

Chapter 8

Monitoring contamination



As kerbside collections expand and people who aren't so committed to recycling start to use them, contamination may rise. Alternate weekly collection schemes encourage high levels of participation but, in some local authorities, incorrect use is high. This chapter explains how you can monitor levels of contamination for both kerbside and bring collections, whether or not materials go to a materials recovery facility.

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

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Monitoring contamination

8.1 Introduction

Monitoring contamination is important if you are to improve the quality of materials received for processing. This chapter describes the problem of contamination and how to monitor contamination levels so that opportunities for improvements can be identified.

8.2 What's the issue?

Contamination of recyclable and compostable waste streams with materials not targeted by the service / scheme can be a major problem. Where materials are sorted at the kerbside, it means unnecessary work for the collection crews and rejected contributions can result in disillusioned residents. Where materials are processed in a materials recovery facility (MRF), it can lead to retrospective charges and additional work pulling out contaminants. Possibly the worst case, though, is where a single material is collected at kerbside, contaminants sneak in unnoticed and whole loads get rejected by reprocessors or impounded at ports. This is not only costly for the local authority or contractor involved, but discredits the recycling industry.

Contamination rates can be reduced by:

- redesigning services / schemes;
- changing work practices; and
- providing better information to residents about what is accepted, along with why certain materials are not currently accepted.

This chapter explains the various ways to monitor contamination. The focus here is on kerbside collections as these tend to be more prone to contamination because more people use them. However, some of the techniques described are appropriate to bring schemes, especially where loads are taken to MRFs or bulking stations.

8.3 Terminology

There are numerous terms used in the waste industry to refer to contamination and/or non-requested materials. Some of the terms that you may have heard include contaminants, prohibitives, objectionables, contraries, rejects and non-target materials. Unfortunately, there has been a lack of consistency across the industry, with different terms being used to mean the same things, and the same terms being used to mean different things depending on local circumstances. This ambiguity does not help communications between local authorities and operators, or local authorities and residents.

The main issue is a need to differentiate between whether the items in question are of a non-target **material** (e.g. nappy waste) or in a non-target **form** (e.g. plastic trays in a collection that takes only plastic bottles).

WRAP recommends the following standard terminology:

- **'Prohibitives'** refers to non-target materials (e.g. food waste in dry recycling containers, nappy waste in a garden waste collection, or plastic bags in food waste only caddies). A good way to think about this is that these materials



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are prohibited by the system and could make it prohibitively difficult to sort the materials.

- **'Contraries'** refers to non-target forms of an accepted material, i.e. items that are classed as made from the correct material but which cannot be collected through the service or scheme (e.g. photographic paper in paper collections or plastic food trays in services or schemes that take only plastic bottles). Think about these as items that are contrary to specification.
- **'Contaminants'** is a general term that covers both of the above categories.

The reason for differentiating between these two types of contaminants is that the communication message needed to address each type is different in how it explains why the material is not currently recycled.

8.4 What monitoring approaches are suitable?

The approach you take to monitoring contamination depends partly on what kind of service / scheme you are operating and what information you require (e.g. range of contaminants, frequency of contaminating behaviour or quantities of contaminating material).

There are two main approaches to assessing contamination – visual monitoring and waste analysis. **Visual monitoring** is about looking at disposal behaviour. It can tell you what types of contaminants are visible in collection containers, as well as giving an indication of the frequency with which contaminating behaviour by households is observed. By comparison, from a **waste analysis**, you will obtain data on the quantity and type of contamination; you will be able to present this as a percentage of material set out for recycling.

There are strengths and weaknesses to both approaches depending on the type of service or scheme you want to monitor. Table 8.1 provides an indication of what methods are suitable for different types of collection service / scheme.

Table 8.1 Suitability of methods for monitoring contamination

Collection service / scheme	Visual	Waste composition analysis
Kerbside box / bag / bin	Yes but you will only be able to assess what is visible on the surface. It will not provide a quantitative measure (e.g. percentage by weight).	Yes – it will identify all the contamination presented for recycling. It will provide a percentage figure by weight of the different types of contamination.
Bulk load co-mingled material	No as it is difficult to spot contamination in piles of mixed material.	Yes
Bulk load single material	Yes	Yes

Whatever your system, monitoring rejected loads as a percentage of all loads is not adequate. Although this will tell you how many loads are so badly contaminated that they fail quality tests, it does not tell you about the types or levels of contamination.

8.5 How do I do an on street visual monitoring contamination check?

Checking contamination on street involves examining containers that have been set out before they are collected by the crews. Contamination monitoring is used as part of the participation monitoring procedure. Surface monitoring of visible contaminants is all that is possible for on street visual assessments. It is not recommended that the monitors 'dig' around in the container to identify contamination. This is based on health and safety considerations as well as the need to work fast to stay ahead of collection crews. The precise way in which this is done will depend on the container used for the collection:

- With boxes and wheeled bins, an examination is made before the crew collects them. It is only possible to assess the surface of the material for evidence of contamination.
- On street checking of contamination of bags and sacks is only possible if they are fully transparent. As observations are difficult for sack-based waste, we recommend that waste analysis be used to measure contamination levels.

On street contamination checks can be combined with participation monitoring. See Chapter 5 for details on how to plan and conduct a participation monitoring study. Even if you are not planning to undertake participation monitoring, you will be working closely with the collection crews so it is worth reading this chapter for some pointers on do's and don'ts.

You need to draw up a form that your monitors can use on the street. This form should list the most likely contaminants and have space to write in others. An example is shown in Table 8.2. Using the results you can calculate quite easily the proportion of containers that had each type of contaminant and the proportion of overall contamination. This will be useful if you plan to launch an awareness campaign because you will know the material on which to focus.

Any data sheets should include an address field. This will enable profiling of the data to assess if there is a particular problem with a certain demographic of the population.



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Table 8.2 Example data capture sheet for on street visual contamination monitoring

Street name	House number or name	Set out	No contamination	Contaminated	Food	Non-bottle plastic	Cardboard	Textiles	Glass	Other
Chester Street	1	0								
Chester Street	2	1	1							
Chester Street	3	1		1		1			1	Nappies
Chester Street	4	1		1			1			Wood, rubble
Chester Street	5	0								
Chester Street	6	0								
Chester Street	7	1		1	1		1	1		
Chester Street	8	1	1							
Chester Street	9	1		1						
Chester Street	10	1		1	1					

The first data entry column records whether any dry recycling has been set out. The second records cases where no contamination has been identified. The third is a general observation of the presence of contamination (this may be omitted for monitoring target materials). The subsequent columns record material-specific information.

The example above shows that 70% of households set out. The following data are calculated as a percentage of **those households that set out** (seven in this worked example):

- Contamination was observed in 71% (5/7) of households;
- There was no contamination by 29% (2/7) of households;
- Food was a contaminant of 29% (2/7) of households; and
- Cardboard was a contaminant of 29% (2/7) of households.

Contamination may range from none to complete contamination where the householder has not undertaken any form of separation. To quantify change, it is useful to have a more sophisticated measure of the degree of contamination rather than just presence or absence (Table 8.3).

Table 8.3 Classification system for degree of contamination observed

Classification	Quantity	Description
X	None	Only target materials observed.
S	Single	Only one article of contaminated material.
F	Few	More than one article but evidence of separation.
M	Many	No apparent attempt at material separation i.e. looks like residual waste.

As observations are carried out, the contents are not moved to ensure a consistent approach, since different monitors may look deeper into contents, making comparison unreliable. Table 8.4 provides an example of a completed data sheet.

Table 8.4 Example data capture sheet and entries showing degree of contamination observed

Street name	House number or name	Set out	Contamination	Material 1	Material 2
High Street	42	1	X		
High Street	44	1	M	1	1
High Street	46	1	S		1
High Street	48	0			
High Street	50	0			
High Street	52	1	S	1	
High Street	54	1	S	1	
High Street	56	1	X		
High Street	58	0			
High Street	60	1	F	1	1

The first data entry column records set out, while the second is the assessment of the degree of contamination, and the subsequent columns record material-specific information.

This example tells us that 70% of households set out. The following calculations are made from the data, as a percentage of those households that **set out** (seven in this worked example):

- Contamination was observed in 71% (5/7) of households – adding up the number of ‘S’, ‘F’ and ‘M’;
- There was no apparent separation of materials by 14% (1/7) of households – number of ‘M’;

- There was more than one article but evidence of separation by 14% (1/7) of households – number of 'F';
- There was a single item of contamination by 43% (3/7) of households – number of 'S';
- There was no contamination by 29% (2/7) of households – number of 'X';
- Material 1 was a contaminant by 57% (4/7) of households; and
- Material 2 contaminant by 43% (3/7) of households.

This is a lot of information to collect, so that the project manager has to be careful not to place impossible demands on the monitor(s). If you are not sure, instruct the monitor(s) to miss a block of households to get ahead of the collection vehicle if necessary at the start of an area. They must mark on the data collection sheet to show that no monitoring has taken place. It is better to miss a few properties than to monitor a lot of properties poorly! Otherwise you may wish to use two monitors.

Please see Chapter 5 on participation monitoring for guidance on how to deal with the data.

8.5.1 Choosing areas for on street visual monitoring contamination checks

In many areas there will be particular rounds that are most prone to contamination. The crews will know where these are. You may wish to target these areas for a contamination assessment, since they will benefit most from improvement. But if you take this approach, you won't be able to generalise about contamination levels across your whole area.

If your objective is to produce a general assessment of contamination in your area, it is important to choose a representative sample of rounds to monitor. Please see Chapter 3 for information on sample selection.

8.5.2 Dealing with queries from the public about contamination monitoring

There has been a lot of negative press coverage on waste issues, particularly around the practice of fining householders for incorrect use of recycling services / schemes. It is important that the person doing the monitoring can reassure the resident that they are bona fide by having photographic identification and a letter of authorisation for the work from the local authority or contracting organisation.

It is also important that monitors are briefed so that they can quickly explain the reasons for the work. These might include:

- a better understanding of how residents are using the scheme;
- assessing what additional information residents might need;
- informing future improvements; and
- reducing rejected loads due to improper use of the service/scheme.

8.6 How do I carry out an assessment of a single stream bulk load?

In many cases a simple visual assessment will be all that is required. Depending on the material it can be relatively easy to spot contamination in tipped loads of a single material (e.g. paper in a load of glass containers). However, this type of

CASE STUDY

Cumbria County Council contamination monitoring

Cumbria County Council identified three key target audiences for their communications campaign including the ACORN Group 'wealthy achievers' (30% of the population). This group recycle regularly and, with more encouragement and information, they could recycle more with less contamination.

A key objective of the monitoring was to identify contamination levels amongst this group. Contamination in the rounds that included this ACORN group was measured by determining the number of recycling containers with contaminating materials as a percentage of the total participation rate for that round.

An increase of 4% participation rate to 95% with a 3% reduction contamination was recorded in the 'wealthy achievers' group.

For more information see full case study in Annex 1.

assessment will only be able to provide you with an indication of the presence of contamination.

For detailed data on the precise nature and scale of the contamination (as a percentage) of a single stream source, it is necessary to carry out a compositional analysis. You may wish to commission an external agency to carry out this work for you (see Annex 5 for advice) due to health and safety requirements, insurance and resource implications for your staff. You would expect to pay around £3000 at March 2009 prices for analysis of one load.

A pile of waste of around 500kg (half a tonne) will normally be sufficient for contamination monitoring and should be obtained for each sampling strata (e.g. Acorn category) you want to target. The physical size of the pile will depend on the material that is being assessed. For example, half a tonne of plastic bottles will be considerably larger than half a tonne of glass. The site's operators will probably have a reasonable idea of the weight of different materials. Physical constraints on site may limit the size of the pile that can be prepared.

If you commission external consultants to conduct this work, it is important when evaluating and comparing their bids to ensure that contractors are sorting comparable amounts of material and not simply extracting a sub-sample for sorting – a practice often referred to as 'coning and quartering'.

Once the sample has been taken, the waste should be sorted through by hand, pulling out contaminants and placing acceptable materials into a separate container. The container of acceptable materials must be weighed full (subtracting the weight of the container). The contaminants should be classified into broad material groups (e.g. paper, cardboard, glass) and each weighed separately. Electronic scales will be required for this. From this information you can calculate the proportion of materials collected that are contaminant. A step-by-step guide follows.

- Step 1** Label ten 240-litre wheeled bins A–J and ten 55-litre kerbside boxes K–T. Weigh each one empty, making a note of the weight.
- Step 2** Sort the material in the piles into the agreed categories (e.g. target materials, non-bottle plastic, food, etc) into either a 240-litre wheeled bin or a 55-litre box. Put target materials into the 240-litre containers and contamination into the 55-litre boxes.
- Step 3** Weigh each container noting down the container label, the material and the weight.
e.g. wheeled bin A: paper 40kg [target]
55-litre box M: glass 10kg [contaminant]
- Step 4** Subtract the weight of the container from each weight.
e.g. wheeled bin A: paper 40kg – 14kg = 26kg
55-litre box M: glass 10kg – 1.7kg = 8.3kg
- Step 5** Repeat for all containers.
e.g. total figures derived after sorting all piles:
473kg for paper; 17kg of glass; 5kg of food waste
- Step 6** Add the total quantity of contaminants to the total quantity of accepted recyclate.
i.e. 473kg of paper+ 17kg of glass + 5kg of food waste =
495kg



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Step 7 Calculate the proportion that each contaminant represents of the total recyclate and contaminants.

Glass: $(17/495) \times 100 = 3.4\%$

Food: $(5/495) \times 100 = 1.0\%$

Combined contamination: $(22/495) \times 100 = 4.4\%$

This procedure should be repeated on several occasions to get a full picture of contamination and avoid one-off loads.

8.7 How do I analyse the composition of co-mingled loads entering a MRF or bulking depot?

If you collect recycling co-mingled or have a mixed organic collection (e.g. food and garden), whether it is being tipped at a bulking facility or taken to a MRF or composting facility, you will need to undertake a waste composition analysis to calculate the quantity of contamination.

The most important step is to create a sampling strategy that will result in a representative sample of the target material. The factors that need to be considered in planning your sample include:

- composition will vary within and between rounds (areas will use the scheme differently); and
- composition will vary over time: day, week and season.

Work commissioned by WRAP has indicated that 40 samples of ~100kg each (total sorted weight 4000kg) should be sampled and sorted to provide an estimate of contamination levels. Assuming contamination levels of around 10%, this will result in about 400kg of contamination being categorised.

The 40 samples should be taken in groups of 3–4 per vehicle entering the site, to account for the variation within collection rounds. As a minimum, vehicles should be randomly sampled over the course of a week. If the collection frequency of material is fortnightly, then the sampling should be spread over a minimum of two weeks.

Ultimately, the decision on how much waste should be analysed will be a fairly pragmatic balance between cost and required reliability of the data.

A step-by-step guide to sampling is given below.

Step 1 Work out if you need to survey for one week, two weeks or more (e.g. one week because recycling collections are weekly).
NB 1 week = 5 days.

Step 2: Take 40 samples over 5 days = 8 samples a day. Based on sampling 4 × 100kg sample from each vehicle, this equals two vehicles a day to obtain eight samples.

Step 3: Select two vehicles randomly.

Once you have worked out your sampling strategy, you will need to consider how to resource the analysis on a day-by-day basis. If you are commissioning a specialist agency they will have the expertise and experience to make this assessment. A good rule of thumb is that a team of three sorters can sample, sort and weigh off a single sample in an hour (depending on the number of materials collected, compaction and contamination).



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The sort method is the same as described in Section 8.6 for single material bulk loads.

In devising the category list by which to sort materials and identify contaminants, you will need to bear in mind how you want to use the data. The list of contaminants that a local authority would want to know about may be a reflection of the communication with residents that they intend to undertake. However, MRF operators may view some aspects of a target material (e.g. shredded paper) as a problem material and you should liaise with them to determine what types of materials they consider as contamination.

When on site, the total waste sampled should be weighed as well as the sorted contaminants. This will enable a calculation to be made of the proportion of waste that each contaminant material makes up.

This method will also provide you with detailed composition data of the dry recycling / composting that could be used in conjunction with residual waste composition data to provide an estimate for calculating capture rates. To derive an estimated amount of each material would require modelling the composition of the dry recycling / composting onto the annual tonnage figure. For more details on capture rates see Chapter 7.

8.8 Can I use the crew to provide data on kerbside schemes?

One simple way of combining service / scheme improvements with gathering data is to provide crews with a feedback form for when containers are contaminated. This will only work when materials are sorted at kerbside. Crews may need to be incentivised to do this correctly since it will slow down the collection operation.

A more rough-and-ready approach would be to simply ask the crews for their observations of the kinds of contaminants that are occurring and if there are particular problem areas within the local authority. Although this won't provide you with quantitative data, it will give you some information to help you redesign your service / scheme or to develop awareness campaigns.

8.9 Other options

There are two other options that are available whichever system is used to collect kerbside materials:

- tying in with a waste composition analysis; and
- carrying out a survey of residents.

8.9.1 *Monitoring contamination during waste composition analysis*

If you are already having a waste composition analysis done, it is worth ensuring that a contamination assessment of the kerbside collection is included. This will tell you precisely what contaminants are present and how much they weigh. The drawback with this approach is that the samples tend to be quite limited, perhaps as few as 35 households within any one socio-demographic area, so the results are potentially subject to bias. Decisions about the future of the service / scheme should not be based solely on this, but it can be a useful supplement to other information (see Chapter 2).

8.9.2 *Monitoring contamination during a survey of residents*

Another approach to understanding contamination is to survey residents to find out how much they understand about what is and is not accepted by each service or scheme. Two questions should be included in a wider questionnaire:

- I am going to read out a list of things people throw away. For each one can you tell me whether you can put it into your recycling box/bag/bin or whether you should keep it out? List various materials in random order including all the materials that can go in and some of the most common contaminants.
- Which of the following materials do you actually put into your recycling box/bag/bin? List the same materials. This question should be skipped if they do not use the kerbside collection.

This is a good approach if you are carrying out a questionnaire survey for other reasons, but you should bear in mind people's tendency to say what they think the interviewer wants to hear. Recycling is perceived to be a 'good thing' and something that people ought to be doing so they can feel under pressure to say they recycle things when in fact they do not. This means that questionnaire data should not be the sole basis for changing a service / scheme or devising an awareness campaign, but it can usefully supplement other information. For more on surveys, see Chapter 4.

8.10 Is seasonality a factor to consider?

Levels of contamination can change according to the season. At Christmas, for example, contamination of paper recyclate tends to increase. If you believe seasonal influences may be important you should take them into account, either by avoiding times of year when contamination is untypical or carrying out contamination assessments across different seasons to measure the impact.

8.11 Summary of chapter

This chapter has:

- explained why contamination is important (Sections 8.1 and 8.2);
- clarified the terminology that is used to differentiate between different types of contamination (Section 8.3);
- introduced the different methods for conducting contamination monitoring (Section 8.4) and described each one namely: carrying out on street checks (Section 8.5); sampling single stream bulk loads delivered to a MRF or bulking station (Section 8.6); and sampling co-mingled loads entering a MRF or bulking station (Section 8.7);
- explained how to use kerbside crews to collect data (see Section 8.8); and
- explained how to combine contamination monitoring with a waste analysis (Section 8.9.1) and/or described how to include contamination questions in a survey of residents (Section 8.9.2).

The chapter has demonstrated that there are several ways to assess levels of contamination. The approach chosen will depend on the collection and processing systems in place. Whatever approach is selected, obtaining a representative sample is crucial. Where waste composition work is required, WRAP recommends that it is carried out by an experienced, commissioned agency.

8.12 Where do you want to go next?

Chapter 1 provides an **introduction** and helps you decide which chapters you need to look at.

Chapter 2 explains how to set **monitoring aims, objectives and KPIs**. It then explains how to use the results of monitoring to **improve a service or scheme or to measure the effects of a communications campaign**.

Chapter 3 gives details for consideration when **sampling and profiling**.

Chapter 4 deals with monitoring **awareness, claimed behaviour and satisfaction**.

Chapter 5 deals with monitoring service or scheme **usage and participation**.

Chapter 6 looks at the use of **tonnage data**.

Chapter 7 explains how to measure **capture rates**.

Chapter 9 looks at approaches to measuring **waste reduction**.

Chapter 10 deals with monitoring **communications campaigns**.

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