
Composition of plastic waste collected via kerbside



Results of a waste compositional analysis of plastics at MRFs and PRFs

Date: October 2018

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Front cover photography: Co-mingled waste at a Materials Recovery Facility [Source: iStock]

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Executive summary

An impressive 99% of local authorities in the UK¹ provide collections of post-consumer waste plastics. However, the complexity of plastic packaging combined with the pace of innovation in how they are utilised make the collection, recycling and reprocessing of plastics particularly challenging. This has resulted in significant variability in the quality of post-consumer plastic packaging collected by local authority recycling schemes. This combined with fluctuating oil prices and changes in export market conditions make the global market for secondary plastics particularly volatile.

A robust evidence base is essential to help understand the type and amount of plastic packaging collected at the kerbside to develop effective actions for increasing the amount and improving the quality of material collected and ultimately sent for reprocessing.

The objective of this project was to undertake compositional analysis of the plastic received and produced by Material Recovery Facilities (MRFs) and Plastic Recovery Facilities (PRFs). This will provide WRAP and the wider supply chain with up to date estimates on the amount and type of post-consumer plastic packaging collected for recycling.

The analysis took place across a sample of 14 facilities in England and Wales between October and early December 2017. The facilities included a variety of sizes, geographical locations and materials accepted for sorting. The sample included 12 MRFs and 2 PRFs. This represents around 14%² of the facilities in the UK.

Across the study 122 samples of input material and 62 samples of output materials were analysed to ascertain the composition in terms of proportion of total plastics, different formats of the packaging e.g. bottles, rigid packaging such as pots, tubs and trays and film, as well as polymer type. The analysis also considered the presence and quantities of black plastic packaging and non-packaging plastics which although technically recyclable, are generally not due to the challenges in sorting and reprocessing of these materials.

Plastics collected at the kerbside

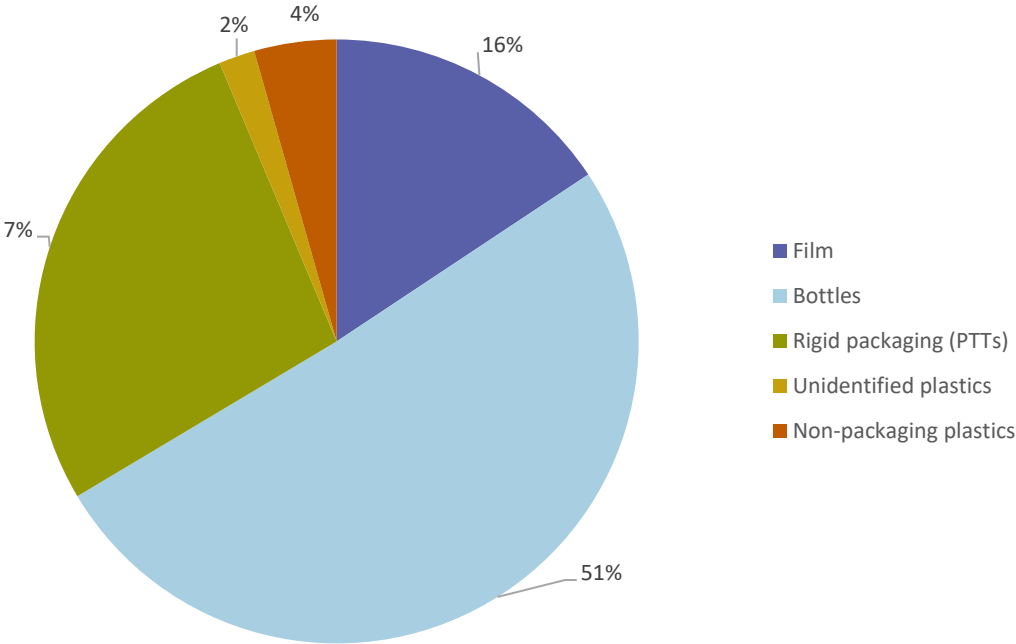
An estimated 503 thousand tonnes of plastics were collected at the kerbside in the UK in 2015/16³. The analysis from this research applies the calculated composition to the 2015/16 tonnages to estimate amounts of plastics collected at the kerbside. The analysis estimates that in 2015/16 half of kerbside collected plastics (50.8% 256,530 tonnes) were bottles followed by rigid plastic packaging pots, tubs and trays (PTT) (27.2% 136,816 tonnes) and film (15.7% 78,971 tonnes). Non-packaging plastics such as toys or pipes made up (4.4% 22,132 tonnes) of the overall plastics and it was not possible to identify 1.9% (9,695 tonnes) of the collected material. This is shown in Figure E1.

¹ <http://www.recoup.org/p/229/uk-household-plastics-collection-survey-2017>

² This is based on the 102 MRFs reporting on the MF portal in 2015/16

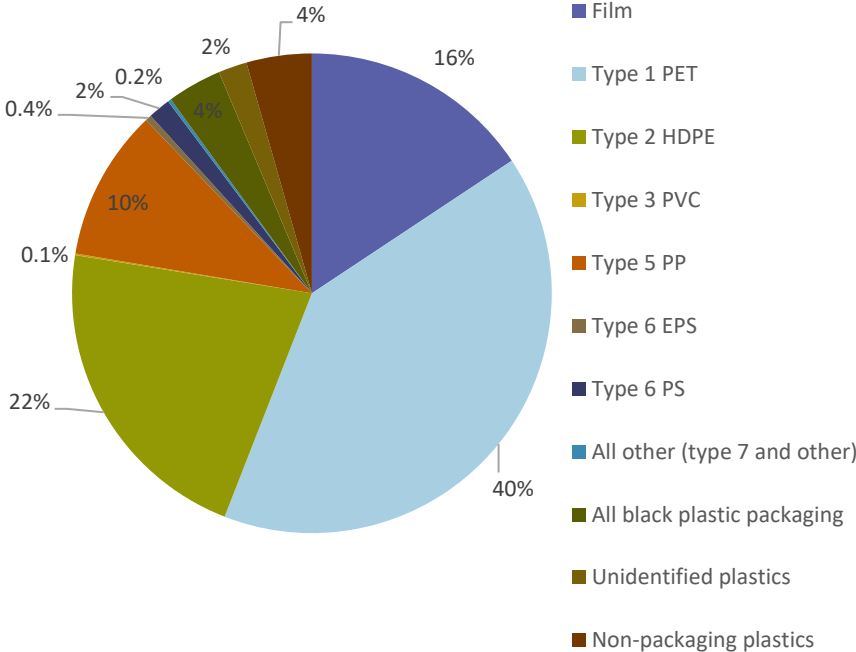
³ Unpublished WRAP estimates

Figure E1 Composition of plastics collected by format



There were three main types of polymer of rigid plastics collected for recycling, PET, HDPE and PP. PET accounted for (40.3% 202,327 tonnes) of the plastics collected followed by HDPE (21.6%, 108,650 tonnes) and PP (10.2%, 51,176 tonnes). The other types of polymers accounted for smaller proportions of the collected plastics: PVC (0.1%), EPS (0.4%) and PS (1.5%). Black plastics accounted for (3.7% 18,495 tonnes) of all plastics collected and were made up of pots, tubs and trays. This is shown in Figure E2.

Figure E2 Composition of plastics collected by polymer type



HDPE, PET and PP accounted for 72% (362,153 tonnes) of the material collected in the UK. The results of the composition study indicates that up to 28% of plastic delivered to the MRFs and PRFs is potentially challenging to sort and/or market for reprocessing.

Plastic output material produced by MRFs and PRFs

The overall composition of the output material produced by the MRFs and PRFs was estimated to comprise 72.2% bottles (218,394 tonnes, MRF only), 13.2% rigid packaging (PTTs) (40,040 tonnes MRF only) and 7.4% of plastic film (22,462 tonnes MRF only).

The output material contained 3.7% of non-plastic materials and 1.0% fines. The proportion of non-plastics varied from zero for PET bottles jazz to as much as 9.6% for mix plastics outputs. Detailed results for the different output materials can be found in Appendix 4.

Additionally, there were fractions of materials that are potentially more difficult to process such as 1.5% of non-packaging plastics (between zero for the PET bottles jazz outputs and 9.8% for PTT outputs).

The issue of quality of the materials produced for reprocessing is increasingly important and topical. The MRF operators are commercially aware of the costs associated with accepting poor quality material and there is a need to work in collaboration with local authorities to reduce the problem at source. Differing recycling schemes offered by local authorities and the variety of polymer types have always been a source of confusion for householders. At the other end of the supply chain, the UK reprocessors are faced with:

- having to invest in additional sorting to ensure that their products are of high quality;
- increased maintenance and repair costs; and
- increased operating costs associated with purchasing additional feedstock because of poor output yield and disposal of contamination.

At the time of writing a number of export markets are becoming more challenging. For example in China, all plastics from post-consumer sources have been banned since the start of 2018 and post-industrial scrap plastic will be banned by end 2018 and since March this has been subject to a strict quality standard which requires no more than 0.5% contamination. There is also a high probability of other countries introducing similar restrictions. This research found that the average level of non-plastic in MRF output was 3.7%. This presents a risk to those selling sorted plastics into these export markets but provides an opportunity for investment in UK plastics collection, sorting and reprocessing.

The data in this report provides information on the amounts and types of plastics currently collected in the UK to aid that debate and inform decisions.

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Glossary

Black plastics – plastic packaging which has been coloured black by the producer, includes items such as food meat trays and ready meal trays. This type of plastic is challenging to separate as optical sorters used for the separation of polymers are not able to recognise the black plastic items against the black conveyor belts and they are therefore often rejected from the process.

Co-mingled collection – Collection of dry recycling materials from the kerbside in a single container and single load. The material requires sorting at a MRF following collection.

Environmental Permitting (England and Wales) (Amendment) Regulations 2014 – regulations that requires that input and output material is tested at MRFs.

EPS – Expanded polystyrene, plastic polymer type often labelled as type 6. Items made out of this material include in-transit packaging for electrical and household items as well as takeaway food trays and disposable hot drinks cups.

HDPE - High-density polyethylene, plastic polymer type often labelled as type 2 Items made out of this material include milk and detergent bottles.

Input material – material that arrives and is fed into a MRF or PRF process for separation

Materials Recovery Facility (MRF) – (also referred to as MF, Materials Facility). A MRF is a facility at which components of a mixed waste stream, in this case primarily either comingled or two stream collected dry recyclables, are separated by the use of mechanical and manual techniques. MF is the term used in the Environmental Permitting (England and Wales) (Amendment) Regulations 2014.

MF Portal – Online database of MRF composition sampling required to comply with Environmental Permitting (England and Wales) (Amendment) Regulations 2014 and maintained by WRAP.

Multi stream collection – Collection of dry recycling material where collection crews separate the material into compartments for individual material types at the kerbside, using specially designed vehicles with a series of compartments.

Non-packaging plastics – plastic items that don't have a primary purpose to package another item. In the waste stream this typically includes items such as toys, pipes, plant pots, broken household items such as bowls or stationary.

Non-plastics – items that are not made out plastic. For the analysis this included generally recyclable items such as paper, card, glass and metals as well as items that are generally not targeted by dry recycling collections such as food waste, textiles, garden waste and nappies.

Non-target material – material that is not targeted or requested by a particular service, MRF operator or reprocessor within the input and output stream.

Output material – material that is produced at the end of a MRF or PRF process.

PET – Polyethylene terephthalate, plastic polymer type often labelled as type 1. Items made out of this material include carbonated drinks bottles or food packaging trays such as punnets.

Plastic film – Thin, flexible, often stretchable plastic material, often made up of low density polyethylene (LDPE). Items made up of this material include carrier bags, bin bags, bubble

wrap, cling film, food wrapping film such as bread bags, crisp and biscuit wrappers. Some local authorities provide single use plastic sacks as a means of containment of dry recyclables. Plastic film is collected by 19% UK local authorities. Some MRFs will accept and sort films so potentially films presented by residents in areas where films are not targeted could get separated for recycling by the MRF. However there is a variety of end destinations for this material post sorting including reprocessing into new material however export or Refuse Derived Fuel are also very common.

PP – Polypropylene plastic, polymer type often labelled as type 5. Items made out of this material include food trays, tubs and pots, detergent and cosmetics bottles, Tupperware and toys.

PRF, Plastic Recovery Facility – a facility where the mixed plastics material is separated into different formats and/or polymers by means of mechanical, optical and manual separation.

PS – Polystyrene, plastic polymer type often labelled as type 6. Items made out of this plastic include clamshells, CD and DVD cases but also some food containers such as yogurt pots.

PTTs – Pots, tubs and trays.

PVC – Polyvinyl chloride, plastic polymer type often labelled as type 3. Items made out of this material include pipes, flooring and in constructions, and in a small proportion of food packaging.

Target material – material that is requested or “targeted” for collection in a particular collection service. This may not always completely align with the material outputs that are produced by the MRF.

Two stream collections – Collection of dry recycling where material is collected on a vehicle with two compartments or by two separate vehicles. In most cases glass will be the material separated from the other types.

Unidentified plastics – plastic items that do not have visible markings, labels or clear physical indicators, making identification of polymer type during the waste compositional analysis impossible.

Waste compositional analysis – a physical analysis of samples of waste material by means of manual sorting and positive identification.

WasteDataFlow – Online reporting tool to record tonnages of Local Authority collected materials and recycling rates.

Weighting - A mathematical process by which figures are adjusted to reflect importance by value or proportion. A weighted average, for example, takes into account the proportional relevance of each component to the total, instead of measuring each individual component equally.

Acknowledgements

We would like to thank the operators, management and staff of the MRFs and PRFs that took part in the research. We would also like to thank the project steering group for their guidance in sector insights.

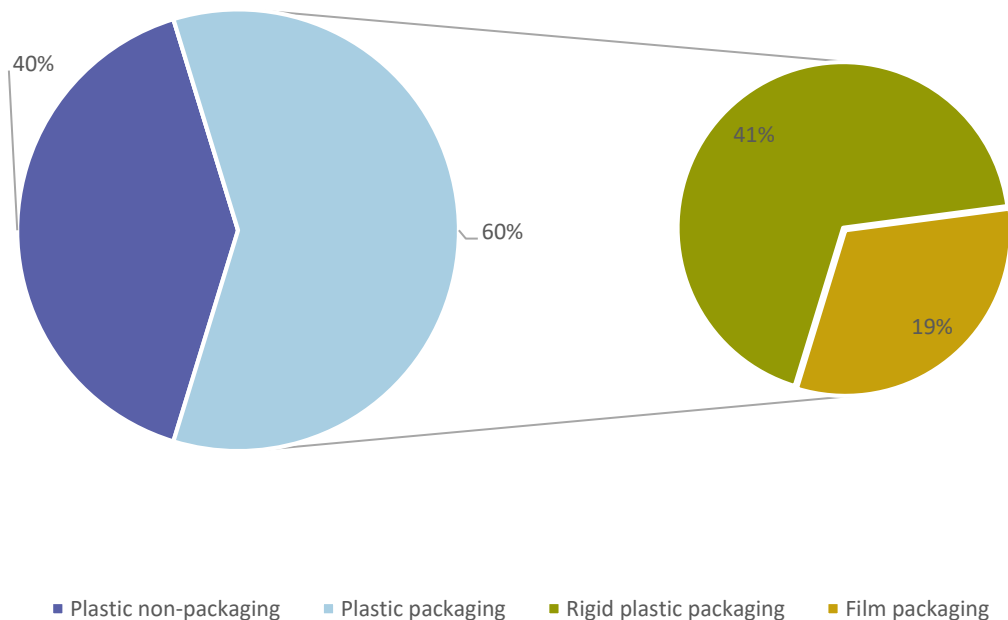
1.0 Introduction

1.1 Background

Plastics include a wide range of versatile polymers, and material innovation over the past two decades has seen plastics used in a rapidly expanding range and volume of products. This has led to significant increases in the amount and type of plastics in the waste stream.

According to *WRAP's Plastics Market Situation Report 2016*⁴ UK plastic waste arisings were estimated to be around 3.7 million tonnes. Packaging was the main source of plastic waste arisings, accounting for approximately 2.2 million tonnes (60%) with non-packaging plastics estimated to be 1.5 million tonnes. Of the total amount of plastic packaging arising around 1.5 million tonnes was estimated to be rigid plastic packaging (i.e. bottles and pots, tubs and trays), while the remaining 0.7 million tonnes was estimated to be films.

Figure 1 Total plastic arisings in the UK 2016, in million tonnes



In the past few years the UK has seen rapid growth in the volumes of plastic packaging collected and separated for recycling.

Nearly all UK councils (99%) now offer householders some form of plastic packaging collection as part of their recycling scheme. Plastic bottle collections are provided by 99% of authorities and 79% also collect plastic pots, tubs and trays. Across the construction, manufacturing and retail sectors the importance of capturing potentially valuable streams of waste plastics and channelling them into efficient recycling and recovery is now recognised as a key way to save costs and reduce environmental impacts of organisations.

⁴ www.wrap.org.uk/sites/files/wrap/Plastics_Market_Situation_Report.pdf

The UK has a plastic packaging recycling target of 57% by 2020. In 2018 WRAP launched the UK Plastics Pact a collaborative initiative that will create a circular economy for plastics. It brings together businesses from across the entire plastics value chain with UK governments and NGOs to tackle the scourge of plastic waste. By 2025, the UK Plastics Pact will transform the UK plastic packaging sector and help stop plastics polluting the environment by:

- Taking actions to eliminate problematic or unnecessary single-use; packaging items through redesign, innovation or alternative (reuse) delivery models;
- 100% of plastic packaging being reusable, recyclable or compostable;
- 70% of plastic packaging effectively recycled or composted; and
- 30% average recycled content across all plastic packaging.

The UK recycled plastics market is part of a global market currently reliant on exports and affected by the price of oil and in the case of PET also cotton prices. As with all global material markets a wide range of factors affect supply and demand and the market price. One consistent message from the plastics reprocessing sector has been the need for the supply chain to work together to ensure that plastic packaging is collected in a manner that helps to meet the quality requirements of the reprocessing sector.

At the time of writing export markets are becoming more challenging. For example in China, all plastics from post-consumer sources have been banned since the start of 2018 and post-industrial scrap plastic will be banned by end 2018 and since March this has been subject to a strict quality standard which requires no more than 0.5% contamination. There are indications that other countries will also look to introduce similar restrictions. The average levels of non-plastic found throughout this research was 3.7%.

With quality being paramount for the success of the UK plastics recycling and reprocessing sector it is important to understand the composition of plastics collected from households and processed in the UK.

1.2 Project aim and objective

The aim of the project was to undertake a compositional analysis of the plastics fraction of material arriving at a representative sample of material recovery facilities (MRFs) and the sorted plastic products being sent to plastics recovery facilities (PRFs) and reprocessors. The project incorporated an analysis of materials entering the supply chain via MRFs and PRFs, as well as the materials produced by these facilities.

The analysis focused on the plastics by format (film, bottle, rigid packaging (PTTs) and non-packaging) and polymer type. All other materials were classified as non-plastics.

The objective was to provide WRAP and the wider supply chain with results on the composition and volume of the plastics present in the recycling streams as well as the material grades produced. This will help inform actions to increase the amount of plastics captured and improve the quality of the materials collected and sent for reprocessing.

2.0 Summary methodology

The methodology for this project was based on analysing a representative sample of material arriving at MRFs and PRFs and the plastics outputs from the plants. The full method can be found in Appendix 1.

Background research was carried out to help define the MRF sector to select facilities that would represent the sector well. However limited data on the characteristics of the MRF sector was available. The MF portal data was then used to define the list of the facilities in scope and to assess the processing throughput tonnages. It should be noted that the PRFs are not required to report via the MF portal.

An initial shortlist of 25 sites were selected which included a variety of sizes, geographical location and the material processed. Broadly this included:

- co-mingled material;
- material from two stream services (mostly without glass); and
- secondary sorting of multi-stream collections where cans and plastics are co-collected.

The facilities' size was defined as:

- Small - less than 10k tonnes reported input
- Medium - 10-50k tonnes reported input
- Large - 50-100k tonnes reported input
- Very large - over 100k tonnes reported input

The MRF and PRF operators were then contacted and asked to participate in the project. Each sample was analysed according to a detailed category list (Appendix 2) focusing on plastics. Details of each sample, input and output, origin and material type were noted.

For the data analysis, the input samples were grouped in terms of collection system and material (co-mingled, two stream, cans/plastics mix or PRF) to calculate the average composition for the different collection systems. The calculated average composition for each of the input sample groups (i.e. collection systems) were then used to weight the 2015/16 plastics tonnages estimates supplied by WRAP.

The material output data analysis grouped the samples based on the output product materials (e.g. PET bottles, mixed bottles, PP etc). The calculated average composition for each product material was used to weight the reported tonnages submitted by the MRF operators for each product reported through the MF Portal.

3.0 Results

3.1 Samples achieved

The fieldwork analysis took place between October and beginning of December 2017 at 14 facilities across England and Wales. The following Table 1 presents the breakdown of the facilities included within the analysis and samples collected.

Table 1 Samples achieved

| Facility type | Region | Size | Material accepted | Samples achieved | | | |
|---------------|----------|------------|------------------------------|------------------|--------------|-----------|--------------|
| | | | | Input | | Output | |
| | | | | No. | Weight (kg) | No. | Weight (kg) |
| MRF | Wales | Small | Two stream | 10 | 570 | 6 | 121 |
| MRF | SW | Small | Two stream | 10 | 665 | 6 | 129 |
| MRF | SW | Small | Plastics and cans | 8 | 294 | 4 | 155 |
| MRF | Wales | Medium | Co-mingled | 10 | 562 | 6 | 160 |
| MRF | NE | Medium | Two stream | 10 | 643 | 6 | 111 |
| MRF | SW | Medium | Various | 5 | 333 | 2 | 69 |
| MRF | NE | Large | Various | 9 | 602 | 5 | 117 |
| MRF | Mid | Large | Two stream and plastics/cans | 9 | 512 | 6 | 138 |
| MRF | SE | Large | Co-mingled | 8 | 677 | 4 | 96 |
| MRF | Wales/NW | Very large | Various | 8 | 963 | 2 | 48 |
| MRF | Mid | Very large | Co-mingled | 7 | 673 | 4 | 141 |
| MRF | SE | Very large | Co-mingled | 10 | 594 | 6 | 120 |
| PRF | SE | Medium | Plastics | 7 | 425 | 3 | 63 |
| PRF | NW | Medium | Plastics | 11 | 226 | 2 | 38 |
| Total | | | | 122 | 7,738 | 62 | 1,505 |

Overall the sample of facilities included a good geographical spread and a variety of sizes of sites in terms of tonnages processed and different sources of material.

3.2 WRAP's estimate on the tonnage of plastics collected in kerbside recycling

WRAP's local authority data team provided an estimate for kerbside collected plastics tonnages (including bottles, PTT and film) for the UK in 2015/16⁵ by recycling collection system⁶. The estimate was that in total 502,659 tonnes of plastic was collected through kerbside collection systems in 2015-16, split by collection system as follows:

- Co-mingled: 237,389 tonnes
- Multi-stream: 109,801 tonnes
- Two Stream: 155,469 tonnes

It is important to note that the WRAP tonnage figures are an estimate based on WasteDataFlow, i.e. data submitted for tonnage collected and disposed by local authorities combined with WRAP's local authority collection systems database. The calculation has to

⁵ WRAP 2018 estimates of all types of plastics entering the kerbside recycling stream, unpublished

⁶ 2015/16 is the most recent date for which WRAP have carried out analysis of WasteDataFlow returns.

address the complexity of assigning collection system types to authorities that operate more than one system, as well as having to estimate the amount of plastics in co-mingled collections. However, this was the best estimate available of the tonnage of plastic by collection system type.

3.3 Composition of plastics collected for recycling (Input samples)

The following sections use the average composition of the input samples grouped by collection type. The calculated average composition profiles were applied to WRAP’s 2015-16 plastic tonnage figures to produce estimates on the amount and type of plastic arisings.

3.3.1 Combined composition by format

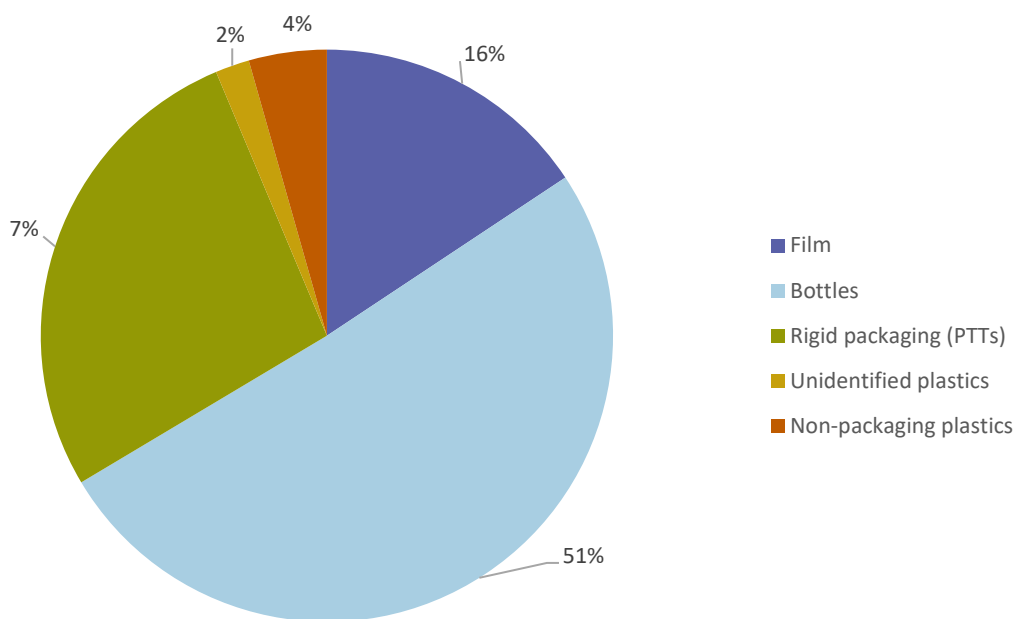
Table 2 shows the combined weighted estimate composition by format (i.e. film, bottles, rigid packaging (PTTs) and non-packaging plastics) calculated from the fieldwork results. The combined composition was applied to the WRAP 2015-16 total plastics tonnage estimate to calculate the volume of different formats of plastics collected through the kerbside recycling systems in the UK.

Table 2 Weighted composition of plastics by format, collected through kerbside recycling applied to 2015/16 tonnage data

| Format | Combined weighted composition | Estimated tonnage |
|------------------------|-------------------------------|-------------------|
| Film | 15.7% | 78,808 |
| Bottles | 50.8% | 255,131 |
| Rigid packaging (PTTs) | 27.2% | 136,886 |
| Unidentified plastics | 1.9% | 9,695 |
| Non-packaging plastics | 4.4% | 22,139 |
| Total | 100.0% | 502,659 |

Overall, of the 503 thousand tonnes of plastics collected at the kerbside in the UK, half (50.8%) was estimated to be bottles followed by rigid plastic packaging (27.2%), film accounted for 15.7% it is noted that the end destination of this material is facility specific and as such it is not possible to categorise this material as a contaminant or target. Non-packaging plastics such as toys made up 4.4% of the overall plastics and are likely to be non-requested items and would potentially be classified as contamination. It was not possible to identify 1.9% of the material. Figure 2 shows the results graphically.

Figure 2 Weighted composition of plastics by format, collected through kerbside recycling applied to 2015/16 tonnage data



3.3.2 Composition by polymer type

Table 3 shows the combined weighted estimate composition by polymer type i.e. PET, HDPE, PVC, PP, EPS, PS, other, black plastic packaging and film.

Table 3 Weighted composition of plastics by polymer, collected through kerbside recycling systems applied to 2015/16 tonnage data

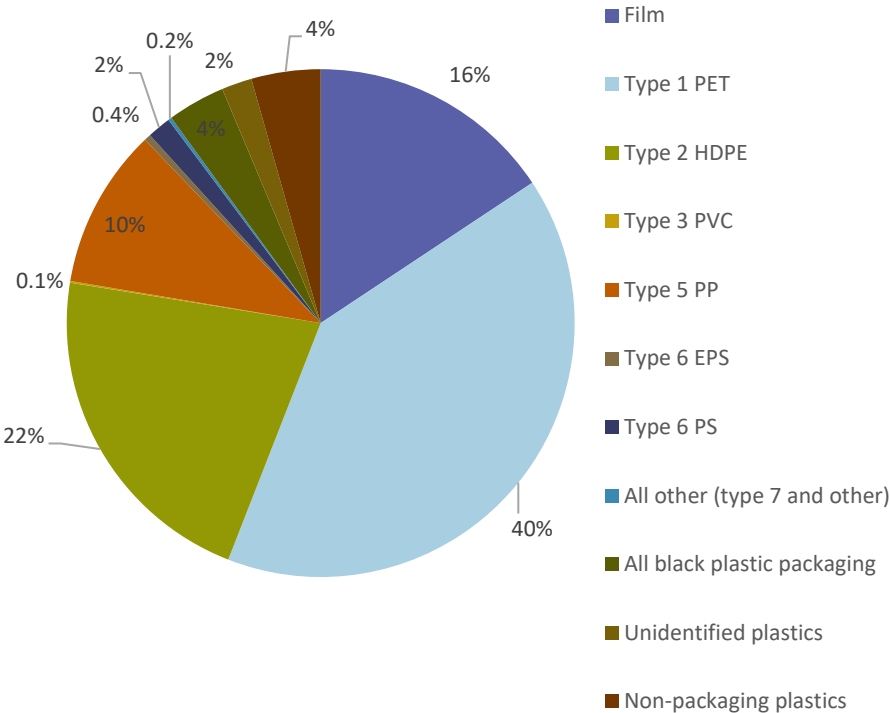
| Polymer | Combined weighted composition | Estimated tonnage |
|--------------------------------|-------------------------------|-------------------|
| Film | 15.7% | 78,808 |
| Type 1 PET | 40.3% | 202,327 |
| Type 2 HDPE | 21.6% | 108,650 |
| Type 3 PVC | 0.1% | 565 |
| Type 5 PP | 10.2% | 51,176 |
| Type 6 EPS | 0.4% | 2,129 |
| Type 6 PS | 1.5% | 7,567 |
| All other (type 7 and other) | 0.2% | 1,107 |
| All black plastic packaging | 3.7% | 18,496 |
| Unidentified plastic packaging | 1.9% | 9,695 |
| Non-packaging plastics | 4.4% | 22,139 |
| Total | 100.0% | 502,659 |

The analysis shows that there were three main types of polymer of rigid plastics collected for recycling in the UK, PET, HDPE and PP. PET was the most prominent at 40.3% (202,327 tonnes) of the total composition followed by HDPE 21.6% (108,650 tonnes) and PP 10.2% (51,176 tonnes). Only small amounts of plastics were made up of other types of polymers

such as PVC (0.1%), EPS (0.4%) and PS (1.5%) and black plastics made up 3.7% (18,495 tonnes).

Overall the polymers that are most commonly reprocessed (HDPE, PET and PP), and therefore more likely to have an end market, accounted for 72.0% (362,153 tonnes) of plastic collected for recycling with the remaining material consisting mostly of plastic film (15.7%) which may be reprocessed in some instances. Figure 3 shows the results graphically.

Figure 3 Weighted composition of plastics by polymer, collected through kerbside recycling applied to 2015/16 tonnage data



As can be seen in Figure 3, plastic film made up 15.7% of the total weighted composition of plastic collected for recycling. Plastic film is unlikely to be labelled with the polymer type, as such the analysis for this material focused on the function. The plastic film fraction was not all packaging but consisted of local authority recycling sacks (2.9%, 14,787 tonnes), carrier bags (1.5%, 7,536 tonnes). Plastic packaging film, which includes for example bread bags and crisp packets, made up 11.2% (56,485 tonnes).

In most instances rigid plastics could be categorised by polymer type (i.e. items had the polymer type symbol stamp) and by function. Table 4 shows the comparison of the polymer composition for plastic bottles and rigid packaging (PTTs).

Table 4 Polymer composition for plastic bottles and rigid packaging (PTTs) in 2015/16

| Polymer | Bottles | | Rigid packaging (PTTs) | |
|----------------|----------------|---------------|------------------------|---------------|
| | Tonnes | % composition | Tonnes | % composition |
| Type 1 PET | 147,830 | 57.9% | 54,497 | 40.1% |
| Type 2 HDPE | 104,992 | 41.2% | 3,658 | 2.7% |
| Type 3 PVC | 126 | 0.0% | 438 | 0.3% |
| Type 5 PP | 2,182 | 0.9% | 48,994 | 36.1% |
| Type 6 EPS | 0 | 0.0% | 2,129 | 1.6% |
| Type 6 PS | 0 | 0.0% | 7,567 | 5.6% |
| Black plastics | 0 | 0.0% | 18,496 | 13.6% |
| Total | 255,131 | 100.0% | 135,779 | 100.0% |

The results show that the collected bottles were almost exclusively made up of PET (57.9%, 147,830 tonnes) and HDPE (41.2%, 104,992 tonnes). Only very small amounts (e.g. some bathroom bottles) were identified as other types.

Rigid plastic PTTs packaging was made up of mostly PET (40.1%, 54,497 tonnes) and PP (36.1%, 48,994 tonnes). A further 13.6% (18,496) of all rigid plastic packaging was black packaging. The black rigid plastic packaging consisted of:

- PET, 51.9%, 9,604 tonnes;
- PP, 17.5%, 3,236 tonnes; and
- Unidentified plastic packaging 30.6%, 5,656 tonnes

In total black plastic packaging and other less common polymer types (including PVC, EPS and PS) accounted for 20.8% of all PTTs, equivalent to 28,630 tonnes of material.

3.3.3 Composition by collection scheme

The following section shows the composition of plastics for the different recycling collection schemes handled by the MRFs and the material entering secondary sorting at PRFs.

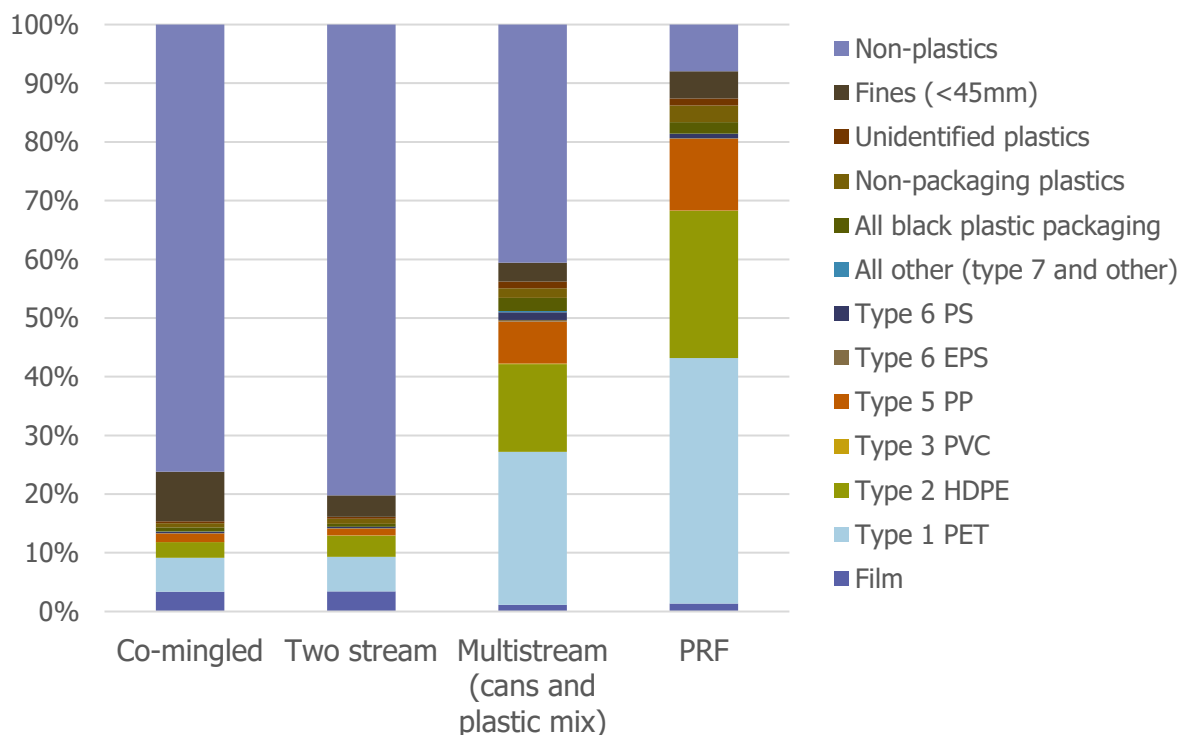
Table 5 below shows total composition of the input samples split into plastics and non-plastics (paper, card, glass, metals, non-target items and contamination) fractions for each collection scheme. Table 5 shows, for example, that 15.4% of the input samples of co-mingled collected material was plastics, whilst 84.6% of the weight was made up of other potentially recyclable materials, fines and other contamination.

Table 5 Estimated composition for the different collection scheme samples and PRF input samples

| Format | Co-mingled | Two stream | Multi stream (cans and plastic mix) | PRF |
|--------------------------------|---------------|---------------|-------------------------------------|---------------|
| Film | 3.4% | 3.5% | 1.1% | 1.3% |
| Bottles | 6.7% | 7.6% | 34.0% | 59.7% |
| Rigid packaging (PTTs) | 4.2% | 3.9% | 18.3% | 22.4% |
| Unidentified plastic packaging | 0.3% | 0.4% | 1.1% | 1.2% |
| Non-packaging plastics | 0.7% | 0.9% | 1.7% | 2.9% |
| Total plastics | 15.4% | 16.1% | 56.2% | 87.4% |
| Fines (<45mm) | 8.5% | 3.6% | 3.3% | 4.6% |
| Non-plastics | 76.2% | 80.2% | 40.5% | 8.0% |
| Total | 100.0% | 100.0% | 100.0% | 100.0% |

The percentage of plastics in co-mingled and two stream schemes are very similar (15.4% and 16.1%) with similar proportions of the different formats. The average percentage of plastics in the inputs to multi stream was 56.2% and for PRFs it was 87.4%. Figure 4 below shows the results in a graphical format.

Figure 4 Estimated composition for the different collection scheme samples and PRF input samples



The composition of the plastics only element for each of the collection systems is presented below to enable a comparison.

The composition of plastics from the cans and plastics collections and the PRFs input (where mixed plastics are sorted into polymer fractions) were combined to estimate the total plastics composition for the multi-stream systems overall. Table 6 and Figure 5 below present the results.

Table 6 Composition of plastics by format for the different collection schemes

| Format | Co-mingled | Two stream | Multi stream (cans and plastic mix) | PRF | Multi-stream (average of cans and plastic and PRF) |
|------------------------|-------------------|-------------------|--|------------------------|---|
| Film | 22.1% | 21.4% | 2.0% | 1.5% | 1.8% |
| Bottles | 43.5% | 47.1% | 60.5% | 68.3% | 64.4% |
| Rigid packaging (PTTs) | 27.5% | 24.1% | 32.5% | 25.6% | 29.1% |
| Unidentified plastics | 2.0% | 2.2% | 2.0% | 1.4% | 1.7% |
| Non-packaging plastics | 4.8% | 5.3% | 3.0% | 3.3% | 3.1% |
| Total | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |
| 2015-16 Tonnage | 237,289 | 109,801 | n/a | n/a⁷ | 155,469 |

Overall the composition of co-mingled and two stream was similar, while the cans/plastics stream and PRF plastics were comparable. The main difference between co-mingled and the predominantly separate schemes was the presence of plastic film. Plastic film made up around a fifth of the total plastics by weight (22.1% and 21.4% for co-mingled and two stream scheme respectively). This result is not surprising as plastic film is generally unlikely to be targeted by multi stream schemes and would be removed by the sorting operatives at the kerbside and it would have been removed if a PRF is accepting material from an MRF for secondary sorting.

Plastic film is not likely to be targeted by co-mingled or two stream services either (only 19% of UK authorities accept plastic film⁸). However, the composition data indicates that plastic film is commonly set-out by residents in co-mingled and two stream collection systems and it is more difficult for the collection crews to identify and then reject this material at the point of collection.

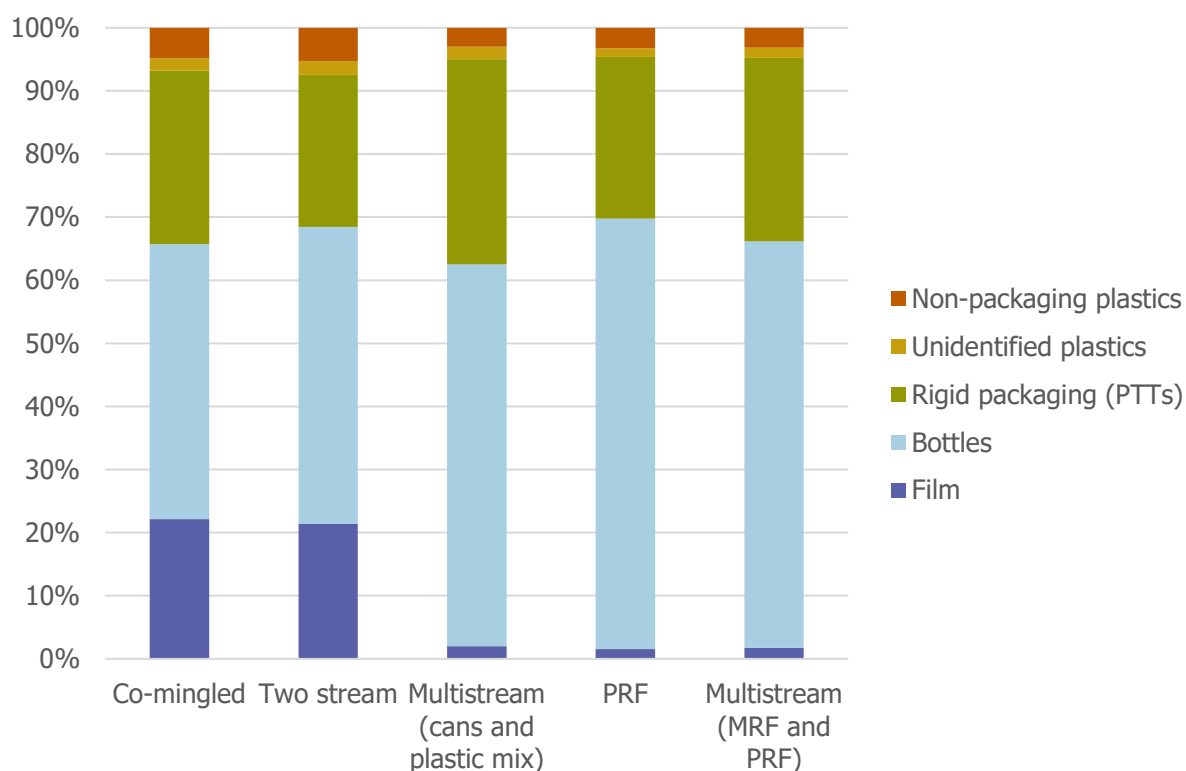
It is worth noting that single use dry recycling collection sacks used by some authorities as a means of containing dry recycling instead of bins or boxes accounted for 4.8% and 3.0% of the composition of co-mingled and two stream materials respectively.

The samples from the co-mingled and two stream services also contained a slightly higher proportion of non-packaging plastics than the multi-stream samples.

⁷ Please note that the tonnages are not available. The composition for the multi stream collection system is based on an average of the PRF and cans and plastics stream

⁸ <http://www.recoup.org/p/229/uk-household-plastics-collection-survey-2017>

Figure 5 Composition of plastics by format for the different collection scheme



The composition of plastics for the different collection schemes by polymer type is shown in Table 7 and Figure 6 below.

Table 7 Composition of plastics by polymer type for the different collection scheme

| Polymer | Co-mingled | Two stream | Multi stream (cans and plastic mix) | PRF | Multi stream (average of cans and plastic and PRF) |
|------------------------------|----------------|----------------|-------------------------------------|------------------------|--|
| Film | 22.1% | 21.4% | 2.0% | 1.5% | 1.8% |
| Type 1 PET | 37.6% | 36.3% | 46.4% | 47.9% | 47.1% |
| Type 2 HDPE | 17.3% | 22.4% | 26.6% | 28.7% | 27.7% |
| Type 3 PVC | 0.1% | 0.1% | 0.2% | 0.1% | 0.1% |
| Type 5 PP | 9.4% | 7.3% | 12.7% | 14.0% | 13.4% |
| Type 6 EPS | 0.4% | 0.6% | 0.5% | 0.1% | 0.3% |
| Type 6 PS | 1.6% | 1.3% | 2.3% | 0.8% | 1.6% |
| All other (type 7 and other) | 0.3% | 0.1% | 0.3% | 0.1% | 0.2% |
| All black plastic packaging | 4.4% | 3.0% | 4.0% | 2.2% | 3.1% |
| Unidentified plastics | 2.0% | 2.2% | 2.0% | 1.4% | 1.7% |
| Non-packaging plastic | 4.8% | 5.3% | 3.0% | 3.3% | 3.1% |
| Total | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |
| 2015-16 Tonnage | 237,289 | 109,801 | n/a | n/a⁹ | 155,469 |

⁹ Please note that the estimated tonnages for the multi stream materials collected alongside the cans and completely separately are not available.

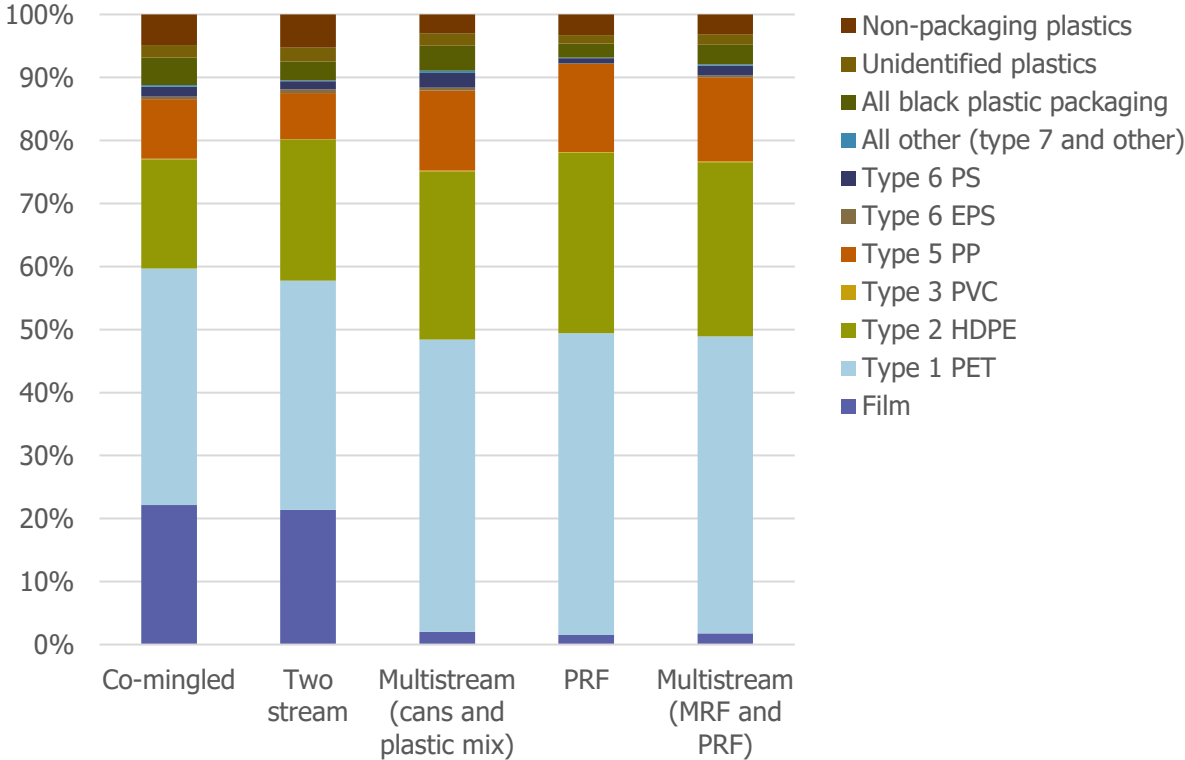
The composition of the co-mingled and two stream schemes was very similar when compared by polymer types although two stream had more HDPE plastics (mostly milk bottles) and less PP (mostly tubs and pots).

The mixed cans and plastics streams coming from the secondary sorting of multi stream and the material going to PRFs was similar in composition however, more PS (mostly yogurt pots) was present in the cans and plastics mix samples.

Overall the materials that are most likely to have stable reprocessor routes such as HDPE, PET and PP accounted for, 64% (co-mingled), 66% (two stream) and 88% (multi stream (MRF and PRF)) of the plastics collected.

These figures clearly demonstrate the problem faced by the MRF operators. Over a third of the plastic materials they receive from local authority co-mingled and two-stream systems potentially have limited or no end market.

Figure 6 Composition of plastics by polymer type for the different collection schemes



The full results for the input streams are included in Appendix 3.

3.3.4 Assessment of variability

This section presents the results of statistical analysis carried out on the input samples. The results presented are for the average proportion of plastics in the sample.

Table 8 Statistical analysis of input schemes

| Statistical measure | Co-mingled | Two stream | Multi stream (cans and plastic mix) | PRF |
|--|------------|------------|-------------------------------------|-------|
| Average proportion of plastics | 15.4% | 16.1% | 56.2% | 87.4% |
| Sample size | 44 | 47 | 16 | 14 |
| Min | 4.6% | 6.8% | 36.5% | 62.8% |
| Max | 42.3% | 30.2% | 90.2% | 98.6% |
| Range (percentage point) | 37.7 % | 23.4% | 53.8% | 35.9% |
| 95% confidence interval (+/- around the average) | 2.1% | 1.7% | 6.5% | 5.1% |

The statistical analysis shows that the average proportion of plastics in the co-mingled stream was 15.4%. The minimum value was found to be 4.6% while the maximum was 42.3%. The range, which is the difference between the minimum and maximum value, was 37.7%. The 95% confidence interval was calculated as 2.1% which means that we can have 95% confidence (i.e. we would expect the result to fall in this range 95 times out of 100 repeat tests) that the average value for this type material overall was between 13.3% and 17.5%.

The results for the multi stream (cans and plastic mix) and the PRF stream have wider ranges and bigger confidence intervals. This is potentially connected to the smaller sample size for these data groups. The analysis enables us to say that for the cans and plastics mix, the 95% confidence interval is 6.5%, which means we are 95% confident that the average proportion of plastics would be between 49.7% and 62.7%.

3.4 Overall composition of MRF output material

Table 9 shows the breakdown of the output samples and the associated tonnage figures. The MF portal data was used to assign reported total tonnages for each output material. Appendix 4 gives a full breakdown of the figures reported against output type.

Table 9 Output samples and the associated tonnages from the MF portal data 2015/16

| Output type | No of samples | MF Portal Tonnage |
|------------------------------|---------------|----------------------|
| PET bottles clear | 5 | n/a |
| PET bottles jazz | 2 | 27,116 |
| PET clear mix inc. bottles | 8 | n/a |
| All PET clear combined | 13 | 37,980 ¹⁰ |
| HDPE bottles natural /milk | 12 | 22,282 |
| HDPE bottles jazz | 5 | 22,117 |
| Mixed plastics (inc bottles) | 11 | 64,667 |
| Mixed bottles | 7 | 89,799 |
| PTT | 2 | 9,282 |
| PP | 1 | 8,380 |
| Mixed plastic film | 4 | 21,009 |
| Excluded | 5 | n/a |
| Total | 62 | 302,632 |

The total tonnage of plastics outputs is not directly comparable to the tonnage of material collected. The reasons for this are complex and connected to the overall flow of the material throughout the supply chain. For example, some of the collected material is not sent to MRFs and is therefore not recorded here and some material collected using multi stream systems ends up in MRFs for secondary sorting.

For some output streams the number of samples were low, however the detailed composition data does provide evidence on which to produce estimates.

3.4.1 Composition by format

The weighted composition of output material is presented in Table 10 and Figure 7.

Table 10 Weighted average composition of plastics output by format, 2015/16

| Format | Total weighted composition % | Total weighted tonnage |
|------------------------|------------------------------|------------------------|
| Film | 7.4% | 22,462 |
| Bottles | 72.2% | 218,394 |
| Rigid packaging (PTTs) | 13.2% | 40,040 |
| Unidentified plastics | 1.0% | 3,064 |
| Non-packaging plastics | 1.5% | 4,588 |
| Fines (<45mm) | 1.0% | 2,959 |
| Non-plastics | 3.7% | 11,125 |
| Total | 100.0% | 302,632 |

The results show that outputs consisted of 72.2% (218,394 tonnes) bottles, 13.2% (40,040 tonnes) rigid packaging (PTTs) and 7.4% (22,462 tonnes) of plastic film.

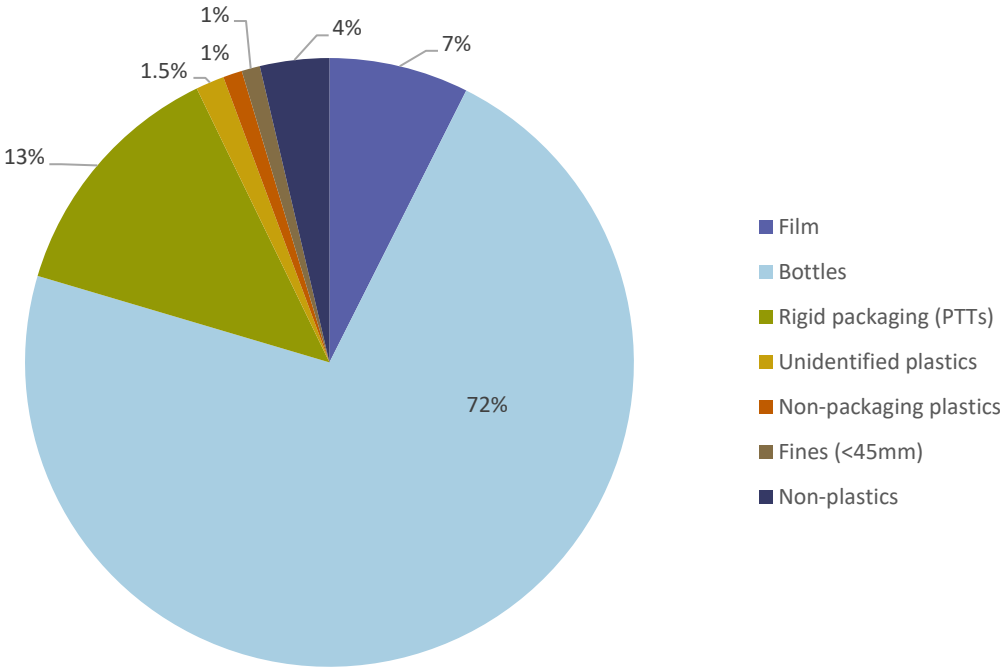
¹⁰ During the analysis it became clear that some of the operators are reporting mixed clear PET bottles and PTTs as PET bottles on the portal. The samples were therefore combined as PET clear and an average for the group was used in further analysis.

It is worth noting that the majority (~85%) of the output material was rigid plastics. However, film was present in varying quantities within these streams. The bottle streams such as HDPE bottles, PET bottles and mixed bottles included less than 1% film, while mixed plastics included in excess of 2% and PP >4%. Although some plastic film was found in the rigid plastic output streams the majority was separated out into a specific mixed plastic film output stream.

The weighted average composition of the output material contained 3.7% of non-plastic materials and 1.0% fines. Again, this varied for the different output streams and was highest for the mixed plastics output at 9.6% of non-plastics and 1.6% of fines. This reflects the effort and investment the MRF operators make in producing single polymer outputs such as HDPE natural bottles.

The composition of the individual output materials is included in Appendix 4.

Figure 7 Weighted average composition of plastics output by format



3.4.2 Composition by polymer type

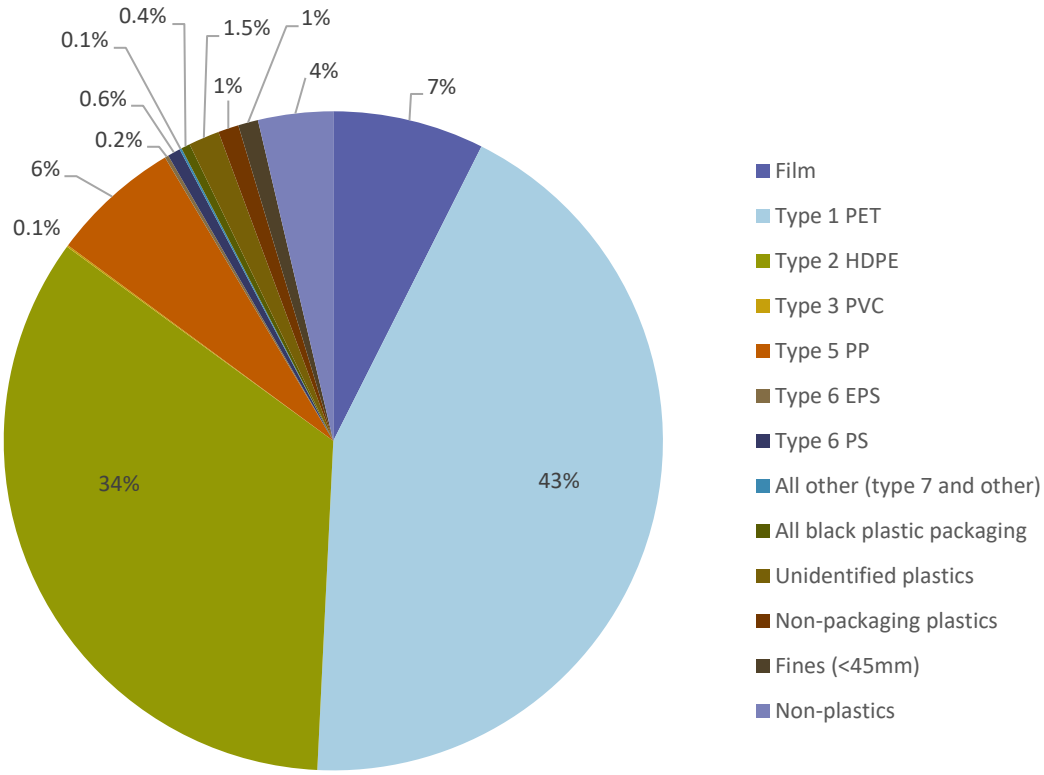
Table 11 and Figure 8 present the weighted composition of the output plastics streams by polymer type.

Table 11 Weighted average composition of output by polymer type

| Polymer | Total weighted composition % | Total weighted tonnage |
|------------------------------|------------------------------|------------------------|
| Film | 7.4% | 22,462 |
| Type 1 PET | 43.4% | 131,198 |
| Type 2 HDPE | 34.3% | 103,658 |
| Type 3 PVC | 0.1% | 247 |
| Type 5 PP | 6.4% | 19,255 |
| Type 6 EPS | 0.2% | 547 |
| Type 6 PS | 0.6% | 1,897 |
| All other (type 7 and other) | 0.1% | 312 |
| All black plastic packaging | 0.4% | 1,320 |
| Unidentified plastics | 1.0% | 3,064 |
| Non-packaging plastics | 1.5% | 4,588 |
| Fines (<45mm) | 1.0% | 2,959 |
| Non-plastics | 3.7% | 11,125 |
| Total | 100.0% | 302,632 |

The majority of the outputs were made up of PET (43.4%, 131,198 tonnes) and HDPE (34.3%, 103,658 tonnes). Full results for the different output streams are included in Appendix 4.

Figure 8 Weighted average composition of output by polymer type



4.0 Conclusions

The project aimed to provide data on the composition and quantity of household plastics collected and processed through kerbside recycling systems in the UK, to help inform the ongoing work to support improvements across the plastics packaging supply chain. The results will be used within the UK Plastics Pact to help drive change in polymer choice, plastic collections and sorting and reprocessing.

The overall composition of collected plastic packaging is dominated by bottles with over half (50.8%, 255,131 tonnes) of the material identified as that. Correspondingly, plastic bottles were also most prevalent in the output stream accounting for 72.2% (218,394 tonnes). Collected rigid plastic packaging (PTTs) made up 27.2% (136,886 tonnes) and plastic film 15.7% (78,808 tonnes).

There were some significant differences in the composition of collected plastics when assessed by collection scheme, which is mainly due to the presence of plastic film. This was significantly higher for the co-mingled and two stream schemes. Some local authorities use single use collection sacks as a means of containment for mixed recycling materials and this accounted for 20% of the plastic film fraction. This suggests that film is routinely set out by residents however only a limited number of local authorities currently collect films at the kerbside.

The majority of the output material produced was rigid plastics. The output results suggest that the more specific the material type (e.g. HDPE natural bottles) the less other forms or polymers were present in the output material. However for mixed plastics outputs on average these included 9.6% of non-plastics and 1.6% of fines.

Black plastics were present in the material collected from households (4.4% of the plastics, 18,496 tonnes). The majority of this material was PET (51.9% of black plastics, 9,604 tonnes) and PP (17.5%, 3,236 tonnes) however almost one third (30.6%, 5,656 of black plastics) was not possible to categorise by polymer type as there was no identification stamp. Black plastic is currently difficult to sort and therefore is likely to end up in the residual waste rejected through the MRF process although a small quantity of black was found in the output streams produced by the facilities (0.4%, 1,320 tonnes) and work is currently ongoing to address this issue.

In terms of polymer types the three main polymers collected were PET (40.3%, 202,327 tonnes), HDPE (21.6%, 108,650 tonnes) and PP (10.2%, 51,176 tonnes). Small amounts of other materials were found such as PS and PVC. Standardising polymers used in packaging potentially would help sorters and reprocessors by providing a more consistent input material and would enable a more consistent recycling message to be used for consumers and householders.

The issue of quality of the materials collected for recycling is increasingly important to MRF and PRF operators as they incur additional costs for sorting the materials to remove non-target items and contaminants. Exporters are also likely to need to invest further into sorting of materials due to increasing restrictions on specifications and challenging markets.

This research gives insight into the types of plastics packaging, by format and polymer, which residents are currently putting into their recycling schemes. These results will be used to help inform packaging polymer choices, aid improved recycling labelling and help remove any consumer confusion. This in turn has the potential to help reduce the amount of non-target materials in recycling schemes and should therefore improve quality.

Appendix 1: Methodology

4.1 Background research

Background research was carried out to define the MRF sector and enable a profile to be established from which to ascertain a representative sample. The MF portal reported data proved the most valuable, even though there were issues with the data that prevented accurate analysis, e.g., transfer station waste not associated with local authorities. This was also the most comprehensive list of MRFs.

The data set was interrogated, and the sites defined in terms of size and types of material accepted based on the outputs reported.

4.2 Initial site selection

The initial selection of the sites aimed to include a variety of sites in terms of geography, size and the type of material accepted. This broadly includes:

- co-mingled material;
- material from two stream services (mostly without glass); and
- secondary sorting of multi-stream collections where cans and plastics are co-collected.

The facilities' size was defined as:

- Small Less than 10k tonnes reported input
- Medium 10-50k tonnes reported input
- Large 50-100k tonnes input reported
- Very large Over 100k tonnes reported input.

4.3 MRF engagement

Shortlisted sites were contacted by a consultant to present the case for participating in the study. The sites were informed that the data collected at the sites would be anonymous and presented as an aggregated average. The sites would also receive copies of their individual raw data.

Health and safety were of particular concern for sites and the operators were reassured that the analysis team would follow the site-specific rules and would have the required Personal Protection Equipment (PPE) with them. Risk assessments and method statements were then submitted to the operators.

Throughout the conversations with the site operators, information was collected on the types of materials the sites accepted and produced to get an idea of the samples that would be possible to target. However, it became clear early on that the study would have to fit in with the schedule and sampling procedures that were specific to each site.

Site visits were carried out where operators felt that face to face assessment of the site and the space available were required.

4.4 Data collection

The sampling of the material was primarily carried out by MRF and PRF staff according to their procedures and schedule of the normal sampling for the site.

In the majority of instances the analysis team were able to work in the same space as the site's sampling teams using their own equipment. In some instances, the team were asked to use the site's own hand sort equipment.

In all cases the team hand sorted and characterised all plastics in detail. This included the characterisation of format and polymer type.

The team used the markings present on packaging to ascertain the polymer type as well as common characteristics that define different polymers, for example seams on HDPE bottles. Additionally, the team and consultants took photos of the less common items and included the descriptions in the category list produced for staff. The same fieldwork staff were used throughout the project where possible.

4.5 Data analysis

Each sample composition was entered into an MS Excel sheet and the quality of entry checked.

Subsequently each sample was classified according to collection system (input) and output material (output and PRFs).

Average composition of plastics for each main collection system (co-mingled, two stream and multi-stream) was calculated from the samples collected. The samples from the secondary sorting of multi-stream material – cans and plastics mix- and the PRF input material plastics composition were averaged to estimate the total multi stream plastics composition.

The overall composition was weighted according to the tonnages of plastics collected from each of these services in the UK in 2015/16 supplied by WRAP.

For the output analysis, data from the MF portal 2015/16 was used as a basis of the tonnages of material produced in England and Wales.

The following table shows the breakdown and reported tonnages for plastic output materials.

Table 12 MF portal 2015/16 output tonnages

| Output materials (MF portal) | 2015/16 tonnage | % Composition | % of plastics |
|---|------------------|---------------|---------------|
| Aluminium | 37,490 | 1.4% | n/a |
| Cardboard | 313,112 | 11.8% | n/a |
| Glass - Clear | 5,824 | 0.2% | n/a |
| Glass - Mixed (Aggregate/Glass Sand) | 212,674 | 8.0% | n/a |
| Glass - Mixed (container / glass fibre) | 363,970 | 13.7% | n/a |
| Hard Plastic | 2,658 | 0.1% | n/a |
| HDPE Bottles - Clear | 22,282 | 0.8% | 7.2% |
| HDPE Bottles - Coloured | 9,842 | 0.4% | 3.2% |
| HDPE Bottles - Mixed | 12,275 | 0.5% | 4.0% |
| Household Plastic Film | 6,459 | 0.2% | 2.1% |
| LDPE Film - Clear | 5,439 | 0.2% | 1.8% |
| LDPE Film - Coloured | 14,550 | 0.5% | 4.7% |
| Mixed Plastic | 64,667 | 2.4% | 21.0% |
| Mixed Plastic Bottles | 89,799 | 3.4% | 29.1% |
| Mixed Rigid Plastic | 987 | 0.0% | n/a |
| Newspapers and Magazines | 303,538 | 11.4% | n/a |
| Paper - Mixed | 976,797 | 36.7% | n/a |
| PET Bottles - Clear | 37,980 | 1.4% | 12.3% |
| PET Bottles - Coloured | 5,327 | 0.2% | 1.7% |
| PET Bottles - Mixed | 21,789 | 0.8% | 7.1% |
| Polypropylene (PP) | 8,380 | 0.3% | 2.7% |
| Pots, Tubs and Trays (PTT) | 9,282 | 0.3% | 3.0% |
| Scrap metal | 10,194 | 0.4% | n/a |
| Steel | 126,422 | 4.7% | n/a |
| Total | 2,661,736 | 100% | 100% |

The composition for each output sample was determined and the average composition for each output stream calculated. This was then applied to the tonnages reported and the overall composition also calculated.

4.6 Key challenges and limitations

- Health and safety issues were of paramount importance at each site. A drawback of this was limited access to the tipping/delivery floor to supervise the collection of samples. As a consequence the representativeness of the results relies on the appropriate sampling procedures being carried out at each of the sites. The method of sample collection varied from site to site, for example some sites sampled from the floor of bays while others had special diversion belts for sampling.
- PRF facilities were challenging to engage and include in the study (the target was 3).
- It became apparent early on that the MRF and plastics sector are even more complicated than anticipated, with different sites accepting material from varying sources and collection systems including from multi stream systems. It also became apparent that this is not a static situation, instead the types and quantities of material accepted at facilities change regularly.
- The lack of a central source of information on what MRFs and PRFs are accepting and producing added a degree of complication and uncertainty to the design and planning of the research. The lack of consistency of reporting through the MF Portal means

that this information source has serious limitations in ascertaining where the input material is from and what the product quality requirements are.

Appendix 2: Category list

| Primary category | Polymer | Colour | Description |
|--------------------------------------|------------------------------|---|---|
| Film | All | LA recycling sacks | |
| | | Other film | |
| | | Carrier bags | |
| Bottles | PET Type 1 | Clear | Clear & LIGHT BLUE Fizzy drinks, water, beer and other kitchen/bathroom bottles |
| | | JAZZ | (all other colours): Brown Beer bottles, green 7-Up or sprite bottles etc, fruit shot |
| | HDPE Type 2 | Milk Bottles | |
| | | All non-milk bottles | (all colours inc white), Carbonated drinks bottles, Household and industrial chemicals bottles |
| | PVC Type 3 | ALL | (inc Natural, white & Jazz): Some squash bottles |
| PP Type 5 | ALL | (inc Natural, white & Jazz) Toiletry bottles, bottle tops, some shampoo & toiletry & kitchen bottles | |
| Plastic packaging, non-bottles, PTTs | PET Type 1 | NATURAL | (Clear): Pre-packed food trays, punnets, meat trays and boil in the bag food pouches |
| | | JAZZ | (all other colours inc. white) |
| | HDPE Type 2 | NATURAL | (Clear): food trays |
| | | JAZZ | (all other colours inc. white); crates/bread trays etc |
| | PVC Type 3 | ALL | (inc Natural, white & Jazz): |
| | PP Type 5 | NATURAL | (Clear): food trays/tubs, yoghurt pots, soup pots, takeaway containers, shower gels, medicine containers e.g. blister packs |
| | | JAZZ | (all other colours inc. white): Coloured Margarine and ice cream tubs, food trays, yoghurt pots, medicine containers e.g. blister packs |
| | PS Type 6 | ALL | (inc Natural, white & Jazz): vending cups; seed trays, a few yogurt and cream pots |
| | EPS Type 6 | ALL | (inc Natural, white & Jazz): Egg boxes; food trays; some hot drink cups; protective packaging; |
| | All black plastic packaging | PET | |
| | | PP | |
| | | Other | |
| | All other (type 7 and other) | All | |
| Unidentified | All | | |
| All other plastic non-packaging | | | |
| Non-plastic | | | Metals, paper, food, card - everything else that isn't plastic.† |
| Fines (<45mm) | | | |

Appendix 3: Individual input streams results

Total composition

| | | No of samples | 44 | 47 | 16 | 14 |
|--|------------------------------|-----------------------------|------------|------------|--|-------|
| Type | Polymer | Category | Co-mingled | Two stream | Multi stream (cans and plastics mix) | PRF |
| Film | Film | Film_LA recycling sacks | 0.7% | 0.5% | 0.0% | 0.1% |
| | Film | FILM_Other film | 2.3% | 2.7% | 1.0% | 1.2% |
| | Film | FILM_Carrier bags | 0.3% | 0.3% | 0.0% | 0.0% |
| Bottles | Type 1 PET | B_PET_NATURAL | 3.7% | 3.8% | 16.9% | 30.4% |
| | Type 1 PET | B_PET_JAZZ | 0.4% | 0.3% | 2.3% | 4.2% |
| | Type 2 HDPE | B_HDPE_Milk Bottles | 1.6% | 2.3% | 8.9% | 16.0% |
| | Type 2 HDPE | B_HDPE_All non-milk bottles | 1.0% | 1.2% | 5.8% | 8.9% |
| | Type 3 PVC | B_PVC_ALL | 0.0% | 0.0% | 0.0% | 0.0% |
| | Type 5 PP | B_PP_ALL | 0.1% | 0.1% | 0.1% | 0.2% |
| Plastic packaging, non- bottles, PTTs | Type 1 PET | Pack_PET_NATURAL | 1.6% | 1.7% | 6.3% | 7.1% |
| | Type 1 PET | Pack_PET_JAZZ | 0.1% | 0.1% | 0.5% | 0.2% |
| | Type 2 HDPE | Pack_HDPE_NATURAL | 0.0% | 0.0% | 0.1% | 0.0% |
| | Type 2 HDPE | Pack_HDPE_JAZZ | 0.1% | 0.1% | 0.3% | 0.2% |
| | Type 3 PVC | Pack_PVC_ALL | 0.0% | 0.0% | 0.1% | 0.0% |
| | Type 5 PP | Pack_PP_NATURAL | 0.6% | 0.4% | 3.8% | 5.9% |
| | Type 5 PP | Pack_PP_JAZZ | 0.8% | 0.7% | 3.2% | 6.1% |
| | Type 6 PS | Pack_PS_ALL | 0.2% | 0.2% | 1.3% | 0.7% |
| | Type 6 EPS | Pack_EPS_ALL | 0.1% | 0.1% | 0.3% | 0.1% |
| | All black plastic packaging | Black_PET | 0.3% | 0.4% | 1.1% | 0.4% |
| | All black plastic packaging | Black_PP | 0.1% | 0.1% | 0.4% | 0.3% |
| | All black plastic packaging | Black_Other | 0.2% | 0.1% | 0.8% | 1.3% |
| | All other (type 7 and other) | Other | 0.0% | 0.0% | 0.2% | 0.1% |
| Unidentified | Unidentified | | 0.3% | 0.4% | 1.1% | 1.2% |
| Plastic non-packaging | Plastic non-packaging | | 0.7% | 0.9% | 1.7% | 2.9% |
| Fines (<45mm) | Fines (<45mm) | | 8.5% | 3.6% | 3.3% | 4.6% |
| Non-plastic | Non-plastic | | 76.2% | 80.2% | 40.5% | 8.0% |

Plastics composition

| Type | Polymer | Category | Co-mingled | Two stream | Multi stream (cans and plastics mix) | PRF | Multi stream (MRF and PRF) | Weighted tonnage | Weighted composition |
|--------------------------------------|-----------------------------|-----------------------------|----------------|----------------|--------------------------------------|------------|----------------------------|------------------|----------------------|
| Film | Film | Film_LA recycling sacks | 4.8% | 3.0% | 0.1% | 0.1% | 0.1% | 14787 | 2.9% |
| | Film | FILM_Other film | 15.1% | 16.5% | 1.8% | 1.4% | 1.6% | 56485 | 11.2% |
| | Film | FILM_Carrier bags | 2.3% | 1.9% | 0.1% | 0.0% | 0.1% | 7536 | 1.5% |
| Bottles | Type 1 PET | B_PET_NATURAL | 23.8% | 23.3% | 30.1% | 34.8% | 32.4% | 132464 | 26.4% |
| | Type 1 PET | B_PET_JAZZ | 2.7% | 1.8% | 4.1% | 4.8% | 4.5% | 15366 | 3.1% |
| | Type 2 HDPE | B_HDPE_Milk Bottles | 10.2% | 14.0% | 15.8% | 18.3% | 17.0% | 66174 | 13.2% |
| | Type 2 HDPE | B_HDPE_All non-milk bottles | 6.2% | 7.5% | 10.2% | 10.1% | 10.2% | 38818 | 7.7% |
| | Type 3 PVC | B_PVC_ALL | 0.0% | 0.0% | 0.1% | 0.0% | 0.0% | 126 | 0.0% |
| | Type 5 PP | B_PP_ALL | 0.6% | 0.4% | 0.2% | 0.3% | 0.2% | 2182 | 0.4% |
| Plastic packaging, non-bottles, PTTs | Type 1 PET | Pack_PET_NATURAL | 10.5% | 10.8% | 11.2% | 8.1% | 9.7% | 51866 | 10.3% |
| | Type 1 PET | Pack_PET_JAZZ | 0.5% | 0.5% | 0.9% | 0.2% | 0.6% | 2631 | 0.5% |
| | Type 2 HDPE | Pack_HDPE_NATURAL | 0.2% | 0.1% | 0.1% | 0.0% | 0.1% | 545 | 0.1% |
| | Type 2 HDPE | Pack_HDPE_JAZZ | 0.7% | 0.8% | 0.5% | 0.3% | 0.4% | 3113 | 0.6% |
| | Type 3 PVC | Pack_PVC_ALL | 0.1% | 0.1% | 0.1% | 0.1% | 0.1% | 438 | 0.1% |
| | Type 5 PP | Pack_PP_NATURAL | 3.8% | 2.6% | 6.8% | 6.7% | 6.7% | 22336 | 4.4% |
| | Type 5 PP | Pack_PP_JAZZ | 5.1% | 4.3% | 5.8% | 7.0% | 6.4% | 26658 | 5.3% |
| | Type 6 PS | Pack_PS_ALL | 1.6% | 1.3% | 2.3% | 0.8% | 1.6% | 7567 | 1.5% |
| | Type 6 EPS | Pack_EPS_ALL | 0.4% | 0.6% | 0.5% | 0.1% | 0.3% | 2129 | 0.4% |
| | All black plastic packaging | Black_PET | 2.2% | 2.3% | 1.9% | 0.5% | 1.2% | 9604 | 1.9% |
| | All black plastic packaging | Black_PP | 0.9% | 0.3% | 0.8% | 0.3% | 0.5% | 3236 | 0.6% |
| | All black plastic packaging | Black_Other | 1.3% | 0.3% | 1.3% | 1.5% | 1.4% | 5656 | 1.1% |
| All other (type 7 and other) | Other | 0.3% | 0.1% | 0.3% | 0.1% | 0.2% | 1107 | 0.2% | |
| Unidentified | | Unidentified | 2.0% | 2.2% | 2.0% | 1.4% | 1.7% | 9695 | 1.9% |
| Non-packaging plastic | | Plastic non-packaging | 4.8% | 5.3% | 3.0% | 3.3% | 3.1% | 22139 | 4.4% |
| Tonnage | | | 237,389 | 109,801 | n/a | n/a | 155,469 | 502,659 | 100.0% |

Appendix 4: Individual output streams composition

| | | No of samples | 5 | 2 | 12 | 5 | 11 | 7 | 2 |
|--------------------------------------|------------------------------|-----------------------------|-------------------|------------------|----------------------------|-------------------|------------------------------|---------------|--------------|
| Type | Polymer | Category | PET bottles Clear | PET bottles jazz | HDPE bottles natural /milk | HDPE bottles jazz | Mixed plastics (inc bottles) | Mixed bottles | PTT |
| Film | Film | Film_LA recycling sacks | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| | Film | FILM_Other film | 0.2% | 0.0% | 0.5% | 0.9% | 2.0% | 0.1% | 1.3% |
| | Film | FILM_Carrier bags | 0.0% | 0.0% | 0.0% | 0.0% | 0.1% | 0.0% | 0.0% |
| Bottles | Type 1 PET | B_PET_NATURAL | 92.0% | 25.4% | 0.2% | 2.4% | 20.2% | 38.5% | 1.2% |
| | Type 1 PET | B_PET_JAZZ | 0.5% | 70.0% | 0.0% | 12.3% | 4.3% | 4.5% | 0.0% |
| | Type 2 HDPE | B_HDPE_Milk Bottles | 0.0% | 0.0% | 86.1% | 5.9% | 11.9% | 31.4% | 0.2% |
| | Type 2 HDPE | B_HDPE_All non-milk bottles | 0.1% | 0.0% | 11.4% | 68.7% | 14.7% | 19.8% | 2.0% |
| | Type 3 PVC | B_PVC_ALL | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.1% | 0.0% |
| | Type 5 PP | B_PP_ALL | 0.0% | 0.0% | 0.0% | 0.3% | 0.5% | 1.1% | 3.2% |
| Plastic packaging, non-bottles, PTTs | Type 1 PET | Pack_PET_NATURAL | 1.3% | 2.6% | 0.1% | 0.8% | 10.6% | 0.4% | 24.6% |
| | Type 1 PET | Pack_PET_JAZZ | 0.2% | 0.9% | 0.1% | 0.0% | 0.5% | 0.1% | 2.8% |
| | Type 2 HDPE | Pack_HDPE_NATURAL | 0.0% | 0.0% | 0.1% | 0.0% | 0.1% | 0.3% | 0.0% |
| | Type 2 HDPE | Pack_HDPE_JAZZ | 0.0% | 0.0% | 0.2% | 0.4% | 0.4% | 0.7% | 0.7% |
| | Type 3 PVC | Pack_PVC_ALL | 0.0% | 0.0% | 0.0% | 0.0% | 0.1% | 0.0% | 1.0% |
| | Type 5 PP | Pack_PP_NATURAL | 0.9% | 0.2% | 0.1% | 0.6% | 6.2% | 0.2% | 12.7% |
| | Type 5 PP | Pack_PP_JAZZ | 0.0% | 0.3% | 0.0% | 0.7% | 6.7% | 0.2% | 20.5% |
| | Type 6 PS | Pack_PS_ALL | 0.0% | 0.0% | 0.0% | 0.4% | 2.0% | 0.0% | 4.5% |
| | Type 6 EPS | Pack_EPS_ALL | 0.0% | 0.0% | 0.0% | 0.0% | 0.3% | 0.0% | 3.1% |
| | All black plastic packaging | Black_PET | 0.1% | 0.0% | 0.1% | 0.1% | 0.6% | 0.0% | 0.1% |
| | All black plastic packaging | Black_PP | 0.0% | 0.0% | 0.0% | 0.0% | 0.1% | 0.0% | 0.0% |
| | All black plastic packaging | Black Other | 0.1% | 0.0% | 0.0% | 0.3% | 0.1% | 0.4% | 0.0% |
| | All other (type 7 and other) | Other | 0.0% | 0.0% | 0.0% | 0.1% | 0.2% | 0.1% | 0.0% |
| Unidentified | | Unidentified | 0.6% | 0.0% | 0.1% | 0.5% | 2.9% | 0.4% | 2.2% |
| Plastic non-packaging | | Plastic non-packaging | 0.1% | 0.0% | 0.2% | 0.7% | 4.2% | 0.2% | 9.8% |
| Fines (<45mm) | | Fines (<45mm) | 0.2% | 0.7% | 0.2% | 0.8% | 1.6% | 0.2% | 4.6% |
| Non-plastic | | Non-plastic | 3.5% | 0.0% | 0.6% | 4.3% | 9.6% | 1.4% | 5.3% |
| Total tonnage | | | | 27,116 | 22,282 | 22,117 | 64,667 | 89,799 | 9,282 |

| Type | Polymer | Category | No of samples | | | | | Total weighted tonnage | Total weighted composition % |
|--------------------------------------|------------------------------|-----------------------------|---------------|------------------------------|--------------------|---------------|----------------|------------------------|------------------------------|
| | | | 1 | 8 | 4 | 13 | 57 | | |
| | | | PP | PET natural mix inc. bottles | mixed plastic film | PET | | | |
| Film | Film | Film_LA recycling sacks | 0.0% | 0.0% | 0.2% | 0.0% | 61 | 0.0% | |
| | Film | FILM_Other film | 4.4% | 0.5% | 77.3% | 0.4% | 18,585 | 6.1% | |
| | Film | FILM_Carrier bags | 0.0% | 0.0% | 17.7% | 0.0% | 3,816 | 1.3% | |
| Bottles | Type 1 PET | B_PET_NATURAL | 4.7% | 68.1% | 0.4% | 77.3% | 84,993 | 28.1% | |
| | Type 1 PET | B_PET_JAZZ | 1.2% | 1.9% | 0.0% | 1.4% | 29,106 | 9.6% | |
| | Type 2 HDPE | B_HDPE_Milk Bottles | 0.5% | 0.2% | 0.2% | 0.1% | 56,475 | 18.7% | |
| | Type 2 HDPE | B_HDPE_All non-milk bottles | 6.1% | 0.1% | 0.1% | 0.1% | 45,769 | 15.1% | |
| | Type 3 PVC | B_PVC_ALL | 0.0% | 0.0% | 0.0% | 0.0% | 85 | 0.0% | |
| | Type 5 PP | B_PP_ALL | 4.2% | 0.0% | 0.0% | 0.0% | 1,966 | 0.6% | |
| Plastic packaging, non-bottles, PTTs | Type 1 PET | Pack_PET_NATURAL | 0.0% | 23.6% | 0.1% | 15.0% | 16,081 | 5.3% | |
| | Type 1 PET | Pack_PET_JAZZ | 0.0% | 0.3% | 0.0% | 0.3% | 1,018 | 0.3% | |
| | Type 2 HDPE | Pack_HDPE_NATURAL | 0.0% | 0.0% | 0.0% | 0.0% | 319 | 0.1% | |
| | Type 2 HDPE | Pack_HDPE_JAZZ | 0.0% | 0.0% | 0.0% | 0.0% | 1,095 | 0.4% | |
| | Type 3 PVC | Pack_PVC_ALL | 0.0% | 0.0% | 0.0% | 0.0% | 162 | 0.1% | |
| | Type 5 PP | Pack_PP_NATURAL | 26.1% | 0.2% | 0.0% | 0.5% | 7,896 | 2.6% | |
| | Type 5 PP | Pack_PP_JAZZ | 31.2% | 0.2% | 0.0% | 0.1% | 9,393 | 3.1% | |
| | Type 6 PS | Pack_PS_ALL | 0.3% | 0.1% | 0.0% | 0.0% | 1,897 | 0.6% | |
| | Type 6 EPS | Pack_EPS_ALL | 0.0% | 0.1% | 0.0% | 0.1% | 547 | 0.2% | |
| | All black plastic packaging | Black_PET | 0.5% | 0.1% | 0.0% | 0.1% | 492 | 0.2% | |
| | All black plastic packaging | Black_PP | 0.6% | 0.0% | 0.0% | 0.0% | 177 | 0.1% | |
| | All black plastic packaging | Black Other | 1.5% | 0.1% | 0.0% | 0.1% | 652 | 0.2% | |
| | All other (type 7 and other) | Other | 0.7% | 0.0% | 0.0% | 0.0% | 312 | 0.1% | |
| Unidentified | Unidentified | | 2.8% | 0.4% | 0.3% | 0.5% | 3,064 | 1.0% | |
| Plastic non-packaging | Plastic non-packaging | | 5.4% | 0.3% | 0.1% | 0.2% | 4,588 | 1.5% | |
| Fines (<45mm) | Fines (<45mm) | | 5.3% | 1.5% | 0.5% | 1.0% | 2,959 | 1.0% | |
| Non-plastic | Non-plastic | | 4.2% | 2.4% | 3.0% | 2.9% | 11,125 | 3.7% | |
| Total tonnage | | | 8,380 | | 21,009 | 37,980 | 302,632 | 100% | |

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