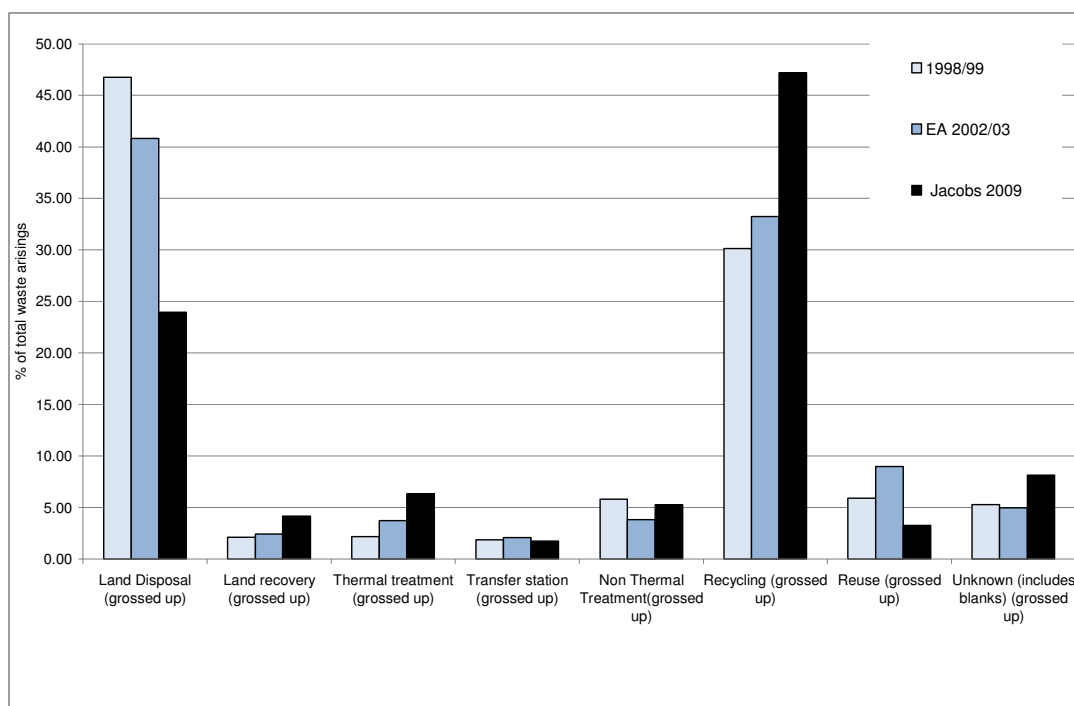
Overall 13.4mt, approximately two thirds of the fall in arisings, resulted from industry. Here the business population has fallen by 18% over the same period. The 6.5mt fall in commercial waste is set against a business population increase of 12% over the same period.

Direct comparison of the 2009 estimate with the 2003 estimate at a sector and material level is hindered by changes in industrial classification and in material classification. Nevertheless there is reasonable alignment in many material and sector categories and comparison reveals some interesting changes.

The waste arisings from a number of sectors fell by over 10%. Given the error within the estimate, these falls can be regarded as real. When account is made of business population, this reduces the sectors where a real and significant fall was in arisings was observed to: Food, drink and tobacco, Chemicals manufacture, Machinery & equipment manufacture, Retail & wholesale and Hotels & Catering. In Education, a 24% fall in waste was observed despite an increase in population of 16%. Waste from the Social work & public administration sector effectively doubled in line with a similar change in population, but this in part reflects the nationalisation of some large banks in 2008 and changes of SIC coding between 2003 and 2007.

With respect to waste types, all fell by at least 20% apart from “discarded equipment” which increased by 409 thousand tonnes (117%) from the 2002/3 value. This likely to reflect the introduction of regulations and resulting change in practice derived from the WEEE Directive over the intervening period.

Figure 9 Waste management methods: A comparison between 1998/9, 2002/3 and 2009



Since 2002/3 the percentage of waste landfilled by business has fallen from 41% to 23%, a drop of 16.4mt. Similarly the degree of recycling has increased by 15% to 48%. Reuse appears to have fallen although this is likely to be due to the removal of blast furnace slags from the data. The amount of C&I waste undergoing treatment has increased by approximately 2mt, 1.5mt of this goes to thermal treatment.

4.3.3 SMEs

Understanding the contribution of Small and Medium Enterprises (SMEs) to the estimate is important. However defining SME within the survey is not straightforward as the survey considers sites not enterprises as such. Nevertheless we have assumed all sites with less than 50 employees to be SME's to provide the following comments.

SMEs represent over 95% of the business population and this has remained consistent since 2003 despite the population of SMEs growing by 10%. Yet, the proportion of the waste from SMEs within the estimate has fallen 3% to 35% (16.6 M te). Overall waste tonnages have fallen by 24% and much of this has been driven by waste reduction within SME's which has dropped by 30% when compared to the 2002/3 value. Over the same period waste from larger businesses only fell by 20%. When account is taken of the exclusion of non-wastes, waste from larger businesses only fell by only 14%.

Detailed analysis of which sectors within SME's have contributed to this fall is problematic due to the change in classification between the two surveys. The survey results for 2009 do show a reduction in SME waste is observed in many sectors within industry and commerce.

Detailed analysis of waste from SMEs, particularly micro-SMEs, is notoriously difficult, and their behaviour on waste management can be much less predictable than for larger enterprises (ref Defra SME study previously provided). In addition, the period surveyed was one of particular upheaval given the economic situation in 2009. Business demographics in this period reflected this, with a record number of businesses closing, and the business birth rate declining¹⁰

4.3.4 EA Landfill data

A high level check of the database outputs was carried out by examining available data on waste to landfill and summing this with the C&I survey figure to affect a mass balance on solid waste to landfill. The calculation used published Defra data from Waste Data Flow¹¹ with other data on construction demolition and excavation waste (CDE) waste from Construction and Resource Waste Management Platform (2008 figures¹²).

Whilst Dataflow is intended to capture residues from recovery and treatment processes there is reasonable information¹³ to indicate that there is under reporting of rejects and residues from MRF and MBT processes and it has been assumed the

¹⁰ <http://www.statistics.gov.uk/pdffdir/bd1210.pdf>

¹¹ www.wastedataflow.org

¹² http://aggregain.wrap.org.uk/templates/temp_agg_publication_details.rm?id=2298&publication=9526

¹³ http://www.letsrecycle.com/do/ecco.py/view_item?listid=37&listcatid=364&listitemid=11061§ion=local_authority

same under reporting is occurring with respect to IBA recycling. Therefore the following factors were applied to 2009/10 data on MSW to yield "indirect" landfill tonnage;

- 15% of thermal treatment tonnages are returned to landfill (approximately equivalent to 60% recycling of IBA)
- 10% of recycling tonnage is returned to landfill

The same factors were applied to the C&I waste to derive an indirect landfill figure for C&I waste.

Table 32 below summaries this:

Table 32 MSW and C&I waste arisings to landfill (mt)

	MSW	C&I	Total
Direct landfill	12.5	11.3	23.8
Indirect landfill	1.4	2.7	4.1
Landfill total	13.9	14.0	27.9

It is estimated that 12.5 million tonnes of CDE waste was landfilled in 2008, assuming this remained the same in 2009 gives total landfill of 41 million tonnes. Data from the EA shows that nearly 44 million tonnes of waste was landfilled in England in 2009, with 43 million tonnes of this classified as non hazardous.

The mass balance closes to well within 10% of the reported landfill figure. Clearly there are some areas where the data used are absolutely aligned e.g. the timing of the MSW and CDE tonnages. Nevertheless given the calculated error within the C&I data and accepting that the reported data will also be subject to error this indicates the mass balance to effectively close and provides considerable reassurance in the 2009 C&I estimate.

4.3.5 Potential for landfill diversion

The survey assessed wastes in terms of their potential to be diverted from landfill by reuse, recycling (including composting) and recovery. The results obtained (based on grossed up data) are summarised in the following figures.

In grossing up the data, it has been assumed that all businesses within a sector have similar waste management practices and therefore the waste has the equal potential to be recycled or not.

By waste stream count, 68% of the waste streams recorded were already either reused, recycled or recovered, with 3% currently reused, 48% currently recyclable and 18% recoverable (i.e. treated in a another form but not recycled or reused) .

Following the grossing up to national tonnages, as shown in Table 33 and Table 34, the wastes potentially reusable, recyclable or recoverable is estimated to be 5 million. This appears to illustrate a potential to increase the diversion of commercial and industrial wastes in England from landfill, provided that the appropriate waste management infrastructure and waste management methods are in position.

It is important to note that there is a high probability of significant cross-over between those materials deemed either "recoverable" and/or "recyclable".

Table 33 Wastes (excluding non-wastes), potentially reusable, recyclable or recoverable in tonnes

Sector	Currently reused	Potentially reusable	Currently recycled	Potentially recyclable	Currently recovered	Potentially recoverable
Food, drink and tobacco	373,000	373,000	2,010,000	4,276,296	598,000	4,906,463
Textiles/wood/paper/publishing	140,000	289,691	1,894,000	2,575,504	359,000	2,684,732
Power & Utilities	127,000	127,000	2,524,000	20,481,734	188,000	1,914,338
Chemical/non-metallic minerals manufacturing	163,000	172,353	1,453,000	3,782,692	816,000	3,191,499
Metal manufacturing	45,000	338,160	2,205,000	3,902,748	198,000	2,123,956
Machinery & equipment (other manufacturing)	23,000	118,446	1,394,000	2,231,046	139,000	2,242,365
Retail & wholesale	213,000	633,306	5,275,000	7,675,988	931,000	8,978,903
Other services	41,000	304,765	1,453,000	2,609,065	142,000	2,681,824
Hotels & catering	64,000	167,742	744,000	5,163,710	972,000	7,326,560
Transport & storage	9,000	142,021	615,000	1,607,038	66,000	1,592,400
Public administration & social work	77,000	364,443	1,463,000	2,471,298	300,000	2,348,975
Education	49,000	377,812	2,598,000	16,178,741	357,000	5,258,676
Total	1,324,000	3,408,740	23,628,000	72,955,859	5,066,000	45,250,691

Table 34 Reusability, recyclability and recoverability of wastes (including non-wastes), by waste type in tonnes

	Potentially reusable	Potentially recyclable	Potentially recoverable
Animal & vegetable wastes	102,484	3,516,805	3,667,414
Chemical wastes	102,096	3,459,713	3,627,778
Chemical wastes	2,783	388,053	1,692,500
Discarded equipment	4,829	77,461	77,461
Healthcare wastes	78	20,540	40,804
Metallic wastes	88,519	1,945,193	1,945,193
Mineral	275,279	23,257,327	1,702,646
Non-metallic wastes	485,907	4,584,917	4,309,545
Animal & vegetable wastes	297,141	3,023,773	3,583,120
Chemical wastes	123,259	1,321,146	2,239,696
Chemical wastes	0	4,199	11,096
Discarded equipment	90,031	1,058,313	1,058,313
Healthcare wastes	3,579	45,659	3,192,568
Metallic wastes	103,264	2,268,115	2,268,115
Mineral	92,866	12,662,778	1,651,827
Non-metallic wastes	1,279,893	15,321,801	14,182,603
Total	2,839,817	65,513,761	36,185,526

Filtering these results to consider waste arisings that were landfilled or unknown only, advances a more crisp illustration of what was being disposed of using unsustainable waste treatment methods and may therefore present an opportunity to reuse, recycle and recover more material. Analysis of the figures by sector

demonstrates particular opportunities in the 'Education', 'Retail & wholesale' and 'Power & Utilities' sectors (this is shown in Table 35).

Table 35 *Potentially reusable, recyclable or recoverable material in 2009 currently landfilled or unknown (including non-wastes) in tonnes*

Sector	Potentially reusable	Potentially recyclable	Potentially recoverable
Food, drink and tobacco	139,406	4,276,296	4,906,463
Textiles/wood/paper/publishing	289,691	2,575,504	2,684,732
Power & Utilities	3,816	20,481,734	1,914,338
Chemical/non-metallic minerals manufacturing	172,353	3,782,692	3,191,499
Metal manufacturing	338,160	3,902,748	2,123,956
Machinery & equipment (other manufacturing)	118,446	2,231,046	2,242,365
Retail & wholesale	633,306	7,675,988	8,978,903
Other services	304,765	2,609,065	2,681,824
Hotels & catering	167,742	5,163,710	7,326,560
Transport & storage	142,021	1,607,038	1,592,400
Public administration & social work	364,443	2,471,298	2,348,975
Education	377,812	16,178,741	5,258,676
Total	3,051,962	72,955,859	45,250,691

Analysis of the figures by waste type, illustrates the opportunity for reusing, recycling and recovering non metallic and mineral wastes as illustrated in Table 36.

Table 36 Actual and potential reusable, recyclable or recoverable material in 2009 (including non-wastes), currently landfilled in tonnes

	Potentially reusable	Potentially recyclable	Potentially recoverable
Animal & vegetable wastes	17,522	185,063	252,641
Chemical wastes	48,480	20,360	35,694
Chemical wastes	341	341	21,972
Discarded equipment	373	2,919	2,919
Healthcare wastes	42	7	7,461
Metallic wastes	6,308	81,370	81,370
Mineral	58,433	11,917,565	262,451
Non metallic wastes	80,368	1,172,153	997,422
Animal & vegetable wastes	53,498	704,159	1,021,627
Chemical wastes	1,908	1,924	4,434
Chemical wastes	0	0	8
Discarded equipment	10,595	363,012	363,012
Healthcare wastes	2,637	2,637	74,351
Metallic wastes	22,602	581,903	581,903
Mineral	74,419	2,154,136	171,230
Non-metallic wastes	321,090	4,348,192	3,590,290
Total	631,900	21,327,057	7,155,559

As part of delivering the work, the call centre, surveyors and team leaders were encouraged to feedback their findings and observations. These included direct comments from the businesses who participated.

This section summarises the main points from this feedback and alongside the thoughts of the Jacobs project team on the survey design and suggests improvements for future surveys to maximise the results though minimum spend.

5.1 Surveyor/Participant Feedback

The summary points below reflect qualitative feedback from businesses, the call centre, surveyors and the survey team leaders. Although subjective, it is informative and provides useful context to the data.

1. Where waste and resource management was allocated to an individual such that it formed a significant part of their role, the understanding of the fate of materials was typically much better than where responsibility was unclear or where it was regarded as a minor responsibility.
2. There appeared to be a practical minimum level at which it was cost effective to segregate at source with smaller businesses not generating enough recycle to warrant the cost of a separate collection.
3. Those businesses using Local Authority collections appeared to have little understanding of destination and fate of their waste and materials.
4. Under the Duty of Care, businesses have a responsibility to consign waste to a registered waste carrier and understand the fate of their waste i.e. that it is being managed within the law at a site registered for waste treatment, recovery or disposal. The survey found little evidence of businesses auditing or verifying that they were meeting the Duty of Care.
5. Despite the widespread availability of information and advice through Government support and delivery bodies, many smaller businesses did not know where to gain advice on waste management
6. The general site manager at larger businesses, particularly retailers had an understanding of local issues relating to waste (e.g. bottle banks, HWRC and other “bring” provision, the availability and capacity of the third sector) but had no detailed understanding of arisings from their own sites. This was often managed through regional and national contracts involving reverse logistics with packaging wastes returning within delivery lorries to distribution centres or other hubs prior to recovery or treatment. As a result, some opportunities for local initiatives and links on recycling and reuse maybe overlooked.
7. Many, if not most, businesses who participated were involved and engaged with the survey aims and recognised the benefits from the work. Some were genuinely and rightly proud of their work in reducing their waste and improving recycling. Others were receptive but appeared to be doing little to improve their resource efficiency. It was unclear what was preventing them engaging but they represent an untapped market for further improvement in how business wastes are managed. Only a few were sceptical and regarded waste as a chore. Overall this may reflect the opt-in basis of the survey.
8. Surveyor perception was that – particularly where written records were maintained - the data provided were good. The basis of the records could be reaffirmed through discussion and site observation.

9. Data from larger companies was invariably of better quality than for smaller companies reflecting the dedicated resource and allocation of responsibility.
10. Mixed waste in bags or closed containers was a particular challenge for surveyors. Surveyors were not allowed to handle the waste to enable a visual assessment and this had to be made based on discussion with the business.
11. A number of businesses would like to have received their own results.
12. Some managers remarked how improving understanding of what should and should not be recycled was an issue within their workforce which impacted the scale and quality of segregated material.
13. A number of businesses were confused by the different service offerings provided by their local authorities to businesses. For smaller and medium sized businesses without the option to negotiate a dedicated contract this made it difficult to apply consistent standards and procedures across different areas.
14. A number of businesses had implemented improvements since 2009, reinforcing the need to revisit the survey within a reasonable timeframe.

5.2 Delivering the Survey – Lessons Learned

The survey methodology was adapted during the study, through the use of better quality information to complete over 6000 samples using up to date variance from 2009 data to guide the process. Whilst this was an improvement on the original agreed approach, we believe that significant changes could be made to method of data collection to deliver an estimate more quickly through the use of a combination of techniques. This would overcome the ideal nature of the target sample frame and address the degree of participation that was found to be considerably lower than in previous surveys.

The recommendations below are based on the feedback above and from the project team's experience of delivering the survey;

1. The survey methodology should be built from a number of desk based studies, back by field data. This could include:
 - a. Data collected by delivery agencies working on behalf of Defra
 - b. Further investigation of other corporately held data, with site surveys to assure data quality.
 - c. the use of telephone and web based surveys for smaller businesses should be further considered
 - d. All types surveys should include elements to assess the relative quality and reliability of each type of data.
 - e. Analysis of mixed commercial wastes would improve the data on mixed composition and reinforce conversion factors.
 - f. The impact of the opt-in basis for the survey should be examined.
 - g. Consideration should be given to incentives that are at, or close to, cost neutral to encourage participation.
 - h. Anonymous benchmarking was provided to a small number of corporate participants and was well received. This showed how they performed within industry grouping in terms of mean waste production and recycling performance. This could be extended.
2. The frequency of the survey should be investigated. It is suggested that:
 - a. The frequency should be increased to allow the gathering of meaningful data on C&I trends to allow the impacts of e.g. the economic cycle and changing behaviour to be better understood and deliver a sounder evidence base for policy makers and the market.

- b. consideration should be given to a programme of surveys over e.g. a four year cycle that deliver trend data using an abridged methodology and sample size for years 2-4 with a more comprehensive sample in year 1, 5.
- 3. Surveyors should be provided with a more comprehensive list of container types reflecting the degree of specialist take back and recovery that is emerging (e.g. coffins for fluorescent tubes).
- 4. A guide on the use of the data should be developed to ensure needs assessments carried out as part of waste and minerals planning properly reflect the limitations of applying highly disaggregated estimates at a WPA level.

Appendix A Survey caveats and limitations

Table 37 *Limitations and caveats of the survey*

	Limitation	Mitigation
	General	
1	The sample size. The survey covered a sample of 6005 businesses against the total number of businesses in the survey area (1.2 million/600 thousand).	1% of the businesses in the 1_6 category. For significant populations a 1% sample size is typical and the error levels at 95% are quantified and understood.
2	Timing issues. The survey took place during a recession year. Differences in business activity between 2009/10 e.g. redundancies, downsizing, bankruptcy, relocation and change of business activity may also have affected both waste arisings and companies' willingness to participate. The survey took place over the summer i.e. there could be no account of seasonal variations in arisings, and companies may have been reluctant to participate due to staff holidays.	No mitigation can be made for the prevailing economic climate, other than linking the data to economic output in the analysis.
	Sample building	
3	The accuracy of both the ONS sample data and the SIC codes provided.	This information could not be verified so no mitigation can be made.
4	The matrix was based on 2002/3 variance.	The outturn variance of the sample has been characterised and understood.
5	No site surveys were undertaken on islands e.g. Isle of Wight and Isles of Scilly.	The C&I arisings from these areas would have little impact on the overall survey.
	Survey bookings	
6	The survey was voluntary so only companies that were willing to participate were surveyed. It was recognised that companies keen to promote their environmental credentials would be more inclined to provide accurate data than companies operating on the edge of the law.	No mitigation can be made for this.
7	Contact centre could have had sector/regional bias, based on the ease of securing appointments.	Contact centre training was provided to ensure this was kept to a minimum. Staff were occasionally rotated to different regions to prevent any bias.
8	The appetite for participation in the survey differed by region. It was much harder to obtain bookings in London, perhaps due to pressure from other direct marketing and surveys carried out here.	No mitigation can be made for this.

	Limitation	Mitigation
	Survey period	
9	A visual assessment of the waste streams can only give a one day picture of the overall waste arisings.	Surveyor training included practical sessions on visual waste assessment to try to overcome any bias. Although the waste assessment is an estimation, dialogue with the client ensured this was the best data that could be obtained.
10	The short survey period made it difficult to collect data on complex waste streams that may have had seasonal variation.	Although the survey period was extended, this would still have been insufficient to address this constraint.
11	The survey was reliant on the information provided by the client i.e. it was dependant on the client being completely honest about their waste arisings. The site walk round was restricted to the waste areas, so there was potential to miss out obscure waste streams and elements of the waste production process.	Surveyors were trained to question the clients to obtain information that could potentially be missed. The data checking and verification process was designed to pick up unusual or missing waste streams.
12	Although the telephone surveys used the same survey form as the site surveys, as they were totally reliant on information provided by the client, they were potentially less accurate.	Telephone surveys were carried out by staff who also had undertaken site surveys, so they were familiar with the types and volumes of waste that would be expected to be generated by businesses. The data checking and verification process was designed to pick up unusual or missing waste streams.
13	The information provided from the site surveys could be affected by the personal perceptions and bias of the surveyor as well as human error e.g. incorrect input on the PDA.	The data checking and verification process ensured that potential bias was minimised and that errors were picked up and corrected.
14	Some companies had little or no knowledge of their waste operations.	Surveyors were trained to extract as much information as they could from the client by questioning to inform the return.
15	Very small and very large businesses seemed to be best prepared for the surveys and were most likely to have information on their waste streams. SMEs appeared to be the group who were most pressurised by time constraints and had the least knowledge about their waste management operations.	Surveyors were trained to use questioning to gain as much information as possible whilst minimising time spent with the client if this was thought to be an issue.
	Statistical analysis	
16	Consistency and robustness of survey checks by team leaders and the accuracy of the data checking process.	The use of a multi-layered data checking and verification process ensured that inaccuracies were picked up and amended.
17	Businesses with 1-4 employees were not surveyed but were calculated using the sample results for businesses with 5-9 employees and grossed up.	This approach was consistent with agreed statistical practice, as per the detail in the report (section 4.4.3).
18	There were instances where the correct SOC code for a waste could be open to interpretation by the surveyor. Some wastes could fall into more than one SOC code.	Surveyors were provided with detailed information as to which SOC code category applied to each waste. This information was updated when specialist waste streams not included in the initial information came to light during the survey period.

	Limitation	Mitigation
19	In the course of the survey it was found that there was evidence of staff taking recyclable waste home to put into the domestic recycling bins or taking recyclable waste to bring banks where there were no recycling facilities at their place of work. This could result in double counting of C&I waste as MSW.	Surveyors were trained to question clients to accurately estimate the volume/ tonnage of all waste arisings from the company.
20	There was a reliance on PPC data for some strata.	This data is collected by regulatory bodies, so should be as accurate as a site survey, if not more so.
21	The accuracy of the conversion factors applied to convert volumes to tonnages. Also the accuracy of standard values applied to specific waste types where the volume or tonnage was not available e.g. loose items such as fridges or fluorescent tubes.	Conversion factors were agreed with the steering group. A desk study was carried out to collate publically available conversion factors. This was submitted to the steering group for review and agreement. These conversion factors are effectively the best available.
22	The statistics assume the populations within the data pools are normally distributed.	Outliers were removed from the grossing up data but were included in the overall totals.
	Other	
23	Businesses may have been reluctant to disclose information on wastes taken from site by unlicensed persons e.g. waste metals taken by unlicensed carriers or fly tipped waste.	Surveyors were trained to question clients to accurately estimate the volume/ tonnage of all waste arisings from the company.
24	There were complications surrounding multi occupancy buildings, serviced buildings and shopping centres where bins were shared by a number of companies. This made it very difficult to establish which waste came from which business.	This data was inevitably less accurate than data obtained from a single company using their own waste containers. Surveyors used standardised container types and volume conversions together with dialogue with the client to ensure the data was the best estimate that could be made.
25	There is no recent national data against which the survey can be accurately benchmarked. The NW survey, although recent, is not of sufficient scale to be comparable.	No mitigation can be made for this.

Appendix B Business types

Table 38 Business types

C&I Sectors	Type of Materials/Processes Involved	Examples	Contact examples
1 Food, Drink and Tobacco	<ul style="list-style-type: none"> • Factory Processing Dairy Products, Meat, Vegetables, Fruit or Fish • Milling/ Manufacture of cereals, grains & starch products • Manufacture of bakery products, cocoa and sugar confectionery • Anywhere making prepared animal feeds (farm & pet food) • Processing/manufacture of tea and coffee, soft drinks and alcoholic beverages • Manufacture of tobacco products 	<ul style="list-style-type: none"> • Abattoir • Brewery • Drink Bottling Factory • Chocolate Factory • Cigarette/ Cigar Factory • Pet food Factory • Tea Bag Factory • Food processing factory • Flour mill • Feed mill • Bakery • Dairy 	<ul style="list-style-type: none"> • Environmental Manager • Production Manager • Hygiene Manager • Waste Manager • Health & Safety Manager • General Manager • Operations Manager
2 Textiles/ Wood/ Paper/ Publishing	<ul style="list-style-type: none"> • Factory manufacturing carpets/rugs, soft furnishings, canvas goods, sacks, rope, netting etc • Factory manufacturing clothes, footwear, accessories, luggage, handbags, saddles and harnesses • Factory involving the tanning and dressing of leather; dyeing of fur • Manufacture of textiles (preparation, spinning, weaving, knitting) • Manufacture of products of wood, cork, straw and plaiting materials (i.e. wooden crates, panels, parquet floors NOT FURNITURE) • Sawmilling and planing of wood; other carpentry and joinery • Manufacture of pulp, paper & paperboard, wallpaper, tissues, toilet rolls • Printing and related service activities, newspapers, labels, binding etc • Reproduction of recorded media, sound, video and computer media 	<ul style="list-style-type: none"> • Carpet Factory • Cotton Mill • Pulping Factory • Printing Company • DVD Factory • Wooden Pallet Factory • Clothing factory • Tannery • Sawmill • Paper mill • Timber preservation plant 	<ul style="list-style-type: none"> • Environmental Manager • Production Manager • Waste Manager • Health & Safety Manager • General Manager • Operations Manager • Site Manager • Facilities Manager
3 Power and Utilities	<ul style="list-style-type: none"> • Manufacture of coke and refined petroleum products, mineral oil refining & 	<ul style="list-style-type: none"> • Power Station • Sewage 	<ul style="list-style-type: none"> • Environmental Manager

	<p>treatment of petroleum products</p> <ul style="list-style-type: none"> • Electric power generation, transmission and distribution • Manufacture of gas; distribution/trade of gaseous fuels through mains • Steam and air conditioning supply • Water collection, treatment and supply 	<p>Treatment Works</p> <ul style="list-style-type: none"> • Gasworks • Water treatment works • Oil refinery 	<ul style="list-style-type: none"> • Production Manager • Waste Manager • Health & Safety Manager • General Manager • Operations Manager • Site Manager • Facilities Manager
4 Chemicals/ Non-metallic Minerals Manufacturing	<ul style="list-style-type: none"> • Manufacture of basic chemicals, fertilisers and nitrogen compounds, plastics and synthetic rubber, dyes and pigments, pesticides and other agrochemical products, paints, varnishes and similar coatings, printing ink and mastics, printing ink, soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations • Manufacture of other chemical products, explosives, glues, essential oils, man-made fibres, pharmaceutical products • Manufacture of rubber and plastic products, (e.g. rubber tyres, plastic plates, sheets, tubes etc) • Manufacture of other non-metallic mineral products: glass, clay building materials, ceramic tiles, household and ornamental articles, ceramic toilets, cement, lime and plaster concrete, cement and plaster • Cutting, shaping and finishing of stone • Production of abrasive products 	<ul style="list-style-type: none"> • Pesticide Factory • Paint Factory • Plastic Manufacturer • Cement Kiln • Rubber Factory • Tyre Retreading Plant • Bathroom Ceramics Factory • Chemical works • Soap and detergent manufacturing plant • Stonemasons • Pharmaceutical manufacture • Glass manufacture 	<ul style="list-style-type: none"> • Environmental Manager • Production Manager • Waste Manager • Health & Safety Manager • General Manager • Operations Manager • Site Manager • Facilities Manager

5 Metal Manufacturing	<ul style="list-style-type: none"> • Manufacture of basic iron and steel (tubes, pipes, hollow profiles and related fittings) • Production of Aluminium, Lead, Zinc, Copper, Tin & Precious metals • Processing of nuclear fuel • Casting of ferrous and non-ferrous metals • Manufacture of fabricated metal products, except machinery and equipment Cold drawing of bars, wire, narrow strip or folding • Manufacture of metal structures, parts of structures, metal doors and windows, tanks, reservoirs and containers, central heating radiators and boilers • Manufacture of weapons and ammunition • Forging, pressing, stamping and roll-forming of metal, Treatment and coating of metals; machining • Manufacture of cutlery, tools and general hardware, locks and hinges • Manufacture of light metal packaging • Manufacture of wire products, chain and springs • Manufacture of fasteners and screw machine products 	<ul style="list-style-type: none"> • Cutlery Factor • Steel Works • Ironmongers • Wiring Plant • Screw/Nail Factory • Aluminium manufacture 	<ul style="list-style-type: none"> • Environmental Manager • Production Manager • Waste Manager • Health & Safety Manager • General Manager • Operations Manager • Site Manager • Facilities Manager
6 Machinery and Equipment (Other Manufacturing)	<ul style="list-style-type: none"> • Manufacture of computer, electronic and optical products • Manufacture of telegraph and telephone apparatus and communication equipment • Manufacture of instruments and appliances for measuring, testing and navigation; watches and clocks • Manufacture of irradiation, electromedical and electrotherapeutic equipment • Manufacture of optical instruments and photographic and cinematographic equipment • Manufacture of magnetic and optical media, industrial process control equipment • Manufacture of electric motors, generators, transformers and electricity distribution and control apparatus • Manufacture of batteries and accumulators, wiring and wiring devices, domestic appliances lighting equipment • Manufacture of machinery and equipment: engines and turbines, except 	<ul style="list-style-type: none"> • Shipyard • Mechanical engineering works • Electrical engineering works • Computer manufacture • Aircraft manufacture • Car factory 	<ul style="list-style-type: none"> • Environmental Manager • Production Manager • Waste Manager • Health & Safety Manager • General Manager • Operations Manager • Site Manager • Facilities Manager

	<p>aircraft, vehicle and cycle engines, pumps and compressors, bearings, gears, gearing and driving elements, ovens, furnaces and furnace burners, lifting and handling equipment, agricultural and forestry machinery, machinery for mining, quarrying and construction, concrete crushing and screening roadworks, earthmoving equipment, plastics and rubber machinery</p> <ul style="list-style-type: none"> • Manufacture of motor vehicles, trailers and semi-trailers, caravans, parts, electronic equipment and accessories for motor vehicles • Building of ships, boats and floating structures • Manufacture of railway locomotives and rolling stock, air and spacecraft and related machinery • Manufacture of military fighting vehicles, transport equipment, motorcycles, bicycles and invalid carriages • Manufacture of furniture, office/shop furniture, kitchen furniture, mattresses • Striking of coins • Manufacture of jewellery, musical instruments, sports goods, games and toys (including professional and arcade games), medical and dental instruments, brooms and brushes • Repair and installation of machinery and equipment including fabricated metal products, electronic and optical equipment, Repair and maintenance of ships and boats, aircraft and spacecraft and transport equipment • Installation of industrial machinery and equipment 		
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7 Retail and Wholesale	<ul style="list-style-type: none"> • Wholesale - i.e. establishments primarily engaged in buying and selling merchandise in large quantities to retailers – • Retail - the stores, stalls and markets (including via mail order houses or via Internet) that buy merchandise from wholesale and sell products directly to consumers • Merchandise includes anything from cars, ships and aircraft to livestock, flowers, pharmaceuticals, food, textiles, glassware, jewellery, musical instruments, agricultural machinery, industrial equipment and supplies, wood, construction materials and sanitary equipment, perfumes, furniture, antiques, fuels, cosmetics, medical and orthopaedic goods, sporting equipment etc 	<ul style="list-style-type: none"> • Wholesalers • Supermarkets • Bakery • DIY store • Costco • Butcher • High street Shops • Pharmacists • Markets • Department stores • Agricultural suppliers • Petrol Stations 	<ul style="list-style-type: none"> • Store Manager • General Manager • Site Manager • Store/ shop owner <p>Larger premises:</p> <ul style="list-style-type: none"> • Environmental Manager • Waste Manager • Health & Safety Manager • Facilities Manager
8 Hotels and Catering	<ul style="list-style-type: none"> • Hotels, Holiday centres and villages, Youth hostels and other short stay accommodation • Camping grounds, recreational vehicle parks and trailer parks • Restaurants, take away food shops and mobile food stands • Event catering and other food service activities • Public houses and bars • Licensed clubs 	<ul style="list-style-type: none"> • Pubs • Hotels • Event Catering • Clubs • Campsites • Youth Hostels • B&B's • Restaurants and cafes 	<ul style="list-style-type: none"> • Store Manager • General Manager • Site Manager • Operations Manager • Environmental Manager • Waste Manager • Hygiene Manager • Health & Safety Manager • Facilities Manager • Restaurant Manager • Catering Manager • Owner • Landlord
9 Public Administration and Social Work	<ul style="list-style-type: none"> • Public administration and defence; compulsory social security • Regulation of the activities of providing health care, education, cultural services and other social services • Fire service activities • Defence activities • Foreign affairs • Justice and judicial activities • Provision of services to the community as a whole • General public administration activities 	<ul style="list-style-type: none"> • Council buildings • Fire Stations • Prisons • Courts • National Embassy's • Job Centre • Social Services • Police Station • Army bases • Hospitals 	<ul style="list-style-type: none"> • Office Manager • Environmental Manager • Waste Manager • Health & Safety Manager • General Manager • Operations Manager • Site Manager • Facilities Manager

	<ul style="list-style-type: none"> • Compulsory social security activities • Hospitals, General and Specialist Medical practises, dental practices, and other human health activities • Residential nursing care for the elderly and disabled, learning disabilities, mental health and substance abuse • Child day-care activities, Social work activities without accommodation for the elderly and disabled 	<ul style="list-style-type: none"> • Doctors Surgeries • Dental Practises • Nursing Homes • Child Day Care 	<ul style="list-style-type: none"> • Practice Manager
10 Education	<ul style="list-style-type: none"> • Pre-primary, Primary, Secondary education (technical and vocational), Higher education (First-degree and Post-graduate level) • Sports and recreation education, Cultural education, Educational support activities • Driving school activities 	<ul style="list-style-type: none"> • Schools • Colleges • Pre-Schools • Driving Schools • Riding Schools • Universities • Adult Learning • Sports centres 	<ul style="list-style-type: none"> • General Manager • Site Manager • Facilities Manager • Head Teacher • Office Manager • Environmental Manager • Waste Manager • Health & Safety Manager
11 Transport and Storage	<ul style="list-style-type: none"> • Land transport e.g. Passenger rail transport, Freight rail transport, transport by underground, metro and similar systems, Taxi operation, Freight transport by road and removal services • Sea and coastal passenger/freight water transport, Inland passenger water/freight transport • Scheduled/Non-scheduled passenger air transport , Freight air transport and space transport • Warehousing and storage/support activities for transportation • Operation of rail passenger facilities at railway stations • Cargo handling • Postal and courier activities 	<ul style="list-style-type: none"> • Coach Companies • Train Companies • Ferry Companies • Air Operators • Royal Mail • Courier Services • Removal Vans • Warehouses 	<ul style="list-style-type: none"> • General Manager • Site Manager • Facilities Manager • Office Manager • Operations Manager • Environmental Manager • Waste Manager • Health & Safety Manager
12 Other Services	<p>INFORMATION AND COMMUNICATION</p> <ul style="list-style-type: none"> • Publishing of books, newspapers, periodicals, journals, directories and mailing lists and other publishing activities • Publishing of computer games and other software publishing • Motion picture, video and television programme production, sound recording and music publishing activities 	<ul style="list-style-type: none"> • Advertising agencies • Hairdressers • Beauty Salon • Bank/Building Society • Estate Agents • Media Company 	<ul style="list-style-type: none"> • General Manager • Site Manager • Facilities Manager • Office Manager • Environmental Manager • Waste Manager

<ul style="list-style-type: none"> • Television programming and radio broadcasting activities • Wired/Wireless/Satellite telecommunications activities • Computer programming, consultancy and related activities, interactive leisure and entertainment software development , business and domestic software development , computer facilities management activities • Data processing, hosting and related activities; web portals, News agency activities, Other information service activities <p>FINANCIAL AND INSURANCE ACTIVITIES</p> <ul style="list-style-type: none"> • Financial service activities: Monetary intermediation, central banking, Banks, Building societies, holding companies (including agricultural, production, construction, distribution and financial services holding companies), Trusts, funds and similar financial entities, venture and development capital companies, real estate investment trusts, credit granting, mortgage finance companies • Insurance, reinsurance and pension funding • Activities auxiliary to financial services and insurance activities: Administration of financial markets, Security and commodity contracts brokerage, Risk and damage evaluation, Activities of insurance agents and brokers, Fund management activities <p>REAL ESTATE ACTIVITIES</p> <ul style="list-style-type: none"> • Buying and selling of own real estate, Renting and operating of own/ leased/ Housing Association real estate, • Letting and operating of conference and exhibition centres • Real estate agencies • Management of real estate on a fee or contract basis <p>PROFESSIONAL, SCIENTIFIC AND TECHNICAL ACTIVITIES</p> <ul style="list-style-type: none"> • Legal and accounting activities: Barristers at law, Solicitors, patent and copyright agents • Accounting, bookkeeping and auditing activities; tax consultancy 	<ul style="list-style-type: none"> • Insurance Company • Publishers • Advertising Agency • Recruitment Agency • Accountancy • Solicitors • Vets • Travel Agency • Research Facilities • Casino • Library • Museum • Zoo • Art Gallery • Laundrette • Funeral Directors • Photographers • Theme Parks • Gyms • Swimming Pools • Racecourses • Dry Cleaners • Window Cleaners • Translators • Locksmith • Tailor/Cobbler • Tattoo Parlour • Betting shop 	<ul style="list-style-type: none"> • Health & Safety Manager • Shop or store Manager • Owner • Partner • Practice Manager
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	<ul style="list-style-type: none"> • Activities of head offices; management consultancy activities: Public relations and communication activities, Financial management • Architectural and engineering activities; technical testing and analysis: Urban planning and landscape architectural activities, Engineering design activities for industrial process and production, Engineering related scientific and technical consulting activities • Scientific research and development: Research and experimental development on natural sciences and engineering, biotechnology, social sciences and humanities • Advertising, Media representation, market research and public opinion polling • Other professional, scientific and technical activities: Specialised design activities, Photographic activities, Film processing, Translation and interpretation activities, Environmental consulting activities, Quantity surveying activities • Veterinary activities <p>ADMINISTRATIVE AND SUPPORT SERVICE ACTIVITIES</p> <ul style="list-style-type: none"> • Renting and leasing of motor vehicles, trucks, personal and household goods, recreational and sports goods, video tapes and disks, media entertainment equipment, other machinery, equipment and tangible goods (including agricultural, construction and civil engineering machinery and transport equipment); Leasing of intellectual property and similar products, except copyrighted works • Employment activities: Activities of employment placement agencies, Motion picture, television and other theatrical casting, Other human resources provision • Travel agency, tour operator and other reservation service and related activities, Activities of tourist guides • Security and investigation activities: Private security activities, Security systems service activities, Investigation activities • Services to buildings and landscape activities: facilities support activities, Cleaning activities (general cleaning of buildings, industrial cleaning, window cleaning, specialised cleaning, furnace and chimney cleaning, disinfecting and 		
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	<p>extermination services, Landscape service activities</p> <ul style="list-style-type: none"> • Office administrative, office support and other business support activities: Photocopying, document preparation and other specialised office support activities, call centres, Organisation of conventions and trade shows, Activities of collection agencies and credit bureaus, Packaging activities <p>ARTS, ENTERTAINMENT AND RECREATION</p> <ul style="list-style-type: none"> • Creative, arts and entertainment activities: Performing arts, Artistic creation, Operation of arts facilities • Libraries, archives, museums and other cultural activities, Operation of historical sites and buildings and similar visitor attractions, Botanical and zoological gardens and nature reserve activities • Gambling and betting activities • Sports activities and amusement and recreation activities: Operation of sports facilities, sports clubs, Fitness facilities, Activities of racehorse owners, Amusement and recreation activities and theme parks <p>OTHER SERVICE ACTIVITIES</p> <ul style="list-style-type: none"> • Activities of membership organisations: business, employers and professional membership organisations, trade unions, religious organisations, political organisations, other membership organisations • Repair of computers and personal and household goods: consumer electronics, household appliances and home and garden equipment, footwear and leather goods, home furnishings, watches, clocks and jewellery • Other personal service activities: Washing and (dry-)cleaning of textile and fur products, Hairdressing and other beauty treatment, Funeral and related activities, physical well-being activities 		
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Appendix C Sample matrix

Table 39 The target sample matrix

Business sector	Business size	Code of strata	North East	Yorkshire and The Humber	East Midlands	West Midlands	East of England	London	South East	South West	Total
1	1	1_1	2	2	2	2	2	5	2	3	20
1	2	1_2	2	2	2	2	2	9	2	7	28
1	3	1_3	3	8	5	7	6	34	8	23	94
1	4	1_4	5	18	11	11	12	35	12	40	144
1	5	1_5	12	41	26	15	23	25	18	50	210
1	6	1_6	10	32	38	22	29	25	13	30	199
2	1	2_1	2	2	2	2	2	16	3	7	36
2	2	2_2	2	2	3	2	2	14	2	5	32
2	3	2_3	2	4	4	3	3	14	3	7	40
2	4	2_4	4	10	13	6	8	30	7	23	101
2	5	2_5	6	19	23	8	15	25	13	40	149
2	6	2_6	6	19	9	3	3	0	9	15	64
3	1	3_1	2	2	2	2	2	2	2	2	16
3	2	3_2	2	2	2	2	2	5	2	2	19
3	3	3_3	2	2	2	2	2	2	2	2	16
3	4	3_4	2	2	2	2	2	2	2	2	16
3	5	3_5	2	2	2	2	2	2	2	2	16
3	6	3_6	0	3	6	5	3	5	6	10	38
4	1	4_1	2	2	2	3	3	7	3	8	30
4	2	4_2	2	2	2	2	2	4	2	5	21
4	3	4_3	3	6	7	6	6	13	8	17	66
4	4	4_4	6	14	13	13	9	21	11	18	105
4	5	4_5	6	10	12	11	6	10	8	22	85
4	6	4_6	25	40	25	30	30	0	30	20	200
5	1	5_1	2	2	2	2	2	2	2	2	16
5	2	5_2	2	2	2	3	2	4	2	4	21
5	3	5_3	6	13	11	27	11	18	12	32	130
5	4	5_4	2	3	2	7	2	3	2	7	28
5	5	5_5	5	11	9	17	3	4	4	17	70
5	6	5_6	7	14	7	17	10	0	3	10	68
6	1	6_1	2	2	2	2	2	3	2	3	18
6	2	6_2	2	2	2	2	2	3	2	3	18
6	3	6_3	2	2	2	3	2	4	3	5	23
6	4	6_4	2	2	2	2	2	3	2	4	19
6	5	6_5	3	5	5	8	6	10	10	22	69
6	6	6_6	11	17	16	29	12	15	23	75	198
7	1	7_1	5	11	9	12	12	72	18	41	180
7	2	7_2	3	8	6	8	9	49	13	27	123
7	3	7_3	6	14	12	15	17	96	25	51	236
7	4	7_4	3	7	5	8	8	47	12	22	112
7	5	7_5	5	10	11	13	13	89	21	35	197
7	6	7_6	19	50	40	50	66	240	90	159	714
8	1	8_1	2	3	2	2	3	24	5	12	53
8	2	8_2	2	2	2	2	2	23	4	11	48
8	3	8_3	2	3	3	3	3	31	5	14	64
8	4	8_4	2	2	2	2	2	13	2	5	30
8	5	8_5	2	2	2	2	2	5	2	2	19
8	6	8_6	2	2	2	2	2	13	2	2	27
9	1	9_1	2	2	2	2	2	6	2	3	21
9	2	9_2	2	2	2	2	2	6	2	3	21
9	3	9_3	2	2	2	3	3	14	4	10	40
9	4	9_4	2	4	4	4	4	29	7	15	69
9	5	9_5	2	2	2	2	2	11	2	5	28
10	1	10_1	2	2	2	2	2	2	2	2	16
10	2	10_2	2	2	2	2	2	2	2	2	16

Business sector	Business size	Code of strata	North East	Yorkshire and The Humber	East Midlands	West Midlands	East of England	London	South East	South West	Total
10	3	10_3	2	2	2	2	2	7	2	4	23
10	4	10_4	2	3	2	3	3	24	5	9	51
10	5	10_5	2	3	2	3	3	19	5	8	45
10	6	10_6	2	4	3	4	4	30	6	16	69
11	1	11_1	2	2	2	2	2	4	2	2	18
11	2	11_2	2	2	2	2	2	10	2	5	27
11	3	11_3	2	3	3	3	4	20	5	12	52
11	4	11_4	2	3	2	3	3	19	4	7	43
11	5	11_5	2	2	2	2	2	17	3	5	35
11	6	11_6	2	4	4	5	3	40	5	10	73
12	1	12_1	4	8	7	8	10	99	17	31	184
12	2	12_2	3	6	6	7	8	85	14	25	154
12	3	12_3	4	9	8	10	12	129	20	35	227
12	4	12_4	3	6	5	6	7	88	13	21	149
12	5	12_5	2	6	5	6	7	87	12	18	143
12	6	12_6	4	8	6	10	8	159	17	22	234
Totals			265	524	452	496	470	2000	592	1201	6000

Table 40 The completed sample matrix

Business sector	Business size	Code of strata	North East	Yorkshire and The Humber	East Midlands	West Midlands	East of England	London	South East	South West	Total
1	1	1_1	2	2	1	2	2	5	2	3	19
1	2	1_2	2	2	1	1	1	9	1	7	24
1	3	1_3	3	8	7	9	6	17	8	22	80
1	4	1_4	5	22	11	6	16	10	10	22	102
1	5	1_5	10	14	16	10	12	9	11	20	102
1	6	1_6	8	17	23	12	21	8	3	19	111
2	1	2_1	2	1	2	1	1	11	4	5	27
2	2	2_2	2	2	3	1	3	14	2	10	37
2	3	2_3	1	5	4	4	2	19	4	5	44
2	4	2_4	1	11	12	5	7	18	7	18	79
2	5	2_5	7	12	20	7	15	1	15	16	93
2	6	2_6	3	8	10	3	3	1	6	6	40
3	1	3_1	7	1	3	3	1	2	3	1	21
3	2	3_2	4	1	1	4	2	3	3	2	20
3	3	3_3	1	2	4	2	6	1	3	4	23
3	4	3_4		5	1	1	3	1	4	2	17
3	5	3_5	4	3	1	4	1	1	9	2	25
3	6	3_6	2	8	5	2	3	1	7	6	34
4	1	4_1	1	2	3	4	3	9	3	7	32
4	2	4_2	3	2	2	2	2	2	2	6	21
4	3	4_3	8	10	11	8	6	13	11	18	85
4	4	4_4	9	14	15	16	10	6	15	15	100
4	5	4_5	11	17	13	13	8	2	8	16	88
4	6	4_6	9	15	9	10	12		17	5	77
5	1	5_1	2	1	2	2	1	3	2	2	15
5	2	5_2	3	1	3	3	2	8	1	5	26
5	3	5_3	4	14	10	25	12	10	15	31	121
5	4	5_4	2	9	4	7	4	3	4	7	40
5	5	5_5	6	9	11	16	5	1	6	13	67
5	6	5_6	6	9	6	9	2		3	1	36
6	1	6_1	2	1	2	1	1	4	3	4	18
6	2	6_2	2	2	1	2	2	1	1	4	15
6	3	6_3	2	4	3	3	3	8	1	4	28
6	4	6_4	2	1	3	2	4	2	2	5	21
6	5	6_5	9	6	4	7	5	10	14	26	81
6	6	6_6	12	13	11	25	11	5	13	30	120

Business sector	Business size	Code of strata	North East	Yorkshire and The Humber	East Midlands	West Midlands	East of England	London	South East	South West	Total
7	1	7_1	7	15	17	24	17	93	34	82	289
7	2	7_2	2	5	6	3	8	79	10	22	135
7	3	7_3	14	26	27	51	40	337	66	251	812
7	4	7_4	3	9	6	9	10	50	12	16	115
7	5	7_5	5	7	13	12	19	70	17	27	170
7	6	7_6	20	52	43	57	74	98	94	112	550
8	1	8_1	3	1	2	2	2	25	7	11	53
8	2	8_2	2	1	3	2	1	24	4	11	48
8	3	8_3	2	2	3	2	3	101	6	13	132
8	4	8_4	1	1	2		4	7	4	5	24
8	5	8_5	1	2	1		1	6	1	2	14
8	6	8_6	1	2	1	1	2	10	2	2	21
9	1	9_1	2	1	1	2	2	7	4	3	22
9	2	9_2	2		3	2	3	4	3	5	22
9	3	9_3	3	2	2	2	2	14	6	13	44
9	4	9_4	3	4	4	4	5	22	9	15	66
9	5	9_5	2	2	2	2	2	8	1	5	24
9	6	9_6	2	2	3	3	1	18	3	5	37
10	1	10_1	2	1	2	2	3	2	2	1	15
10	2	10_2	2	4	2	6	2	1	2	3	22
10	3	10_3	2	2	3	2	2	9	2	8	30
10	4	10_4	2	2	3	4	4	19	3	9	46
10	5	10_5	2	5	2	3	3	15	4	7	41
10	6	10_6	2	4	4	5	4	32	6	14	71
11	1	11_1	2	2	2	1	2	4	2	2	17
11	2	11_2	1	1	2	3	2	10	2	5	26
11	3	11_3	3	5	4	4	2	24	5	15	62
11	4	11_4	1	3	2	2	4	19	5	6	42
11	5	11_5	2	3	2	3	2	30	3	6	51
11	6	11_6	2	4	3	2	5	19	7	8	50
12	1	12_1	3	10	6	7	8	140	20	31	225
12	2	12_2	6	6	5	8	9	78	14	22	148
12	3	12_3	4	9	9	14	10	163	18	32	259
12	4	12_4	3	5	6	8	5	91	12	27	157
12	5	12_5	2	5	5	9	8	59	11	18	117
12	6	12_6	4	8	6	13	10	81	19	18	159
Totals			277	467	445	488	497	1987	643	1201	6005

Appendix D Survey questionnaire

Table 41 The survey questionnaire

Part 1 - Survey Details

Date		To be booked by contact centre
Name of Surveyor		To be completed by the contact centre
Primary SIC Code	Producer Number 000001	From IDBR data – contact centre to check
Secondary SIC Code (if applicable)		From IDBR data – contact centre to check
Sector Number	[Check Autofill from Survey database] <input type="checkbox"/> 1 Food, Drink and Tobacco <input type="checkbox"/> 2 Textiles/ Wood/ Paper/ Publishing <input type="checkbox"/> 3 Power and Utilities <input type="checkbox"/> 4 Chemicals/Non-metallic Minerals Manufacturing <input type="checkbox"/> 5 Metal Manufacturing <input type="checkbox"/> 6 Machinery and Equipment (Other Manufacturing) <input type="checkbox"/> 7 Retail and Wholesale <input type="checkbox"/> 8 Hotels and Catering <input type="checkbox"/> 9 Public Administration and Social Work <input type="checkbox"/> 10 Education <input type="checkbox"/> 11 Transport and Storage <input type="checkbox"/> 12 Other Services	From IDBR data – contact centre to check see contact centre businesses reference sheet Surveyor to note if this is significantly different from what is seen on site. Refer to businesses reference sheet

Part 2 – Company and Site Details

Company Name	[Check Autofill from Survey database]	From IDBR data – contact centre to check
Address	[Check Autofill from Survey database]	From IDBR data – contact centre to check
Town/City	[Check Autofill] Postcode [Check Autofill]	From IDBR data – contact centre to check
County	[Check Autofill from Survey database]	From IDBR data – contact centre to check
Waste Planning Authority	[Check Autofill from Survey database]	Calculated from IDBR data – contact centre to check this is correct based on the address Surveyor to check during call
Region	[Check Autofill from Survey database] <input type="checkbox"/> North East <input type="checkbox"/> Yorkshire and The Humber <input type="checkbox"/> West Midlands <input type="checkbox"/> East Midlands <input type="checkbox"/> South East <input type="checkbox"/> East of England <input type="checkbox"/> South West <input type="checkbox"/> London	Calculated from IDBR data – contact centre to check this is correct based on the address Surveyor to check

Contact name for Survey	[Check Autofill]	Position	[Check Autofill]	To be updated by the contact centre if required
Contact details	Telephone	[Check Autofill from Survey database]		To be checked by contact centre
	Fax	[Check Autofill from Survey database]		To be checked by contact centre
	E-mail	[Check Autofill from Survey database]		To be checked by contact centre
Do you have a nominated person who is responsible for Waste Management?	Name	[Check Autofill from Survey database]		To be checked by contact centre
	Job Title	[Check Autofill from Survey database]		To be checked by contact centre
	Telephone	[Check Autofill from Survey database]		To be checked by contact centre
	Email	[Check Autofill from Survey database]		To be checked by contact centre
Company size band (Total paid employees)	[Check Autofill from Survey database] <input type="checkbox"/> 5-9 <input type="checkbox"/> 10-19 <input type="checkbox"/> 20-49 <input type="checkbox"/> 50-99 <input type="checkbox"/> 100-249 <input type="checkbox"/> 250+			To be checked by contact centre Surveyor to also check during survey

Part 3 – Details of waste streams produced and waste management methods

Information Required	Notes		
Surveyor to enquire about materials delivered to site to understand mass balance			
Information required	Notes	e.g. Waste Stream 1 – Waste type and management route	Waste stream is defined by both type and management route e.g. waste paper for general recycling and confidential paper for shredding are two separate waste streams.

Description of waste	1. Waste Type	SOC Coding	<p><input type="checkbox"/> Chemical Wastes</p> <ul style="list-style-type: none"> <input type="checkbox"/> Spent solvents <input type="checkbox"/> Acid, alkaline or saline wastes <input type="checkbox"/> Used oils <input type="checkbox"/> Spent chemical catalysts <input type="checkbox"/> Chemical preparation wastes <input type="checkbox"/> Chemical deposits and residues <input type="checkbox"/> Industrial effluent sludges <p><input type="checkbox"/> Metallic Wastes</p> <ul style="list-style-type: none"> <input type="checkbox"/> Metallic wastes <p><input type="checkbox"/> Healthcare Wastes</p> <ul style="list-style-type: none"> <input type="checkbox"/> Health care and biological wastes <p><input type="checkbox"/> Non-metallic Wastes</p> <ul style="list-style-type: none"> <input type="checkbox"/> Glass wastes <input type="checkbox"/> Paper and cardboard wastes <input type="checkbox"/> Rubber wastes <input type="checkbox"/> Plastic wastes <input type="checkbox"/> Wood wastes <input type="checkbox"/> Textile wastes <input type="checkbox"/> Waste containing PCB <p><input type="checkbox"/> Discarded Equipment</p> <ul style="list-style-type: none"> <input type="checkbox"/> Discarded vehicles <input type="checkbox"/> Batteries and accumulators wastes <input type="checkbox"/> WEEE and other discarded equipment <p><input type="checkbox"/> Animal & Vegetable Wastes</p> <ul style="list-style-type: none"> <input type="checkbox"/> Animal waste of food preparation and products <input type="checkbox"/> Animal faeces, urine and manure <input type="checkbox"/> Animal & vegetal wastes <p><input type="checkbox"/> Mixed Ordinary Wastes</p> <ul style="list-style-type: none"> <input type="checkbox"/> Household and similar wastes <input type="checkbox"/> Mixed and undifferentiated materials <input type="checkbox"/> Sorting residues <p><input type="checkbox"/> Common Sludges</p> <ul style="list-style-type: none"> <input type="checkbox"/> Common sludges (excluding dredging spoils) <input type="checkbox"/> Dredging spoils <p><input type="checkbox"/> Mineral Wastes</p> <ul style="list-style-type: none"> <input type="checkbox"/> Combustion wastes <input type="checkbox"/> Contaminated soils and polluted dredging spoils <input type="checkbox"/> Solidified, stabilised or vitrified wastes <input type="checkbox"/> Other mineral wastes <input type="checkbox"/> Construction and demolition wastes <input type="checkbox"/> Asbestos wastes <input type="checkbox"/> Waste of naturally occurring minerals 	<p>REMEMBER DATA FROM 2009 CALENDAR YEAR NEEDED</p> <p>Need to provide information for every waste stream.</p> <p>Ask the client to describe the business. What happens on site; what are the processes. Think about the inputs and outputs to the business/ process e.g. what materials arrive on site? What leaves the site (materials and wastes)?</p> <p>Think about the mass balance. Think about all the processes on site where waste could be generated. Produce list of all the wastes generated on site e.g.</p> <ul style="list-style-type: none"> • Packaging waste e.g. cardboard • Waste from production or site operations • Waste from transport e.g. oils, paint • Waste from maintenance or construction work • Chemicals and solvents • Bulky waste e.g. furniture • Electrical equipment e.g. IT equipment • Batteries • Office wastes – general waste • Recycled waste streams e.g. paper, bottles, cans, metal, • Printer cartridges • Fluorescent tubes • Canteen waste e.g. food waste • Garden waste • Clinical/ sanitary waste <p>Note where on site each waste stream is arising.</p>
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			<input type="checkbox"/> Non-wastes <input type="checkbox"/> blast furnace slag and <input type="checkbox"/> virgin timber	Included to compare with data from previous survey, even though these are no longer classed as 'waste.' Check definitions if these waste streams are present on site.
	2. Physical form	Identify whether the waste is solid or liquid	<input type="checkbox"/> Solid <input type="checkbox"/> Liquid <input type="checkbox"/> Sludge	Look at the waste if not obvious.
	3. Nature of Waste	Is the waste hazardous or non-hazardous	<input type="checkbox"/> Haz <input type="checkbox"/> Non-haz	Client to respond. If does not know, class as non-hazardous. If you believe the waste has been wrongly classified advice can be offered.
	4. Treatment	Does the waste require any specialist treatment	<input type="checkbox"/> Yes <input type="checkbox"/> No	Client to respond. If does not know = no
	5. Source of waste data	What type of waste data do you have for 2009?	<input type="checkbox"/> 1: Weight (tonnes) <input type="checkbox"/> 2: Volume (m ³) <input type="checkbox"/> 3: None (go to 9- waste estimation)	Make sure you are not mixing volume and weight data (volume is size of container m ³ ; weight is tonnage – kg, tonnes etc).
	6.: Weight/ volume	What is the source of the weight/ volume?	<input type="checkbox"/> Company records <input type="checkbox"/> Waste collector returns <input type="checkbox"/> Other, please state	e.g. internal records e.g. Waste Transfer Notes or Consignment Notes e.g. invoicing information
	7.	Are these actual weights or estimated weights?	<input type="checkbox"/> A: Actual <input type="checkbox"/> B: Estimated <input type="checkbox"/> C: Don't know	Record all information, but if estimated weights, wastes will need to be estimated in addition to recording the weight.
	8.	If A (Actual) or B (Estimated) enter the total tonnage for 2009	[] tonnes	Remember 2009 calendar year data only.
		If Volumes, (Actual or Estimated) B(Estimated weights) or C (Don't know) go to the Waste Estimation section		

	9. Waste Estimation (Use this section where weights have been estimated, volumes have been provided or if no waste data has been provided)	9.A Details of type and dimensions of container used to store the waste. How many containers were provided on site for each waste stream in 2009?	Refuse Bag <input type="checkbox"/> Refuse Bag Dustbin <input type="checkbox"/> Dustbin ETC	Refer to pictures of waste containers to assist with this question.
		9.B. How full was the average container that was collected in 2009?	<input type="checkbox"/> % <input type="checkbox"/> Don't know	
		9.C. How often were these emptied in 2009?	<input type="checkbox"/> times emptied per year	Ask how many times the waste was collected in 2009 – what was the frequency e.g. weekly, daily or monthly collection or is collection not on a set frequency i.e. contractor collects when the bin is full.
	10.	Please confirm the type of contract arrangement you have	<input type="checkbox"/> Set frequency e.g. weekly, daily <input type="checkbox"/> Collect when full <input type="checkbox"/> Other	

How is the Waste managed on Site?	11. Mixed waste streams	11.A. If the waste is a mixed waste stream, identify as far as possible the components and proportion of the waste stream they comprise	% Comp	Use composition data provided by the company, if available. Look at waste and estimate % volume in each category NB ONLY FOR MIXED WASTE STREAMS
		<input type="checkbox"/> Chemical Wastes		
		11.B,C,D,E (each waste component)	ETC	
		11.F. How was the composition of the mixed waste stream identified?	<input type="checkbox"/> Company analysis <input type="checkbox"/> Visual inspection by surveyor <input type="checkbox"/> Other	
How is the Waste managed externally?	12.Waste Collection	Who collects the waste?	<input type="checkbox"/> Waste Contr' <input type="checkbox"/> LA <input type="checkbox"/> Employees <input type="checkbox"/> Charity <input type="checkbox"/> Other	e.g. Biffa, Veolia, Shanks etc Local Authority Staff re-use or recycle e.g. Oxfam, community schemes e.g. Supplier take-back, CA site, another company collects to re-use/re-sell

	13.Waste management	How is the waste managed?	<input type="checkbox"/> Land disposal <ul style="list-style-type: none"> <input type="checkbox"/> Landfill <input type="checkbox"/> Land recovery <ul style="list-style-type: none"> <input type="checkbox"/> Compost-like outputLandfill <input type="checkbox"/> Inert wastes <input type="checkbox"/> Unknown <input type="checkbox"/> Thermal with Energy Recovery <ul style="list-style-type: none"> <input type="checkbox"/> Energy from waste (EfW) facilities <input type="checkbox"/> Pyrolysis <input type="checkbox"/> Gassification <input type="checkbox"/> Waste Derived Fuel <input type="checkbox"/> Unknown <input type="checkbox"/> Thermal without Energy Recovery <ul style="list-style-type: none"> <input type="checkbox"/> Incinerators <input type="checkbox"/> Crematoriums <input type="checkbox"/> Pyrolysis <input type="checkbox"/> Gassification <input type="checkbox"/> Unknown <input type="checkbox"/> Transfer Station <input type="checkbox"/> Treatment <ul style="list-style-type: none"> <input type="checkbox"/> Mechanical Biological Treatment (MBT) <input type="checkbox"/> Biological Mechanical Treatment <input type="checkbox"/> Autoclave <input type="checkbox"/> Mechanical Heat Treatment <input type="checkbox"/> Alternative Treatment Technologies <input type="checkbox"/> Unknown <input type="checkbox"/> Recycling <ul style="list-style-type: none"> <input type="checkbox"/> Materials Recycling Facility (MRF) <input type="checkbox"/> Bring banks <input type="checkbox"/> Reprocessor <input type="checkbox"/> Unknown <input type="checkbox"/> Composting <ul style="list-style-type: none"> <input type="checkbox"/> Windrow Composting <input type="checkbox"/> In-Vessel Composting (IVC) <input type="checkbox"/> Anaerobic Digestion (AD) <input type="checkbox"/> Unknown <input type="checkbox"/> Reused off-site <ul style="list-style-type: none"> <input type="checkbox"/> Recycled Aggregates <input type="checkbox"/> Secondary Aggregates <input type="checkbox"/> Unknown <input type="checkbox"/> Don't know	<p>What happens to the waste when it leaves the site?</p> <p>Use list of technologies to map to the appropriate box.</p>
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	14/15 Destination of waste	14. Where is the waste managed?	<input type="checkbox"/> In region of origin <input type="checkbox"/> Other region <input type="checkbox"/> Don't know	Use the regional map provided to assist with this question.
		15. Do you know the facilities which the materials are being sent to? Please state	[] <input type="checkbox"/> Don't know	
Reuse, Recycling and Recovery	16/17. Reused	16. Could this waste be reused in production or elsewhere on site?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Don't know	e.g. Could production waste be re-processed? Could packaging be re-used?
		17. Could this waste be reused offsite by another organisation?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Don't know	e.g. Could the material be sent to another company for re-use e.g. packaging?
	18. Recyclable	Could this waste be recycled if it is not already?	<input type="checkbox"/> Already recycled <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Don't know	e.g. could paper, metal, glass plastic etc be sent for recycling?
	19. Recoverable	Could this material be recovered if it is not already, or if it is already recycled? i.e. via incineration with energy, MBT etc	<input type="checkbox"/> Already recovered <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Don't know	Could the material be sent to any waste process other than landfill? e.g. EfW Direct the client to the website <insert> if they need further information.
Additional information	20. Comments	Record any additional information about the waste stream.	<i>Regulated under producer responsibility legislation, e.g. packaging</i>	Is the clients' business subject to any specific regulations regarding waste or producer responsibility legislation e.g. the Packaging Waste Regulations?

Part 4 – Finish Survey

Check on missing fields	<input type="checkbox"/> Yes <input type="checkbox"/> No	Check all data input
I confirm that the data collected in this survey has been recorded fairly and honestly	[signature of business]	Obtain client signature

Appendix E Substance Oriented Classification codes

Table 42 SOC classifications

SOC classification	Example	Likely sectors
Chemical wastes		
Spent solvents	Paint and paint stripper, degreasing chemicals (in vehicle maintenance for example)	2, 3, 4, 5, 6
Acid, alkaline or saline wastes	Acid/alkaline - pure acids/alkalis, or acid/alkali treated materials. Saline waste - tannery waste can contain saline waste	2, 4, 5, 6
Used oils	Spent rags and oils from industrial processes, vehicle maintenance etc, engine/lubricating oils	1, 2, 3, 4, 5, 6, 7, 9, 11
Spent chemical catalysts	Precious metal salts, industrial alcohols, hydrogen peroxide	2, 4, 5
Chemical preparation wastes	Agrochemical wastes, unused medicines, paint/varnish/ink/adhesive wastes, unused explosives, mixed chemical wastes	2, 4, 5
Chemical deposits and residues	Tars, bitumen, oils/water emulsions/sludges, waste fuels, chemical reaction residues	2, 4, 5
Industrial effluent sludges	Sludge from industrial processes and effluent treatment	2, 4, 5
Metallic wastes		
Metallic wastes	Scrap metal waste, aluminium, copper, lead, mixed metal wastes (e.g. packaging and other recyclables)	5, 6, 11
Healthcare wastes		
Health care and biological wastes	Infectious health care wastes (disposed of subject to special requirements to prevent infection), non-infectious wastes such as body parts & organs, blood bags, petri dishes, absorbent dressings, syringes and needles, medical PPE, diapers etc.	4, 9, 10
Non-metallic wastes		
Glass wastes	Glass packaging (e.g. bottles), other industrial glass wastes	All
Paper and cardboard wastes	Packaging (e.g. boxes, newspaper etc), fibre rejects from industry	All
Rubber wastes	Waste rubber, rubber belts, tyres	4, 6, 7, 11
Plastic wastes	Containers, packaging, plastic strapping, piping, PVC window and door frames, vehicle upholstery, polystyrene	All
Wood wastes	Non-virgin timber in form of pallets, woodchip/sawdust, cork, furniture etc.	2, 4, 5, 6, 7, 11
Textile wastes	Clothing, threads, towels, leather wastes	2, 7, 8
Wastes containing PCBs	Switchgear, transformers, capacitors, starter units for fluorescent lights, possibly in oil-filled electrical equipment	3, 5, 6, 7, 11

SOC classification	Example	Likely sectors
Discarded equipment		
Discarded vehicles	End-of-life cars, planes, motorbikes etc	7, 11
Batteries and accumulators wastes	Portable, industrial and automotive batteries (accumulator = rechargeable battery) including mobile phone, watch and laptop batteries.	All
WEEE and other discarded equipment	WEEE is anything electrical or electronic, plus fluorescent tubes, light bulbs, toner cartridges, brake pads, oil filters etc.	All
Animal & vegetable wastes		
Animal waste of food preparation and products	Just the animal waste - eggshells, bones, skins, feathers etc.	1, 7, 8
Animal faeces, urine and manure	Self explanatory!	1, 12
Animal & vegetable wastes	Veterinary waste, dead animals not used for food, green wastes, vegetable waste (e.g. peelings), biodegradable kitchen/canteen wastes, edible oils and fats etc.	All
Mixed ordinary wastes		
Household and similar wastes	Office bin waste, mixed MSW, bulky waste (e.g. collected furniture)	All
Mixed and undifferentiated materials	Mixed packaging, mixed dry recyclables - try to avoid using as a catch-all	All
Sorting residues	May arise in rejects from pulping of waste paper/card in industry, but generally not expected to see unless surveying a treatment facility – e.g. wastes from sorting mixed recyclables at a recycling facility, off-specification compost etc.	2 (perhaps)
Common sludges		
Common sludges (excluding dredging spoils)	Waste water treatment (e.g. from public sewerage), sludges from purification of water, cesspit contents. Unlikely to use this as not collecting data on sewage.	12
Dredging spoils	Excess material carried away from underwater excavation activities (e.g. waterway management) - mainly a construction activity but may occur in others	12

SOC classification	Example	Likely sectors
Mineral wastes		
Combustion waste	Slags and ashes from thermal treatment and combustion (excluding from blast furnaces in iron manufacturing), wastes from flue gas purification	3, 4, 5
Contaminated soils and polluted dredging spoils	Soils or dredging spoils from a contaminated source (e.g. from clearing up oil spills)	12
Solidified, stabilised or vitrified wastes	Vitrification uses heat to melt and then solidify harmful chemicals in a solid mass of glasslike material. All ways of dealing with hazardous material	3, 4, 5
Other mineral wastes	Sand, gravel, rocks	12
Construction and demolition waste	Brick, concrete, fitted kitchens and wardrobes, plasterboard, structural wood, soil from excavations, doors and windows, roofing materials, mixed skip waste	Any premises undertaking building works
Asbestos wastes	Cement sheets, wallboards, ceiling tiles, fire doors, insulation	Any premises undertaking building works
Waste of naturally occurring materials	Peat, topsoil, sand, clays etc.	12
Non-wastes (reclassified by EA from waste to "by-products", but to be recorded for comparability with 2002/03 survey)		
Virgin timber	Whole/woody parts of trees (incl. branches and bark) derived from forestry works, woodland management, tree surgery etc. Also virgin wood processing (e.g. offcuts, sawdust etc) from timber product manufacture dealing in virgin timber	2
Blast furnace slag	Produced in parallel with hot iron in a blast furnace, with the production process of the iron adapted to ensure that the slag has the requisite technical qualities to be used in a number of clearly defined end uses	5

Appendix F Waste descriptions and management methods

Table 43 Waste classifications

Waste management method	Definitions	Descriptions
Landfill	The disposal of waste materials by burying in land. Landfills are non-hazardous, inert or hazardous.	Landfill: The most basic level landfilling involves placing waste in a hole in the ground and covering it with soil. Today, the engineering of a modern landfill is a complex process, typically involving lining and capping individual "cells" or compartments into which waste is compacted and covered to prevent the escape of polluting liquid or gases. In newer landfill sites, systems are installed to capture and remove the gases and liquids produced by the rotting rubbish.
Land recovery	Some waste materials can be used for the reclamation, restoration or improvement of land as a substitute for virgin materials	Compost-like output (CLO): The compost-like output produced from an MBT process may be suitable for application to previously developed land, subject to various restrictions (i.e. not to agricultural land used for growing food or fodder crops, or any land that is likely to grow food or fodder crops in the future).
		Inert Wastes: Inert waste such as excavated soil may be used in quarry restoration/other conservation activities subject to the necessary permits/consents.
Thermal treatment (energy recovery)	The combustion of waste under controlled conditions in which heat is recovered for beneficial purpose. This may be to provide steam or hot water for industrial or domestic use or for electricity generation. Energy recovery processes are sometimes linked with Combined Heat and Power (CHP) technology whereby waste heat is exported for use by local facilities as steam or hot water.	Energy from Waste (EfW) facilities: Waste is combusted under controlled conditions to reduce its volume (by approx. 90%) and to generate electricity and/or heat. The material outputs from EfW are Incinerator Bottom Ash (IBA) which is an inert material that can be recycled into aggregate and used in the construction industry; and a small fraction of Air Pollution Control (APC) residues which result from the cleansing of the flue gas. APC residues are hazardous and must be disposed of in hazardous landfill.
		Pyrolysis: Is the thermal decomposition of waste material into gaseous or liquid fuels in the absence of oxygen at relatively low temperatures. The solids and gases produced can then be subjected to further treatment options. The solids are sometimes run through a gasification process.
		Gasification: Is the thermal decomposition of material in the presence of air/oxygen with higher temperatures being required. Most of the organic matter in the reactor chamber is transformed to fuel gas.
Thermal treatment	The combustion of waste without energy recovery (i.e. a form of disposal, like landfill)	Clinical Waste Incinerators: High temperature incinerators used to dispose of infectious clinical waste generated by the healthcare sector
		Crematoriums: An incineration facility used in reducing the dead to ashes.
Transfer station	A waste transfer facility serves to bulk up waste before it is transferred to other facilities in larger vehicles	Materials such as recyclables may be baled together and temporarily held on site until there is enough to transport a full load together to a reprocessing plant.

Waste management method	Definitions	Descriptions
Non-thermal treatment	Treatment includes a physical, thermal, chemical or biological process - which can include sorting - to change the characteristics of the waste to either reduce its volume, reduce its hazardous nature, facilitate its handling, or enhance its recovery.	Mechanical Biological Treatment (MBT): Involves a two stage process: i) a mechanical sorting phase, removing recyclables from the waste stream; ii) A biological phase, involving the stabilisation of the biodegradable fraction of the waste stream, producing various products from the waste including a refuse-derived fuel fraction (RDF). RDF is a dry, shredded feedstock which has had any inert (glass) material and any organic material (Compost-like Output, CLO) removed. It can be combusted in industrial processes as a substitute or supplementary fuel.
		Autoclave: Involves a pressurised rotating vessel which, through a combination of steam, pressure and agitation, results in the organic fraction of the waste being separated and broken down into a sanitised fibre which can potentially be sold on to markets for use within the manufacture of fibre board, insulation board, door and wall panelling and potentially any product made using cellulose fibre as base material. The fibre may also be used as a low-grade soil conditioner or as a fuel source. The remainder of the waste passes through the process, which extracts the glass, metal and plastic for recycling. The recycled materials are clean and have an added value when sold on the market place.
		Mechanical Heat Treatment: A heat treatment process, drying and sanitising MSW and selected commercial waste to allow easier separation of recyclables and to produce a refined biomass material, which could be used as RDF.
		Alternative Treatment Technologies: High temperature treatment plants disinfect clinical waste by heating the waste either directly using steam injection (autoclaves, rotoclaves, steam injection augers) or indirectly (microwaves and hot oil augers).
Recycling	Recycling recovers materials, by preventing them from being disposed of, and makes them into new goods. This can involve turning the old material into a new version of the same thing, or materials can be recycled into something completely different. For example, used glass bottles can be recycled into new bottles, or they can be recycled into something different, such materials used in road construction.	Materials Recycling Facility (MRF): A facility that sorts, grades and prepares waste fractions (e.g. paper, cans, plastic bottles etc.) suitable for onward dispatch to a reprocessor.
		Reprocessor: Once separated into their constituent parts, recyclables are reprocessed at a reprocessing plant. The activities at these plants are specific to the material being processed. For example: <ul style="list-style-type: none"> - metals and glass are heated to a high temperature and may be reprocessed into new products or the original product - with material such as plastic, the waste is converted into a granulate or pellet which is then used in the manufacture of a recycled or part recycled plastic product - paper is pulped and shredded and it too will be added to a mix forming part of the raw material for the paper
Composting	Composting refers to a biological process in the in which organic wastes, such as garden and kitchen waste are converted into a stable granular material (i.e. compost). The end-product, compost, can be applied to land to improve soil structure and enrich the nutrient content of the soil.	Windrow Composting: A simple process where garden waste is set out in long elongated piles (windrows) and left to compost for a period of approx. 16 weeks. Piles are turned regularly to evenly distribute oxygen. Not suitable for food waste.
		In-Vessel Composting (IVC): An enclosed system in which conditions are carefully controlled to optimise composting. IVC can process food waste as the material reaches a high enough temperature that pasteurises meat and products of animal origin so the end product meets the standard required to protect human health and the environment.

Waste management method	Definitions	Descriptions
		Anaerobic Digestion (AD): This involves the decomposition of organic materials by bacteria in the absence of oxygen within a controlled, closed vessel. AD can be used to treat separated organic waste or mixed residual waste. The process results in a biogas (methane & carbon dioxide) which can be used to generate electricity and heat.
Reused off-premise	Waste material from one business could be a valuable material for re-use for another business/process. For example, Incinerator Bottom Ash (IBA) produced from an EfW facility is an inert material that can be recycled into aggregate and used in the construction industry. Aggregates are primarily used for the manufacture of Asphalt and Concrete Products.	Recycled Aggregates: Derived from reprocessing materials previously used in construction. Examples include recycled concrete from construction and demolition waste material (C&DW) and railway ballast.
		Secondary Aggregates: Usually by-products of other industrial processes not previously used in construction. Secondary Aggregates can be further sub-divided into <i>manufactured</i> and natural, depending on their source. Examples of manufactured secondary aggregates are pulverised fuel ash (PFA) and metallurgical slags. Natural secondary aggregates include china clay sand and slate aggregate.

Appendix G Non-waste data

The Waste Framework Directive¹⁴ allows for materials to be taken out of the specific requirements of waste regulation. Certain materials are defined as by-products which have a clear and sustainable market for a lawful beneficial reuse without the need for further testing processing or quality assurance. These materials no longer fall within the definition of wastes but are regarded as products. They do not require any form of regulation governing their handling transport or treatment and do not form part of any analysis of arisings or recycling and recovery. They have become known as “non-wastes”.

There are two wastes in particular which were surveyed as wastes in the last survey of 2002/3, but are now no longer classified as wastes under the Waste Framework Directive, therefore “non-wastes” as termed in this project. These are blast furnace slag and virgin timber.

Data on the two non-wastes in question, blast furnace slag and virgin timber, were gathered as part of the survey to allow comparisons with previous C&I surveys but are not within the estimate. Data on these materials are included separately in the text of the report but are not within the database or data tables.

The Waste Framework Directive also allows for the development of a process to remove materials from regulation where they can be deemed fully recovered. The EA initiative on Waste Protocols has defined methodologies for removing certain materials from regulation where they are reprocessed and tested within defined processes and to defined standards. It was beyond the scope of this survey to verify the proportion of recycled wasted from sectors where protocols apply which may be deemed “fully recovered” and therefore are no longer wastes. Any such data were recorded as recycled within the estimate.

¹⁴ <http://ec.europa.eu/environment/waste/legislation/a.htm>

Appendix H Standard waste container types

Table 44 Typical dimensions of various waste containers and skips

Container type	Dimensions (mm)		
	Height	Width	Length (depth)
Wheeled Bin			
2 Wheeled			
80 ltr (euro)	865	440	500
90 ltr (euro)	824	485	545
100 ltr (euro)	800	505	525
120 ltr (euro)	1075	555	505
140 ltr (euro)	1066	480	550
240 ltr (euro)	1060	730	575
360 ltr (euro)	1080	875	580
4 Wheeled			
500 ltr (4 wheels)	1200	980	740
660 ltr (4 wheels)	1210	1370	780
770 ltr (4 wheels)	1370	1370	780
820 ltr (4 wheels)			
1000 ltr (4 wheels)	1295	1265	1070
1100 ltr (4 wheels)	1350	1360	1080
1280 ltr (4 wheels)	1450	1280	1000
Drums			
25 ltr Metal Drum	470	280	
Skips			
2 cubic yard (1.5m ³)	760	1010	1530
4 cubic yard (3.1m ³)	960	1220	1800
6 cubic yard (4.6m ³)	1220	1520	2600
8 cubic yard (6m ³)	1220	1680	3660
10 cubic yard (8.85m ³)	1500	1780	3740
12 cubic yard (9.2m ³)	1680	1780	3700
14 cubic yard (10.7m ³)	1800	1750	4100
16 cubic yard (12.2m ³)	2000	1840	4200
Roll on Roll off			
12 cubic yard (9.18m ³)	2690	2230	6070
15 cubic yards (11.5m ³)	904	2235	5790
16 cubic yard (12.23m ³)	1220	2230	6070
18 cubic yards (13.8m ³)	1081	2235	5790
20 cubic yard (15.3m ³)	1199	2235	5790
25 cubic yards (19.1m ³)	1494	2235	5790
30 cubic meters (23m ³)	1790	2235	5790
35 cubic yard (25.76m ³)	2085	2235	5790
40 cubic yard (30.6m ³)	2381	2235	5790
50 cubic yards (38.2m ³)	2791	2235	5790

Container type	Dimensions (mm)		
	Height	Width	Length (depth)
Rear end Loader-Open			
6 cubic yard (4.6m ³)	1220	1676	2820
8 cubic yard (6m ³)	1220	1676	3776
10 cubic yard (8.85m ³)	1525	1676	3810
12 cubic yard (9.2m ³)	1675	1676	4040
14 cubic yard (10.7m ³)	1830	1676	4415
16 cubic yard (12.2m ³)	2080	1676	4340
Rear end Loader-Closed			
6 cubic yard (4.6m ³)	1220	1676	2820
8 cubic yard (6m ³)	1220	1676	3776
14 cubic yard (10.7m ³)	1525	1676	3810
16 cubic yard (12.2m ³)	1675	1676	4040
Front End loader - Wendy			
6 cubic yard (4.6m ³)	1837	1803	1778
8 cubic yard (6m ³)	2000	1803	2130
Front End loader - Box			
4 cubic yards (3m ³)	1343	1803	1500
6 cubic yard (4.6m ³)	1830	1803	1370
8 cubic yard (6m ³)	2000	1803	1760
10 cubic yard (8.85m ³)	2000	1803	2130
Compactors			
30 cubic meters (23m ³)	1675	1675	5791
35 cubic yard (25.76m ³)	2185	2185	5791
40 cubic yard (30.6m ³)	2490	2490	5791

Appendix I Conversion factors

Table 45 Conversion factors

Waste type		Conversion factor	Source	Note
Chemical wastes	Spent solvents	0.9	WRAP conversions used in their tools	
	Acid, alkaline or saline wastes	0.9	Urban Mines report based on	Assumed to be in liquid form.
	Used oils	0.9	Urban Mines report for Wales 2009	
	Spent chemical catalysts	0.24	Urban Mines report for Wales 2009	
	Chemical preparation wastes	0.36	Urban Mines report for Wales 2009	Assumed to be in powder form
	Chemical deposits and residues	0.92	Based on MOD conversion factors	
	Industrial effluent sludges	0.92	Urban Mines report for Cheshire Council	
Metallic wastes	Metallic wastes - Commercial	0.063	WRAP material bulk densities (Jan 2010)	From analysis of mixed cans in kerbside (no compaction)
	Metallic wastes - Industry	0.3	Urban Mines report for Wales 2009	For metal filings and turnings
Healthcare wastes	Health care and biological wastes	0.2	Urban Mines report for Cheshire Council	
Non-metallic wastes	Glass wastes	0.57	Urban Mines report for Wales 2009	
	Paper and cardboard wastes	0.2	Urban Mines report for Wales 2009	Assumed not to be dependent on sector
	Rubber wastes	0.47	Urban Mines report for Wales 2009	
	Plastic wastes - Commercial	0.34	WRAP material bulk densities (Jan 2010)	From analysis of mixed plastic in 1,100 litre wheeled bins (no compaction)
	Plastic wastes - Industry	0.22	Urban Mines report for Wales 2009	Including plastic packing and shavings/turnings from manufacture of plastic products
	Wood wastes	0.25	Urban Mines report for Wales 2009	Including sawdust, shavings from wood processing
	Textile wastes - Commercial	0.2	Urban Mines report for Wales 2009	Including cloths, off-cuts and other textile pieces
	Textile wastes - Industry	0.61	Urban Mines report for Wales 2009	Including textile fibres
	Waste containing PCBs	0.304	Based on MOD conversion factors	

Waste type		Use	Source	Note
Discarded equipment	Discarded vehicles	0.219	Hadley and Hunter Report	Based on vehicle parts
	Batteries and accumulators wastes	1.35	Urban Mines report for Wales 2009	
	WEEE and other discarded equipment	0.3	Urban Mines report for Wales 2009	
Animal & vegetable wastes	Animal waste of food preparation and products	0.29	WRAP material bulk densities (Jan 2010)	Based on analysis of 23 litre kerbside caddies
	Animal faeces, urine and manure	0.92	Urban Mines report for Wales 2009	
	Animal & vegetal wastes	0.29	WRAP material bulk densities (Jan 2010)	Based on body parts
Mixed ordinary wastes	Household and similar wastes non compacted	0.11	Urban Mines report for Wales 2009	Non-compacted
	Household and similar wastes compacted	0.26	Urban Mines report for Wales 2009	Compacted
	Mixed and undifferentiated materials	0.06	WRAP Hospitality study	Co-mingled recyclables
	Sorting residues	0.260	Urban Mines report for Wales 2009	Not expected to be encountered
Common sludges	Common sludges (excluding dredging spoils)	0.92	Urban Mines report for Wales 2009	
	Dredging spoils	0.510	WRAP conversions used in their tools	Not expected to be encountered
Mineral wastes	Combustion wastes	1.08	Urban Mines report for Wales 2009	
	Contaminated soils and polluted dredging spoils	1.3	Urban Mines report for Wales 2009	
	Solidified, stabilised or vitrified wastes	1.35	Urban Mines report for Wales 2009	
	Other mineral wastes	1.23	Urban Mines report for Cheshire Council	
	Construction and demolition wastes	0.42	Urban Mines report for Wales 2009	
	Asbestos wastes	0.32	Urban Mines report for Wales 2009	
	Waste of naturally occurring minerals	1.1	Urban Mines report for Wales 2009	

Appendix J Completing the sample matrix

This section provides more details on the data sources and the tasks involved in completing the survey sample.

Around 1,000 data points in the original sample frame design could not be filled through face-to-face and telephone interviews alone. This was due to fewer businesses within the IDBR sample agreeing to participate directly in the survey.

In many of these cases the entire population within a specific pool was required to be surveyed in order for the sample to be achieved. These pools had been identified as 'exhausted pools' reflecting that all the available entries within the sample had been called. In general, the exhausted pools were the smaller pools, 'Size group 6' i.e. the larger companies and those in industry sectors 1-5. Several of the exhausted pools were the same across all regions, e.g. size groups 4-6, therefore limited points were collected for these pools leading to relatively large errors.

A number of tasks have been identified below which were used to fill this data gap.

Task 1: Obtaining samples in the field & telephone (listed here for completeness)

4,074 data points sourced from site visit and telephone survey data.

Task 2: Incorporating PPC data

As the case was that many of the missing samples were in size group 6, some of these organisations might have a Pollution Prevention and Control (PPC) license.

PPC is a regulatory regime for controlling pollution from certain industrial activities, and organisations operating under the PPC regime must provide a range of data including information on all waste materials generated. Companies operating within the PPC regime are often larger industrial plants and, as mentioned above, difficulties had been found in recruiting larger companies to participate and thus the PPC data could be used in filling this gap. In addition, some of these businesses were the biggest producers of waste, without including these in the sample would underestimate the amount of waste produced overall in England. It was always likely to be the case that PPC data be used to ensure that the sample included large facilities which could not be omitted – all previous C&I surveys had included PPC data.

Given the nature of this data, i.e. its use for licensing and the requirement to collect and supply on a yearly basis to the EA, this should therefore provide better data than an ad hoc survey on site.

The addresses in the PPC data were compared to the addresses held within the sample received from the ONS. A manual check was then made of site names so that the matches could be confirmed. Following this, a further check was made on those sites already visited as a field survey in order to avoid duplication within the database. Any sites that had received a survey were removed from the analysis.

The PPC data was used in the grossing in a similar method used in the 2002/3 study, i.e. it had been found that some PPC businesses might produce more waste

than comparable non-PPC businesses, in which case these businesses would have to be grossed up separately. However, if PPC businesses were not different, then it was not necessary to focus on this separate group. A decision was made based on whether the businesses were within three standard deviations of the mean for that strata

PPC data that were included within the grossing up exercise included those that were within an agreed range for both the total tonnage and the tonnage per employee of the relevant SIC group. Those outside this range would be added to the grossed up figure.

Task 3: Data from companies who refused to be interviewed but would provide head office data – using only sites that were within the sample frame derived from the IDBR data

During the operation of the contact centre, it was discovered that a number of major companies did not wish to participate in the survey. Others were unhappy for us to survey their premises, but were willing to provide data from head offices. These companies were large outfits whose data was gathered proactively and systematically by central functions tasked with monitoring site and group performance. They were often based on contractors' returns based on tonnage. They were invariably better than site collected data and other returns as their provenance was clear and they typically included contractors' data from distribution and logistics centres that were often not available to site managers.

Therefore, use of this type of data should increase the accuracy of the survey result. Additionally the incorporation of data from companies willing to provide it allowed for the waste of those companies to be represented in the final results, leading to a more robust estimate of the waste arisings. Otherwise these companies would have been excluded.

The data collected from these sources covered a wide range of businesses, from parcel delivery businesses to High Street retailers and national organisations such as banks, power generators etc. It corresponded to several hundred data points within the sample frame.

A methodology was developed and agreed with Defra to ensure that the corporate data was included so that the sample was not distorted and that the error across each stratum was minimised. The methodology identified the number of data points (sites) from a particular company that could be imported without skewing the results towards the waste management practices of an individual company. It also maintained the appropriate representation of companies within each of the strata.

For example, the sample from the IDBR database contained 928 of Company X out of approximately 120,000 records. Given that this was around 1/120th of the overall database the implication was that there would be 50 Company X to be included in the final results. However, this took no account of the distribution of size groups or geographical distribution. Instead the method had been applied to account for the size groups and geographic location of these companies.

In addition, to keep proportionality within the 12 headline industrial classifications being used, the makeup of the SIC groups was considered. Table 46 shows the SIC categories within the headline sector grouping. Sector 12 has been included but not broken down to this level due to the number of chapters.

Table 46 SIC categories and headline sector groupings

Headline sector	1	2	3	4	5	6	7	8	9	10	11
SIC(2007) chapters	10 11 12	13 14 15 16 17 18	19 35 36	20 21 22 23	24 25	26 27 28 29 30 31 32 33	45 46 47	55 56	84 86 87 88	85	49 50 51 52 53

Method

- ◇ The number of required remaining surveys was calculated for each pool, i.e. region, size, SIC group and SIC chapter.
- ◇ For each given headline SIC group, the distribution amongst its constituent SIC (2007) chapters had been determined i.e. in SIC group 1 the distribution between 10, 11 and 12 had been determined. This was based on IDBR data. There were eight regions and six size groupings (total of 48 strata) for each headline SIC group.
- ◇ Lists of companies potentially willing to provide waste data were drawn up for each of the 12 SIC groups.
- ◇ The distribution of each of these companies' total sites (from the entire IDBR database sample) by pool were then mapped against the required surveys remaining (as calculated in 1).
- ◇ Under each pool, each company's total sites were calculated as a proportion of total sites present in that pool on the IDBR database. This showed the number of companies' sites that would be expected in each pool. This was the data we had used to estimate which sites we should use in each pool.

By taking this approach, the estimated number of sites for a particular company could be determined. This would be the number of visits that would be expected given randomised sampling and all companies being willing to participate.

Task 4: Usage of remaining corporate data of points in the place of companies who refused to participate or to provide head office data, keeping within pools and SIC chapters,

Some major companies had not wished to participate in the survey and did not wish to provide any corporate data; this included a number of major organisations summing to several hundred data points within the sample frame. Without these data many pools would be left unfilled as many of them were within priority pools for completion, due to their share of the market. Additionally there was a risk of not representing a particular company, such as a major retailer, within the survey.

The 'main companies' (i.e. the companies with most duplicates) in each of the SIC groups were identified. The number of each company, within the full IDBR database, in each of the pools was determined, as was the total number of database entries in each pool. This enabled the calculation of the proportion of any individual company within each pool.

In the cases of these companies, we had undertaken a substitution of a similar company from a series of similar companies. Companies were only replaced when they were in the same pool. Within this task, the distribution within a headline SIC and its constituent SIC(2007) chapters remained constant.

Task 5: Using corporate data to maximise sample points and to minimise error across each strata

Following Task 4, there were still around 1,000 missing data points missing i.e. where the target sample had still not been achieved through all these tasks. These pools would never be filled as there was no remaining data to fill them within the IDBR database or corporate data.

Therefore, to enable the sample of 6,000 to be met, two sources of data were used; i.e. additional PPC data and corporate data in other pools.

The PPC data and other sources were looked at (with assistance from the EA) to analyse any data points which should be included as they were the largest generators of waste in England.

The selection of the points used was based on minimising the error across each strata and for the sample as a whole. This also ensured that the sample size required in both the South West and London was met. This required the final sample matrix to be based on an analysis of the variance observed in the data collected (based on ~5,000 points). This was developed and agreed with Defra and the Steering Group to ensure a more accurate result from the completed sample.

This meant using data points in different size groupings, regions or sectors, depending on the variances. Using this method enabled the project to be completed within agreed timescales and the best data to be used to minimise the error within the results.

The population of the final matrix used a randomised sampling of the remaining corporate data to assist in populating the priority pools to avoid skewing in favour of any particular company.

Summary

The five tasks described above led to the breakdown given in Table 47:

Table 47 Survey Number and Data Type

Data type	Final before data completion	Final report
Face-to-face	3273	3273
Telephone	801	801
Corporate task 3 and 4.	665	665
Corporate - Completion of survey	0	947
PPC	298	298
PPC - Completion of survey	21	21
Total data points	5037	6005
% error	7.75	7.62

Appendix K Grossing methods

A statistically robust methodology for grossing of the sample output to the national level using business population data.

Jacobs have adopted the same grossing methodology as the one used in previous surveys (e.g. the 2002/3 national survey and the 2007 surveys for Wales and the North West Region) in order to ensure compatibility and consistency with past studies. The methodology allows the comparison of results of this survey with those of the previous surveys at a high level. The outputs are also compatible with the requirements of the EU Regulations (EC) No. 2150/2002 on waste statistics.

Total waste arisings

National estimates

The national estimate of total waste arisings in England was obtained by adding the total waste arisings in North West Region to the total weight grossed up from the results of this survey.

The grossed up weight was calculated by summing the total waste arisings across all the strata in the eight English regions. The total waste arisings in a stratum was calculated by multiplying the business population in the stratum by the mean business waste arisings obtained from all the samples collected for the stratum. Mathematically, this process is represented by Equation 1.

Equation (1):

$$W = W_{NW} + \sum_{i=1}^{12} \left(N_{io} \bar{w}_{io} + \sum_{j=1}^6 N_{ij} \times \frac{\sum_{k=1}^{n_{ij}} w_{ijk}}{n_{ij}} \right)$$

Where:

W	= National estimate of total waste arisings
W_{NW}	= Total Waste arisings in North West Region
N_{io}	= Number of businesses with 1-4 employees in the i th business sector
\bar{w}_{io}	= Mean business waste arisings for businesses with 1-4 employees in the i th business sector $= r_i \times \frac{\sum_{k=1}^{n_{i1}} w_{i1k}}{n_{i1}}$
N_{ij}	= Population size of the stratum (i,j) . A stratum (i,j) is the subpopulation of businesses in the business sector number i and with number of employees in the size band j . The sector numbers and size bands are defined in our response to CB2.
w_{ijk}	= Waste arisings of the k th sample in the stratum (i,j)
n_{ij}	= Number of samples in the stratum (i,j)

Regional estimates

The total waste arisings in a Region was estimated by summing the total waste arisings across all the strata in the Region. The total waste arisings in each stratum of a Region was calculated by adding an estimate of the total waste arisings for businesses that have not been surveyed to the total waste arisings of businesses that have been surveyed.

The total waste arisings for businesses that have not been surveyed in a stratum of a Region was estimated by multiplying the number of businesses that have not been surveyed by the mean business waste arisings. For businesses with 1-4 employees, the mean business waste arisings in each stratum was calculated using the approach described above. For businesses with more than 4 employees, the mean business waste arising was calculated from all the sample results collected for the stratum nationally. Mathematically, this process is represented by Equation 2.

Equation (2):

$$W_R = \sum_{i=1}^{12} \left\{ N_{ioR} \bar{w}_{io} + \sum_{j=1}^6 \left[\sum_{k=1}^{n_{ijR}} w_{ijk} + (N_{ijR} - n_{ijR}) \times \frac{\sum_{p=1}^{n_{ij}} w_{ijp}}{n_{ij}} \right] \right\}$$

Where:

W_R	= Total waste arisings for Region R
N_{ioR}	= Number of businesses with 1-4 employees in the i th business sector for region R
\overline{W}_{io}	= Mean business waste arisings for business with 1-4 employees in the i th business sector (as defined in Equation 1)
w_{ijk}	= Waste arisings of the k th sample in the surveys for Region R and the stratum (i,j) . A stratum (i,j) is the subpopulation of businesses in the business sector number i and with number of employees in the size band j . The sector numbers and size bands are defined in our response to CB2.
N_{ijR}	= Population size of the stratum (i,j) in Region R
n_{ijR}	= Sample size of the stratum (i,j) in Region R
w_{ijp}	= Waste arisings of the p th sample in the national survey for the stratum (i,j)
n_{ij}	= Total number of samples for the stratum (i,j) nationally

Waste Planning Authority estimates (for London and South West)

The grossed up weights at a WPA level was obtained by using the same approach as the one described above for obtaining Regional estimates. For this case, the variables with suffix R in Equation 2 are interpreted to be the variables for the WPA R.

Total Waste Arisings by Category

For categories (e.g. waste types) where the waste arisings in a stratum do not depend on the location of the business, we will gross up the results from a stratum to the WPA, regional and national levels using the aforementioned approach for grossing up total waste arisings. The variables $w_{i,j,k}$ in Equations 1 and 2 are interpreted to the sample weight for the category of interest.

For categories (e.g. waste management method) where the waste arisings in a stratum depend on the location of the business, we will obtain the estimates at WPA Regional and national levels using the following approach.

Waste Planning Authority estimates (for London and South West Region)

The total waste arisings in a WPA area for the category of interest was estimated by summing the total waste arisings across all the strata in the WPA area for the category of interest. The total waste arisings in each stratum of a WPA area for the category of interest was calculated by adding an estimate of the total waste arisings for businesses that have not been surveyed to the total waste arisings of businesses that have been surveyed.

The total waste arisings for businesses that have not been surveyed in a stratum of a WPA area was estimated by multiplying the number of businesses that have not been surveyed by the mean waste arisings for the category of interest. For businesses with 1-4 employees, the mean business waste arisings in each stratum was calculated using the approach described above. For businesses with other sizes, the mean business waste arising was calculated from all the sample results

collected for the stratum in the Region where the WPA resides. Mathematically, this process was represented by Equation 3.

Equation (3):

$$W_A = \sum_{i=1}^{12} \left\{ N_{ioA} \bar{w}_{ioR} + \sum_{j=1}^6 \left[\sum_{k=1}^{n_{ijA}} w_{ijk} + (N_{i jA} - n_{i jA}) \times \frac{\sum_{p=1}^{n_{ijR}} w_{ijp}}{n_{ijR}} \right] \right\}$$

Where:

W_A	= Total waste arisings for the Waste Planning Authority A for the category of interest
N_{ioA}	= Number of businesses with 1-4 employees in the i th business sector for the Waste Planning Authority A.
\bar{w}_{ioR}	= Mean business waste arisings for the category of interest for businesses with 1-4 employees in the i th business sector for Region R $= r_i \times \frac{\sum_{p=1}^{n_{i1R}} w_{i1p}}{n_{i1R}}$
r_i	= Ratio shown in Table 1 for the i th business sector
w_{ijp}	= Waste arisings for the category of interest of the p th sample in the surveys for Region R and the stratum (i,j) . A stratum (i,j) is the subpopulation of businesses in the business sector number i and with number of employees in the size band j . The sector numbers and size bands are defined in our response to CB2.
w_{ijk}	= Waste arisings for the category of interest for the k th sample in the surveys for the Waste Planning Authority A and the stratum (i,j)
N_{ijA}	= Population size of the stratum (i,j) for the Waste Planning Authority A.
n_{ijA}	= Sample size of the stratum (i,j) for the Waste Planning Authority A
n_{ijR}	= Number of samples for the stratum (i,j) in Region R where the Waste Planning Authority A resides

Regional estimates

The regional estimate of the total waste arisings for the category of interest was obtained by summing the total waste arisings for the category of interest across all the strata in the Region. The total waste arisings in a stratum was calculated by multiplying the business population of the stratum in the Region by the mean business waste arisings for the category of interest. For businesses with 1-4 employees, the mean business waste arisings in each stratum was calculated using the approach described above. For businesses with other sizes, the mean business waste arising was calculated from all the sample results collected for the stratum in the Region. Mathematically, this process is represented by Equation 4.

Equation (4):

$$W_R = \sum_{i=1}^{12} \left[N_{ioR} \bar{w}_{ioR} + \sum_{j=1}^6 N_{ijR} \times \frac{\sum_{k=1}^{n_{ijR}} w_{ijk}}{n_{ijR}} \right]$$

Where:

W_R	= Total waste arisings for the category of interest in Region R.
N_{ioR}	= Number of businesses with 1-4 employees in i th business sector in Region R
\bar{w}_{ioR}	= Mean business waste arisings for the category of interest for businesses with 1-4 employees in Region R (as defined in Equation 3).
N_{ijR}	= Population size of the stratum (i,j) for Region R. A stratum (i,j) is the subpopulation of businesses in the business sector number i and with number of employees in the size band j . The sector numbers and size bands are defined in our response to CB2.
w_{ijk}	= Waste arisings for the category of interest of the k th sample in the surveys for Region R and the stratum (i,j)
n_{ijR}	= Sample size of the stratum (i,j) in region R

National estimates

The national estimate of the total waste arisings for the category of interest was obtained by summing all the Regional estimates, including the estimates for North West Region.

Appendix L Margins of error

Method

We have considered sampling errors only in evaluating the precision of the national and regional total waste arising estimates. We have assumed that the waste arisings in a stratum follow a normal distribution. The margin of error (%) at 95% confidence level in the national total waste arisings estimate was calculated by using Equation 5.

Equation (5):

$$E_N = 100 \times 1.96 \times \frac{1}{W} \sqrt{\sum_{i=1}^{12} \sum_{j=1}^6 \frac{s_{ij}}{n_{ij}} \left(1 - \frac{n_{ij}}{N_{ij}}\right) \times N_{ij}^2}$$

Where:

E_N	= Margin of error (%) in the national total waste arisings at 95% confidence level
W	= National total waste arisings estimate
s_{ij}	<p>= Standard deviation of business waste arisings in the stratum (i,j)</p> $= \sqrt{\frac{\sum_{k=1}^{n_{ij}} (w_{ijk} - \bar{w}_{ij})^2}{(n_{ij} - 1)}}$ <p>A stratum (i,j) is the subpopulation of businesses in the business sector number i and with number of employees in the size band j. The sector numbers and size bands are defined in our response to CB2.</p>
\bar{w}_{ij}	<p>= Mean business waste arisings in the stratum (i,j)</p> $= \frac{\sum_{k=1}^{n_{ij}} w_{ijk}}{n_{ij}}$
n_{ij}	= Sample size of the stratum (i,j)
N_{ij}	= Population size of the stratum (i,j)

The margin of error (%) at 95% confidence level in the Regional estimate of the total waste arisings is calculated by using Equation 6.

Equation (6):

$$E_R = 100 \times 1.96 \times \frac{1}{W_R} \sqrt{\sum_{i=1}^{12} \sum_{j=1}^6 \frac{s_{ij}}{n_{ij}} \left(1 - \frac{n_{ij}}{N_{ij}}\right) (N_{ijR} - n_{ijR})^2}$$

Where:

E_R	= The margin of error (%) in the regional total waste arisings estimate
W_R	= Regional total waste arisings estimate
s_{ij}	<p>= Standard deviation of business waste arisings in the stratum (i,j)</p> $= \sqrt{\frac{\sum_{k=1}^{n_{ij}} (w_{ijk} - \bar{w}_{ij})^2}{(n_{ij} - 1)}}$ <p>A stratum (i,j) is the subpopulation of businesses in the business sector number i and with number of employees in the size band j. The sector numbers and size bands are defined in our response to CB2.</p>
\bar{w}_{ij}	<p>= Mean business waste arisings in the stratum (i,j)</p> $= \frac{\sum_{k=1}^{n_{ij}} w_{ijk}}{n_{ij}}$
n_{ij}	= Sample size of the stratum (i,j)
N_{ij}	= Population size of the stratum (i,j)
N_{ijR}	= Population size of the stratum (i,j) in Region R
n_{ijR}	= Sample size of the stratum (i,j) in Region R

Results

The margin of error at a 95% confidence interval is given below at sector level

Business sector	Business size	Code of strata	Margin of error (%) in the regional total GUW at 95% confidence level	
			Per Band	Per Sector
1	1	1_1	18.63	3.40
1	2	1_2	28.72	
1	3	1_3	9.80	
1	4	1_4	7.30	
1	5	1_5	6.57	
1	6	1_6	4.80	
2	1	2_1	18.81	7.60
2	2	2_2	13.98	
2	3	2_3	14.05	
2	4	2_4	7.49	
2	5	2_5	6.23	
2	6	2_6	16.64	
3	1	3_1	21.65	19.80
3	2	3_2	20.10	
3	3	3_3	28.38	
3	4	3_4	20.12	
3	5	3_5	35.46	
3	6	3_6	24.78	
4	1	4_1	23.58	5.98
4	2	4_2	36.71	
4	3	4_3	14.87	
4	4	4_4	7.25	
4	5	4_5	10.66	
4	6	4_6	6.71	
5	1	5_1	24.40	10.91
5	2	5_2	30.22	
5	3	5_3	9.02	
5	4	5_4	36.66	
5	5	5_5	14.73	
5	6	5_6	15.38	
6	1	6_1	18.35	6.51
6	2	6_2	33.77	
6	3	6_3	23.19	
6	4	6_4	20.60	
6	5	6_5	11.49	
6	6	6_6	8.45	
7	1	7_1	10.10	3.20
7	2	7_2	7.26	
7	3	7_3	7.17	
7	4	7_4	7.30	
7	5	7_5	6.79	
7	6	7_6	1.61	
8	1	8_1	12.83	5.74
8	2	8_2	14.10	
8	3	8_3	5.29	
8	4	8_4	22.35	

Business sector	Business size	Code of strata	Margin of error (%) in the regional total GUW at 95% confidence level	
			Per Band	Per Sector
8	5	8_5	17.79	19.01
8	6	8_6	25.15	
9	1	9_1	20.13	
9	2	9_2	58.19	
9	3	9_3	18.69	
9	4	9_4	17.53	
9	5	9_5	24.91	
9	6	9_6	18.32	
10	1	10_1	46.88	6.81
10	2	10_2	13.88	
10	3	10_3	16.85	
10	4	10_4	9.37	
10	5	10_5	13.01	
10	6	10_6	10.22	
11	1	11_1	24.91	10.47
11	2	11_2	23.89	
11	3	11_3	24.73	
11	4	11_4	20.07	
11	5	11_5	21.56	
11	6	11_6	13.86	
12	1	12_1	10.20	7.38
12	2	12_2	9.40	
12	3	12_3	11.34	
12	4	12_4	30.18	
12	5	12_5	8.89	
12	6	12_6	14.95	

Appendix M London Region

Introduction and approach

The Department of Environment, Food and Rural Affairs (Defra) commissioned this study to obtain data from businesses in England on Commercial and Industrial (C&I) waste arisings and management methods in calendar year 2009. The survey was funded in partnership with the London Waste and Recycling Board (LWaRB).

There are few current comprehensive data sources concerned with the production and management of commercial and industrial waste. At present, there are no formal reporting requirements for businesses with respect to material flows or waste arisings.

LWaRB needed C&I waste information to:

- Underpin local and regional waste management and land-use planning direction;
- Aid regional business opportunity analysis and development by providing geographic information on the potential for further recovery of materials, not least in stimulating competition for waste infrastructure development.

Caveats and limitations

The results of this survey represent the most reliable and comprehensive set of data on C&I waste for over 5 years. Sampling was intensified in the London area specifically to improve the quality of regional results. However the results from any voluntary field survey are subject to limitations with respect to the quality of the data gathered. Some of the key limitations are summarised below:

- The survey was entirely voluntary so only companies that were willing to participate were surveyed. This is more likely to capture data from companies that are more progressive with respect to managing their wastes.
- The survey is for 2009 only, a year within the deepest recession since 1930s. This may be viewed as atypical and outside of the normal business cycle and is likely to have affected business activity and as a result, C&I waste tonnages. It is also likely to have reduced businesses willingness to participate.
- The data may provided may inaccurate or have failed to capture all material streams. The survey was not able to verify individual site returns with respect to their origin and accuracy. However, returns were sense checked and subject to statistical checks against data from the same sub-population to detect unusual or missing data.
- The composition of mixed waste was assessed visually. This approach can only give a one day picture of the composition of mixed waste on the day in question. Surveyor training included practical sessions on visual waste assessment to try to overcome any bias and ensure consistency.

Survey design and preparation

Development of the sample matrix

Jacobs' statisticians adopted a random optimised stratified sampling methodology to derive a sample matrix that aimed to deliver a national estimate which has an error of +/-4% at a 95% confidence interval. This was founded on the variance within the 2003/ sample data. The matrix was stratified using the 2007 Standard Industry Classification of Economic Activities (SIC codes).

There were 12 specified business sectors used in this study, six Industrial and six Commercial. Business sectors covering Agriculture, Mining, Construction and Demolition were excluded from the study. The waste management industry was excluded to avoid potential double counting of waste arisings. This is consistent with previous C&I waste survey methodologies.

The next stratification considered was scale. Six bands of business size ranging from businesses with 5 or more employees to those with greater than 250 employees gave a basic matrix with 72 strata.

This basic matrix was further classified by the eight English regions covered in the survey. This regional classification developed the matrix into a total of 576 'pools': combinations of sector, size band and region that were required to be sampled.

The number of samples required in each of the 576 pools was allocated proportionally according to the waste arising within the stratum (defined by the business sector and size) and the stratum's population size in the region, with the following conditions:

- The minimum number of surveys per stratum in each region was set to two.
- The maximum number of surveys per stratum in each region was set to the population size of the stratum in the region.

This enabled the 'optimal' sample frame to be derived based on the 2002/3 variance. This sample was modified by Defra to reflect the additional funding provided by the LWaRB whilst maintaining the overall statistical objectives for the national estimate.

Development of the survey questionnaire

The survey questionnaire was developed by Jacobs and finalised following review by Defra and the project steering group. The survey was designed to meet both the needs of the project and European reporting requirements. It was developed in line with the previous 2002/3 C&I waste survey form, which has since been used as the basis of the 2007 Wales and North West survey forms, as well as the current 2009 North West form.

The first two parts of the survey form provided details regarding the nature of the company, its activities and its size. Part three of the survey collected information regarding each individual waste stream generated on site. The data collected included:

- A description of the waste;
- The form and nature of the waste (i.e. liquid or solid, hazardous or non-hazardous);

- Whether the waste required any specialist treatment;
- Source of data (i.e. company records, waste transfer notes);
- The weight or volume of the waste and whether this was an actual or estimated value;
- The composition of any mixed waste streams;
- Who collected the waste (e.g. waste contractor, local authority);
- The waste management method (e.g. recycled, landfilled);
- The destination of the waste (if known);

It was also noted if the waste could be easily segregated for reuse/ recycling/ composting or could be further processed to reduce the quantity of C&I waste sent to landfill.

The last section of the form completed the survey with a signature from the surveyor and client to confirm that data has been entered accurately.

Contact centre and survey team set up

A contact centre was set up at Jacobs' Winnersh office to make the survey bookings. Staff with experience in telesales and the use of Excel and Word were recruited into the contact centre team. Technical training was provided by Jacobs and Jacobs staff were on hand at all times to answer any technical queries from the contact centre staff or to resolve any issues that arose within the contact centre.

A team of surveyors was set up in the London survey area. The team was headed by a Team Leader, who was responsible for:

- Surveyor training
- Dealing with any issues or queries from the surveyors
- Quality assurance of the surveys completed.

Surveyors were selected based on their professional discipline, their experience in surveying/auditing and their knowledge of specific processes and industries. The logistics team were responsible for ensuring there were appropriate travel arrangements for the surveyors and overnight accommodation if required. All teams received training appropriate for their role within the project

Data gathering and management

The project originally aimed to complete the matrix through both face-to-face and telephone surveys. As fieldwork progressed it was recognised, with Defra, that completing the optimum sample across all 576 pools was not achievable through face-to-face and telephone interviews alone. This was due to three factors.

- The first was the requirement of the matrix for a sample that was close to or indeed a complete census for some pools with a low sub-population and/or high variance. Given an average positive response rate to calls of approximately one in ten, fulfilling the optimum sample for these pools was practically unachievable.
- The second was the requirement within many businesses to gather, manage and disseminate information on environmental and social performance at a corporate level and not a site by site basis. The adoption of the Corporate Social Responsibility (CSR) agenda led to many businesses declining to participate in the surveys either from the outset or after a number of visits. Instead, many offered to provide data gathered centrally for 2009. This became clear early on

in the field work and as such a specific unit was identified within the project to engage with businesses at a corporate level and secure these 'corporate data'.

- The final factor was, despite best efforts, some businesses did not want to take part in the survey. A number of reasons for this were identified by the contact centre:
 - The work involved with getting the data prepared;
 - Lack of time;
 - Loss of revenue resulting from doing activities that were not core;
 - Staff shortages from sickness, holidays or staff cuts;
 - Although the initial person contacted was willing, their manager did not want the company to participate;
 - They couldn't believe we weren't 'selling' anything;
 - They claimed not to generate any waste;
 - They felt their waste streams were so inconsequential that a visit was unnecessary;
 - They just weren't interested in taking part.

Pools where the sample could not be fulfilled were identified as 'exhausted pools'. To complete the sample matrix a significant amount of data was secured from large companies who supplied high quality corporate data. Data was also secured from companies who have to submit data to the Environment Agency under Pollution Prevention and Control (PPC) requirements.

Data validation, quality assurance of raw data

A rigorous approach was applied to data validation based on comprehensive checking, reviewing, verification and approval of databases and models.

The checks can be broken down into the following categories, described below:

- Surveyor checks - the training package delivered to all surveyors included detailed instructions on how to conduct the survey and how their actions in the field could minimise the errors in the final results. On completing the entry of data surveyors were requested to undertake a number of standard checks.
- Team leader review - PDAs were used to record the information during the site surveys. The data collected by the PDAs was then accessed by the Team Leaders for inclusion in the grossing database. As part of the QA procedure the Team Leaders undertook high level review of this data.
- Line by line data checks - It was identified that due to the range of waste collection receptacles, the extensive list of "standard" waste containers used within the PDA and telephone survey form was not inclusive. This meant that the 'other' classification had been used on a large number of occasions. To ensure that these data were correct, a line by line check was undertaken.
- Sense checks - Then two sense checks were run on the data following the line by line checks. The first looked at the typical waste streams expected in each pool and the second likely waste arisings.
- Outlier checks - The data was screened for outlier based on two standard deviations.

Grossing approach at Regional and WPA Level

The same grossing methodology was used as in previous surveys (e.g. the 2002/03 national survey, the 2007 surveys for Wales and the North West Region) in order to ensure compatibility and consistency with past studies. The methodology allowed for the comparison of results of this survey with those of the previous surveys at a high level. The outputs were also compatible with the requirements of the EU Regulations (EC) No. 2150/2002 on waste statistics. Any business that might produce considerably more waste than a comparable business was treated separately in the database.

Total waste arisings at Regional Level

The regional estimate for the London Region was derived using the approach adopted for the other 7 regions and this is set out in detail in the main report. With respect to the regional estimate the additional data points improved the estimate above what it would have been but not necessarily above that of other regions as this is dependent on the overall business population(s) within each region and variance in the regional populations.

Total waste arisings at WPA Level

The additional data points within the London samples provide an improved foundation for deriving estimates of arisings at WPA level.

Although the sample frame was not designed to deliver the target errors at a WPA or even a regional level, it can be used to illustrate the challenge inherent in providing reliable estimates to this resolution. With respect to London and the 33 Boroughs this effectively provides a sample frame of 72 strata by the 33 Boroughs or 2376 pools. Irrespective of business populations and data variance it is immediately clear that with 2000 data points there are more types of data within an estimate of this resolution than there are data points.

Clearly many business types will not be represented in each Borough and therefore, practically, the 2376 pools do not exist but it serves to illustrate that even with 2000 data points the survey will deliver pools at a WPA level that have very low sample numbers within them. Grossing of these small sample numbers would not yield a reliable result.

The challenge in deriving the WPA estimate was to capture the value of the additional data points without delivering an outcome that was distorted by low sample numbers at the WPA level. This was done though combining a bottom up grossing approach at WPA level using the local data and where there were insufficient data adopting a top down approach to use regional or national means multiplied by the business population within this “pool” to fill gaps. This approach inevitably leads to the figure for London within the National report differing from that using the local data.

Therefore the approach to derive WPA estimates followed the following logic;

1. The sample numbers and values in each pool were reviewed to ensure each pool had a minimum of two samples to deliver a local mean which could be used for grossing. This regional mean was then assessed to ensure it did not sit outside (+/- 3 standard deviations) of the equivalent the national means and based on this applied within the WPA estimate for specific strata..

2. Where the regional means were believed to be unreliable through low sample numbers at a regional level, national means were used.

For businesses with 1-4 employees, the mean business waste arisings in each stratum at WPA level was calculated using the approach set out in the main report.

We have considered sampling errors only in evaluating the precision of the national and regional total waste arising estimates and these are provided within the main report.

Results

The following tables are estimates of London's arisings based upon the grossing up of the data collected in this survey including data collected through all methods (face-to-face and telephone surveys, PPC and corporate data).

The data is presented with totals for all C&I waste arisings for industrial and commercial sectors. Results are shown by:

- By WPA:
 - Sector
 - Waste Type - Including mixed waste as a column heading
 - Waste Type - Excluding mixed waste column heading & redistribute mixed across other SOC groups
 - Waste Management Method

Table M 1 London results by WPA and business sector ('000s tonnes)

WPA	Food, drink & tobacco	Textiles / wood / paper / publishing	Power & utilities	Chemicals / non-metallic minerals manufacture	Metal manufacturing	Machinery & equipment (other manufacture)	Retail & wholesale	Hotels & catering	Public administration & social work	Education	Transport & storage	Other services	Total
Barking and Dagenham	9	2	0	5	1	43	26	3	4	4	8	6	111
Barnet	3	2	10	6	0	1	52	14	12	7	7	27	141
Bexley	17	5	6	17	3	2	30	7	6	5	7	11	116
Brent	28	6	0	8	1	3	46	11	9	4	11	16	143
Bromley	3	2	0	7	2	2	39	12	10	6	5	23	111
Camden	2	7	6	1	0	3	55	38	18	15	14	92	251
City of London	0	2	0	0	0	1	20	27	5	2	8	141	206
Croydon	1	5	0	1	3	3	50	13	14	7	7	30	134
Ealing	40	7	0	8	1	3	56	12	7	5	13	23	175
Enfield	8	4	1	3	3	2	86	9	10	6	9	16	157
Greenwich	2	7	0	6	3	2	28	7	8	6	7	12	88
Hackney	1	10	0	1	0	1	21	7	9	4	4	22	80
Hammersmith & Fulham	3	4	0	1	0	1	33	18	8	4	7	36	115
Haringey	8	6	0	7	0	1	29	7	7	5	6	12	88
Harrow	3	1	0	4	0	1	27	6	7	5	3	15	72
Havering	2	4	5	20	1	2	39	10	6	5	8	13	115
Hillingdon	10	3	7	17	4	3	60	22	10	6	48	32	222
Hounslow	5	1	3	1	1	3	53	12	8	5	26	27	145
Islington	3	20	6	1	0	1	27	19	15	6	7	57	162
Kensington and Chelsea	1	4	0	0	0	0	46	33	8	3	5	30	130
Kingston upon Thames	1	3	0	4	0	1	32	9	7	4	3	16	80
Lambeth	1	2	6	2	0	1	25	14	16	5	7	25	104
Lewisham	1	14	0	1	0	1	24	7	8	6	3	10	75
Merton	2	3	0	14	1	2	28	8	5	4	5	15	87
Newham	6	2	10	2	0	2	29	8	9	6	8	26	108
Redbridge	0	1	0	1	1	2	29	8	10	6	5	12	75
Richmond upon Thames	7	1	0	6	0	1	25	13	5	4	4	22	88
Southwark	4	9	11	2	1	1	33	17	13	8	12	50	161
Sutton	0	7	0	1	0	1	30	6	8	4	6	13	76
Tower Hamlets	2	27	11	1	0	1	31	17	12	6	9	48	165
Waltham Forest	6	6	0	7	2	2	32	4	5	4	4	11	83
Wandsworth	4	4	0	4	0	1	50	15	12	6	9	26	131
Westminster	7	9	1	2	2	2	145	126	46	10	26	196	572
Total	190	190	83	161	30	96	1,336	539	337	183	311	1,111	4,567

Table M 2 London results by WPA and Waste Type - Including mixed waste as a column heading ('000s tonnes)

WPA	Animal & vegetable wastes	Chemical wastes	Common sludges	Discarded equipment	Healthcare wastes	Mixed wastes	Metallic wastes	Mineral	Non-metallic wastes	Non-wastes	Total
Barking and Dagenham	4	15	0	2	3	62	1	1	23	0	111
Barnet	11	9	0	5	8	62	2	4	40	0	141
Bexley	6	20	0	3	5	43	3	8	29	0	117
Brent	19	12	0	4	7	54	2	2	41	0	141
Bromley	6	9	0	4	7	48	2	3	34	0	113
Camden	9	6	0	6	15	117	3	11	86	0	253
City of London	7	3	0	4	12	101	2	5	72	0	206
Croydon	5	4	0	4	10	61	3	3	44	0	134
Ealing	18	16	0	6	8	71	3	3	50	0	175
Enfield	8	14	0	6	7	48	3	3	67	0	156
Greenwich	4	9	0	2	4	33	2	2	31	0	87
Hackney	2	3	0	3	5	36	1	2	29	0	81
Hammersmith and Fulham	5	3	0	3	9	53	1	3	38	0	115
Haringey	5	8	0	3	5	36	2	1	27	0	87
Harrow	3	4	0	3	5	34	1	2	21	0	73
Havering	8	19	0	4	5	43	2	2	31	0	114
Hillingdon	15	28	0	5	11	79	5	9	68	0	220
Hounslow	10	4	0	4	8	63	3	3	49	0	144
Islington	7	12	0	4	9	71	3	5	50	0	161
Kensington and Chelsea	5	3	0	4	10	62	1	2	44	0	131
Kingston upon Thames	3	5	0	4	5	35	1	2	25	0	80
Lambeth	3	4	0	3	7	48	2	7	30	0	104
Lewisham	3	8	0	2	4	29	1	2	26	0	75
Merton	5	12	0	2	4	37	2	2	25	0	89
Newham	10	5	0	3	6	39	2	18	26	0	109
Redbridge	3	3	0	3	5	36	1	2	22	0	75
Richmond upon Thames	9	6	0	3	5	39	1	2	25	0	90
Southwark	9	7	0	4	9	70	2	9	49	0	159
Sutton	4	2	0	2	5	31	1	1	30	0	76
Tower Hamlets	10	14	0	4	10	66	2	5	54	0	165
Waltham Forest	4	8	0	3	4	31	2	2	30	0	84
Wandsworth	8	5	0	4	9	54	1	3	48	0	132
Westminster	21	13	0	14	44	265	7	12	196	0	572
Total	249	293	0	130	270	1,957	70	141	1,460	0	4,570

Table M 3 London results by WPA and Waste Type - Excluding mixed waste column heading & redistribute ('000s tonnes)

WPA	Animal & vegetable wastes	Chemical wastes	Common sludges	Discarded equipment	Healthcare wastes	Metallic wastes	Mineral	Non-metallic wastes	Non-wastes	Total
Barking and Dagenham	13	17	0	2	3	8	3	65	0	111
Barnet	20	9	0	6	8	9	5	82	0	139
Bexley	13	22	0	3	5	7	8	57	0	115
Brent	29	12	0	5	7	9	3	77	0	142
Bromley	13	9	0	5	7	8	4	67	0	113
Camden	26	6	0	7	15	13	14	170	0	251
City of London	20	3	0	4	13	8	8	149	0	205
Croydon	14	4	0	5	10	9	4	87	0	133
Ealing	30	18	0	6	8	10	4	97	0	173
Enfield	15	15	0	7	7	9	4	101	0	158
Greenwich	9	10	0	3	4	6	3	54	0	89
Hackney	8	3	0	3	5	5	3	55	0	82
Hammersmith and Fulham	13	3	0	4	9	6	4	76	0	115
Haringey	11	8	0	4	5	6	2	52	0	88
Harrow	9	4	0	3	5	5	3	44	0	73
Havering	14	20	0	4	5	7	3	61	0	114
Hillingdon	27	28	0	6	12	12	10	125	0	220
Hounslow	19	5	0	4	9	9	4	95	0	145
Islington	18	12	0	4	10	8	7	102	0	161
Kensington and Chelsea	15	3	0	5	10	7	3	87	0	130
Kingston upon Thames	8	6	0	5	5	4	3	50	0	81
Lambeth	11	4	0	3	7	6	8	64	0	103
Lewisham	7	8	0	3	4	4	3	46	0	75
Merton	10	12	0	3	5	6	2	51	0	89
Newham	17	6	0	3	6	6	19	53	0	110
Redbridge	8	3	0	3	5	5	3	47	0	74
Richmond upon Thames	15	6	0	3	5	5	3	52	0	89
Southwark	20	8	0	4	9	8	11	99	0	159
Sutton	8	2	0	3	5	4	2	52	0	76
Tower Hamlets	19	15	0	4	10	8	7	102	0	165
Waltham Forest	9	8	0	3	4	5	2	52	0	83
Wandsworth	17	5	0	5	9	7	4	86	0	133
Westminster	63	14	0	16	44	28	18	388	0	571
Total	548	308	0	148	275	257	184	2,845	0	4,565

Table M 4 London results by WPA and Waste Management Method ('000s tonnes)

WPA	Landfill	Land recovery	Thermal treatment (energy recovery)	Thermal treatment	Transfer station	Non-thermal treatment	Recycling	Composting	Reuse	Unknown	Total
Barking and Dagenham	11	0	2	2	37	7	40	1	3	8	111
Barnet	25	3	5	5	3	7	64	1	5	23	141
Bexley	20	0	7	3	2	4	51	3	5	22	117
Brent	21	3	5	4	2	5	69	2	5	26	142
Bromley	20	0	3	3	2	5	50	1	4	24	112
Camden	49	0	8	7	5	10	118	3	8	43	251
City of London	45	0	8	5	4	7	96	3	4	34	206
Croydon	24	0	4	5	3	7	63	1	5	21	133
Ealing	30	2	8	4	3	6	85	3	6	27	174
Enfield	18	0	3	3	3	12	90	3	5	20	157
Greenwich	13	1	2	5	7	4	39	1	3	14	89
Hackney	15	0	3	2	2	4	39	1	3	14	83
Hammersmith and Fulham	20	0	8	4	3	5	53	1	3	18	115
Haringey	13	1	3	2	2	4	40	1	3	18	87
Harrow	14	0	3	3	1	4	31	1	3	12	72
Havering	17	2	3	3	2	4	49	2	4	28	114
Hillingdon	31	0	6	7	4	8	115	2	9	38	220
Hounslow	24	1	4	5	3	5	77	1	5	20	145
Islington	28	4	6	4	3	8	74	2	5	26	160
Kensington and Chelsea	27	0	5	4	4	6	58	1	4	21	130
Kingston upon Thames	15	0	2	5	2	4	36	1	3	13	81
Lambeth	20	0	3	4	2	4	46	1	5	19	104
Lewisham	11	2	2	2	1	5	36	0	3	12	74
Merton	14	1	2	2	2	3	37	1	3	23	88
Newham	15	3	5	3	2	3	61	2	4	13	111
Redbridge	13	0	3	2	2	4	34	1	3	14	76
Richmond upon Thames	16	5	3	2	2	3	34	1	3	20	89
Southwark	29	2	5	4	3	6	76	2	6	26	159
Sutton	13	0	3	2	1	3	40	1	2	11	76
Tower Hamlets	28	6	7	4	3	8	81	2	5	23	167
Waltham Forest	13	1	2	2	1	4	42	1	3	16	85
Wandsworth	22	1	4	4	2	7	65	1	4	21	131
Westminster	115	1	24	18	13	24	265	6	17	90	573
Total	789	39	161	134	131	200	2,154	54	153	758	4,573

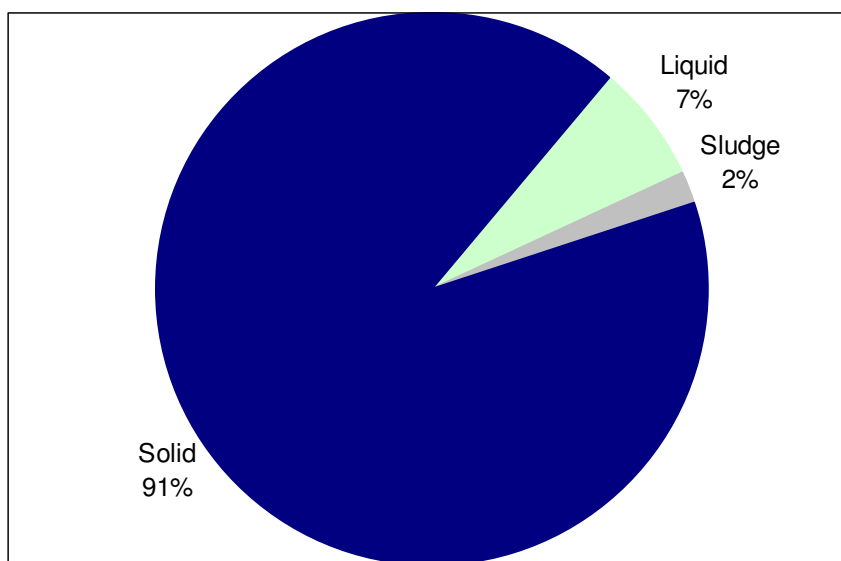
Additional Survey data

In addition to the tables provided above the following information was also gathered in the surveys.

f) Physical form: Solid / liquid / sludge

The physical form of each material stream recorded was collected by the surveyors. This was based upon information provided by the business or a visual inspection. The chart in Figure M 1 shows these results.

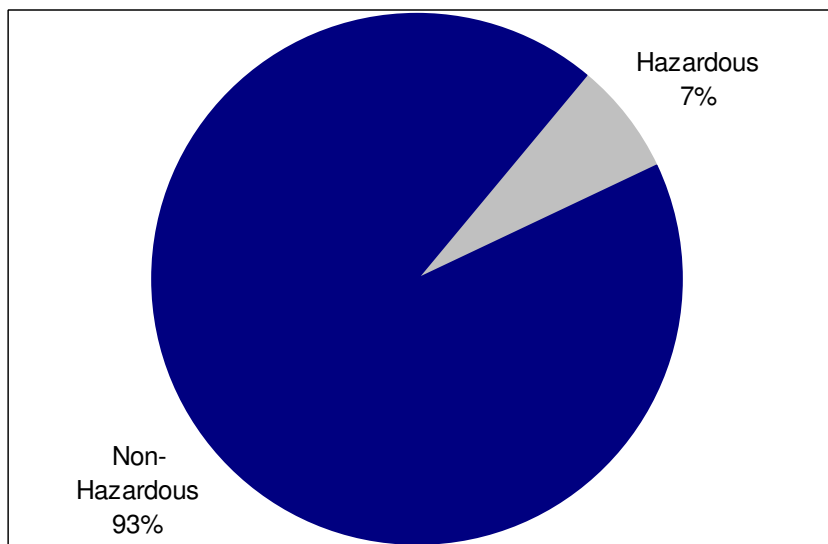
Figure M 1 Physical form of recorded waste streams



g) Nature: Hazardous / Non-hazardous

Each waste stream recorded was assessed in terms of hazardous or non hazardous waste. This was based upon information supplied by the business. The chart in Figure M 2 shows the percentage hazardous and non-hazardous waste against business sector.

Figure M 2 Nature of recorded waste streams

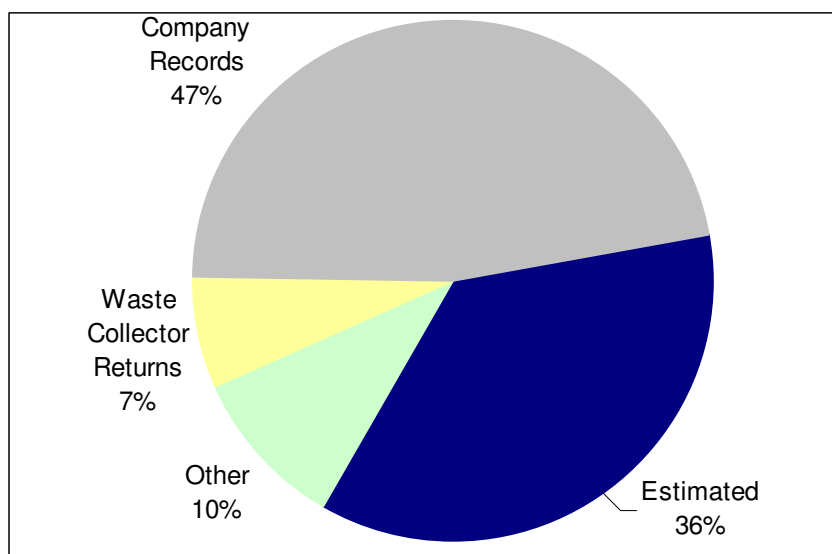


h) Data source

A variety of steps were taken to ensure the quality of the data collected. For the face-to-face interviews, surveyors were given tools to estimate waste tonnages from containers, but were encouraged to either take quantities from the company's written records (invoices, transfer notes etc) or if not available, to take estimates provided by the company themselves, and agreed with the surveyor.

The final data set showed that 64% of the data came from written records or company records. The chart in Figure M 3 shows these results.

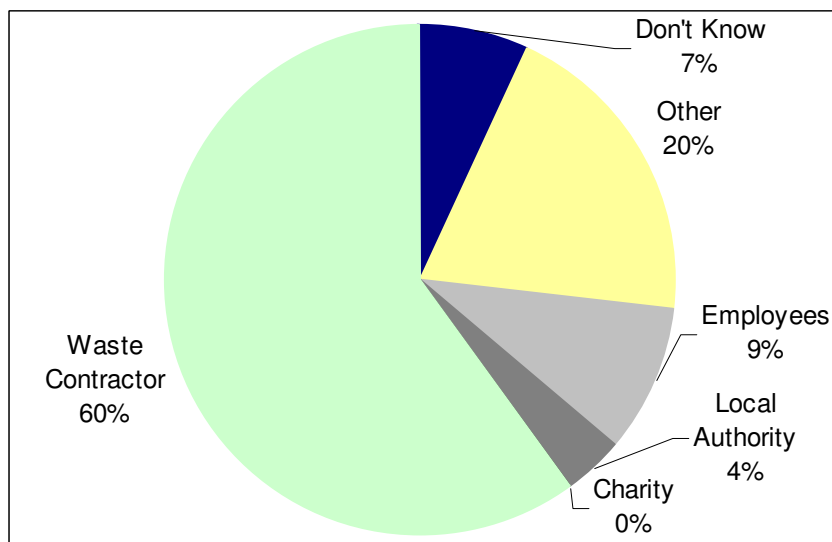
Figure M 3 Data source...



i) Waste collector

For each waste stream, the type of contractor who collected and either treated or disposed of the waste concerned was recorded where the information was available and recorded in Figure M 4. The data is provided on a regional basis, by number of companies served and tonnage.

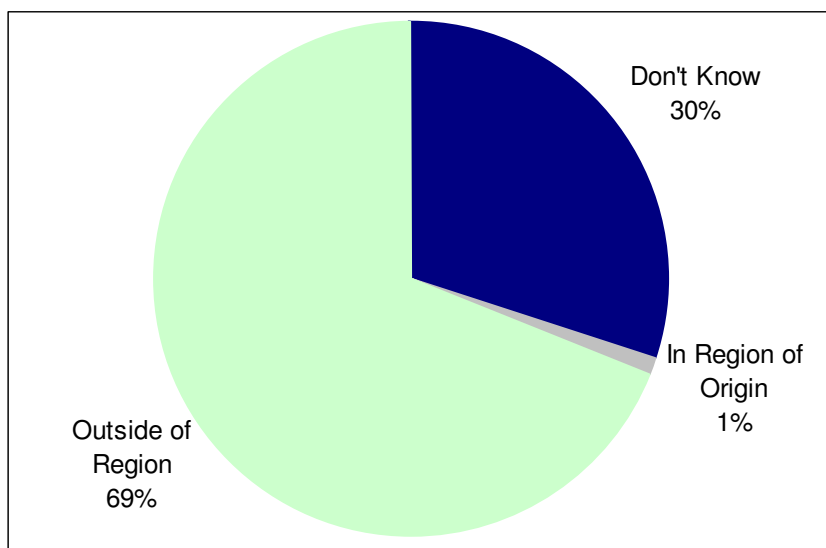
Figure M 4 Type of collection contract



j) Waste destination

For each waste stream the destination of the waste was recorded i.e. was the waste destined to go to a treatment, recovery or disposal facility inside London or within another region. This was based upon the knowledge of the business, but in many cases this was not known. The results are shown in Figure M 5.

Figure M 5 Destination of waste inside or outside of a region



Commentary and Conclusions

It should be noted that the London results presented in this appendix differ from the main report. This reflects the difference in approach to grossing the London and South West Data to reflect the increased sample and deliver the optimal local estimate.

The total C&I waste arisings for London in 2009 based on the survey data is 4.5M tonnes. This is roughly 10% of the total C&I waste arisings in England (48M tonnes) in 2009. This is split 13%:87% between industrial and commercial businesses. This is a reduction of 41% from the 2002/3 survey.

The accuracy of the London waste arisings was 7.14 at a 95% confidence interval.

Of London's waste arisings, 17% were landfilled, 10% treated via thermal or other methods and 51% was reused, recycled or composted. 1% of the waste arisings were managed within the London region and 65% outside the region. It is not known where the remaining 30% was managed.

In the 2002/3 study 40% of waste was landfilled and only 44% was recycled or composted. This shows the trend of decreased landfilling and increasing recycling rates of C&I waste arisings in London is extremely positive.

Results shown in Table M 2 and Table M 3 show that the major C&I waste arisings in London are mixed wastes 44% and 33% of non metallic wastes. When the mixed waste is broken down non metallic wastes remains the highest quantity.

The reason for the high proportion of non metallic wastes is undoubtedly a result of the high number of Retail and Education businesses in London.

There were a high number of cancellations in the London region and a reliance on data from the retail sector. Taking a different to the survey methodology could improve this (see full recommending in main report).

Appendix N South West Region

Introduction and approach

The Department for Environment, Food and Rural Affairs (Defra) commissioned this study to obtain data from businesses in England on Commercial and Industrial (C&I) waste arisings and management methods in calendar year 2009. The survey was funded in partnership with the South West region.

There are few current comprehensive data sources concerned with the production and management of commercial and industrial waste. At present, there are no formal reporting requirements for businesses with respect to material flows or waste arisings.

The South West needed C&I waste information to:

- Underpin local and regional waste management and land-use planning direction;
- Aid regional business opportunity analysis and development by providing geographic information on the potential for further recovery of materials, not least in stimulating competition for waste infrastructure development.

Caveats and limitations

The results of this survey represent the most reliable and comprehensive set of data on C&I waste for over 5 years. Sampling was intensified in the South West area specifically to improve the quality of regional results. However the results from any voluntary field survey are subject to limitations with respect to the quality of the data gathered. Some of the key limitations are summarised below:

- The survey was entirely voluntary so only companies that were willing to participate were surveyed. It is likely that this more likely to capture data from companies that are more progressive with respect to managing their wastes.
- The survey is for 2009 only, a year within a significant recession. This may be viewed as atypical and outside of the normal business cycle and is likely to have affected business activity and as a result, C&I waste tonnages. It is also likely to have reduced businesses willingness to participate.
- The data may provided may inaccurate or have failed to capture all material streams. The survey was not able to verify individual site returns with respect to their origin and accuracy. However, returns were sense checked and subject to statistical checks against data from the same sub-population to detect unusual or missing data.
- The survey can only give a one day picture of the overall waste arisings. This risk was minimised by the thorough training programme provided to the surveyors so they could gain an understanding of how the survey day fitted into the pattern of waste production throughout the year.
- A visual assessment of the composition of mixed waste streams can only give a one day picture of the overall waste arisings. Surveyor training included practical sessions on visual waste assessment to try to overcome any bias and ensure consistency.

Survey design and preparation

Development of the sample matrix

Jacobs' statisticians adopted a random optimised stratified sampling methodology to derive a sample matrix that aimed to deliver a national estimate which has an error of +/-5% at a 95% confidence interval. This was founded on the variance within the 2003/ sample data. The matrix was stratified using the 2007 Standard Industry Classification of Economic Activities (SIC codes).

There were 12 specified business sectors used in this study, six Industrial and six Commercial. Business sectors covering Agriculture, Mining, Construction and Demolition were excluded from the study. The waste management industry was excluded to avoid potential double counting of waste arisings. This is consistent with previous C&I waste survey methodologies.

The next stratification considered was scale. Six bands of business size ranging from businesses with 5 or more employees to those with greater than 250 employees gave a basic matrix with 72 strata.

This basic matrix was further classified by the eight English regions covered in the survey. This regional classification developed the matrix into a total of 576 'pools': combinations of sector, size band and region that were required to be sampled.

The number of samples required in each of the 576 pools was allocated proportionally according to the waste arising within the stratum (defined by the business sector and size) and the stratum's population size in the region, with the following conditions:

- The minimum number of surveys per stratum in each region was set to two.
- The maximum number of surveys per stratum in each region was set to the population size of the stratum in the region.

This enabled the 'optimal' sample frame to be derived based on the 2002/3 variance. This sample was modified by Defra to reflect the additional funding provided by the South West region whilst maintaining the overall statistical objectives for the national estimate.

Development of the survey questionnaire

The survey questionnaire was developed by Jacobs and finalised following review by Defra and the project steering group. The survey was designed to meet both the needs of the project and European reporting requirements. It was developed in line with the previous 2002/3 C&I waste survey form, which has since been used as the basis of the 2007 Wales and North West survey forms, as well as the current 2009 North West form.

The first two parts of the survey form provided details regarding the nature of the company, its activities and its size. Part three of the survey collected information regarding each individual waste stream generated on site. The data collected included:

- A description of the waste;
- The form and nature of the waste (i.e. liquid or solid, hazardous or non-hazardous);

- Whether the waste required any specialist treatment;
- Source of data (i.e. company records, waste transfer notes);
- The weight or volume of the waste and whether this was an actual or estimated value;
- The composition of any mixed waste streams;
- Who collected the waste (e.g. waste contractor, local authority);
- The waste management method (e.g. recycled, landfilled);
- The destination of the waste (if known);

It was also noted if the waste could be easily segregated for reuse/ recycling/ composting or could be further processed to reduce the quantity of C&I waste sent to landfill.

The last section of the form completed the survey with a signature from the surveyor and client to confirm that data has been entered accurately.

Contact centre and survey team set up

A contact centre was set up at Jacobs' Winnersh office to make the survey bookings. Staff with experience in telesales and the use of Excel and Word were recruited into the contact centre team. Technical training was provided by Jacobs and Jacobs staff were on hand at all times to answer any technical queries from the contact centre staff or to resolve any issues that arose within the contact centre.

A team of surveyors was set up in the South West region. The regional team was headed by a Team Leader, who was responsible for:

- Surveyor training
- Dealing with any issues or queries from the surveyors
- Quality assurance of the surveys completed.

Surveyors were selected based on their professional discipline, their experience in surveying/auditing and their knowledge of specific processes and industries. The logistics team were responsible for ensuring there were appropriate travel arrangements for the surveyors and overnight accommodation if required. All teams received training appropriate for their role within the project

Data gathering and management

The project originally aimed to complete the matrix through both face-to-face and telephone surveys. As fieldwork progressed it was recognised, with Defra, that completing the optimum sample across all 576 pools was not achievable through face-to-face and telephone interviews alone. This was due to three factors.

- The first was the requirement of the matrix for a sample that was close to or indeed a complete census for some pools with a low sub-population and/or high variance. Given an average positive response rate to calls of approximately one in ten, fulfilling the optimum sample for these pools was practically unachievable.
- The second was the requirement within many businesses to gather, manage and disseminate information on environmental and social performance at a corporate level and not a site by site basis. The adoption of the Corporate Social Responsibility (CSR) agenda led to many businesses declining to participate in the surveys either from the outset or after a number of visits. Instead, many offered to provide data gathered centrally for 2009. This became clear early on

in the field work and as such a specific unit was identified within the project to engage with businesses at a corporate level and secure these 'corporate data'.

- The final factor was, despite best efforts, some businesses did not want to take part in the survey. A number of reasons for this were identified by the contact centre:
 - The work involved with getting the data prepared;
 - Lack of time;
 - Loss of revenue resulting from doing activities that were not core;
 - Staff shortages from sickness, holidays or staff cuts;
 - Although the initial person contacted was willing, their manager did not want the company to participate;
 - They couldn't believe we weren't 'selling' anything;
 - They claimed not to generate any waste;
 - They felt their waste streams were so inconsequential that a visit was unnecessary;
 - They just weren't interested in taking part.

Pools where the sample could not be fulfilled were identified as 'exhausted pools'. To complete the sample matrix a significant amount of data was secured from large companies who supplied high quality corporate data. Data was also secured from companies who have to submit data to the Environment Agency under Pollution Prevention and Control (PPC) requirements.

Data validation, quality assurance of raw data

A rigorous approach was applied to data validation based on comprehensive checking, reviewing, verification and approval of databases and models.

The checks can be broken down into the following categories, described below:

- Surveyor checks - the training package delivered to all surveyors included detailed instructions on how to conduct the survey and how their actions in the field could minimise the errors in the final results. On completing the entry of data surveyors were requested to undertake a number of standard checks.
- Team leader review - PDAs were used to record the information during the site surveys. The data collected by the PDAs was then accessed by the Team Leaders for inclusion in the grossing database. As part of the QA procedure the Team Leaders undertook high level review of this data.
- Line by line data checks - It was identified that due to the range of waste collection receptacles, the extensive list of "standard" waste containers used within the PDA and telephone survey form was not inclusive. This meant that the 'other' classification had been used on a large number of occasions. To ensure that these data were correct, a line by line check was undertaken.
- Sense checks - Then two sense checks were run on the data following the line by line checks. The first looked at the typical waste streams expected in each pool and the second likely waste arisings.
- Outlier checks - The data was screened for outlier based on two standard deviations.

Grossing approach at a Regional and WPA Level

The same grossing methodology was used as in previous surveys (e.g. the 2002/03 national survey, the 2007 surveys for Wales and the North West Region) in order to ensure compatibility and consistency with past studies. The methodology allowed for the comparison of results of this survey with those of the previous surveys at a high level. The outputs were also compatible with the requirements of the EU Regulations (EC) No. 2150/2002 on waste statistics. Any business that might produce considerably more waste than a comparable business was treated separately in the database.

Total waste arisings at Regional Level

The regional estimate for the South West Region was derived using the approach adopted for the other 7 regions and this is set out in detail in the main report. With respect to the regional estimate the additional data points improved the estimate above what it would have been but not necessarily above that of other regions as this is dependent on the overall business population(s) within each region and variance in the regional populations.

Total waste arisings at WPA Level

The additional data points within the South West samples provide an improved foundation for deriving estimates of arisings at WPA level.

Although the sample frame was not designed to deliver the target errors at a WPA or even a regional level, it can be used to illustrate the challenge inherent in providing reliable estimates to this resolution. With respect to the South West and the 16 WPAs this effectively provides a sample frame of 72 strata by the 16 WPAs or 2376 pools. Irrespective of business populations and data variance it is immediately clear that with 1201 data points there are more types of data within an estimate of this resolution than there are data points.

Clearly many business types will not be represented in each WPA and therefore, practically, the 2376 pools do not exist but it serves to illustrate that even with 1201 data points the survey will deliver pools at a WPA level that have very low sample numbers within them. Grossing of these small sample numbers would not yield a reliable result.

The challenge in deriving the WPA estimate was to capture the value of the additional data points without delivering an outcome that was distorted by low sample numbers at the WPA level. This was done though combining a bottom up grossing approach at WPA level using the local data and where there were insufficient data adopting a top down approach to use regional or national means multiplied by the business population within this “pool” to fill gaps. This approach inevitably leads to the figure for London within the National report differing from that using the local data.

Therefore the approach to derive WPA estimates followed the following logic;

1. The sample numbers and values in each pool were reviewed to ensure each pool had a minimum of two samples to deliver a local mean which could be used for grossing. This regional mean was then assessed to ensure it did not sit outside (+/- 3 standard deviations) of the equivalent the national means and based on this applied within the WPA estimate for specific strata.

2. Where the regional means were believed to be unreliable through low sample numbers at a regional level, national means were used.

For businesses with 1-4 employees, the mean business waste arisings in each stratum at WPA level was calculated using the approach set out in the main report.

We have considered sampling errors only in evaluating the precision of the national and regional total waste arising estimates and these are provided within the main report.

Results

The following tables are estimates of the South West regional arisings based upon the grossing up of the data collected in this survey including data collected through all methods (face-to-face and telephone surveys, PPC data and corporate data).

The data is presented with totals for all C&I waste arisings for industrial and commercial sectors. Results are shown by:

- By WPA:
 - Sector
 - Waste Type - Including mixed waste as a column heading
 - Waste Type - Excluding mixed waste column heading & redistribute mixed across other SOC groups
 - Waste Management Method

Table N 1 South West results by WPA and business sector ('000s tonnes)

WPA	Food, drink & tobacco	Textiles / wood / paper / publishing	Power & utilities	Chemicals / non-metallic minerals manufacture	Metal manufact- uring	Machinery & equipment (other manufact- ure)	Retail & wholesale	Hotels & catering	Public adminis- tration & social work	Education	Transport & storage	Other services	Total
Bath & NE Somerset	3	13	1	3	2	2	25	16	4	10	4	16	99
Bournemouth	0	1	0	2	0	1	25	17	4	4	4	17	75
Bristol, city of	34	15	1	14	37	7	65	29	13	14	15	60	304
Cornwall	92	25	3	16	5	13	82	52	14	13	20	28	363
Devon	54	49	4	30	9	29	117	65	22	20	28	48	475
Dorset	131	31	0	10	16	19	49	30	8	12	12	24	342
Gloucestershire	74	29	3	28	112	57	78	42	16	21	20	48	528
Isles of Scilly	0	0	0	0	0	0	0	1	0	0	0	0	1
North Somerset	17	19	1	4	3	9	25	12	5	4	10	13	122
Plymouth	15	2	1	2	30	19	34	15	7	6	11	17	159
Poole	9	29	0	6	21	12	24	9	3	4	5	13	135
Somerset	130	72	2	27	38	28	77	40	14	14	16	31	489
South Gloucestershire	16	29	2	19	32	13	37	14	5	7	12	23	209
Swindon	0	11	1	21	6	24	38	18	3	5	14	23	164
Torbay	10	0	1	7	1	3	15	13	5	3	3	7	68
Wiltshire	34	23	1	34	8	15	60	39	11	13	15	33	286
Total	619	348	21	223	320	251	751	412	134	150	189	401	3,819

Table N 2 South West results by WPA and waste type – Including mixed waste as a column heading ('000s tonnes)

WPA	Animal & vegetable wastes	Chemical wastes	Common sludges	Discarded equipment	Healthcare wastes	Mixed wastes	Metallic wastes	Mineral	Non-metallic wastes	Non-wastes	Total
Bath & NE Somerset	5	5	1	4	2	36	3	2	41	0	99
Bournemouth	2	2	0	3	3	32	2	1	31	0	76
Bristol, city of	25	25	2	13	9	96	11	27	96	0	304
Cornwall	38	44	25	18	7	108	9	6	110	0	365
Devon	28	57	12	21	10	143	19	8	175	0	473
Dorset	26	112	7	11	5	74	13	9	86	0	343
Gloucestershire	28	127	4	17	8	132	28	40	143	0	527
Isles of Scilly	0	0	0	0	0	1	0	0	1	0	2
North Somerset	11	12	2	5	2	37	5	2	48	0	124
Plymouth	6	15	1	6	3	44	12	23	47	0	157
Poole	7	7	1	4	2	33	8	16	58	0	136
Somerset	77	65	13	13	7	125	19	28	142	0	489
South Gloucestershire	17	24	3	8	3	50	13	23	68	0	209
Swindon	5	21	1	6	3	45	18	5	59	0	163
Torbay	6	9	1	3	2	23	2	2	21	0	69
Wiltshire	23	35	5	14	6	91	11	6	95	0	286
Total	304	560	78	146	72	1,070	173	198	1,221	0	3,822

Table N 3 South West results by WPA and waste type - Excluding mixed waste column heading & redistribute ('000s tonnes)

WPA	Animal & vegetable wastes	Chemical wastes	Common sludges	Discarded equipment	Healthcare wastes	Metallic wastes	Mineral	Non-metallic wastes	Non-wastes	Total
Bath & NE Somerset	10	5	1	5	2	7	3	66	0	99
Bournemouth	7	3	0	4	3	6	2	53	0	78
Bristol, city of	39	26	2	14	9	22	31	163	0	306
Cornwall	58	45	25	18	7	23	7	182	0	365
Devon	50	58	12	23	11	36	10	273	0	473
Dorset	37	112	7	11	5	22	10	138	0	342
Gloucestershire	49	128	4	18	8	43	44	232	0	526
Isles of Scilly	0	0	0	0	0	0	0	1	0	1
North Somerset	17	12	2	5	2	9	3	73	0	123
Plymouth	13	15	1	7	3	17	26	76	0	158
Poole	12	7	1	5	2	12	16	81	0	136
Somerset	96	66	13	14	7	33	31	228	0	488
South Gloucestershire	24	24	3	8	3	18	25	103	0	208
Swindon	12	22	1	6	3	23	6	92	0	165
Torbay	10	9	1	3	2	5	2	37	0	69
Wiltshire	37	36	5	15	6	22	8	159	0	288
Total	471	568	78	156	73	298	224	1,957	0	3,825

Table N 4 South West n results by WPA and Waste Management Method ('000s tonnes)

WPA	Landfill	Land recovery	Thermal treatment (energy recovery)	Thermal treatment	Transfer station	Non-thermal treatment	Recycling	Composting	Reuse	Unknown	Total
Bath & NE Somerset	30	0	0	2	5	2	49	2	2	6	98
Bournemouth	25	0	0	3	4	1	36	1	1	5	76
Bristol, city of	90	7	10	10	14	11	133	5	8	16	304
Cornwall	85	7	5	17	15	19	173	12	12	21	366
Devon	116	17	5	16	24	22	218	9	18	28	473
Dorset	60	10	2	8	12	17	113	2	9	109	342
Gloucestershire	114	27	7	10	23	55	210	5	12	64	527
Isles of Scilly	0	0	0	0	0	0	1	0	0	0	1
North Somerset	30	5	2	4	5	6	59	2	3	6	122
Plymouth	49	2	2	4	7	4	73	7	3	7	158
Poole	26	1	1	2	6	3	85	4	3	6	137
Somerset	122	50	11	11	20	21	194	7	12	40	488
South Gloucestershire	54	3	1	8	8	14	103	2	3	14	210
Swindon	37	1	1	7	6	7	89	3	3	9	163
Torbay	19	2	1	3	3	4	28	2	1	4	67
Wiltshire	78	6	5	11	13	11	131	4	8	20	287
Total	935	138	53	116	165	197	1,695	67	98	355	3,819

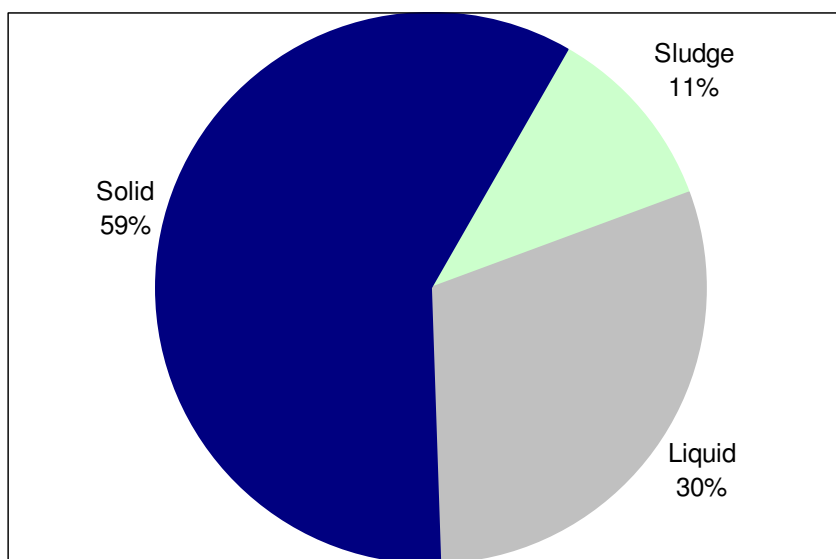
Additional Survey data

In addition to the tables provided above the following information was also gathered in the surveys.

k) Physical form: Solid / liquid / sludge

The physical form of each material stream recorded was collected by the surveyors. This was based upon information provided by the business or a visual inspection. The chart in Figure N 1 shows these results.

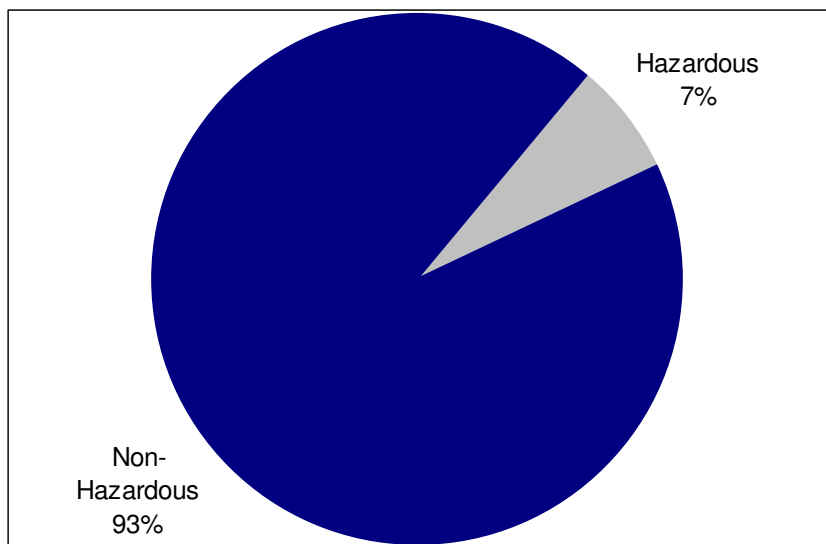
Figure N 1 Physical form of recorded waste streams



l) Nature: Hazardous / Non-hazardous

Each waste stream recorded was assessed in terms of hazardous or non hazardous waste. This was based upon information supplied by the business. The chart in Figure N 2 shows the percentage hazardous and non-hazardous waste against business sector.

Figure N 2 Nature of recorded waste streams

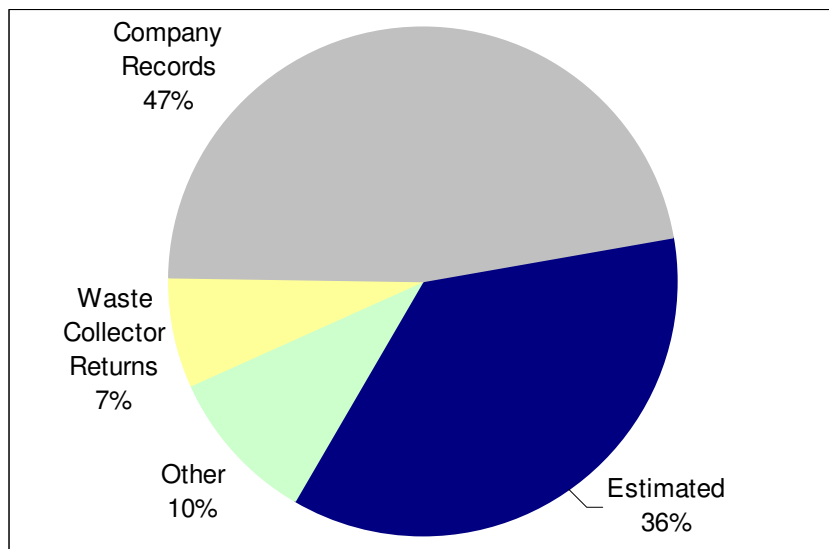


m) Data source

A variety of steps were taken to ensure the quality of the data collected. For the face-to-face interviews, surveyors were given tools to estimate waste tonnages from containers, but were encouraged to either take quantities from the company's written records (invoices, transfer notes etc) or if not available, to take estimates provided by the company themselves, and agreed with the surveyor.

The final data set showed that 64% of the data came from written records or company records. The chart in Figure N 3 shows these results.

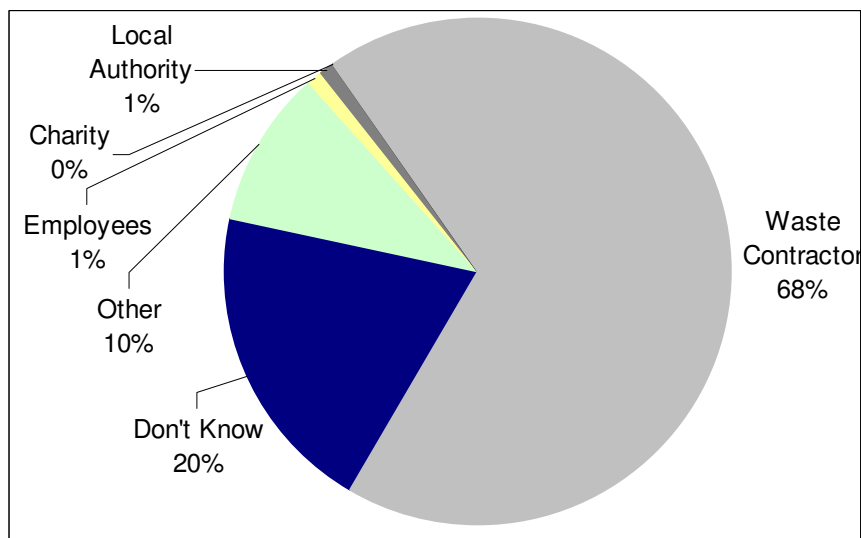
Figure N 3 Data source



n) Waste collector

For each waste stream, the type of contractor who collected and either treated or disposed of the waste concerned was recorded where the information was available and recorded in Figure N 4. The data is provided on a regional basis, by number of companies served and tonnage.

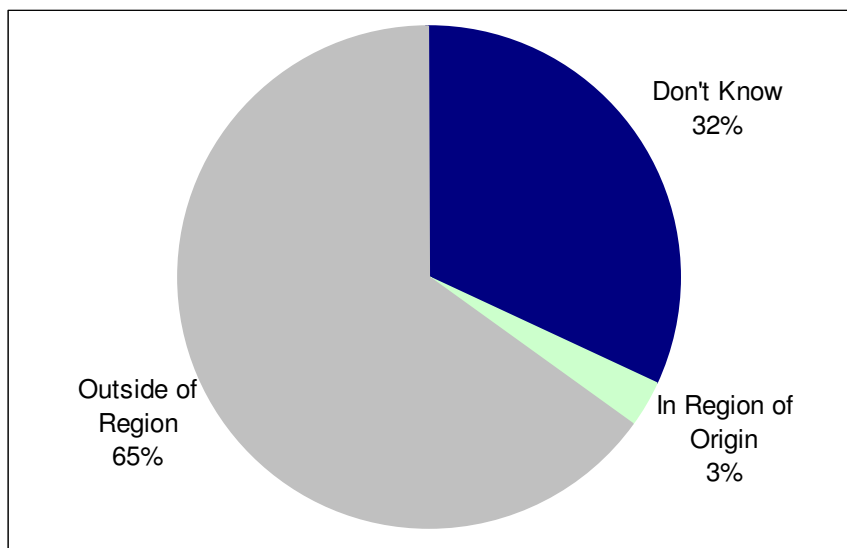
Figure N 4 Type of collection contract



o) Waste destination

For each waste stream the destination of the waste was recorded i.e. was the waste destined to go to a treatment, recovery or disposal facility inside the region in which the business was based or within another region. This was based upon the knowledge of the business, but in many cases this was not known. The results are shown in Figure N 5.

Figure N 5 Destination of waste inside or outside of a region



Commentary and Conclusions

It should be noted that the South West results presented in this appendix differ from the main report. This reflects the difference in approach to grossing the London and South West Data to reflect the increased sample and deliver the optimal local estimate.

The total C&I waste arisings for the South West in 2009 based on the survey data is 3.6M tonnes. This is split 45%:55% between industrial and commercial businesses. This is a reduction of 34% from the 2002/3 survey.

The accuracy of the South West waste arisings was 7.23 at a 95% confidence interval.

Of the SW's waste arisings 23% was landfilled, 10% treated via thermal or other methods and 49% was reused, recycled or composted. 3% of the waste arisings were managed within the South West region, 65% outside the region. It is not known where the remaining 32% was managed.

In the 2002/3 study, 34% of waste was landfilled and only 30% was recycled or composted. This shows the trend of decreased landfilling and increasing recycling rates of C&I waste arisings in SW is extremely positive.

Results shown in Table N and Table N show that the major C&I waste arisings in the South West 33% of waste is non metallic wastes. When the mixed waste is broken down non metallic wastes remains the highest quantity.

Appendix O Glossary and abbreviations

Glossary of Terms

Terms	Definitions
Benchmarking	Analyse collected waste data against various sources to record consistency and information on variability.
Conversion factors	Agreed numerical value used to convert specific waste type volumes to weight
Confidence interval	Is a particular kind of interval estimate of a population parameter and is used to indicate the reliability of an estimate. It is an observed interval (i.e it is calculated from the observations), in principle different from sample to sample, that frequently includes the parameter of interest, if the experiment is repeated. How frequently the observed interval contains the parameter is determined by the confidence level or confidence coefficient.
Estimators	Function of the observable sample data used to estimate unknown parameters.
Grossing up	The process of extrapolating the waste arisings of surveyed businesses to estimate total waste arisings at a national or regional level.
NUTS 1 regions of England'	The Nomenclature of Units for Territorial Statistics is a European standard for statistical geographies
Standard deviation	Measure of the variance from the average, indicating the level of variability in results SIC.

List of Abbreviations

Abbreviations	Definitions
C&I	Commercial and Industrial
CSR	Corporate Social Responsibility
Defra	Department for Environment, Food and Rural Affairs
EA	Environment Agency
EC	European Community
ELV	End of Life Vehicles
EU	European Union
GOSW	Government Office South West
HSE	Health, Safety and Environmental
IDBR	Inter-Departmental Business Register
LWaRB	London Waste and Recycling Board
MSW	Municipal Solid Waste
ONS	Office for National Statistics
PDA	Personal Digital Assistant
PPC	Pollution Prevention and Control
QA	Quality Assurance
SIC	Standard Industry Classifications
SOC	Substance Oriented Classification
SPA	Safe Plan of Action
UM	Urban Minds
WEEE	Waste Electrical and Electronic Equipment
WPA	Waste Planning Authority
WRAP	Waste and Resources Action Programme