
Final Report

Literature Review - Relationship between Household Food Waste Collection and Food Waste Prevention



This literature review has been undertaken to assess the evidence base to support the anecdotal evidence that food waste collections promote food waste prevention behaviour.

WRAP helps individuals, businesses and local authorities to reduce waste and recycle more, making better use of resources and helping to tackle climate change.

Legacy research commissioned by the previous government

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Front cover photography: [Emptying separate food waste caddy]

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Executive summary

SKM Enviros were commissioned by WRAP in May 2010 to undertake a literature review of published and unpublished research, to assist in understanding how food waste collections might interact with and influence householder behaviour in relation to food waste prevention. For the purposes of this literature review, the term food waste prevention is used to describe only genuine waste prevention 'at source' (i.e. before it is created) and not the diversion of food waste from the residual waste stream to home composting. Possible impacts on home composting have also been considered however, as changes to composting behaviour in the presence of a food waste collection may affect what can be concluded about food waste prevention.

The initial brief for this project was to look for evidence on how different types of food waste collection/disposal schemes influence the amount and types of food waste generated by households. Of particular interest were changing household behaviour when collections are introduced, and what factors might affect this. Additionally any evidence on the connection between waste prevention messages and food waste collections were highlighted as being of interest.

Relevant literature was identified through a number of resources including WRAP and key stakeholders, Higher Education establishments, waste management journals and other key waste management sources such as CIWM, Lets Recycle, Waste Information Network and the Resource Recovery Forum.

The initial research identified 81 reports, which were pre-reviewed for their ability to provide evidence to answer the above research questions. Following the pre-review assessment, 18 reports were chosen to be fully reviewed, the results of which are included in this report.

These studies were not specifically designed to answer the questions of key interest for this research. On the basis of the evidence and data available, the focus of this study was narrowed to two more modest research questions:

- Does the introduction of food waste collections result in a reduction in collected food waste overall (including residual waste)?; and if so
- Is this the result of waste prevention at source and/or diversion to home composting through householders changing their behaviours.

Some of the studies provided evidence that the introduction of a food waste collection scheme was associated with a reduction in overall collected food waste arisings. However, as these studies had originally been designed to review the performance of food waste collection systems in relation to yields, participation and capture rates, as opposed to reviewing the impact that the food waste collection had on food waste prevention behaviour, the data sets were often not appropriate or complete enough to determine whether food waste prevention 'at source' had occurred. This was particularly evident when trying to determine whether a reduction in food waste arisings following a change in collection methods was a result of waste prevention 'at source' or whether it was due to a reduction in participation and diversion of food waste back into the residual stream, or a diversion of food waste into home composting.

The WRAP food waste collection trials (*WRAP, June 2009*) indicated that a reduction in collection yields was associated with a reduction in participation and a diversion of waste back into the residual waste stream rather than prevention at source or home composting. However, in the 'attitudinal' surveys carried out as part of this research, 4% to 8% of respondents claimed that the food waste collection system had changed their behaviour in relation to food waste creation, representing a small but not insignificant number. In addition 63% stated that the food waste collection had not influenced their home composting habits while 24% reported that they composted less than they had before, which should have, in theory, helped to maintain yield. It may be that a small minority (<13%) were also influenced to home compost more. It is not possible to draw firm conclusions from these results, since no data on the quantity of waste diverted to home composting was collected to substantiate these reported behaviours.

The Community Composting Network Scotland (CRNS) food waste collection scheme at Kingways Court in Glasgow (*CRNS, Dec 2009*), concluded that food waste yields had decreased towards the end of the trial and that this was a result of an increased awareness of the levels of food wastage and hence waste prevention behaviour.

In considering this conclusion, it is difficult to know whether this decrease is a result of genuine food waste reduction or through a diversion back into the residual waste stream, as the latter was not monitored during this trial. Home composting was not believed to be a factor here due to the type of residential property (e.g. flats with no gardens). The results of the study show an increase in yields for week 1 – 48, and thereafter a steady decrease in yields. The increased yields for the majority of the trial were thought to be as a result of the changes to the collection system (a new door-to-door service and a second food waste collection every week) introduced in Week 16 and 45 of the trial respectively. The results of the attitudinal survey indicate that 30% of residents believed that they had changed their food waste creation behaviour for the good as a result of the food collection scheme. However, as the survey was not designed to assess the food waste arisings in the residual waste stream, it is difficult to draw any firm conclusions on the reason for the recorded decline in collected food waste arisings.

Somerset Waste Partnership (*Somerset Waste Partnership, March 2010*) has undertaken extensive monitoring of their food waste collection scheme and results demonstrate a 24% reduction in overall collected food waste arisings. These results are based on a review of both the residual and food waste collection tonnages and therefore it can be assumed that there is a genuine reduction in overall food waste arisings via both food waste and residual collection streams. However, food waste collections here were introduced alongside other collection service changes. And the question still remains as to where this 'food waste' is going. It could represent 'at source' prevention or it could represent diversion to home composting. Again, no data was available on the levels of food waste diverted into – or out of – home composting, so no firm conclusions can be made in relation to food waste prevention 'at source'.

A number of other studies have been undertaken into how the 'visibility' of food waste generation influences food waste behaviour (*Waste Watch, May 2007; Changeworks, April 2010*), which would be the logical mechanism by which food waste collections might lead to food waste prevention, or other changed behaviour around food disposal, by householders. These studies indicate that when households become more aware of the levels of food waste that they are generating they start to take action to reduce this. The Western Riverside area of London observed a 50% reduction of food waste in the residual waste stream, when they invited a number of residents to separate their food waste and start home composting, without any introduction of food waste collections. They also introduced volunteers to smart shopping initiatives to reduce over-purchasing of food. Similar to the studies discussed above, this project does not quantify how much of the reduction has been through diversion to home composting, and was in any case, a relatively small scale qualitative study, with a focus on engaging individuals in behaviour change, rather than understanding change in a more everyday context. Although it would seem very likely that a proportion of this reduction was the result of home composting, this cannot be proven from the available data (*Waste Watch, May 2007*).

One study explored the link between the type and capacity of the waste collection system to accept waste and the benefits of different collection configurations on overall waste arisings and therefore waste prevention (*Defra, Oct 2009*). This study observed that in local authorities that implement a fortnightly residual waste collection, lower overall waste arisings were reported. A further study by Resource Futures to assess the reduction in overall food waste arisings (*WRAP, Aug 2010*) from 2006 to 2009, presented some interesting results. It revealed that when comparing two groups of local authorities, the group which contained a significant proportion with fortnightly residual collections and separate weekly food waste collections, showed a greater reduction in overall food waste arisings.

Two of the reports reviewed (*WRAP, March 2007b; WRAP, Nov 2009a*) did look at the connection between collection and prevention to some extent, and, while the question was the focus of neither study, did not indicate a significant association between the type of food waste collections and food waste prevention. However, one of these cases, relating to disposal via the sewer, does not necessarily challenge the proposition that food waste collections might influence prevention behaviour. If the link between collections and prevention comes from people seeing their food waste and reacting to the realisation that it is a significant volume of waste, then we would not expect to see a prevention effect in cases where no prompt is available, and this may be the case here. Alternatively the type of food disposed of via the sewer may be conceptualised differently by householders in other ways. Certainly households did not think that they disposed of a lot of food waste 'down the drain' (i.e. to sewer), despite WRAP research concluding that 1.8 million tonnes of waste is disposed of via the sewer (*WRAP, Nov 2009a*).

Overall, the literature review demonstrates that there is little evidence to substantiate any firm conclusions that implementing a separate food waste collection will lead to a change in behaviour around food waste prevention 'at source'. There is, however, good evidence that there is a very considerable reduction in collected food waste

arisings overall (24% in the most convincing study). However the extent to which diversion to home composting contributes to this is unknown, and could be significant. Changed composting behaviour, diverting food to or from collections, might reasonably be expected to be influenced by changes in food waste collections, in much the same way it is suggested collections might introduce changes in food waste prevention behaviour.

In considering this conclusion in relation to the original research questions, it should be noted that there are a number of limitations in the methodologies of the studies reviewed. This is mainly because the studies were not designed to assess the impacts of food waste collections on food waste prevention at source or through home composting. Common issues include a lack of data on participation over time, an incomplete assessment of the waste composition of all waste, including that in the residual waste bin, and the limitations of self-assessment when participants weigh or make a visual assessment of their own food waste in smaller scale studies. The length of the studies also varied from 1 week to 2 years and often data was not collected over time to measure sustained behaviour change.

The literature review has therefore identified a number of evidence gaps in relation to how food waste collections impact on food waste prevention. These include the lack of data around:

- the amount of food waste remaining in or returning to the residual waste collection stream as a scheme becomes established, which was not measured in the vast majority of studies;
- how much food waste is diverted to home composting when a food waste collection scheme is introduced (thus making any prevention effect appear larger than it actually is); and
- the impacts of food waste to sewer (via macerators or otherwise) on food waste prevention;

and ensuring:

- complete, statistically robust and accurate data sets incorporating the quantities of food waste in the residual as well as the food waste collection (i.e. compositional analysis of the residual waste), participation rates for the food waste collection and related survey work to identify particular behaviours; and
- that all of this data is collected regularly and over an extended period of time to identify whether any changes are long-lasting (i.e. sustained behaviour change.)

Addressing these evidence gaps is essential to understanding how food waste collection schemes – or other means of raising awareness - influence food waste prevention behaviour, at source and through home composting. More sophisticated and rigorous studies, designed to address the original research questions, will ultimately allow far better evidence to be provided to local authorities on how to ensure that their food waste collection schemes are working to maximise food waste prevention. It is also likely to inform understanding of the amount of AD feedstock likely to be made available by the introduction of food waste collections.

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1.0 Project Introduction

1.1 Aim

SKM Enviros Consulting Limited were commissioned by WRAP in May 2010 to undertake a literature review of published and unpublished research, to assist in understanding how food waste collections may influence household food waste prevention behaviour.

The focus is on understanding behavioural issues in relation to food waste prevention, and how collection systems impact on this behaviour. The purpose of the review is to use information from the literature review to identify any robust evidence and to identify gaps in the evidence so as to steer future research needs for the food waste programme at WRAP.

1.2 Objectives

The initial brief for this project was to look for evidence on how different types of food waste collection/disposal schemes influence the amount and types of food waste generated by households. Of particular interest were changing household behaviour when collections are introduced, and what factors might effect this. Additionally any evidence on the connection between waste prevention messages and food waste collections were highlighted as being of interest.

In practice, given the evidence available, this brief was subsequently focused on two specific questions:

- Does the introduction of food waste collections result in a reduction in collected food waste overall (including residual waste)?; and if so
- Is this the result of waste prevention at source and/or diversion to home composting through householders changing their behaviours?

2.0 Methodology

2.1 Task 1 - Project Inception Meeting

A project inception meeting was held between SKM Enviros and WRAP on 25th May 2010 and provided the opportunity to do the following:

- Discuss in more detail the issues around the objectives of the work, in particular to confirm the approach to accessing unpublished research;
- Share information sources for published and unpublished work and key contacts for obtaining access to this unpublished work;
- Confirm project scope, deliverables, timing and content of the final report;
- Confirm review procedure for the summary report to take into account the range of stakeholders required to be involved in this process; and
- Meet key stakeholders and establish lines of communication.

A key output from the meeting was the confirmation of the project's main focus, to review evidence around the impact of food waste collection schemes on overall waste arisings and food waste prevention.

2.2 Task 2 - Identification of Relevant Literature

Following the inception meeting, the next task was to identify any relevant published or unpublished literature. This list of relevant literature would be pre-assessed (Task 3) for its suitability to answer the research questions and therefore be included in the full literature review (Task 4).

To ensure that a comprehensive list of published and unpublished research was developed, the following actions were undertaken:

- **WRAP and Key Stakeholders** – the inception meeting provided the opportunity to discuss and develop the initial list of published research.
- **Key Universities** – contact was made with the following higher education establishments - University of Northampton, Cranfield University, University of Leeds and University of Central Lancashire – to identify further research of relevance to this project. This was coordinated through the University of Northampton who run a network for Universities.
- **Journal Review** – key waste management and behaviour journals were reviewed to identify any reports that would be of relevance, for example around food waste collections, behavioural change, home composting and the maceration of food.
- **Conference Proceedings** – relevant food waste conference proceedings were reviewed to identify key stakeholders and unidentified published research. The key stakeholders were contacted to request information and publications of relevance.
- **EU and International Contacts** – liaison with key contacts at the Association of Cities and Regions for Recycling and Sustainable Resource management and the International Solid Waste Management Association to identify EU and international reports of relevance.
- **Internet Research** – key waste management internet sources and websites were reviewed such as the Resource Recovery Forum, CIWM, Waste Information Network and Let's Recycle.

Following completion of this task, 81 reports were identified which could be of relevance to the literature review. A full list of these reports is provided in Appendix 1a. A list of the key contacts is provided in Appendix 1b.

The next task was to undertake a pre-review assessment of these reports to identify which reports were relevant and should be included in a detailed literature review.

2.3 Task 3 – Pre Review Assessment (81 reports)

Each of the reports identified in the initial stage of the research was summarised and assessed for its relevance to the project by identifying the level of detail provided on the following key topics:

- householder awareness in relation to food waste prevention;
- different configurations of food waste collection schemes and how these impact on the type and quantity of food waste generated;
- waste prevention messages; and
- communications related to food waste schemes.

An example of the pre-review assessment form is provided in Appendix 2.

Following the pre-review assessment, 18 reports (Appendix 3) were considered to be relevant in providing potential insights. It should be noted that the selected studies were not specifically designed to answer the above

research questions, and as such, the data which is available in these reports is more likely to provide an insight into the following more modest research questions:

- Does the introduction of food waste collections result in a reduction in collected food waste overall (including residual waste)?; and if so
- Is this the result of waste prevention at source and/or diversion to home composting through householders changing their behaviours.

2.4 Task 4 – Prepare Literature Review (18 reports).

The final task was to prepare this report to present the evidence available from the literature review to answer the research questions. A review of the evidence is detailed in Section 3. Section 4 reviews the limitations of the methodologies used in the various studies to answer the research questions, and Section 5 provides an overview of the evidence gaps that were identified.

3.0 Literature Review

Eighteen reports (Appendix 3) were reviewed in detail for the literature review, with the majority of these providing some evidence to support the theory that the introduction of food waste collections is associated with a reduction in food waste arisings. A full review of each report is provided in Appendix 4.

The following text should be reviewed with consideration given to the fact that these studies were not specifically designed to assess the impact of food waste collections on 'at source' food waste reduction. Therefore, evidence is taken from these reports to be used in different context from that in which it was collected. For example, a common theme across all of the reports was the fact that where a reduction in food waste arisings had been observed, there was limited data to confirm how much food waste had simultaneously been diverted from the residual waste stream to home composting and how much was a result of 'at source' waste prevention behaviour. A number of the reports considered the diversion of food waste to home composting, as a contributor to waste reduction, as this reduced the food waste arisings collected at the kerbside.

It is important to note that in this report we refer to food waste prevention 'at source' (e.g. through more waste aware shopping, use of leftovers etc.). Thus food disposed of to home composting still counts as food wasted for the purposes of this study. This is because while diversion to home composting from the residual waste stream may represent a real environmental gain (by reducing the amount of food waste that is landfilled), the environmental impact of food waste is related to the entire life cycle of food; and impacts associated with producing, processing and transporting the food remain, regardless of disposal option. The term 'yield' is used to refer to the quantities of food waste collected on segregated food waste collections.

Overall the reports demonstrate that while there is some evidence to support the theory that implementing a food waste collection can lead to an overall reduction in collected food waste (including that in both the residual and food waste streams), there is currently no significant evidence to demonstrate to what extent this is due to prevention 'at source' as opposed to diversion to home composting. A number of the reports support the need for further research in this area.

Despite these issues, the reports reviewed do provide useful insights into the potential impact of food waste collections on food waste reduction. The key observations from these reports are provided below.

3.1 Evidence of Food Waste Reduction related to Food Waste Collections

A number of the reports reviewed provide some evidence to support the theory that when a food waste collection is introduced there is a reduction in collected food waste arisings (including the food waste in the residual collection). This has previously (although anecdotally) been thought to be associated with the fact that once householders start to separate out their food waste for collection they start to acknowledge the quantities of food disposed of, realise the significance of this, and hence begin to reduce what they throw away.

However, as these studies were not designed to specifically assess the impact of food waste collection on the reduction of food waste arisings, whilst decreases in food waste might have been reported, there are in fact three

possible explanations for why reductions might have occurred, and insufficient evidence to definitively decide between them. Possible explanations are that:

- the reduction in food waste arisings is a result of food waste prevention “at source”
- the reduction represents diversion of food waste back into the residual waste bin; or
- the reduction represents diversion of food waste to home composting.

An overview of the reports which provide some relevant evidence to support this theory is provided below.

3.1.1 WRAP - Food Waste Collection Guidance and Trials (WRAP, June 2009 & July 2009).

WRAP have developed a comprehensive guide for local authorities to assist them in developing food waste collection schemes (*WRAP, July 2009*). This guidance draws heavily on the experience gained from the 21 separate food waste collection trials that ran between January 2007 and March 2008 (*WRAP, June 2009*). The guidance concludes that a key aspect to any food waste collection is the ability to monitor and evaluate its success through tonnages, compositional analysis, capture rates, levels of participation and stakeholder surveys. The guidance also promotes the importance of home composting as the preferred environmentally sustainable option for treating the majority of food waste and highlights that this should be communicated carefully to residents.

In reviewing the performance of these trials, the guidance highlights that high yields and high participation in food waste collections were generally maintained on trials with fortnightly refuse and weekly food waste collection schemes. A key question for this literature review is therefore whether this means that there is or isn't any waste prevention with these types of schemes. The evaluation of the separate food waste collection trials undertaken by WRAP in June 2009 (*WRAP, June 2009*) provides further details on how participation and food waste yields changed over the lifetime of the trial.

The majority of the food waste collection trials reported decreasing yields over time and the trials demonstrated that this was more pronounced with weekly refuse collections. For example, over the 50 week period, food waste yields with weekly refuse collections decreased from an average of 1.5 kg/household served/week to 1.25 kg/household served/week (16% decrease). However, this does not mean that there was necessarily an overall reduction in food waste arising due to and related to 'at source' food waste prevention as this reduced yield could have been attributed to a number of other factors with the key ones being a reduction in participation (with food waste going back into the residual waste) or diversion to home composting.

It is difficult to determine the reasons for the reduction in overall yields, as the trials sought to understand *collected* yields and were not designed to determine the quantity of food waste that was diverted to home composting, or to review whether waste prevention 'at source' was occurring as a result of the food waste collection. In relation to home composting a survey was undertaken in the trial areas to confirm how the food waste collection had impacted on their home composting behaviour. The results showed that 63% stated that it had made no difference to their home composting activity and 24% reported that they composted less than they had before, diverting waste into the food waste collection scheme. However, there was no quantifiable data to support these claims on the actual versus perceived behaviours.

The trials did, however, provide quantifiable information on food trial participation rates and concluded that where participation monitoring was conducted over more than one phase, a decrease in participation was experienced. For example, in Mole Valley, average participation rates decreased from ~72% in phase one of monitoring to 69% in phase 2 (i.e. a ~3% decrease). As with the food waste yields, the trials indicated that the decrease in participation was more pronounced with weekly refuse collections, with Calderdale showing a decrease from 62% to ~51% from phase 1 to phase 2 of monitoring (i.e. a ~9% decrease).

Combining the results of the food waste yields and participation monitoring demonstrates that higher food waste yields are associated with higher participation rates as would be expected. A decrease in yield may therefore be purely attributed to a decrease in participation, with waste being diverted back into the residual stream rather than waste prevention 'at source' or diversion to home composting. However, in the 'attitudinal' surveys carried

out as part of this research, 4% to 8% of respondents claimed that the food waste collection system had changed their behaviour in relation to food waste creation, representing a small but not insignificant number. In addition 63% stated that the food waste collection had not influenced their home composting habits while 24% reported that they composted less than they had before, which should have in theory helped to maintain yield. It may be that a small minority (<13%) were also influenced to home compost more. It is not possible to draw firm conclusions from these results, since no data on the quantity of waste diverted to home composting was collected to substantiate these perceived behaviours.

A number of the trial areas also undertook compositional analysis to determine capture and diversion rates. This work was undertaken by Waste Watch (unpublished), for 5 of the trial areas, with the results showing the typical household level of food waste diverted, the nature of food waste being diverted and the types of food waste not being captured/diverted. This information is useful as it highlights which food types are being 'reduced' i.e. removed from the food waste collection and residual waste stream. The results show the compositional analysis for a specific 'snap shot' of time and the analysis for Shropshire shows that the majority of food waste in both the food waste collection and the residual bin was 'preparation by-products, non-edible element' with 54% and 84% respectively. However, there was a large (42% in the food collection and 10% in the residual) quantity of food which was "avoidable" (i.e. consisting of food that could have been eaten had it been handled differently at some point prior to be thrown away). This second category of food waste can be addressed via 'at source' food waste prevention initiatives.

The level of monitoring and evaluation of the separate food waste collection trials was substantial and provided detailed information on the performance of the food waste collection trials. However, the focus was on collection methods. To allow for a more detailed review of food waste arisings and prevention impacts, the monitoring and evaluation could have been further developed to include the following:

- **Participation Monitoring** - This was carried out in 20 of the trial areas and the number of times which participation monitoring was repeated was variable, with only 1 area undertaking monitoring 4 times throughout the duration of the trial. It is recommended that any future schemes designed to assess waste prevention undertake regular participation monitoring to track changes over time.
- **Waste Compositional Analysis** – To help establish the reasons behind a reduction in food waste arisings, changes in participation rate need to be tracked against what is happening to the food waste (including that in the residual waste) in both those households that are still participating and those that are not. In six of the trial areas, waste compositional analysis was undertaken (500 households) with the capture rate and waste composition data being taken as a 'snap shot'. Although this provides valuable information on waste composition, it does not assess the change in behaviour and composition over time. It is recommended that compositional data is recorded at different points in the trial/food waste scheme, and separately for those that are still participating and those that have dropped out, to provide a more detailed assessment of changes over time.
- **Attitude Surveys** – 'Attitudinal Surveys' (more properly behavioural surveys) were carried out in only 5 of the trial areas (2,500 households). Therefore, not all of the trials had survey data to provide behaviour change reasons for the observed changes in the waste. It is recommended that any future work on waste prevention includes behavioural survey work in all trial areas.

It is important to have on-going participation, composition and behavioural survey data throughout a trial to determine the links between these aspects and waste reduction. The need for this level of data is further confirmed in a presentation delivered by Dr Julian Parfitt in April 2009 (*Resource Futures, April 2009*), where he reviewed the data arising from two key WRAP reports (*WRAP, June 2009; WRAP, April 2008*). This review indicated that there is less food waste collected overall in areas where there is a separate food waste collection. However, there are a number of interacting factors which affect the results and the presentation concludes that in order to fully review the impact of food waste collections on overall waste reduction, the study needs to have pre and post research which is linked to compositional analysis.

3.1.2 Community Recycling Network Scotland - Kingsway Court Food Waste Collection (CRNS, Dec 2009)

The issues relating to the completeness of datasets in determining whether waste prevention 'at source' has occurred are further considered in the review of the Community Recycling Network Scotland's (CRNS) report on the performance of the Kingsway Court food waste collection scheme (CRNS, Dec 2009).

In February 2010, CRNS published the results of a food waste collection trial from Kingsway Court, Glasgow. Kingsway Court is a high density housing area with 600 residents, many of whom are Muslims (the relevance of this is noted below). A food waste collection trial was implemented on 23rd September 2008 and ran for 12 months, with an average participation rate of 200 participants per week. Prior to the trial, and 6 months into it, an 'attitudinal survey' was conducted to collate participants' feedback on the service and note any changes in behaviour. The tonnes of food waste collected and participation rates were monitored each week of the 12 month trial. In conjunction with the food waste collection service, an on-site in-vessel composting facility was built to process the food waste from the residents.

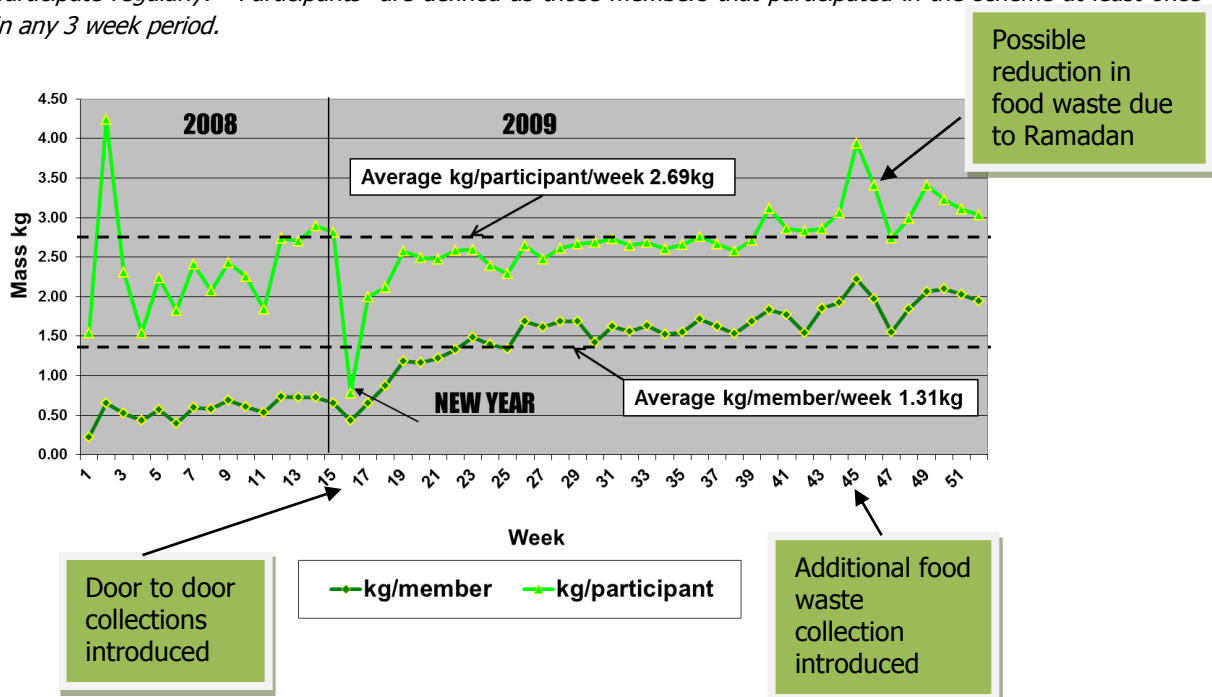
The study reports that they observed a drop off in yields/participant/week towards the end of the trial. They state that the maximum yield at the start of trial was 4.1kg/participant/week (week 2) and that this had reduced to 2.9kg/participant/week at the end of the trial (week 52) (Figure 1).

In reviewing the change in yields over time, it is important to note a number of changes to the food waste collection scheme. These are detailed below and annotated on the graph:

- **Roll Out** - initial food waste collections were based on a 'bring scheme' whereby a separate bin was placed in the chute rooms and residents were asked to deliver their food waste to the communal bin;
- **Week 16** - following a review of the 'bring scheme', the collection scheme was changed in one block of flats to a door-to-door collection. This scheme was rolled out throughout the estate over the next 5 weeks.
- **Week 45** - the food waste collection scheme was enhanced and residents were offered two food waste collections per week. However, as this was introduced at the same time as the Muslim fast of Ramadan, no immediate increase in food waste yields was observed.

Figure 1 Kingsway Court – kg/participant/week

NB: Everyone who signed up for the scheme was classed as a "member". However, not all members went on to participate regularly. "Participants" are defined as those members that participated in the scheme at least once in any 3 week period.



In relation to the changes to the food waste collection and the impact on food waste yields (kg/participant/week) the following observations can be made:

- Following the introduction of the door-to-door collections, the kg/participant/week appears to remain more constant with fewer fluctuations. This could be related to the fact that residents no longer have to take their food waste to a separate bin in the chute room, and are therefore more likely to participate more regularly in the scheme.
- The introduction of the second food waste collection appears to initially generate higher yields per participant per week (~3.5kg/participant/week). However, from week 48 to 52, it can be seen that although the yields are generally higher, a decrease in the average kg/participant/week is observed. Following further discussions with CRNS it was established that monitoring continued beyond the scope of the graph, up to Week 66, and during this time the decrease continued, with 2.56kg household/week being recorded in Week 66.

Overall the report concludes that *'the reported fall in yield/participant/week recorded in the last few months of the trial are taken to reflect increased awareness by participants of wastage of food'*, and, presumably, the gradual adoption of behaviours to minimise this. The study also states that this conclusion is backed up by responses to the second awareness survey, in which 30% of respondents reported that they had changed their behaviours as a result of the food waste collection.

In reviewing the observations of this report a number of important points should be considered:

- The starting kg/participant/week figure of 4.1kg could be caused by a delay to the initial collections or through an initial interest in the scheme. This level of collection was not maintained and could therefore be considered to be a data anomaly.
- During week 1 to 52, there was generally an increase in food waste yields per participant. However, these increased yields could have been related to the change in the food waste collection scheme (door-to-door collections started in Week 16) and a second weekly food waste collection being introduced (Week 45).
- The additional monitoring data (week 52 to 66), highlights only a slight decrease from the average of 2.69kg/participant/week shown over the 1st 52 weeks, i.e. a reduction of 0.13kg/participant/week or around 5% (to 2.56kg).
- The study did not include monitoring of food waste arisings in the residual waste stream.

It is therefore difficult to establish the scale of the decrease in food waste arisings, and to know whether this decrease is a result of genuine reduction or through a diversion back into to the residual waste stream. It is worth noting that diversion to home composting in this case was not considered significant due to the high density of the housing (i.e. a lack of gardens etc.). These observations do not mean that waste reduction has not occurred, but highlights the importance of assessing the food waste arisings in the residual waste stream as well as yield in food waste collections, when reviewing the impact of waste prevention 'at source' on overall waste arisings.

3.1.3 Somerset Waste Partnership – SORT IT! Campaign (Somerset Waste Partnership, March 2010).

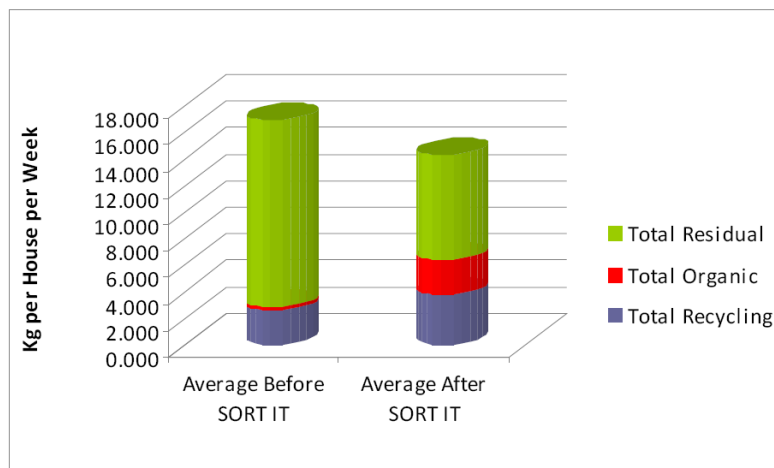
Somerset Waste Partnership (SWP) in conjunction with their waste contractor May Gurney have undertaken extensive monitoring of their food waste collection scheme and this has included an assessment of tonnage and compositional data for both the food waste collection and residual waste stream (*Somerset Waste Partnership, March 2010*). A summary of the results of this assessment is provided below and it should be noted when reviewing this data that due to the commercial sensitivity of this information¹ we were unable to obtain full details on the methodologies used and therefore are unable to fully comment on the validity of the conclusions.

SWP was one of the first areas to roll out a large scale food waste collection, after the introduction of the Animal By-products Regulations in 2005. This was delivered in conjunction with ECT Community Interest Group (now known as May Gurney), and was rolled out to 160,000 households by November 2006. SWP were keen to collect food waste as a waste composition survey in 2002/3 identified food waste as the largest category in the residual bin.

¹ Survey work has been undertaken by May Gurney and as such the full details of the assessments were not available due to the commercial sensitivity of this data.

The collection scheme consisted of alternative weekly collection for residual waste, weekly food waste collections, dry recycling collections and a charged garden waste collection. The report highlights that the scheme has shown significant reductions in overall waste arisings (Figure 2), in part through reducing food waste collected at the kerbside by 9,500 tonnes p.a. Overall levels of food waste collected at the kerbside (separately collected food and in residual waste) reduced by 24% and the report attributes this to diversion of the food waste to home composting and a change in other food waste prevention behaviours (e.g. purchasing habits) reducing the waste 'at source'. However, at the time of writing, additional information to support this explanation of the observed decrease was not publically available. SWP also state that some of the reduction in food waste could be due to moisture loss while the waste is waiting to be treated, although such an effect would be highly unlikely to account for all of the observed decrease.

Figure 2 Reduction in Waste from SORT IT! Campaign



In summary, the results of the study show a reduction in overall waste arisings and a significant reduction in the quantity of food waste in the total waste stream. However, as mentioned above we were only able to obtain headline information on the success of the SORT IT! Campaign and as such we have been unable to identify the quality and quantity of data used to determine the above conclusions. Food waste collections in this case were associated with other service changes, and waste reduction activity. For the purposes of this review it would also be beneficial to establish the split in waste reduction between food waste diverted to home composting and that attributed to food waste prevention 'at source'. Therefore, although the report indicates that food waste prevention 'at source' was observed, for the purposes of this literature review, there is currently insufficient data to confirm the scale of this.

3.1.4 Project Reduce - 'What not to Waste' (Waste Watch, May 2007)

In addition to studies on the introduction of the separate food waste collection schemes, there are reports that are not related to food waste collection schemes but which still provide evidence to support the theory that once householders start to become more aware of the quantities of food that they are wasting, they start taking action to reduce it. This is a result of the waste prevention behaviour change that is thought to occur in response to the visibility of the food waste (i.e. separating food waste from the residual waste stream). This is considered to be relevant to this literature review as when implementing a food waste collection, households are thought to become more aware of the amount of food waste generated through its separation.

In January 2006, the Western Riverside area of London introduced 'Project REDUCE - 'What not to Waste'' (Waste Watch, May 2007). This project ran for 9 months and formed part of a larger Monitoring and Evaluation programme to develop a common set of tools to measure the relative and absolute impact of a range of waste prevention initiatives. The project aimed to test the effectiveness of directly engaging householders at a local level in waste prevention and minimisation activities and to measure the impact this had on behaviour and on reducing overall waste output. A number of participants (16 households) were recruited to the project to take part in a series of waste prevention challenges. Recruitment was targeted and focused mainly on low recyclers and those willing to engage in behaviour change. The participants were all volunteers to the project and this point should be noted when interpreting the results, as although they were traditionally low recyclers, the participants volunteered to take part and therefore it can probably be assumed that they would be more

receptive to behaviour change. The level of participant engagement would not be typical of a normal food waste collection.

Each household was given three, fortnightly waste prevention 'challenges' including:

- **Challenge 1:** Increase recycling and home composting: *Participants were asked to separate their food waste, weigh it on a weekly basis and where possible to home compost.* Participants also weighed their black bin waste.
- **Challenge 2:** Focus on junk mail and smart shopping.
- **Challenge 3:** Reuse – donating and reusing unwanted items.

The project was evaluated through the use of an 'attitudinal' survey, conducted with 100 Western Riverside residents, including the 16 participants, to determine attitudes to recycling and waste prevention and related waste behaviour and shopping habits. Waste audits were also conducted as the principle method of establishing the campaigns impact on waste arisings. Waste audits were conducted at the start of the project, prior to the first challenge, and at the end of the campaign, focusing on residual waste, separated food waste and recycling. The data from residents self-weighing black bag and food waste was excluded from the final evaluation due to the poor quality of the data collected.

The results of the project indicate that as participants interacted more with their waste they were successful in changing their behaviour and reducing their overall waste. This is thought to be attributed to participants becoming more aware of their levels of waste and therefore taking action to reduce it. Overall, total waste arisings reduced by 34%, with significant changes to the percentage contribution of different types of waste to the overall waste arisings. At the end of the study, recycling accounted for 30% of waste produced. General residual waste and food waste both decreased in their percentage contribution to total waste by 13% and 7% respectively. Furthermore, the total quantity of residual waste reduced by 62% (99.3kg to 41.1kg per week) and in relation to the compositional analysis, food waste in the residual waste stream reduced by 51% (50.9kg to 25.1kg).

The project concluded that the reduction in food waste arisings was attributed to 6 households who started to home compost following Challenge 1 and to a change in food purchasing behaviour. The food purchasing behaviours were promoted through Challenge 2, where information was provided on 'smart shopping'.

However, in considering this conclusion, there was no quantitative assessment of how much of the reduction in food waste arisings was attributed to a diversion to home composting as against waste prevention 'at source', for example through changes to food purchasing behaviour. The results of the 'attitudinal' surveys also do not demonstrate that waste prevention at source is occurring as the number of participants who have started to use 'smart shopping' behaviours and hence avoid over-purchasing is not reported.

In summary, the project does provide some evidence to support the theory that the visual interaction with food waste, as would be expected from introducing a food waste collection, has a significant influence on the quantities of collected food waste, whether that be through a diversion to home composting and/or through waste prevention 'at source'. It should be noted, however, that the project was 'challenge' based with participants perhaps more motivated to reduce their overall waste than the average resident.

3.1.5 The Kitchen Canny Report. (Changeworks, April 2010)

The report on Changeworks Kitchen Canny project (*Changeworks, April 2010*) also indicated that participants reduced their food waste arisings as a result of becoming more aware of the amount of food that they were wasting. As mentioned above, this is relevant to the literature review as awareness leading to change is the mechanism by which participants in a food waste collection are thought to reduce food waste – in the case of collections by becoming more aware of their food waste through separating it out for collection.

The Kitchen Canny project was a 2 year project in the Lothian and Border region aimed at engaging with households to reduce food waste by 25%. The project used community champions to distribute campaign packs on how to reduce food waste accompanied by a kitchen caddy. Participants monitored their food waste through a visual assessment of how full the kitchen caddy was after a 4 day period. Participants were also asked to weigh their kitchen caddies. The participants then repeated this visual assessment and weighing exercise three weeks

later over another 4 day period. The results showed a reduction in food waste of 52%. However, due to the survey methods employed, it is not possible to conclude to what extent this apparent reduction is necessarily due to waste reduction, either through the diversion to residual or home composting bin or through prevention 'at source'. This is discussed in further detail below.

It may also be that this study is not typical of the wider population. The report indicates that 76% of the households participating in the project home composted. In relation to evidence which suggests that people who home compost are more likely to produce less waste overall, the results are not considered to be representative of the UK population and could be biased towards those who are already engaged in waste prevention activity. To support this, some participants commented that the study was already '*preaching to the converted*'.

The method of recording the levels of food waste was reliant on self-assessment by the participants. The results suggest that the accuracy derived from this method of visual assessment was variable. For example, 7 respondents claimed that their caddies were empty in the second evaluation exercise, but the weight of these caddies ranged between 0.1kg and 0.37kg.

Furthermore, there was no overall compositional data analysis or an assessment of how much food waste was in the residual bins. This makes it difficult to conclude whether a reduction in food waste arisings in the kitchen caddy was a result of waste prevention 'at source' or diversion of the food waste into the home composting bins or residual bins. As mentioned above, the sample contained a large proportion of households who state that they home compost, and it is therefore quite possible that the reduction in food waste could have been due to a diversion to home composting. However, there is no quantifiable evidence to back up this observation.

In summary, the report suggests that householders reduce their overall food waste as a result of becoming more 'visually aware' of the quantity of food wastage occurring. However, as the study was not designed to measure the food waste arisings in the residual bin, or the diversion of food waste to home composting, it is difficult to confirm these conclusions.

3.1.6 Other key reports in relation to food waste prevention

Further to the thought that visual engagement with food waste makes people exhibit waste prevention behaviour, it also seems likely that the type of food collection roll out in a given location might also variably effect food waste prevention behaviour. There have been a number of studies that consider how the frequency of collection, container size and side waste policies affect the overall waste arisings, and these could inform decisions on collection design that sought to maximise prevention effects.

A key study in relation to this is 'Understanding Waste Growth at a Local Level' (*Defra, Oct 2009*). This report aimed to provide a more informed understanding of the factors that influence growth in household waste through reviewing a number of case studies with 28 local authorities. The principle aim was to focus on the effect that local waste policies have in influencing waste growth or waste reduction. One aspect of the study was to review the impact of introducing alternate weekly collections (AWC) on waste arisings.

The report observed that the Local Authorities that introduced AWC reported a downward trend in the amount of residual waste collected at the kerbside. This suggests that this type of collection system may encourage householders to increasingly separate out dry recycling and garden waste (if separate collections are offered free of charge) at the kerbside. In terms of quantity, the report estimates that AWC roll out can reduce kerbside residual arisings by 120kg per household per year. The report also noted that a switch to AWC can be accompanied by a temporary increase in waste taken to HWRC sites, however this is a very short term effect. This study did not focus explicitly on separate food waste collections, but similar effects might be hypothesised.

A further study undertaken by Resource Futures for WRAP (*WRAP, Aug 2010*) assessed the degree to which national household food waste arisings had changed between 2006 and 2009. Household food waste was defined to include food waste in the following collections – *kerbside collected residual waste, specifically collected separate food waste collections and mixed food and garden waste collections*. This study was undertaken to assist with monitoring around the WRAP targets set in the context of the Courtauld Commitment.

Despite that focus, this study generated some interesting results in relation to food waste arisings and the impact of collection systems. The study looked at the food waste arisings from 2 different groups; Group A (30 Local Authorities, 8 of which have fortnightly residual collection and separate food waste collection) and Group B (22

Local Authorities, as Group A, but excluding the 8 that have fortnightly residual collection and separate food waste collection).

The study used data from WasteDataFlow (2009 data), and identified a mean food waste arising total of 167.1 kg/hh/year for Group A collectively and 174.4 kg/hh/year for Group B collectively. These mean values were then grossed up to generate the total household waste arisings. Group A showed a total of ~3.8 million tonnes and Group B ~4.0 million tonnes, a difference of ~170,000 tonnes. When compared to 2006 data (collated from a previous Defra Study, WR0119), the following reductions were observed:

Study Group	Group A	Group B
2006/7 Food Waste Arisings	4,556,176	4,556,176
2009 Food Waste Arisings	3,792,491	3,957,736
Estimated Reduction	763,685 (17%)	598,440 (13%)

Although not the main purpose of the study, it can be seen from the table that the analysis based on the Group A data showed a greater decrease in food waste arisings compared to that based on the Group B data, with the only difference between the two groups being that Group A included the 8 authorities that operated fortnightly residual waste collections alongside weekly food waste collections. The report highlights the importance of this finding in giving further support to the hypothesis that separate food waste collections result in overall food waste reductions. WRAP is undertaking further analysis work in this area.

Finally, in relation to discussion of how different collection systems may differentially impact on prevention, a report 'Behaviour Change – Scoping the Way Forward' (Defra, March 2005) may also be of relevance, although, again, it was not specifically written with food waste prevention in mind. It suggests that changes to waste collection regimes that make prevention seem easier than disposal are likely to lead to improved waste prevention activity. It is not clear that provision of food waste collections in and of themselves would have such an effect, but in combination with other waste collection provision, this is a factor that could influence household behaviour.

3.1.7 Summary

In summary, there are a number of reports which observe a reduction in collected food waste arisings resulting from the initiation of food waste collections or as a result of a visual engagement with the amount of food waste generated. However, as these studies have not been specifically designed to review waste prevention 'at source', they do not provide sufficient evaluation to substantiate whether a reduction in overall waste arisings is due to 'at source' prevention, or as a result of a diversion of food waste to home composting or the residual bin.

One aspect which is explored is the impact of the design of the collection system on overall waste arisings. There is evidence to support the contention that some systems, such as fortnightly residual waste collections and separate food waste collections, are associated with less overall waste arisings, including food waste arisings.

3.2 Reports Providing No Evidence of Food Waste Reduction as a Result of Food Waste Collections

Two reports, using household surveys and self-assessment to determine waste arisings and any changes in behaviour (WRAP March 2007b; WRAP Nov 2009a) did not identify any evidence of a reduction in collected food waste arisings as a result of a separate food waste collection. A third study used previous data to model the impact of waste prevention (WRAP, May 2010) and again, no evidence of a link between food waste collections and prevention was demonstrated.

The studies, 'Down the Drain - Quantification and exploration of food and drink waste disposed of to the sewer by households in UK.' (WRAP, Nov 2009a) and 'We Don't Waste Food: A Survey of Household Perceptions and Behaviours around Food Waste Production' (WRAP, March 2007b), indicate that the food waste collection/disposal method has no impact on householder waste prevention behaviour. In the latter report, a total of 2,939

interviews were conducted with households in 13 local authorities to determine householder perception and behaviour around food and food waste.

The questionnaire asked a number of questions in relation to food shopping behaviour, pre shopping activity, eating habits, disposal of food waste and changing behaviour on food waste. Of particular interest, the questionnaire asked '*whether the food waste collection scheme had any impact on the amount of food waste that was thrown away?*' The majority of the responses stated that the food waste collection had no impact on the amount of food thrown away and many respondents qualified this by stating that their shopping, cooking and eating habits had not changed.

In a slightly different context, the study into the quantification of food and drink waste disposed of through the sewer system (*WRAP, Nov 2009a*), revealed that both before and after a period of recording what they disposed of, participants felt that they did not dispose of a lot of food waste. This was despite the results of the overall study concluding that 1.8 million tonnes of waste is disposed of via the sewer, more than was anticipated by the research team. Furthermore, participants believed that they never disposed of certain items down the sewer (alcoholic drinks and bottled water) and indicated that they felt it was acceptable to dispose of waste in this manner. The reasons for these attitudes could be linked to the fact that the disposal of waste to sewer leaves little visual reminder to the householder of the volumes of waste as the waste is generally disposed of quickly on a single occasion and no further action is required.

The methodologies used in these two reports are subject to the limitations of householder survey work. Questionnaire based studies record the 'declared' or 'perceived' behaviour of individuals and this can be different to the actual behaviour. Most waste behaviour survey work can be supported by waste compositional analysis to determine actual behaviour, however, the nature of this study meant this was not possible. The study did include a week-long diary exercise for participants to record what they disposed of and the reasons for disposal. The quantities noted in the diaries were then converted into weights. This type of approach has many benefits in terms of the motivation of the participants; however, this method is also subject to data inaccuracies in the way that different people interpret volumes of waste and whether or not people record all their waste. Additionally, the act of keeping a diary is likely to raise awareness of food waste in and of itself, and this is an inherent limitation of this research method.

The 'Analysis of Food Waste Behaviours' (*WRAP, Unpublished*) report undertakes a more detailed statistical analysis of the dataset contained within 'The Food We Waste in Scotland' (*WRAP, 2008*). The objective of this further analysis was to identify the most wasteful those behaviours most closely linked to food waste arisings, and how various socio-economic and waste collection practices combined to determine householder behaviours. The model concluded that the local waste collection regime (frequency of residual waste collection and presence and absence of food waste collection) did not have a statistically significant direct or indirect effect on the quantity of avoidable food waste. However, this was a complex piece of analysis, and it may be other factors masked any effect. Additionally, only a relatively small sub-sample of households (15%) had food waste collections.

In interpreting this conclusion in relation to food waste reduction, the limitations of the methodology of this study must be taken into account. Firstly, the original data was not collected with this modelling approach in mind and as the data was presented at the householder level, it was highly variable in nature. Secondly, the questionnaire data was not collected to answer the specific questions identified in this research, and questionnaire data was not followed up with more detailed one-to-one interviews or focus groups. This would have been beneficial as it would have provided further detail on the key behaviours and food waste arisings. Finally, the waste compositional data was analysed as an isolated snap shot in time, which did not allow the study to take account of longer term variations.

In summary there are a few reports which do not find evidence of an effect from food waste collections on waste prevention. However, there are a number of other factors which could influence these results, not least the fact that the data examined has not been collected to answer the specific research questions of interest.

4.0 Review of Methodologies

A number of limitations to the methodologies have been discussed in the review of the literature in Section 3. These limitations highlight that there are a number of considerations that must be borne in mind when

interpreting the results of the various reports and when planning future work to analyse the impact of food waste collections on food waste prevention. A summary of these limitations is provided below.

4.1 Methods of Evaluation

4.1.1 Self-Assessment

The self-assessment method of evaluation involves a householder weighing or observing the amount of waste produced, through either food waste diaries or evaluation forms. This method can be used effectively in small groups and can provide immediate and measurable results. This method can also play an important role in putting people 'in touch' with their waste and provides a visible reminder of their commitment to reduce it.

However, this method is generally thought to be ineffective in providing robust statistical evidence on weight based reductions. It relies on individuals to complete the forms and this can lead to a variation in the levels of understanding of the requirements of the data reporting and therefore data inaccuracies and ultimately misreporting. This method of self-reporting can also skew results in relation to the effectiveness of food waste collections as it could be assumed that when people weigh their waste they are more likely to change their behaviour, as they have both visual and quantifiable data to inform these behaviour changes.

4.1.2 Tonnage and Composition Data

Tonnage data is important to determine the quantities of waste arisings. However, on its own this data is insufficient to determine conclusions on food waste prevention and this should be backed up with qualitative and survey evidence. It is important when assessing a behaviour change to have evidence on both 'how' and 'why' things have changed. Compositional analysis should review the composition of all waste to determine the overall arisings of food waste in both the residual and separate food waste collection. Consideration should also be given to inclusion of food waste diverted to home composting.

4.1.3 Attitude and Behaviour Surveys

Householder surveys are used to capture declared attitudes and behaviours and are often coupled with focus groups or one-on-one surveys to provide more detailed information on the reasons for specific types of behaviour. They are an important component of any waste data collection exercise as it is useful to know why things have changed as well as how they have changed. At the start of the project surveys can be beneficial to set a baseline on which the impact of an intervention can be measured. These surveys generally work well, but sample size and design must be carefully considered. Questions need to be very specific to elicit useful responses. The results of surveys tend to have many caveats and many samples are deemed to be too small to be representative of the UK population as a whole.

4.1.4 Participation Rate Analysis

A number of the participation surveys detailed in the studies were provided as an average participation over the year or trial period. In order to measure the impact of change over a period of time, it is important to have regular participation rate monitoring (e.g. rolling three-weekly participation levels). The regular participation monitoring can then be used in conjunction with regular tonnage and compositional analysis data to help to determine cause and effect relationships between the various interacting factors.

4.1.5 Period of Monitoring

Due to the objectives of the studies in question, the majority focused on short-term evaluation of behaviour change and did not review the performance of food waste collection schemes post trial. It would be beneficial for studies to prolong their period of research to provide a more detailed insight into waste arisings taking into account weekly and seasonal variations. Monitoring the food waste collection performance beyond the 'experimental period' should assist in understanding the genuine and sustained changes in behaviour. This is considered to be a key aspect of genuine waste prevention behavioural change.

5.0 Evidence Gap and Further Work

The literature review has identified a number of gaps in the evidence to understand how food waste collections impact on food waste prevention, particularly in regard to 'at source' waste prevention. These are listed below.

- **Home Composting** - There is a clear gap in the data available in terms of understanding how much food waste is diverted to home composting when a food waste collection scheme is introduced. This is essential to understanding the scale of other 'at source' waste prevention activities and further work should be undertaken to review practical options for measuring this waste management behaviour.
- **Maceration** – None of the reports which were identified in this literature review provided any guidance on how the introduction of macerators will impact on waste prevention behaviour. It was suggested from the results of the report, 'Down the Drain - Quantification and exploration of food and drink waste disposed of to the sewer by households in UK' (*WRAP, Nov 2009a*), that as there was no visual accumulation of waste (waste disposed of via the sewer effectively vanishes - from the householder perspective - at the moment of disposal) that macerators are likely to have little positive impact on food waste prevention. Further work is recommended to understand the impact of these systems on both the environment and waste prevention.
- **Complete Data Set** –To assess the impact of food waste collections on waste prevention behaviour, there is a need to provide comprehensive data on tonnes collected, waste composition (all wastes), participation rates and behaviour surveys. Ideally, this data set would also include evidence on the tonnes of food waste diverted to home composting to allow an assessment of 'at source' prevention as a factor in overall food waste reduction.
- **Monitoring Period** – In relation to the above comment on generating a complete data set, data should be collected with a higher level of frequency to track changes. There is also a need for data to help identify whether there is sustained behaviour change beyond the lifetime of the study or trial. This will allow the genuine and sustained changes in behaviour to be monitored outside of an experimental environment where participants are likely to be more aware of their behaviours.

The practical and financial aspects of implementing these recommendations have not been considered and it is acknowledged that further work into the impact of food waste collections on food waste prevention behaviour will need to be designed and delivered with consideration of available budgets.

6.0 Summary and Conclusions

Eighteen reports were reviewed in detail for the literature review. Some of these reports and studies provided evidence that the introduction of a food waste collection scheme was associated with a reduction in overall collected food waste arisings (separated food and residual). However, as these studies had originally been designed to review the performance of food waste collection systems in relation to yields, participation and capture rates, as opposed to reviewing the impact that the food waste collection had on food waste prevention behaviour, the data sets were often not appropriate or complete enough to determine whether the reduction in food waste was through prevention 'at source', or through diversion to the residual or home composting bins.

The WRAP food waste collection trials (*WRAP, June 2009*) indicated that a reduction in collection yields was associated with a reduction in participation and a diversion of waste back into the residual waste stream rather than prevention at source or home composting. However, in the 'attitudinal' surveys carried out as part of this research, 4% to 8% of respondents claimed that the food waste collection system had changed their behaviour in relation to food waste creation, representing a small but not insignificant number. In addition 63% stated that the food waste collection had not influenced their home composting habits while 24% reported that they composted less than they had before, which should have, in theory, helped to maintain yield. It may be that a small minority (<13%) were also influenced to home compost more. It is not possible to draw firm conclusions from these results, since no data on the quantity of waste diverted to home composting was collected to substantiate these reported behaviours.

The Community Composting Network Scotland (CRNS) food waste collection scheme at Kingways Court in Glasgow (*CRNS, Dec 2009*), concluded that food waste yields had decreased towards the end of the trial and that

this was a result of an increased awareness of the levels of food wastage and hence waste prevention behaviour. However, it is difficult to know to what extent this decrease results from genuine food waste reduction, as opposed to diversion back into the residual waste stream. Home composting was not believed to be a factor here due to the type of residential property (e.g. flats with no gardens). The results of the study show an increase in yields for week 1 – 48, and thereafter a steady decrease in yields. The increased yields for the majority of the trial were thought to be as a result of the changes to the collection system (a new door-to-door service and a second food waste collection every week) introduced in Week 16 and 45 of the trial. The results of the attitudinal survey indicate that 30% of residents believed that they had changed their food waste creation behaviour for the good as a result of the food collection scheme. However, as the monitoring was not designed to assess the food waste arisings in the residual waste stream, it is difficult to draw any firm conclusions on the reason for the decline in collected food waste arisings.

Somerset Waste Partnership (*Somerset Waste Partnership, March 2010*) has undertaken extensive monitoring of their food waste collection scheme and results demonstrate a 24% reduction in overall collected food waste arisings. These results are based on a review of both the residual and food waste collection tonnages and therefore it can be assumed that there is a genuine reduction in overall food waste arisings. However, this change was observed in relation to other service changes, and the question still remains as to where this 'food waste' is going. Again, in the absence of data on the levels of food waste diverted to home composting, no firm conclusions can be made in relation to food waste prevention 'at source'.

A number of other studies have been undertaken into how the 'visibility' of food waste generation influences food waste behaviour (*Waste Watch, May 2007; Changeworks, April 2010*). These studies indicate that when households become more aware of the levels of food waste that they are generating they start to take action to reduce this. The Western Riverside area of London observed a 50% reduction of food waste in the residual waste stream, when they invited a number of residents to separate their food waste and start home composting, without any introduction of food waste collections. The project also introduced smart shopping initiatives to the volunteers to reduce over-purchasing of food. Similar to the studies discussed above, this project does not quantify how much of the reduction has been through diversion to home composting. Although it would seem very likely that a proportion of this reduction was the result of home composting, this cannot be proven from the available data (*Waste Watch, May 2007*). These studies are based on small samples and intensive engagement activity, which would not be typical of most food waste collection participants.

One study explored the link between the type and capacity of the waste collection system to accept waste and the benefits of different collection configurations on overall waste arisings and therefore waste prevention (*Defra, Oct 2009*). This study observed that in local authorities that implement a fortnightly residual waste collection, lower overall waste arisings were reported. A further study by Resource Futures to assess the reduction in overall food waste arisings (*WRAP, Aug 2010*) from 2006 to 2009, presented some interesting results. It revealed that when comparing two groups of local authorities, the group which contained a significant proportion with fortnightly residual collections and separate weekly food waste collections, showed a greater reduction in overall food waste arisings.

Two reports reviewed (*WRAP, March 2007b; WRAP, Nov 2009a*) indicated that there is no significant association between the type of food waste collections and food waste prevention. However one related to food waste disposed 'down the drain' (i.e. to sewer). If the mechanism by which collections influence prevention behaviour is as a result of residents reacting to the visual cue of seeing how much food is wasted, then the lack of a connection in this study might be considered less surprising. Disposal to sewer leaves little visual reminder of the total quantities of food wasted, and thus would not be expected to prompt behavioural change in this way.

Overall, the literature review demonstrates that there is little available evidence to substantiate any firm conclusions that implementing a food waste collection will lead to a change in behaviour around food waste prevention 'at source'. There is, however, good evidence that there is a very considerable reduction in collected food waste arisings overall (24% in the most convincing study). However, the extent to which uncollected disposal routes, such as composting, contribute to this is unknown, and could well be significant. Whilst representing a waste prevention gain from the point of view of collections then, these results do not necessarily demonstrate an improvement in waste prevention at source.

In considering this conclusion in relation to the original research questions, it should be noted that there are a number of limitations in the methodologies of the studies reviewed. This is mainly because the studies were not designed to assess the impacts of food waste collections on food waste prevention at source or through home composting; typically they were measuring the effectiveness of food waste collections as a standalone question.

This means available studies have limitations when seeking to answer the questions posed in this literature review, which prioritises prevention effects, rather than collection effectiveness. Common issues include a lack of data on participation over time, an incomplete assessment of the waste composition of all waste, including that in the residual waste bin, and the limitations of self-assessment in participants weighing or making a visual assessment of their own food waste. The length of the studies also varied from 1 week to 2 years and often data was not collected over time to measure sustained behaviour change.

The literature review has therefore identified a number of evidence gaps in relation to how food waste collections impact on food waste prevention. These include the lack of data around:

- the amount of food waste remaining in or returning to the residual waste collection stream as a scheme becomes established;
- how much food waste is diverted to home composting vs prevention at source when a food waste collection scheme is introduced; and
- the impacts of food waste to sewer (via macerators or otherwise) on food waste prevention;

and ensuring:

- complete, statistically robust and accurate data sets incorporating the quantities of food waste in the residual as well as the food waste collection (i.e. compositional analysis of the residual waste), participation rates for the food waste collection and related survey work to identify particular behaviours; and
- that all of this data is collected regularly and over a sufficient period of time to identify whether any changes are long-lasting (i.e. sustained behaviour change.)

Addressing these evidence gaps is essential to understanding how food waste collection schemes influence waste prevention behaviour, at source and through home composting. More sophisticated and rigorous studies, designed to address the original research questions, will ultimately allow far better evidence to be provided to local authorities on how to ensure that their food waste collection schemes are working to maximise food waste prevention.

Appendix 1a: Full list of literature identified

Sponsor / Author	Date of Publication	Document Title
Changeworks	Apr-10	Kitchen Canny Monitoring - Mini Report 2.
Community Recycling Network for Scotland	Dec-09	Kingsway Court Food Waste Collection and Composting Pilot Project
Defra / AEA Technology and The Future Foundation	Aug-07	Modelling the Impact of Lifestyle Changes on Household Waste Arisings - WR0107.
Defra / Brook Lyndhurst	Mar-07	Lifestyle Scenarios: The Futures for Waste Composition - WR0104
Defra / Brook Lyndhurst	Nov-09	Household Waste Prevention Evidence Review - WR1204.
Defra / Brook Lyndhurst and Waste Watch	Jan-07	Establishing the behaviour change evidence base to inform community-based waste prevention and recycling
Defra / Brook Lyndhurst, Resource Recovery Forum and Waste Watch.	Mar-09	Enhancing Participation in Food Waste Collection Schemes. WR0209
Defra / Cranfield University & Enviros Consulting Ltd.	Feb-07	Health impact assessment of alternate week waste collections of biodegradable waste
Defra / Dorset County Council	Mar-08	Household Waste Prevention Activity in Dorset - WR0116
Defra / Eunomia	Nov - 06	Optimising Kitchen Waste Collections.
Defra / Global Action Plan	Feb-08	Building Greater Understanding of the Techniques and Processes Required to Promote Sustainable Waste Management through Behaviour Change Programmes - WR0114
Defra / Resource Futures	2008	Review of Municipal Waste Component Analyses - WR0119.
Defra / Resource Futures	Oct-09	Understanding Waste Growth at Local Authority Level. WR0121.
Defra / Resources for Change	2008	Benefits of Third Sector Involvement in Waste Management. Annex 2. The SORT IT campaign. WR0506.
Defra / The Social Marketing Practice.	Mar-05	Behaviour Change: Scoping the way forward. WR0508.
Defra / Tucker P and Douglas P.	Jan-07	Understanding household waste prevention - final report and technical annex. University of Paisley.
EPA Ireland	2008	Organic waste management in apartments – final report - Ireland.
EU	Apr-10	Draft Report on the Commission Green Paper on the management of bio-waste in the European Union
EU / Eunomia	May-07	Managing Bio-wastes from Households in the UK (full report and technical annex).
EU / Eunomia	Feb-10	Management of Bio-Waste in the EU
Eunomia	Jul-07	Improving the Kitchen Waste Collection Service by Supplying Liners
Food Waste Conference 2008g	Mar-08	How the Food Industry Can Help Reduce "The Food We Waste". Andrew Parry, WRAP.

Food Waste Conference March 2008a	Mar-08	Enhancing participation in kitchen waste collections - Key Findings in Participation. Jayne Cox, Brook Lyndhurst.
Food Waste Conference March 2008b	Mar-08	In-home food waste logistics. Corinne Wilkins.
Food Waste Conference March 2008c	Mar-08	Communicating about food waste. Sara Giorgi, Brook Lyndhurst.
Food Waste Conference March 2008d	Mar-08	Food Waste Collection Trials - Update and lessons learnt. Linda Crichton, WRAP.
Food Waste Conference March 2008e	Mar-08	An EU overview - strategies for optimising food waste collections. Enzo Favoino, ISWA.
Food Waste Conference March 2008f	Mar-08	Householder Participation and Food Waste Capture. Julian Parfitt, ECT.
Food Waste Conference March 2008g	Mar-08	Maximising Capture in mixed food waste collection systems - Bexley LB. Stephen Didsbury, Head of Waste, Bexley.
Food Waste Conference March 2008h	Mar-08	Kitchen Waste Collection Service. Trish Flint, Recycling Team Leader, City & County of Swansea.
Food Waste Conference Nov 2007a	Nov-07	The Sustainable Food Challenge, Brownes Jones Defra.
Food Waste Conference Nov 2007b	Nov-07	Consumers, Food Waste and Sustainability. Alan Knight, Sustainable Development Commission.
Food Waste Conference Nov 2007c	Nov-07	Household Food Waste - Scale of the Problem. Andrew Parry, WRAP
Food Waste Conference Nov 2007d	Nov-07	Peoples Food Waste Attitudes and Behaviours. Barbara Leech, WRAP
Food Waste Conference Nov 2007e	Nov-07	Consumer views on recycling food waste. Jayne Cox, Brook Lyndhurst.
Food Waste Conference Nov 2007f	Nov-07	Benefits of separate food waste collections. Julian Parfitt, Resource Futures or ECT Recycling.
Food Waste Conference Nov 2007g	Nov-07	Options for dealing with food waste. Dominic Hogg, Eunomia.
Foresight Programme / Parfitt J, Barthall M and Macnaughton S.	April 2010 (Unpublished).	Foresight - Food and Farming Futures Project: Driver Review (Waste). Includes draft report and write up from workshops.
Hinckley & Bosworth Borough Council	(No date) Unpublished	Hinckley and Boswell Food Waste Trial Survey Results.
Husaini I.G, Garg A, Kim K, Marchant J, Pollard SJT and Smith R.	2007	European Household Waste Management Schemes: their effectiveness and applicability in England. Resources, conservation and Recycling 51 (1), 248 - 263.
Knipe, Dr A D	Nov-05	The management of household food waste. Environmental Research & Consultancy.
Lancashire County Council	Jun-07	Kitchen Waste Composting Trial
Milton Keynes Council / Organic Resource Agency	Jan-07	Pilot food waste collection trials in Milton Keynes 2005 - 2007.
MRW Article	Jun-09	Article on MRW - Recycling Incentives aren't necessary claims May Gurney.
Pitts C.	No Date (Unpublished)	Food Waste: A Growing Problem. University of Southampton.
Remade Scotland	Feb-07	Factors for Success – Review of Scottish

		Kerbside Recycling Schemes
Remade Scotland	Oct-08	Scottish Food Waste Collection Trials
Resource Futures	Apr-09	Presentation - Analysis of Food Waste Arisings Data
Resource Recovery Forum	Aug-09	International Review of Household Waste Prevention Policies and Practices.
Social Marketing Foundation	May-08	Creatures of Habit – The Art of Behavioural Change.
Somerset Waste Partnership	Mar-10	Somerset SORT IT Campaign - 3 reports + article on RRF on May Gurney work in Somerset.
Tim Evans Environment	Jun-07	Environmental impact study of food waste disposers for Hertfordshire County and Worcestershire County Council (full report and summary).
Waste Works	March 2009 (Unpublished).	Analysis of the residual waste set out by households who have not previously set out a food waste container for collection.
Western Riverside / Waste Watch	May-07	What not to Waste - Western Riverside Authority
WRAP	Mar-06	Improving the Performance of Waste Diversion Schemes – Good Practice Guide to Monitoring & Evaluation
WRAP	Jul-09	Food Waste Collection Guidance
WRAP	March 2007a	Understanding Food Waste, Research Summary.
WRAP	Nov 2009a	Down the Drain - Quantification and exploration of food and drink waste disposed of to the sewer by households in UK.
WRAP	Nov 2009b	Household Food and Drink Waste in the UK.
WRAP / Brook Lyndhurst	Jun-07	Food Behaviour Consumer Research: Quantitative Phase (Brook Lyndhurst).
WRAP / CEC & KSB	(No Date)	Scotland Food Waste Trials.
WRAP / Entec	July 2007a	Alternate weekly collections guidance. Entec UK.
WRAP / Enviros Consulting	Jun-08	Kerbside Recycling – Indicative Costs and Performance and Technical Annex. Enviros Consulting.
WRAP / Eunomia	Mar-07	Dealing with Food Waste in the UK.
WRAP / Eunomia	Oct-08	Food Waste Collection: Update to WRAP Bio-waste Cost Benefit Study
WRAP / Exodus Market Research	Apr-08	The Food We Waste [v2 - revised July 2008] (Executive Summary and Full Report). Exodus Market Research.
WRAP / Exodus Market Research	March 2007b	We Don't Waste Food: A Survey of Household Perceptions and Behaviours around Food Waste Production
WRAP / Exodus Market Research	Sept 2009a	The Food We Waste in Scotland. Exodus Market Research.
WRAP / Hyder Consulting	April 2009 (Unpublished)	Leicestershire Waste Partnership Food Waste 'Non-Participants' Survey. Hyder Consulting Ltd.
WRAP / Ipsos MORI	July 2007b	Understanding Consumer Food Management Behaviour. IPSOS MORI.
WRAP / MEL Research	Feb-10	Performance analysis of mixed food and garden waste collection schemes. MEL Research.
WRAP / Oakdene Hollins	Jul-10	Waste arisings in the supply of food and drink to households in the UK.
WRAP / Resource Futures	August 2010	Assessment of Household Food Waste.

WRAP / Resource Futures	Mar-08	Improving Low Participation Areas – Effective communications planning Guidance Document. Resource Futures.
WRAP / Resource Futures	Sep-08	Evaluation of the WRAP Separate Food Waste Collection Trials. Resource Futures.
WRAP / Resource Futures	Jun-09	Evaluation of WRAP Food Waste Collection Trials, Final Report (Updated). Resource Futures.
WRAP / Resource Futures	Sept 2009b	Home Composting Diversion – District Level Analysis (update to previous reports). Resource Futures.
WRAP / Waste Watch	(No date) Unpublished	Monitoring Food Waste Capture Rates of the Rotate Food Waste Collection Trials (WRAP).
WRAP / Women’s Institute	Oct-08	Love Food Champions - Women’s Institute.
WRAP / WRc	(Unpublished)	Analysis of food waste behaviours. WRc.
WRAP / WRc	Sept 2009c	Home Composting Diversion – Household Level Analysis. WRc.

Appendix 1b: Key Contact List

The table below provides details of the key contacts which were used to collate research for the literature review. NB – key WRAP contacts are not included.

No	Stakeholder	Name
1	Association of Cities and Region for Recycling & Sustainable Resource Management	Jean-Pierre Hannequart
2	Brook Lyndhurst	Jayne Cox
3	CIWM	Carmel Golden
4	Defra	Sal Burgess
5	Defra	Marc Owen
6	Defra	Lisa Oakes
7	Defra	Judicaelle Hammond
8	Defra	Fay Skevington
9	Defra	Andrea Collier
10	DOENI	Owen Lyttle
11	DOENI	Betty Perris
12	GLA	Andy Richmond
13	Independent Expert	Enzo Favoino
14	Lets Recycle	Caelia
15	London Remade	Dee Moloney
16	Materials Recycling Weekly	Paul Sanderson
17	Northampton University	Margaret Bates
18	Recycling and Waste World	Geraldine Faulkner
19	ReMade Scotland	Colin Murchison
20	Resource Futures	Julian Parfitt
21	Resource Recovery Forum	Kit Strange
22	Scottish Government	Gordon Jackson
23	WAG	Emily Finney
24	WLGA	Georgina Taubman

Appendix 2: Pre review assessment form.

WRAP Literature Review – Pre Review Assessment Form

Objective

This form has been designed to undertake an initial review of all the technical food waste/waste prevention reports which have been identified through the initial stage of research.

The assessment summarises the report, highlights where the report refers to the key aspects of the literature review and provides a score in relation to the level of detail.

Based on the key aspects addressed, the report is either approved or rejected to be included in the full literature review process.

Report No (project log)			
Report Title			
Publication Status	Published	Unpublished	
Date of Report			
Author			
Source			
Report Summary			
Please select the key topics covered by the report and provide some detail along with information on the level of detail. <i>Please note reference to food waste collection includes – mixed food and garden waste, separate food waste, home composting and maceration.</i>			
Topic	Topic Covered (yes/no)	Summary of Information	Comments on level of details.
Householder awareness of food waste prevention e.g. Love Food Hate Waste.			
How different food waste collection systems impact on quantity and quality of food waste collected.			
Compositional analysis in relation to food waste collections.			
Communications for food waste collections and impact on householder behaviour.			
Other (please specify).....			
Overall Comments on report (in relation to suitability to review).			
Taken forward to full literature review (please select).	Yes	No	

Appendix 3: Literature review reports.

Sponsor / Author	Date of Publication	Document Title
Defra / AEA Technology and The Future Foundation	Aug-07	Modelling the Impact of Lifestyle Changes on Household Waste Arisings - WR0107.
Defra / Brook Lyndhurst	Nov-09	Household Waste Prevention Evidence Review - WR1204.
Changeworks	Apr-10	Kitchen Canny Monitoring - Mini Report 2.
Community Recycling Network for Scotland	Dec-09	Kingsway Court Food Waste Collection and Composting Pilot Project
MRW Article	Jun-09	Article on MRW - Recycling Incentives aren't necessary claims May Gurney.
Resource Futures	Apr-09	Presentation - Analysis of Food Waste Arisings Data
Defra / Resource Futures	Oct-09	Understanding Waste Growth at Local Authority Level. WR0121.
WRAP / Resource Futures	Aug 2010	Assessment of Household Food Waste.
Defra / Resources for Change	2008	Benefits of Third Sector Involvement in Waste Management. Annex 2. The SORT IT campaign. WR0506.
Somerset Waste Partnership	Mar-10	Somerset SORT IT Campaign - 3 reports + article on RRF on May Gurney work in Somerset.
Defra / The Social Marketing Practice.	Mar-05	Behaviour Change: Scoping the way forward. WR0508.
WRAP / Waste Watch	(No date) Unpublished	Monitoring Food Waste Capture Rates of the Rotate Food Waste Collection Trials (WRAP).
Western Riverside / Waste Watch	May-07	What not to Waste - Western Riverside Authority
WRAP	March 2007b	We Don't Waste Food: A Survey of Householders Perceptions and Behaviours around Food Waste Production
WRAP / Resource Futures	Jun-09	Evaluation of WRAP Food Waste Collection Trials, Final Report (Updated). Resource Futures.
WRAP	Jul-09	Food Waste Collection Guidance
WRAP / Exodus Market Research	Nov 2009a	Down the Drain - Quantification and exploration of food and drink waste disposed of to sewer by households in UK.
WRAP / WRc	(Unpublished)	Analysis of food waste behaviours. WRc.

Appendix 4: Review of reports included in literature review.

Report Title	Modelling the Impact of Lifestyle Changes on Household Waste Arisings.	
Publication Status	Published – Yes	Unpublished
Date of Report	31 July 2006	
Author	AEA Technology, The Future Foundation and the Social Marketing Practice.	
Source	Defra (WR0107)	
Report Summary	<p>Objective: The study aimed to develop a forecasting tool that provides a range of alternative projections on the impact of different lifestyle trends on the future of household waste composition and arisings in England through to 2020. The model has been designed to allow policy makers to identify probable trends in the main economic and social drivers on household waste arisings, such as increasing affluence or decreasing household occupancy. It also provides evidence as to which waste streams are most sensitive to potential policy interventions and allows resources to be prioritised.</p> <p>Methodology: An initial scoping study was undertaken to identify historical waste trends. The model was then developed to using a series of data assumptions and incorporating the fact that the majority of householder waste is a reflection of consumer spending. The model was then reviewed as through stakeholder workshops and extensive consultation.</p> <p>Additional research was carried out in July 2006, as new data on waste has become available. This additional research reviewed the new data against what the model would have predicted.</p> <p>Key Conclusions: An innovative and flexible model has been developed to allow Defra to explore the economic, social and consumer attitudes and behaviours which have the greatest impact on future waste composition and arisings.</p> <p>The additional research revealed that the initial model would have predicted higher levels if waste growth for the years which reported statistics were now available. It is considered that the differences in reporting are a result of a number of factors responsible for waste growth. A key recommendation is that further research should be conducted to determine the quantifiable impacts of particular waste growth scenarios and local practices e.g. frequency and size of residual collection, green waste policy. The model can then be refined leading to greater confidence in future waste arising predictions.</p> <p>Relevance to literature review: The report does not provide any evidence on food waste prevention, but it does highlight the importance of further research on the factors which will impact on future waste arisings. The outcomes of any further studies into waste prevention and food waste should consider how the results can be integrated into this model and assist in more accurate assessment of future waste growth.</p>	

Report Title	Household Waste Prevention Evidence Review	
Publication Status	Published - Yes	Unpublished
Date of Report	October 2009	
Author	Resource Recovery Forum, Brook Lyndhurst and the Social Marketing Practice.	
Source	Defra (WR 1204)	
Report Summary	<p>Objective: The study set out to consolidate the evidence base on household waste prevention. The study reviewed the extent to which waste prevention behaviours were practised at household level, what barriers and motivations are and what options and measures exist to encourage waste prevention behaviour.</p> <p>Methodology: An extensive literature review was undertaken reviewing reports from Defra, WRAP, academic papers and key pieces of practitioner research.</p> <p>Key Conclusions: In relation to the literature review the study concluded the following:</p> <ul style="list-style-type: none"> ■ There is no single activity involved in waste prevention and it is difficult to distinguish the impact of a waste prevention behaviour from another impact; ■ In reviewing the impact of policy measures on waste prevention, the report identified that the organisation of collection regimes, including AWC/residual bin restriction combined with extensive recycling provision, could have a potential waste prevention impact of 0.7 million tonnes per year. ■ Some evidence to suggest that making food waste visible to people (diaries, weighing waste or food waste collection) can encourage them to think more about reducing waste. However, the report states that further research is needed on this. <p>Relevance to food waste prevention: The report provides some useful information on waste prevention activities in general. It indicates that there is some evidence that when people interact with food waste that this drives waste prevention behaviour. However, the report acknowledges that further research is required. The report also provides links to two other key Defra reports WR0105 and WR0506.</p>	

Report Title	Kitchen Canny Monitoring	
Publication Status	Published - Yes	
Date of Report	April 2010	
Author	Changeworks	
Source	Changeworks	
Report Summary	<p>Objectives: The 'Kitchen Canny' campaign is a 2 year long INCREASE III funded project to reduce food waste across the Lothian and Borders region. This is being delivered by Changeworks. The report provides an overview of the campaign between September 2009 and March 2010.</p> <p>Methodology: Overall the project aims to engage with 3,000 household with the aim of reducing food waste in households by 25%. To date the project has successfully engaged with 49 households who are actively participating in the project.</p> <p>The project focuses around the identification of community champions who distribute campaign packs including information on how to reduce food waste, a kitchen caddy to allow for the trial collection of food waste and a portioning cup.</p> <p>The campaign pack contained an evaluation form to allow participants to monitor food waste. This data was used to evaluate reductions in food waste and the effectiveness of the campaign.</p> <p>Participants were asked to add food waste to their kitchen caddy over a period of 4 days and record how full their caddy was on the evaluation form. Participants then repeated this exercise 3 weeks later.</p> <p>Some of the limitations of this method for drawing conclusions on waste prevention behaviour:</p> <p>Sample Size – The sample size (49) is too low to draw any firm conclusions on the success of the approach. The demographics of the sample are also limited in that participation in the scheme has not been determined by selecting a range of households that are representative of the UK population. Currently larger households are more represented in the sample. The report also indicates that they have a larger proportion of participants who are likely to home compost and it concludes that these people are more likely to be environmentally aware. Some participants commented that the study was already 'preaching to the converted'. The report states that they do expect further responses as the project is still ongoing.</p> <p>Method of evaluation – The method of recording the levels of food waste were reliant on self assessment from the participants on how full their kitchen caddy was. When compared to weights of the caddy, it was apparent that these results had limited accuracy. For example, 7 respondents claimed that that their caddies were empty in the second evaluation exercise, but the weight of these caddies ranged between 01 and 0.37kg.</p> <p>Length of evaluation – The assessment of food waste arisings was undertaken for 4 days over two periods 3 weeks apart.</p> <p>Data - As mentioned above participants were asked to record how full their caddy was and weigh this at the end of the week. No data on composition of these waste streams was recorded and no data was taken from the amount of food waste in the residual bin. This makes it difficult to conclude whether a reduction in food waste arisings in the kitchen caddy was a result of waste prevention or diversion of the food waste into the home composting or residual bin. As the sample size contained a large proportion of households who state that they home compost, it is possible</p>	

that the reduction in food waste could have been due to a diversion to home composting. However, there is no conclusive evidence to back up this observation.

Key Conclusions:

- In the first food waste monitoring exercise on average the caddies were approximately 40% full, with an average weight of 1kg per household (32 participants weighed the caddy). However, there was wide variation in the weight of food waste (0.04 – 5kg).
- In the second food waste monitoring exercise participants stated that on average that their caddies were 15% full and that the average weight was 0.5kg (25 participants weighted caddy). The weights in the second week ranged from 0 to 3kg.
- The report concludes that the average food waste reduction of those who participated in weighing the caddy in both evaluation weeks (25 participants), was 52% and that when considering the fullness of the caddy the waste reduction was 42% (47 participants in both evaluation weeks).
- The results of this section of the evaluation of the project were similar to those reported in January.

The attitude survey revealed the following results:

- 94% stated that they will try to reduce the amount of food waste.
- 22% requested further information on home composting suggesting that further diversion of materials to home composting.

Relevance to food waste prevention: Shows a reduction in food waste collected over time. However for the purposes of this review, the limitations of the methodology listed above (relating to weight and the lack of assessment of the residual bin) limit the ability to draw firm conclusions. The attitudes survey suggests increased awareness and behaviour change

Report Title	Kingsway Court Food Waste Collection and Composting Project	
Publication Status	Published - Yes	Unpublished
Date of Report	February 2010	
Author	Scottish Organic Services	
Source	Community Recycling Network for Scotland	
Report Summary	<p>Objectives: This study was undertaken as part of the Scottish Food Waste Collection trials in recognition of the specific circumstances that high density urban housing presents in relation to food waste collections. The project was funded by the Scottish Government and was undertaken by the Community Recycling Network in close collaboration with Dumbarton Road Corridor Environment Trust. The objectives of the trial were to implement a food waste collection service and monitor the success of the scheme for diverting food from landfill.</p> <p>Methodology: Two months prior to the trial an intensive communications campaign was conducted to raise awareness and communicate the benefits of the service to residents. The trial started on 23rd September 2008 and ended on 22 September 2009. Prior to the trial and six months into it, an attitudinal survey was also conducted to collate participant's feedback on the service and note any changes in behaviour.</p> <p>The tonnes of food residues and participation rates were recorded each week.</p> <p>In relation to the literature review this study has the following considerations in relation to food waste prevention:</p> <ul style="list-style-type: none"> ■ Focus of Study - Study was only undertaken on high density housing in urban areas and as previous WRAP studies have shown these study areas generate lower participation rates and yields and have their own considerations for food waste behaviours. This is largely due to the socio demographics that high density housing represents. ■ Sample size – Kingsway Court has 6 blocks which contain 684 flats. Of these 274 members (at the end of the trial) were members of the trial, of which 169 were actively participating in the food waste collection. This is a low sample number to be representative of the UK. ■ Measurement of food waste – Only the tonnes of food waste collected in the food waste collection bin were weighted and therefore any reduction in food waste collection (even if linked to participation rate) cannot be conclusively linked to waste prevention as the food waste may have been diverted into the residual bin. ■ On site composting facility – The food waste collection was run in conjunction with a community composting scheme and an in vessel composting facility was constructed on site, with the ideal that residents will use this compost in ground maintenance. This is different to the majority of food waste collection schemes which collect food waste for large scale treatment off site and could have impacted on the results. The report concludes that a benefit of this onsite composting facility is waste minimisation. <p>Key Conclusions</p> <p>The study provided the following key results:</p> <ul style="list-style-type: none"> ■ Significant in food waste collected following the introduction of door to door collections (2,000kg to 5,100 kg/per quarter). ■ On average there were 200 participants per week with an average of 2.6 – 3kg. Only 28% of residents participate regularly in the food waste collection. 	

- Average food waste yields per participant per year were observed to be 140kg.
- The report concludes '*the reported fall in yield/household/week recorded in the last few months of the trial are taken to reflect increased awareness by participants of wastage of food*'. The study also states that this conclusion is backed up by responses to second awareness survey, in which 30% of respondents reported that they had changed their behaviours as a result of the food waste collection.
- Reviewing this data shows that the highest yield (4.1kg/hh./week) is not maintained and could be considered to be a data anomaly and perhaps a result of the start of the scheme and delays to the collection of food waste.
- The results of the study show an increase in yields for week 1 – 48, and thereafter a steady decrease in yields. The increased yields for the majority of the trial were thought to be as a result of the changes to the collection system (a new door-to-door service and a second food waste collection every week) introduced in Week 16 and 45 of the trial.
- Attitudinal surveys showed that 48% of participants were more aware of food waste and 30% claim to have changed their behaviour after realising the amount of food they were wasting.
- The social benefits of a the community food waste collection and composting scheme was stated to have a number of benefits over a local authority kerbside collection:
 - High visibility in the community
 - Flexibility of collections
 - Inclusions with opportunities for volunteering.
 - On site community composting scheme to enhance awareness of end use of waste.
 - Use of compost on estate in maintenance of grounds and gardens.
- Monitoring of the scheme is due to take place in May 2010 and March 2011 to monitor any changes in participation and behaviour change.

Relevance to Food Waste Prevention:

Report concludes there is a reduction in yields towards end of project. However, as the survey was not designed to assess the food waste arisings in the residual waste stream, it is difficult to draw any firm conclusions on the reason for the decline in collected food waste arisings. Home composting is unlikely to be an issue in high density housing. Report demonstrates a change in behaviour. (Although note the limitations of survey data of declared behaviour). Housing type and on-site composting vessel are atypical.

Report Title	Recycling Incentive schemes are not necessary
Publication Status	Published article
Date of Report	09/06/2010
Author	May Gurney
Source	MRW
Report Summary	<p><u>Overview of Article</u></p> <p>In June 2010 an article in MRW confirmed the results of the Somerset Waste Partnership SORT IT! Campaign, where introducing a food waste collection reduced the overall amount of food waste disposed of by 25%. This is linked to householders seeing how much food they are throwing away and taking actions to reduce this. Nicola Peake (May Gurney) calls for a more comprehensive recyclables collection scheme that included food recycling, fortnightly waste collection and weekly dry recyclable collection, as this approach, in their experience has led to recycling rates between 65% and 70%, low residual waste volumes, partly due to reduced food waste, high capture rates for food and dry recyclables, with the best carbon dioxide profile and a lower overall system cost including kerbside collection, treatments and disposal.</p> <p><u>Relevance to food waste prevention</u></p> <p>The statement from May Gurney supports their results from the SORT IT! Campaign implemented for Somerset Waste Partnership. This supports the theory that overall food waste yields are reduced with separate food waste collections.</p>

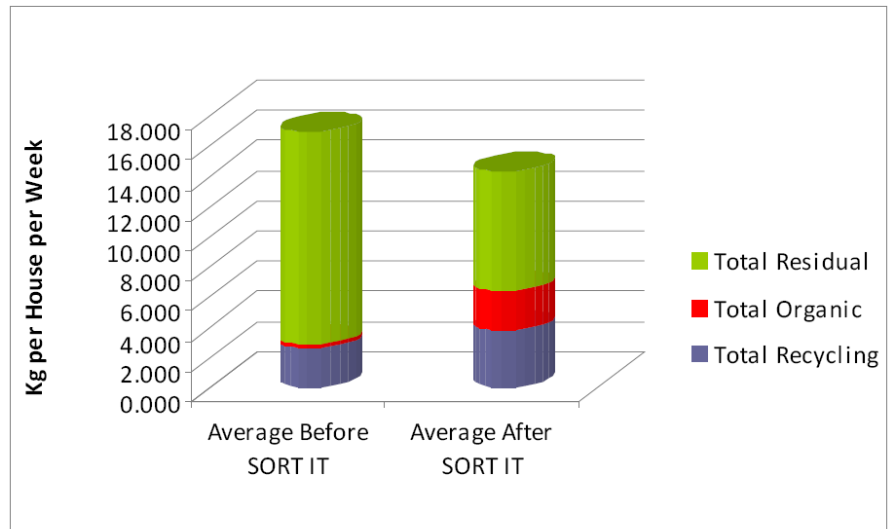
Report Title	Presentation – Analysis of Food Waste Arisings Data	
Publication Status	Published – Yes	Unpublished
Date of Report	April 2009	
Author	Dr Julian Parfitt	
Source	Resource Futures	
Report Summary	<p><u>Objectives and Methodology</u></p> <p>The presentation was delivered by Dr Julian Parfitt in April 2009. The presentation looks at the food waste arisings data collated from the WRAP for the Food We Waste report and the separate food waste collection trials. These two data sets represent 16 sample areas. The presentation aims to review the variations in the food waste arisings in the 16 different areas and assess whether the variations are due to sampling methodologies, socio demographic factors or other factors.</p> <p><u>Key Conclusions</u></p> <p>The review of the sample data provides an indication that there is less food waste overall in areas where there is a food waste collection. However, there are a number of interacting factors which affect the results. To fully review the impact of food waste collections on waste prevention the study needs to have pre and post research which is linked to compositional analysis.</p> <p><u>Relevance to Food Waste Prevention</u></p> <p>The presentation supports the theory that where food waste collections are implemented there is a reduction in overall food waste arisings. This indicates that waste prevention is occurring, however, there are a number of other influencing factors that may determine a reduction in food waste arisings.</p>	

Report Title	Understanding Waste Growth at Local Authority Level	
Publication Status	Published – Yes	Unpublished
Date of Report	October 2009	
Author	Ashley Robb and Dr Julian Parfitt, Resource Futures	
Source	Defra (Waste and Resources Evidence Programme)	
Report Summary	<p><u>Objectives</u></p> <p>The study aimed to provide a more detailed understanding of the factors that influence waste growth in household waste. The study specifically focused on the effect that local waste policies have on influencing household waste growth. This will provide further support to the development of the household arisings model developed for Defra by AEA Technology.</p> <p><u>Method</u></p> <p>28 local authorities were contacted to provide information on a range of information on changes in waste policy and waste arisings. The local authorities were selected as they represented a range of demographics, had a reasonable time series of waste arisings data and represented both WCA and UA. Of the 28 authorities, 50% demonstrated waste growth and 50% represented a decline in household waste arisings. The data captured included:</p> <ul style="list-style-type: none"> ■ Total waste arisings and per household ■ Changes to collected waste infrastructure and associated policies ■ Key demographics ■ Locally held waste statistics ■ Changes in waste data reporting – e.g. definition of waste. ■ Changes in management of non household element and ■ Information on local trends pre-2001. <p>This data was collected through a 'data capture template' and this was complemented with a visit to each case study authority.</p> <p><u>Key conclusions</u></p> <p>The study revealed that there are a number of factors that appear to affect household waste trends. In relation to local authority policies the key conclusions were:</p> <ul style="list-style-type: none"> ■ AWC suggests reduction in arisings of 120 kg/household/year ■ Lower level of reduction for AWC where garden waste collection is operational – 13 – 30kg per household per year. ■ Diversion of residual waste to HWRCs when AWC introduced. Although local authorities reported this as a temporary issue. <p><u>Relevance to food waste prevention</u></p> <p>The report does not provide a review of the impact of implementing food waste collection and does not provide any direct evidence on the impacts of food waste collection schemes on waste prevention behaviour. However, it demonstrates that there are a number of factors which are influential in promoting a reduction in waste arisings. The findings of the study do provide an indication on how the introduction of Alternate Weekly Collections (AWC) is associated with a reduction in waste arisings, as householders reconsider when and what to put in the residual</p>	

bin. The study also demonstrates that in the initial stages of an AWC, local authorities observed an increase in waste at HWRCs, showing a diversion of waste from the kerbside collection. It was reported that this behaviour was generally only short lived. This provides further indication that the introduction of a food waste collection may lead to the diversion of food waste into another waste stream – residual, home composting or even HWRC sites. Any study into the impacts of a food waste collection on waste prevention should consider the likely impact of the diversion of food waste into another waste stream.

Report Title	Benefits of Third Sector Waste Management – Annex 2 Case Study
Publication Status	Published - Yes
Date of Report	Unknown
Author	Resources for Change, New Economics Foundation and Resource Futures
Source	Defra WR0506
Report Summary	<p><u>Objectives</u></p> <p>Defra commissioned Resources for Change and the New Economics Foundation to undertake a review of the benefits of third sector involvement in waste management. The key objectives of the research were:</p> <ul style="list-style-type: none"> • What are the net benefits that third sector organisations (TSOs) generated through their involvement in local authority waste management and what is their value? • Are these benefits more prevalent in TSOs or shared by the private sector? • How do the social, economic and environmental (SEE) benefits created by TSOs meet the needs of local authorities? • What are the opportunities for increasing the SEE value captured by waste management activities? <p>As part of this review, a case study on ECTs (Community Interest Company) involvement in implementing the SORT IT campaign for Somerset Waste Partnership was evaluated. This campaign involved the implementation of a separate food waste collection. <i>NB – ECT were bought by May Gurney, and now operate as a private sector company.</i></p> <p><u>Methodology</u></p> <p>The data to evaluate this case study was provided independently by Somerset Waste Partnership and we do not have access to the original data sets to cross reference the validity of any conclusions on waste prevention.</p> <p><u>Key Conclusions</u></p> <p>ECT CIC, now May Gurney, deliver the innovative SORT IT campaign which is the first large scale recycling scheme with separate food waste collections to be established after the Animal By-product Regulations were introduced in 2005. The scheme was implemented to 160,000 households in November 2006 and consisted of the following:</p> <ul style="list-style-type: none"> - AWC for residual - Weekly food waste collection - Weekly dry recycling - Charged separate collection of green waste to encourage home composting. <p>The results of the scheme are impressive:</p> <ul style="list-style-type: none"> • Increased recycling by 30,000 tonnes and reduced food waste by 9,500 tonnes per year. Overall levels of food waste have reduced by 24% and this is attributed to a change in purchasing habits, home composting and moisture loss. • The scheme has led to a very low residual waste per household, at 220 kg per year (reduced by 40% from 14 – 8kg per household per week). • Cost savings for households arise from reduced food purchasing costs because consumers can see their food waste. • Social benefits also arise from work placements.

Reduction in Waste from SORT IT! Campaign

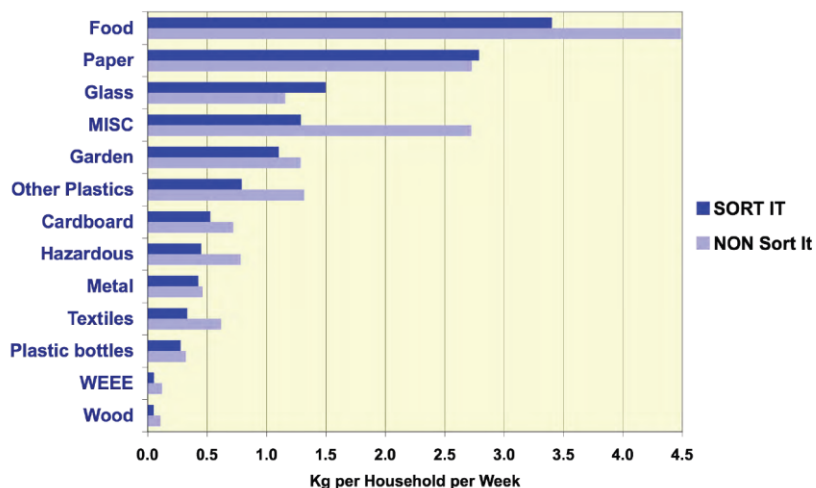


Relevance to food waste prevention

The report reviews the case study for ECT CIC implementing an innovative SORT IT! Campaign for Somerset Waste Partnership. This scheme involves a separate food waste collection and results in the report indicate that this has provided a 24% reduction in overall food waste. It acknowledges that some of this waste is due to diversion to home composting, but also allocates some of this to waste prevention through a change to consumer purchasing habits. The data used to evaluate this scheme was provided by SWP and therefore we have been unable to assess the quality and quantity of this dataset.

Report Title	Somerset Sort It campaign Information pack, Press release 2010, Sort it trials report
Publication Status	Published
Date of Report	June 2008 version
Author	Somerset Waste Partnership
Source	
Report Summary	<p><u>Objectives</u></p> <p>Information on the SORT IT! Scheme was provided by David Mansell (Strategy and Communications Team Leader). The SORT IT! Scheme which was introduced in October 2004 as part of an integrated package of waste collection services, which includes:</p> <ul style="list-style-type: none"> • Weekly recycling and food waste collections, with kerbside sorting for recyclables; • Fortnightly refuse collections, with 180-litre wheeled bins provided to most households; • Optional charged garden waste collections using wheeled bins or compostable paper sacks. <p>SORT IT! was rolled out in phases and expanded to cover over 160,000 households throughout Mendip, South Somerset and Taunton Deane in 2006. The waste partnership includes Mendip, Sedgemoor, South Somerset and West Somerset District Councils, Taunton Deane Borough Council and Somerset County Council.</p> <p>The new collections were supported by a comprehensive communications plan, with home composting promoted as the preferred option for organic waste.</p> <p><u>Key Conclusions</u></p> <p>The SWP was keen to collect food waste because waste composition analysis undertaken in Somerset over 4 seasons during 2002 - 03 had shown that food waste was the largest category of the WCA bin waste stream not being targeted for recycling. This analysis found that food waste contributed more than 200 kg per household per year to bin waste.</p> <p>Overall, in SORT IT! collection areas, total WCA waste has reduced by 12 and 21%, refuse levels have halved and recycling rates have more than doubled to 45-49%, with a quarter of these rates contributed by food waste. Further details are provided in the summary of Report 85.</p> <p>The information does indicate that the waste arisings at the HWRCs have increased which may account for some of this reduction of waste at the kerbside.</p> <p>The SORT IT! Campaign was not rolled out to all districts in Somerset. In March 2006, the scheme was operational in 3 districts and when comparing SORT IT! with non SORT IT! areas it can be seen that waste arisings from food waste have decreased. Again, it is not known whether this is waste prevention or home composting. Compositional analysis at HWRC sites confirms that diversion of food waste to HWRC was not a significant factor in reduction.</p>

COMPARISON OF SORT IT! AND NON-SORT IT! YIELDS – MARCH 2006



Relevance to food waste prevention

The SORT IT! Scheme indicates that overall waste arisings have reduced and of this a 24% reduction in food waste has been observed. The reasons for this reduction are diversion to home composting, waste prevention of moisture loss of material awaiting treatment.

Report Title	Behaviour Change – Scoping the way forward.	
Publication Status	Published - Yes	Unpublished
Date of Report	March 2005	
Author	Veronica Sharp - The Social Marketing Practice.	
Source	Defra	
Report Summary	<p><u>Objective</u></p> <p>The scoping study was commissioned in March 2005 by the Waste and Resources R&D Programme to provide a broad overview of the current and developing research relating to behaviour change programmes in the UK. The study was designed to provide:</p> <ul style="list-style-type: none"> - Identify and gather recent research material. - Undertake gap analysis - Prepare recommendations to inform waste policy. <p><u>Method</u></p> <p>The study was conducted through desk based research, involving an extensive literature review, followed up by telephone calls to verify some of the conclusions.</p> <p><u>Key Conclusions</u></p> <p>In relation to the literature review the following aspects of this report were deemed relevant:</p> <p>Further work on waste prevention behaviour should focus on actual rather intentional/declared behaviour. The report states that there is little evidence to demonstrate actual behaviour which will help to determine the services and infrastructure required to facilitate the required behaviour. A number of research studies focus on the declared rather than actual behaviour.</p> <p>To encourage the desired behaviours infrastructure should be designed to optimise the convenience factor. The report states that convenience is a key factor in behavioural terms and can reinforce persistence.</p> <p><u>Relevance to Literature Review</u></p> <p>A number of the reports on food waste arisings and behaviours focus on the declared rather than the actual behaviour. This should be a focus on any future food waste prevention studies. The conclusion that convenience is a key factor in behaviour change is comparable with the conclusions of the performance of food waste collections.</p> <p>In the best performing schemes the collection of food waste is arguably more convenient than use of the residual alternative. (Associated with changes to container sizes or collection frequency).</p> <p>In relation to the food waste prevention it may be that scheme design needs to consider this aspect further, and consider collection convenience in relation to incentives to prevent food waste. However, any schemes designed in this way must also consider the possible impacts of reducing the convenience of a food waste collection, in diversion of food waste back into the residual waste stream.</p>	

Report Title	Project REDUCE – What not to Waste
Publication Status	Published – Yes
Date of Report	May 2007
Author	Waste Watch
Source	Defra WR0105
Report Summary	<p><u>Objective</u></p> <p>The main objectives of the REDUCE Monitoring and Evaluation (M&E) research project are to develop and to test a common set of tools to measure the relative and absolute impact of a range of waste prevention initiatives. The project was part-funded by the European Union via the INTERREG IIIB North-western Europe programme, the Department for the Environment, Food and Rural Affairs Waste and Resources Evidence Programme, and the Waste and Resources Action Programme.</p> <p><u>Methodology</u></p> <p>Project REDUCE ran from January 2006 to September 2006 and was delivered in the four boroughs - Hammersmith & Fulham, Lambeth, Wandsworth and the Royal Borough of Kensington and Chelsea.</p> <p>The project consists of two major elements. The first is a desk-based research study to assess the range of M&E methodologies used by past and present waste prevention initiatives in the UK. The second element focuses on developing and trialling different M&E techniques, drawing on the research findings, through two household waste prevention initiatives in the London Western Riverside area.</p> <p>The project that was trialled and is relevant to this literature review is the 'What not to Waste' project. The aim of the 'What Not to Waste' (WNTW) project was to test the effectiveness of directly engaging householders at local level in waste prevention and minimisation activities and to measure the impact this has on reducing overall waste output and changing waste behaviour.</p> <p>The project recruited a number of households in the boroughs to take part in the challenge. In selecting the participants a strong emphasis was placed on recruiting low recyclers. They also considered the following criteria:</p> <ul style="list-style-type: none"> • Receptiveness to change • Willingness and ability to participate for the entirety of the project • Willingness to be interviewed by press and to participate in publicity events <p>16 households were selected to participate in the study. Each household was given three fortnightly waste prevention challenges. Households received support and ongoing support throughout the duration of the challenge. The challenges were:</p> <ul style="list-style-type: none"> • Challenge 1 – Increase recycling and home composting: Participants were asked to separate their food waste, weigh it on a weekly basis and where possible to home compost. Participants also weighed their black bin waste. • Challenge 2 – Waste Prevention – focus on junk mail and smart shopping. • Challenge 3 – Reuse – donating and reusing unwanted items. <p>The project was evaluated with the following methodologies:</p> <ol style="list-style-type: none"> 1. Baseline and follow up survey 2. Waste Audits – used to test claimed behaviour and undertaken at start of project, prior to the 1st challenge and at the end of the campaign. Participants were asked to keep one weeks worth of waste including recyclables, food and residual waste. 3. Challenge evaluation – participants were asked whether they intended to keep their new behaviours in relation to waste prevention.

4. Self monitoring – participants were asked to weigh their residual and food waste and recyclables every time they were put out for collection so that changes over time could be recorded.

Limitations of methodology

- Household sample – participants were selected for their willingness to change and participate in the scheme and were based on traditionally low recyclers. The sample may not be representative of the UK and will be heavily weighted to participants who are motivated to reduce waste.
- Nature of the 'challenge' – As waste prevention was sold to participants as a challenge, this would have impacted on behaviour as participants are going to be more aware during this time of how much waste they produce.
- Sample Size – Only 14 households participated in the survey, giving a small sample size to make these results representative of the UK.
- Evaluation Method – The evaluation method was generally good with aspects of waste composition (residual and separate food waste collection) at the start, middle and end of the challenge period. The self weighing data was removed from the analysis as it did not provide a reliable data set due to problems encountered with data collection.
- Waste Audits – inconsistency in recording of data, collections and audits fell on a bank holiday.
- Questionnaire Surveys – A complete set of surveys was not obtained and these were only used where both (before and after) datasets were returned.
- Long term impacts of behaviour – these have not yet been verified.

Key Conclusions

In relation to this literature review the key conclusions were:

Participants were successful in reducing their overall waste arisings (34% reduction). The main reductions being seen with residual (62%) and food waste arisings (51%). Not all of the residual reduction was due to food waste as there were a number of challenges focusing on a number of different waste streams.

Almost all participants reduced their total waste arisings. The most significant changes come with the types of waste produced. At the end of the challenge recycling now made up 58% of the total waste produced (a 30% increase). Food waste was reduced to 22% of the total waste arisings, which decreased from 29%. Residual waste decreased from 33% to 20% following the waste prevention challenges.

Residual waste per week reduced by 60%. Of the material in the residual bin food waste was seen to reduce by 50.7% (50.9kg/week to 25.1kg/week), with a significant reduction in the other recyclable materials. The reduction in food waste in the residual bin was attributed towards an increase in home composting. Six household started or restarted to home compost. This reduction was also thought to be attributed to smart shopping initiatives. However, there was no assessment of how much of this food waste has been diverted to the home composting scheme or whether this is waste prevention.

Relevance to food waste prevention

The report demonstrated amongst a small group (14 participants) that waste reduction activities can occur with a supportive waste prevention activity.

Food waste – composting or waste prevention.

Limitations of the methodology.

Report Title	We don't waste food – A Household Survey	
Publication Status	Published - Yes	Unpublished
Date of Report	March 2007	
Author	WRAP	
Source	WRAP	
Report Summary	<p><u>Objective</u></p> <p>This report provides the results of a quantitative survey of householder's perception and behaviour around food and food waste. It examines consumer attitudes and claimed behaviour in relation to food waste. The key aims of the study were to:</p> <ul style="list-style-type: none"> - Quantity of post consumer food waste. A further research project was undertaken to determine this aspect and is detailed in Household Food and Drink Waste in the UK (WRAP, Nov 2009); - How food waste arisings vary in relation to range of household characteristics; - Variation in food waste arisings as a result of local authority service provision; and - Conduct consumer research on householder behaviour in relation to food and food waste. <p><u>Methodology</u></p> <p>13 local authorities were approached to take part in the survey and these were selected for a variety of factors (geographical coverage, range of residual collection, food waste collection and demographics). Two rounds per authority were selected and doorstep interviews were conducted using a sampling framework to give a representative sample of households in the UK. In total 2,939 interviews were successfully conducted.</p> <p>The questionnaire asked a range of questions in relation to food shopping behaviour, pre shopping activity, eating habits, disposal of food waste and changing behaviour on food waste. The key conclusions listed below relate to those results which are relevant to this literature review and focus on food waste disposal and changing food waste behaviour.</p> <p>The limitations of this methodology for drawing conclusions on waste prevention behaviour:</p> <ul style="list-style-type: none"> - Questionnaire based – The results of the survey are based on a questionnaire, albeit to a large sample of households, however, there is no direct waste arisings and composition data to back up the claimed behaviours. <p><u>Key Conclusions</u></p> <p>In order to assess the anecdotal evidence that <i>'once households start to separate out their food waste for collection they start to appreciate the large quantities and begin to reduce what they throw away'</i>, the survey asked householders that participated in a food waste collection <i>'whether the food waste collection scheme had any impact on the amount of food waste that was thrown away?'</i>. The results indicate that most householders stated that the food waste collection had no impact the amount of food thrown away and many respondents qualified this by stating that their shopping, cooking and eating habits had not changed.</p>	

1 in 6 of the respondents felt that the amount of food waste had decreased as a result of participating in a scheme and others stated that they tried to keep waste to a minimum as they did not like the food waste in the house.

Relevance to food waste prevention

The report indicates that a food waste collection scheme has little impact on the amount of food waste that people perceive that they throw away. The limitations of this conclusion are based around the methodology of the study. The questionnaire based approach provides useful information on householders perceived behaviours. However, for these behaviours to be confirmed, detailed compositional analysis and capture rates (with participation monitoring) need to be undertaken to fully understand the reality of these claims. A number of householders who do not think that they have reduced their waste may well find that they have through this type of quantifiable survey.

Report Title	Evaluation of the WRAP separate food waste collection trials.	
Publication Status	Published – Yes	Unpublished
Date of Report	June 2009	
Author	Eric Bridgwater and Dr Julian Parfitt, Resource Futures	
Source	WRAP	
Report Summary	<p><u>Objectives</u></p> <p>The report provides a review of the 21 separate food waste collection trials which were funded by WRAP and run from Jan 2007 – March 2008. The lessons learnt from the trials has been included WRAP Food Waste Collection Guidance (July 2009) – Report 7 as part of this literature review.</p> <p><u>Methodology</u></p> <p>The 21 trials had similar scheme characteristics:</p> <ul style="list-style-type: none"> - Food waste collected weekly - Food waste collected separate from residual and garden waste - Small dedicated collection vehicles were used - Caddies and liners were provided. <p>The variation in the trials was provided in the socio demographics of the area where the scheme was implemented and in the mix of residual and recycling collection schemes. The trials collected data on:</p> <ul style="list-style-type: none"> - Tonnes of food waste collected; - Vehicle pick and pass rates; - Householder participation; - Householder attitudes; and - Waste composition and capture rates. <p>There are a number of comments on the methodology in how the results could be interpreted in relation to food waste prevention:</p> <ul style="list-style-type: none"> - <u>Participation Monitoring</u> – Participation monitoring was carried out in 20 of the trial areas. The number of times which participation monitoring was repeated was variable between the trial areas, with only 1 area undertaking monitoring 4 times throughout the duration of the trial. Without regular monitoring of participation rates it is difficult to determine whether any decrease in food waste collected is a result of waste prevention or reduced participation. - <u>Waste Composition/Capture Rate</u> – In six of trial areas waste compositional analysis was undertaken (500 households). The capture rate and waste composition was only taken as a snap shot of data and therefore allows no evaluation of change in behaviour over time. To measure a change in behaviour and the impact of a waste collection scheme you would need to review the waste composition and capture rate over time and link this to participation to link a reduced overall yield to waste prevention activities. NB – this comment does not take account of diversion of food waste to home composting. These six areas would have also had participation monitoring data, however (see below), these areas did not have responses to attitudinal surveys. In determining the influences of waste prevention activities it is important to have participation, composition and attitudinal surveys to determine the links between these aspects and the waste prevention behaviour. - <u>Attitudes Questionnaire</u> – Attitudinal surveys were carried out in 5 of the trial areas (2,500 households). These surveys asked a number of 	

questions relating to food waste, and in relation to this literature review asked respondents about their disposal behaviour for different types of food waste and whether the food waste collection had an impact home composting activity. These 5 areas were not the same as the waste compositional areas, but will have included in the participation monitoring. As mentioned above it is important in any waste prevention research to have access to participation, composition and attitude surveys to determine the links between these aspects and the waste prevention behaviour.

Key Conclusions

Collectively the trials provided a service to 135,540 households, diverting 10,200 tonnes of food waste from landfill. Some of the key results are listed below:

- From the 21 trials food waste yields/household served ranged from 0.32kg (flat bring scheme) to 2.1kg (kerbside). Higher yields were experienced where the residual collection was less convenient i.e. sacks or fortnightly collection and in more affluent areas. In these circumstances food yields are expected to be 20% higher than schemes which collected residual waste weekly and provide wheeled bins.
- Lower yields were experienced in the food waste schemes in flats at approximately 0.5kg/household served per week.
- The results showed decreasing yields overtime (per household served), with the trials running alongside weekly refuse collection decreasing significantly steeper. There is evidence in the report which suggests that those areas where participation monitoring was conducted over more than one phase, a decrease in participation was experienced. This could be linked to the decreasing yields over time. As there is a steeper decrease in yields over time with the food waste collections associated with weekly refuse collections and because these types of collections have previously been cited as having lower levels of participation, it could be concluded that the decrease in food waste collected was a result of this reduction in participation and not because of any waste prevention behaviour. Furthermore, this decrease in yield does not take account of whether food waste is being diverted to the residual waste stream and therefore there is no evidence to suggest that this is due to waste prevention behaviour. The report also concludes that schemes with fortnightly refuse collections generally maintained or in some cases increased yields and participation levels. This further questions whether there is any waste prevention behaviour as a result of the collections, if yields and participation are maintained.
- Participation rates ranged from 21 – 76% and for those areas where participation monitoring was repeated throughout the duration of trial, they experienced a drop off in participation.
- Waste compositional analysis of 500 households (6 trial areas) revealed that 53% of the waste in the food waste collection bin was unavoidable (peelings, cores and bones). This analysis also revealed that the capture rate ranged from 43 – 77%, with an average of 59% across the six trial areas.
- Attitudinal surveys showed that participants were happy with the food waste collection services. Those who did not participate said that this was because of perceived hygiene issues (24%), not producing enough food waste (21%) or because they already home composted their food waste (9%). The surveys also indicated that 4 – 8% of households stated that they have changed their behaviour as a result of the food waste collection (e.g. food purchasing habits and avoiding food waste). However, there were varied responses to this between the trial areas and the results may not be statistically significant.

	<ul style="list-style-type: none"> - In relation to home composting, the attitudinal survey states that 24% of respondents home compost. Of these 63% said the food waste collection had made no difference to their home composting behaviour, 24% said they compost less and divert waste into the food waste collection and 5% said that they composted more. Previous reports (Report 7 – Food Waste Collection Guidance) conclude that food waste collections will have limited impact on home composting behaviour. Participants state that they tend to compost uncooked vegetables and fruit peelings, tea bags and coffee grounds and participate in the food waste collection to recycle the remaining food waste. In conclusion there is no conclusive evidence of the impact that food waste collections have on home composting behaviour as these are results from an attitudinal survey which are not backed up by actual behaviours. - The report provides a ready reckoner for predicting food waste yields, participation rates and set out rates. <p><u>Relevance to Food Waste Prevention</u></p> <p>Method for determining waste prevention behaviour Decreasing yields over time – residual, prevention or participation Home composting behaviour – attitude survey no back up of actual behaviour.</p>
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Report Title	Food Waste Collection Guidance (Final Report)	
Publication Status	Published – Yes	Unpublished
Date of Report	July 2009	
Author	Chris Mills and Jude Andrews (WRAP)	
Source	WRAP	
Report Summary	<p><u>Objectives</u></p> <p>The objective of the report is to provide guidance to local authorities on implementing a food waste collection scheme. It draws heavily on the experience gained from the WRAP separate food waste collection trial.</p> <p><u>Methodology</u></p> <p>The report takes its guidance from the lessons learnt from 21 separate food waste collection trials (Jan 2007 – March 2009). The guidance also highlights experience from Somerset Waste Partnership and food waste collection trials which have been rolled out across Scotland.</p> <p><u>Key Conclusions</u></p> <p>The report concludes that the following aspects are key considerations of any food waste collection scheme:</p> <ul style="list-style-type: none"> ■ Compositional Analysis – This helps to determine the quantities of food waste that are available for collection. ■ Capture Rate – The food waste collection trials observed between 43 – 77% capture rates (food waste collected as a % of what is available). Higher capture rates were observed with food waste schemes where you can include a range of food waste e.g. inclusions of meats. ■ Yields – Average food waste yields are estimated to be between 2.5 and 4 kg per household setting out. Yields can be impacted by a range of factors. Higher yields are generally observed with the following aspects: <ul style="list-style-type: none"> - More affluent areas; - Refuse collection is fortnightly and food waste collection weekly; - Effective communication strategies; - Capacity of the residual container is restricted or less convenient (e.g. black sac). ■ Mixed food and garden waste – Local Authorities should consider the merits of a mixed food and garden waste collection as these have been shown to generate lower capture rates and lead to more expensive treatment options. Mixed garden and food waste collections must be treated in ABPR compliant facilities. This increases costs. ■ Home Composting – The attitudinal surveys carried out as part of the food waste collection trials revealed that only a small % of participants claimed that home composting was a reason why they did not participate in a food waste collection scheme (9%). Home Composting is suitable for about 50% of food waste produced by the householder and therefore there is an element of food waste that can be collected via a food waste collection scheme. The majority of participants in the food waste trials (66%) who home composted stated that the collection scheme had made no difference on their composting behaviour. However, 24% stated that they had reduced the amount of waste that they home composted and only 5% stated that they composted more. The guidance concludes that the introduction of a food waste collection 	

scheme will have little impact on home composting and therefore, it may be assumed that diversion of food waste to home composting will be minimal and reductions in food waste could be attributed to waste prevention. However, there is little direct evidence to substantiate these claims.

- **Communications** should be clear and concise and should continue to promote the use of home composting as this is the most environmentally sustainable option to treat a large proportion of food waste.

The guidance states that during the Food Waste Collection Trials attitudinal surveys were undertaken. It summarises the following points:

- Main reason for not participating was the thought that they did not produce enough food waste (21% non participants) followed by home composting (9%).
- Some participating households (4 – 8%) stated that they had changed their behaviour following the food waste collection scheme.

The report also reviews the approach that local authorities should take towards monitoring and evaluation of a food waste collection scheme. It mentions the importance of the following data:

- Tonnage data – kg/household and kg/participating household.
- Set out rate (no of bins put out) and participation rate (no of participating households – at least once during monitoring period);
- Waste capture established through comprehensive compositional analysis of food waste and residual bin.
- Stakeholder feedback on the service delivery.

Relevance to Food Waste Prevention

- **Yields and participation maintained** - Report states that yields and participation are generally maintained with fortnightly refuse collections and weekly food waste collection – does this mean that there is no waste prevention?
- **Attitude surveys** – stated that 4 – 8% of people participating in trials had changed their food waste behaviours. Indicates that food waste collection scheme which is visual makes householder more aware of the food waste they are throwing away.
- **Home composting** - Any evidence to show diversion of waste from home composting? Yes.
- **M&E** – mentions all the key aspects but this is mainly focused on generating data on how much collected and increasing collection/yields. No waste prevention consideration and how often the monitoring scenarios should be undertaken to track any changes in behaviours.

Report Title	Down the Drain	
Publication Status	Published – Yes	
Date of Report	November 2009	
Author	Sarah Gray, WRAP	
Source	WRAP	
Report Summary	<p><u>Objectives</u></p> <p>The report aims to estimate the quantities and type of food & drink waste disposed of by sewer in UK households. The 3 main objectives were to:</p> <ol style="list-style-type: none"> 1. Produce robust estimates on the amount (kg) and cost (£) of food and drink disposed to the sewer by UK households per week per year; 2. Produce estimates of sewer disposal as a proportion of major types of food and drink waste purchased; and 3. Investigate reasons for using the sink and sewer to dispose of food and drink waste, and attitudes to this activity. <p><u>Methodology</u></p> <p>Overall 319 households participated in the survey and completed a 1 week diary outlining the type and quality of food/drink waste disposed of down the drain and the reason for disposal. Subsequent analysis converted the quantities noted in the diaries into weights and food category dependent on whether the food was avoidable or unavoidable. Participants were also asked to complete a questionnaire before and after the week long diary exercise to measure any changes in attitudes towards food waste disposal. Of note to the literature review, 8 of the households who participated in the diary exercise did have macerators fitted in their kitchen. The total number was too small to draw any conclusions and the report does not specifically look at their attitudes and behaviours in relation to food waste disposal.</p> <p>Key points on the methodology:</p> <ul style="list-style-type: none"> - Diary Method – limitations of this approach in relation to participants forgetting to record items, choosing not to record items, misunderstanding reporting method and changing behaviour during survey. - Length of survey – The period of the survey was 1 week and it could be questioned whether this was long enough to produce representative results. It also limits the ability of the survey to take into account seasonal effects and any impact of behaviour change over time. The length of the diary could be questioned whether this was long enough to produce representative results. The length of the diary exercise also limited the ability of comparing the attitudinal survey results with the diary exercise to back up the claims made in the attitude surveys. - Conversion of volumes to weights – relying on participant measuring the waste correctly and applying a general conversion factor to a range of different types of food waste. - Sample size for survey - 319 participants took part in the diary exercise and this is a low level of participants to be representative of the UK. The results have been scaled up to reflect the situation in the UK and in presenting its results the report produces low levels of interval confidence (+/-50%) and states that the findings in the report should be treated as approximation rather than a precise estimate. <p><u>Key Conclusions</u></p>	

- Overall UK households are estimated to dispose of 1.8 million tonnes of waste down the sewer (excludes water) per annum, with the majority of this listed as 'avoidable' food waste (1.5 million tonnes).
- Key food types that were disposed of down the sewer include:
 - o Drinks (42%)
 - o Dairy and eggs (20%)
 - o Meals (6%)
 - o Other – condiments, staple foods, meat and fish, processed vegetables and salad (32%)
- The main reason for disposal was listed as prepared and cooked too much with the exception of dairy (milk) and eggs where the reason was because the product was out of date.
- The total cost to the consumer of this method of disposal is estimated to be £2.7 billion, with a carbon impact of 4.6 million tonnes CO₂ (avoidable waste stream only).

As mentioned above the report monitored attitudes and behaviours before and after the survey and concluded the following:

- A large proportion of participants reported at start of survey claimed that they never disposed of some food types (bottled water, alcoholic drinks) by sewer. This mirrors the conclusions from other reports which state that the reason for householders not participating in a food waste collection because they don't have enough food waste.
- The attitudinal survey indicated that participants felt that it was ok to dispose of liquid waste down the sink
- Both before and after the diary exercise participants felt that they did not dispose of a lot of food waste down the sink. Their attitudes had not changed.

Relevance to Food Waste Prevention

The report indicates that the quantities of food and drink disposed of by the sewer are larger than expected. However, householders participating in this survey felt that they never disposed or dispose of very little wastes down the sink and they did not change their attitudes following the survey. Without a change in attitude we could assume that there would be no behaviour change and that this method of food waste disposal did not instigate any waste prevention behaviour. This could be because as the food waste is disposed via the sink on a single occasion the accumulated volumes of food waste which the householder can see are not there. There is limited evidence to back up these observations and the results of the survey are limited in its application by the methodology discussed above.

Report Title	Analysis of Food Waste Behaviours	
Publication Status	Published	Unpublished – Yes
Date of Report	12 May 2010	
Author	Sarah Clist and Andrew Davey (WRc)	
Source	WRAP	
Report Summary	<p>Objectives: WRAP commissioned WRc to undertake a more detailed statistical analysis of the dataset contained with <i>The Food we Waste in Scotland (WRAP, 2008)</i>. The objective of this further analysis was to identify the most wasteful behaviours and how various socio-economic and waste collection practices combined to determine householder behaviours.</p> <p>Methodology: Waste composition data and questionnaire responses from 1,169 households in Scotland formed the basis of the analysis. The data was analysed and a series of models were produced to predict levels of avoidable food waste levels from households and how dependent these are on a number of key factors. The food waste levels included all food present in the separate food waste collection and the residual bin.</p> <p>The model tested and quantified each explanatory factor, and where factors were correlated, isolated the independent effect of each factor by statistically holding all the other factors constant.</p> <p>There are a number of key limitations to the methodology in drawing conclusions on waste prevention behaviour:</p> <p>Data Set – The data set was not collected with the modelling approach in mind and as the data was provided at the household level it is highly variable. This limited the quantity and quality of the data and the conclusions which could be drawn from it. The nature of the data also limited the ability to provide definite evidence of cause and effect relationships. For example the models explained 22% of the variation in avoidable food waste amongst households. This is low in absolute terms, meaning that the models only have a limited ability to predict food waste for individual households. The models can be used to predict more generally the key influences on household levels of food waste.</p> <p>Design of Survey – A key limitation to the conclusions of this work are related to the fact that the original survey was not designed to answer to specific questions of this study.</p> <p>Method of Data Collection – Data was collected through a detailed questionnaire and the responses will be based on householders subjective perception of their own behaviours and not necessarily relate to actual behaviour. The report suggests that this survey could be supplemented by one on one interview or kitchen diaries to obtain a more detailed overview of key behaviours and food waste arisings.</p> <p>Waste Composition – The waste composition data was analysed as an isolated snap shot of waste produced on one occasion and will not take account of weekly variations. Repeating this analysis over time will provide more accurate insight into the food contained within separate food waste and residual collections.</p> <p>Representative of the UK – The study was based on 1169 households in Scotland and the report questions how readily these results can be extrapolated into the UK context. I.e. whether the relationships between food waste, behaviour and food waste attitudes, and household characteristics are typical of those found elsewhere.</p> <p>Key Conclusions: The models explained 22% of the variation in avoidable food</p>	

waste amongst households. This is low in absolute terms, meaning that the models only have a limited ability to predict food waste for individual households. The models can be used to predict more generally the key influences on household levels of food waste. In relation to the literature review the models conclude that the local waste collection regime (frequency of residual waste collection and presence and absence of food waste collection) did not have a significant direct or indirect effect on quantity of avoidable food waste. The model also identified that households who home compost were likely to produce 30% less waste overall. It was not possible to state how much of this was due to composters generating less avoidable waste and how much this was due to them diverting this from the kerbside. The report also concludes that households that home compost tend to exhibit less wasteful behaviours. This may mean that home composting creates a greater awareness of food waste or it might mean that the type of people that home compost are the same people who try to avoid food waste.

There was some evidence in the models that behaviours were influenced by the local waste collection regime. The collection regime was associated with four behaviours:

- Food waste collections = more likely to buy fresh food reduced to clear = less avoidable food waste.
- Food waste collection = more likely to home compost = less avoidable food waste.
- Fortnightly residual = less likely to throw away fresh food bought on offer, reduced or in larger pack sizes = less avoidable food waste.
- Fortnightly residual = less likely to eat out or eat takeaway = less avoidable food waste.

It was concluded that it seems unlikely that these associations have a direct cause effect relationship. It was concluded that these results could be a spurious effect reflecting broader differences between local authorities.

There are a number of interacting factors that influence household behaviour and therefore food waste levels.

Relevance to Food Waste Prevention: In using an existing data set that has a number of limitations in the accuracy of its results, the report concludes that there is no statistical relationship between the local collection regime and food waste arisings. The model however, does make some association between behaviours and the local collection regime, but these are considered to be a spurious relationship often reflecting the broader differences between local authorities. The model does provide a correlation between home composting and food waste arisings identifying that households who home compost were likely to produce 30% less waste overall. It was not possible to state how much of this was due to composters generating less avoidable waste and how much this was due to them diverting this from the kerbside. The report also concludes that households that home compost tend to exhibit less wasteful behaviours. This may mean that home composting creates a greater awareness of food waste or it might mean that the type of people that home compost are the same people who try to avoid food waste. There are a number of limitations to the methodology which are discussed above in assessing the accuracy of the outcomes of the model and it should be borne in mind that there are a number of interacting factors which influence household behaviour and therefore food waste levels. The limitations of the methodology should be taken into account when developing further studies in waste prevention and food waste collections.

Report Title	Assessment of Household Food Waste	
Publication Status	Published - Yes	Unpublished
Date of Report	August 2010	
Author	Julian Parfitt and Eric Bridgewater	
Source	Resource Futures	
Report Summary	<p><u>Objectives</u></p> <p>The reports objective was to review the decrease in household food waste arisings in England since 2006.</p> <p><u>Methodology</u></p> <p>Used data from previous Defra report (WR0119) for 2006 data and then used information from WDF to generate estimated food waste arisings for 2009. This is all food waste arisings (residual and source separate).</p> <p>Two groups (Group A and B) were created to take account of the fact that some LA have implemented a fortnightly residual waste collection with separate food waste collections. It was felt that these LA would skew the results by overestimating the reduction in food waste arisings. Group A included an additional 8 LA who have implemented this waste collection system. Group B excluded these LA.</p> <p>The mean food waste arising per HH for Group A and Group B were generated, and then this mean was multiplied by the number of HH in England.</p> <p>2006 and 2009 food waste arisings were generated to compare the decrease.</p> <p><u>Key Conclusions</u></p> <p>In relation to food waste prevention the key conclusion/observation was that Group A showed a larger decrease in FW arisings, giving some suggestion that the fortnightly residual and weekly food waste collection leads to a larger decrease in FW arisings and that this collection system contributes towards waste prevention behaviour.</p> <p><u>Relevance to Food Waste Prevention</u></p> <p>Suggests that collection scheme has impact on promoting waste prevention. However, no assessment of home composting, so we do not know whether this material has been prevented at source or diverted to home composting.</p>	

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