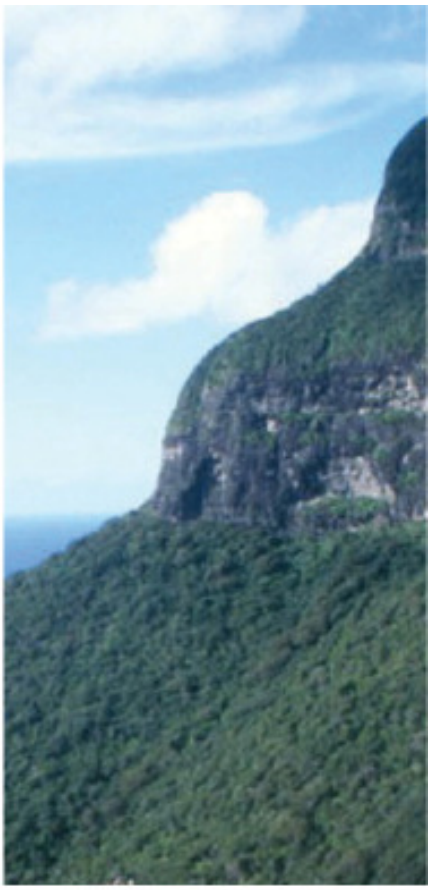

MRF RESIDUAL WASTE AUDIT

FOR

ACT NOWaste

July 2009

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DEFINITIONS

Commingled Collection*: Pick up and transportation of mixed dry recyclable materials.

Contamination: Material not accepted by a council in its recycling or green-waste stream.

Recyclable*: Able to be recovered, processed and used as a raw material for the manufacture of useful new product through a commercial process.

Recycling Stream: Material source-separated for the purposes of recycling.

Total Waste Stream: The combined waste, recycling and garden organics streams.

Waste Stream Analysis*: Determination of the quantities and qualities of individual components present in a waste stream.

Waste Stream Characterisation*: Classification and analysis of the waste stream.

Waste Stream Classification*: System to identify and categorise materials of weight or volume.

Waste Stream Composition*: Component material types by proportion of weight or volume.

*** Source: AS/NZS 3831:1998**.

EXECUTIVE SUMMARY

In May 2005, June 2006 and November 2007, APC conducted an audit of residual material produced by the Materials Recovery Facility at Hume. This process has been repeated in May 2009. The project objectives were to:

- Sample residual waste to landfill from the MRF.
- Identify and quantify the materials that are incorrectly placed into recycling bins and suggest actions that ACT NOWaste might take to achieve a reduction in such contamination.
- Identify and quantify what recyclable material is not currently processed successfully. Document the reasons material is not successfully recycled and make suggestions as to how the process might be improved.
- Analyse and report on trends and opportunities to further improve recycling.

ACT NOWaste elected to retain the same sample size and sampling period as previous audits of 2.5 tonnes audited in one week. The 2009 audit sorted a total of 2,471kgs. However, in addition, a number of supplementary audits were undertaken to ascertain the content of plastics bags, to count, weigh and photograph specific items and to assess material removed by staff from the receiving hall material prior to the process. Typically, these are large, heavy, dangerous and long items that may impede the operation of the sorting line and create breakdowns.

The 2009 audit revealed a significant improvement in the proportion of recyclable material that remained in the residual sample with a reduction from 66.6% in 2007 to 30.8% in 2009. The introduction of a new process to recover glass fines at the MRF is having a significant positive impact, with glass fines now just 5.9%, down from 32.7% in 2007.

We are advised that the Hume MRF is processing approximately 55,700 tonnes of recyclables generated from three sources: domestic kerbside collection, public drop off areas and commercial customers generating approximately 4,200 tonnes of residual material each year. Based on our analysis, about 1,300 tonnes of potentially recyclable material is lost per annum. Expressed as a percentage of through-put, approximately 2.3% of potentially recoverable material is currently not recovered. This exceeds accepted best practice standards for MRFs and is an excellent achievement.

The supplementary audit of the contents of plastic bags found that more than 75% of the contents were non recoverable materials with food/kitchen waste alone accounting for 32% and contaminated paper 20%. This result strongly supports the view that some residents are using the recycling bin as a garbage bin. In addition, a large number of items found in the audits due to their characteristics (i.e. size, weight or configuration) have the capacity and potential to cause machinery breakdown, which has financial and operational implications on the MRF.

Contamination remains an issue for the MRF operators with residents placing non recoverable materials in the recycling bins. In addition, contamination from the public drop off bins is a significant issue and one that requires greater scrutiny by ACT NOWaste.

The removal of such a large amount of heavy glass fines affected the volume of waste that needed to be sorted in order to meet the required sample weights specified in the scope of works. It is therefore suggested that future audits consider a volume-based sample rather than a weight-based sampling regime.

1. BACKGROUND

The Materials Recovery Facility (MRF) at Hume is operated by Thiess Services and currently sorts commingled recyclables collected from residential households, public drop-off centres and commercial and industrial customers in and around Canberra.

We are advised that the Hume MRF is processing approximately 55,700 tonnes of recyclables generated from the three sources above and generating approximately 4,200 tonnes of residual material each year.

Residual material from the sorting process leaves the plant via a conveyor belt and is deposited in a sealed compactor. Some large items are removed by floor staff from loads immediately after they are deposited in the receiving area. These items are placed in open bins for later disposal.

APC has conducted prior audits of residual material produced at Hume in May 2005, June 2006 and November 2007.

Thiess Services has recently installed a process designed to increase the recovery of glass fines. In previous audits, glass fines have made up a significant proportion of the total weight of the residual stream.

The aim of this project was to audit this residual waste stream over a period of one week using the same methodology and sample size as was applied to the prior audits to enable trend analysis and comparisons to be made.

2. INTRODUCTION

The project objectives are to:

- Sample residual waste to landfill from the MRF using methodology and reporting consistent and comparable with previous MRF audits.
- Identify and quantify the materials that are incorrectly placed into recycling bins, as an aid to developing and assessing education campaigns, and to suggest actions that ACT NOWaste might take to achieve a reduction in such contamination.
- Identify and quantify what recyclable material is not currently processed successfully, document the reasons material is not successfully recycled and make suggestions as to how this process might be improved.
- Analyse and report on trends and opportunities to further improve recycling.

This report contains the result and analysis of the 2009 audit and relevant discussion of the results and comparisons with prior years.

3. METHODOLOGY

3.1 Sample Size

When we know the approximate proportion of the material we are seeking to measure, we can calculate the sample number that would give us results with our desired level of accuracy and within agreed confidence intervals. However, in practice we are measuring a number of materials, all with differing proportions.

Where material is expected to be reasonably homogenous, (as in this case), a relatively small sample is all that is required in order to get an accurate result. Previously, a 500kg sample per day of material was deemed a suitable sample size.

ACT NOWaste expressed its concern with the variation in confidence intervals with this sample size. However, the 500kg sample is the average daily amount sorted in 2005, 2006 and 2007, based on advice from APC's statistician as the composition of the residual material is also not expected to vary greatly by day.

A number of samples of a specified weight or volume needed to be selected in a systematic, random way over the sample period to provide a representative sample. It is important that each sample be of uniform size. Ideally, this would be either 50 litres or 50 kilograms as a suitable unit sample. We can consider the weekly flow of residual waste generated as about 84 tonnes, or 1,680 units of 50 kilograms each.

If we assume that the material we are measuring comprises approximately 50% of the MRF residual waste stream, then the sampling algorithm will result in the largest recommended sample size.

- If we are surveying material over a week (i.e. approximately 84 tonnes or 1,680 units of 50 kilograms), and a specific material is present as a proportion of 50%, and we want to be able to estimate this within plus or minus 10% (i.e. a 90% confidence interval), then we would need to take 94 samples of 50 kilograms, distributed evenly over the week, or 4.7 tonnes of material.

- If we are surveying material over two weeks (i.e. approximately 168 tonnes or 3,360 units of 50 kilograms), and a specific material is present as a proportion of 50%, and we want to be able to estimate this within plus or minus 10% (i.e. a 90% confidence interval), then we would need to take 97 samples of 50 kilograms, distributed evenly over the two weeks, or 4.85 tonnes.

However, to audit this sample size requires two teams and double the labour force used previously as the sample size and timeframe has doubled. ACT NOWaste elected Option 1 in the APC tender submission to retain the same sample size of 2.5 tonnes and conduct the audit over a period of one week's duration.

The amount of material sorted during the audits conducted to date by APC, is shown in the table below.

Table 1 – Amounts of Residual Material Sorted by Audit

Year	Month	Smallest Daily Amount (kg)	Largest Daily Amount (kg)	Total Amount (kg)	Daily Average (kg)
2005	May	490	614	2,623.5	524.7
2006	June	501	699	2,770.6	554.1
2007	November	161.3	537.9	2,094.7	418.8
2009	May	316.6	611.1	2,471.1	494.2

As can be seen for the 2009 audit, an average daily sample size of 494kg was sorted from a total weight of 2,471kgs.

3.2 Sample Selection

Collecting individual samples would have been the preferred sample selection process, however all residual material is discharged from the plant via a conveyor to a compactor bin located external to the building.

In 2006, Thiess Services constructed a chute on the residual waste outlet to allow the flow of the residual material to be intercepted.

On each of the five audit days, Thiess Services collected the required sample by placing a 1.5m^3 bin under the chute and diverting the residual line to the bin. Samples were taken at three times throughout the day over the five days – one in the morning, one in the middle of the day and one in the afternoon. The average daily weight of the sample taken was 494kg, close to the target weight of 500kg.

This year, as in 2007, there was substantial variation in the weights collected on a daily basis in the bulk bins, ranging from 316.6kg to 611.1kg.

ACT NOWaste identified a number of areas of concern with the recycling process. These include:

1. Long items that jam machinery (e.g. hoses, wire etc)
2. Electrical and compound items
3. Large plastic items
4. Presence of big, heavy items
5. Items in plastic bags
6. Broken glass
7. Presence of disposable nappies
8. Plastic bottles containing liquid
9. A presence of black items where optical sorting is used

A pre project meeting between APC and Thiess Services identified that items 1 – 4 are typically removed at the front of the processing line where possible to prevent high maintenance and plant breakdowns, while items 5 – 9 are present in the residual bins at the end of the process line.

It was agreed that APC would audit samples provided by Thiess Services collected three times per day from the residual line as done previously and APC would sample the bulk bins containing the front end or receival hall's contaminated materials.

Due to the additional time and cost to undertake these additional sorts, counts, weights and photographs, it was suggested that on each day the sorting of one of the categories would occur but not on every day. Over the five-day period, sufficient new data was collected to provide indicative data.

3.3 Sorting

Because of space constraints at the MRF site, the only area available for sorting the residual loads was inside the MRF. However, the MRF operates typically until 3pm each day and a suitable area for sorting is not available until after that time. As the MRF is locked at 9pm, the time between operational shut down at 3pm and locking up at 9pm was the only available time for sorting of the residual loads.

However, due to increased tonnages being processed at the time, the sorting area was not available to APC's auditors until 5pm each day. Samples were collected by Thiess Services and stored inside the MRF awaiting APC's staff, who sorted as much of the sample as possible prior to 9pm.

The list of material categories was devised in consultation with ACT NOWaste for the 2005 audit and used for the 2006 and 2007 audits. The categories into which the residual material was sorted are listed below:

- Mixed clean paper including cardboard
- Liquidpaperboard
- Glass Fines (less than 50mm)
- Glass containers
- Aluminium
- Steel
- PET clear
- HDPE semi opaque
- Mixed plastic containers
- Food and kitchen waste
- Green waste and timber
- Non-recyclable glass and crockery
- Film plastics and plastic bags
- Hazardous
- Nappies
- Expanded polystyrene
- Textiles
- Other miscellaneous

In addition to the categories above, the following categories were included in 2009 at the request of ACT NOWaste:

- Non-recyclable waste sorted into the following sub-categories:
  - Electrical appliances
  - Automotive
  - Non-recyclable waste
- Items contained in plastic bags – these were weighed and then sorted into the categories listed above.

Quantities of each material category present were weighed and the weight recorded on a datasheet.

3.4 Labour and Equipment

Thiess Services was required to collect and store the samples and to dispose of the audited material. All labour and equipment associated with the sorting of samples was supplied by APC with the exception of wheelie bins, which were supplied by Thiess Services.

3.5 Problematic Contaminants

ACT NOWaste identified a number of problematic contaminants within the recycling process. Each of these issues are summarised in the table below and accompanied by an acknowledgement or explanation of how APC's approach appropriately considered these issues during the audit process.

Table 2 - Problematic Contaminants

Issues	APC Action	Frequency of Sample Collection
Jamming of machinery from hoses, wire etc	Visual item count, Recording by weight and photographs of separated items e.g: • Carpet • Large textiles • Rope • Electrical cables or string	Monday – Friday (5 days)
Items in plastic bags	Store separately, weigh and then sort at the end of the main sort into the agreed categories	Monday – Friday (5 days)
Presence of electrical and compound items	Visual item count Recording by weight and Photographs of separated items	Monday, Tuesday (2 days)
Large plastic items causing breakdowns	Visual item count Recording by weight and Photographs of separated items	Monday, Tuesday (2 days)
Presence of big, heavy items	Visual item count Recording by weight and Photographs of separated items Agree on definition of big and heavy. APC suggests: Any single item weighing more than 18kg Any item that measures any material with two of any three of its dimensions greater than 400mm or any one of its three dimensions greater than 1,000mm	Monday – Wednesday (3 days)
Broken glass	Glass fines less than 50mm and glass are already separated	Monday – Friday (5 days)
Presence of disposable nappies	Disposable nappies are already weighed	Monday – Friday (5 days)
Plastic bottles containing liquid	A sub-sort of plastics to determine the number of bottles that contain liquid as a percentage of total bottles	Monday – Friday (5 days)
A presence of black items where optical sorting is used	A secondary sort of plastics could identify the number and weight of black items	Monday and Tuesday (2 days)

3.6 Analysis

The table below indicates how materials found in the audit have been categorised during the analysis phase of the project.

Table 3 – Classification of Material

Material	Class	Category
Mixed clean paper and cardboard	Recyclable	Recyclable paper
Liquidpaperboard	Recyclable	Other containers
Glass containers	Recyclable	Other containers
Aluminium	Recyclable	Other containers
Steel	Recyclable	Other containers
PET (1)	Recyclable	Plastic containers
HDPE (2)	Recyclable	Plastic containers
Mixed rigid plastic containers	Recyclable	Plastic containers
Plastic bags (3)	Contamination	Other material
Plastic film	Contamination	Non-recyclable plastic
Food and kitchen waste	Contamination	Other material
Green waste and timber	Contamination	Other material
Glass Fines (<50 mm diameter) (4)	Recyclable	Glass fines
Non-recyclable glass and crockery	Contamination	Other material
Nappies	Contamination	Other material
Expanded polystyrene	Contamination	Non-recyclable plastic
Textiles	Contamination	Other material
Hazardous	Contamination	Other material
Electrical appliances	Contamination	Other material
Automotive parts	Contamination	Other material
Other miscellaneous	Contamination	Other material
Contaminated paper	Contamination	Contaminated paper
Glass dust and small scraps of paper	Contamination	Other material
Other plastics	Contamination	Non-recyclable plastic
PET after liquid emptied (5)	Recyclable	Plastic containers
HDPE after liquid emptied (6)	Recyclable	Plastic containers
Liquid (7)	Contamination	Other material

Notes

1: Empty PET containers
2: Empty HDPE containers
3: Plastic bags with material packed inside (removed at front end)
4: Fragments of glass smaller than 50 mm diameter – excluding glass dust
5: PET containers removed at front end as they contained liquid
6: HDPE containers removed at front end as they contained liquid
7: Liquid taken from (5) and (6)

4. RESULTS

4.1 Residual Composition

The table below shows the quantities of each materials sorted by day. This data includes the material found in plastic bags as well as all 'additional material' that was audited.

Table 4 – Quantities of Materials by Day

Material	11-May-	12-May	13-May	14-May	15-May-	Total	Per cent
	(weight in kg)						
Mixed clean paper/card	14.6	11.6	24.4	13.8	27.0	91.4	3.7%
Liquidpaperboard	1.5	2.0	2.1	2.6	2.2	10.5	0.4%
Glass containers	5.1	11.6	15.1	14.6	7.0	53.4	2.2%
Aluminium	3.7	8.5	7.1	7.9	3.5	30.7	1.2%
Steel	21.4	17.2	19.0	19.2	18.9	95.7	3.9%
PET	12.2	24.2	22.3	19.4	18.0	96.0	3.9%
HDPE	7.0	21.6	28.1	18.0	16.3	91.0	3.7%
Mixed rigid plastic containers	15.7	26.9	26.3	32.8	26.0	127.7	5.2%
Plastic bags	3.6	24.7	33.9	35.5	10.1	107.8	4.4%
Plastic film	7.0	22.3	22.6	22.2	17.6	91.7	3.7%
Food and kitchen waste	14.6	12.5	80.3	55.8	24.7	187.9	7.6%
Green waste and timber	15.7	9.5	8.0	14.4	22.5	70.0	2.8%
Glass fines	23.6	34.5	20.9	43.4	22.9	145.4	5.9%
Non-recyclable glass/crockery	0.0	2.6	3.3	4.7	2.2	12.7	0.5%
Nappies	0.6	10.1	11.4	12.3	9.6	44.1	1.8%
Expanded polystyrene	0.9	1.5	2.0	1.5	0.9	6.8	0.3%
Textiles	15.7	37.4	31.0	20.6	22.1	126.9	5.1%
Hazardous	1.6	2.8	1.3	5.4	1.3	12.4	0.5%
Electrical appliances	8.2	26.5	17.5	33.4	36.7	122.3	4.9%
Automotive parts	19.1	2.0	21.0	1.3	0.0	43.3	1.8%
Other miscellaneous	23.3	51.9	28.9	18.5	25.2	147.8	6.0%
Contaminated paper	31.2	61.6	80.5	40.2	62.8	276.4	11.2%
Glass dust/scraps paper	43.0	68.8	54.1	40.3	30.1	236.3	9.6%
Other plastics	12.9	34.7	23.6	23.3	16.6	111.1	4.5%
PET after liquid emptied	2.0	5.1	0.0	4.3	3.4	14.9	0.6%
HDPE after liquid emptied	0.7	0.3	0.0	0.3	0.0	1.3	0.1%
Liquid	11.4	31.0	26.5	24.6	22.1	115.6	4.7%
Total	**316.6**	**563.2**	**611.1**	**530.4**	**449.8**	**2,471.1**	**100.0%**

Potential recoverable materials account for 24.8% of the residual stream, while the remaining materials are non-recyclable. Contaminated paper was the single largest component accounting for 11.2% with glass dust/scraps of paper (9.6%), and food and kitchen waste (7.6%). Other key categories include other miscellaneous (6%), glass fines (5.9%), mixed rigid containers (5.2%), textiles (5.1%), electrical appliances (4.9%), liquid in bottles (4.7%), other plastics (4.5%) and plastic bags (4.4%).

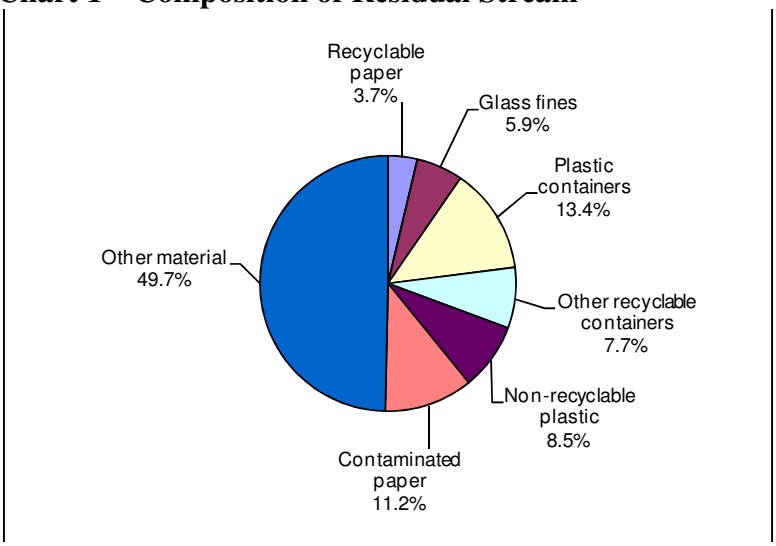
4.2 Consolidated Composition of Residual Stream

The table and chart below show the consolidated composition of residual stream and presents the materials consolidated into a number of key categories for ease of review. 'Other material' represents almost half of the total (49.7%). The major components of 'Other material' are food and kitchen waste, green waste and timber, glass dust and small scraps of paper, textiles, electrical appliances, automotive parts and liquid still in drink containers. Plastic containers (13.4%) and contaminated paper (11.2%) are the next most significant streams. Potential recoverable materials accounts for 24.8% of the residual stream while the remaining materials are non-recyclable.

Table 5- Consolidated Composition of Residual Material

Category	Amount (kgs)	Per cent
Recyclable paper	91.4	3.7%
Glass fines	145.4	5.9%
Plastic containers	330.9	13.4%
Other recyclable containers	190.3	7.7%
Non-recyclable plastic	209.6	8.5%
Contaminated paper	276.4	11.2%
Other material	1,227.1	49.7%
Total	**2,471.1**	**100.0%**

Chart 1 – Composition of Residual Stream



Based on the Hume MRF generating 4,200 tonnes of residual material to be disposed of to landfill each year, this analysis suggests that about 1,000 tonnes is potentially recyclable material. Expressed as a percentage of through-put, approximately 2.5% of potentially recoverable material is currently lost to waste.

5. COMPARISON WITH PREVIOUS AUDIT

5.1 Comparison by Material Category 2007 – 2009

The table below shows the proportion of each category present in the sample compared with the 2007 audit.

Table 6 – Comparison by Category 2007 – 2009 Audit

	Per cent	
Material	**2007**	**2009**
Mixed clean paper/cardboard	3.0%	3.7%
Liquidpaperboard	1.4%	0.4%
Glass containers	2.9%	2.2%
Aluminium	0.8%	1.2%
Steel	1.6%	3.9%
PET	2.1%	4.5%
HDPE	2.0%	3.8%
Mixed rigid plastic containers	7.8%	5.2%
Plastic film/plastic bags	6.6%	8.1%
Food and kitchen waste	4.6%	7.6%
Green waste and timber	1.5%	2.8%
Glass fines	32.7%	5.9%
Non-recyclable glass/crockery	0.4%	0.5%
Nappies	0.8%	1.8%
Expanded polystyrene	0.2%	0.3%
Textiles	4.3%	5.1%
Hazardous	1.2%	0.5%
Contaminated paper	12.3%	11.2%
Other miscellaneous	13.9%	31.5%
Total	**100.0%**	**100.0%**

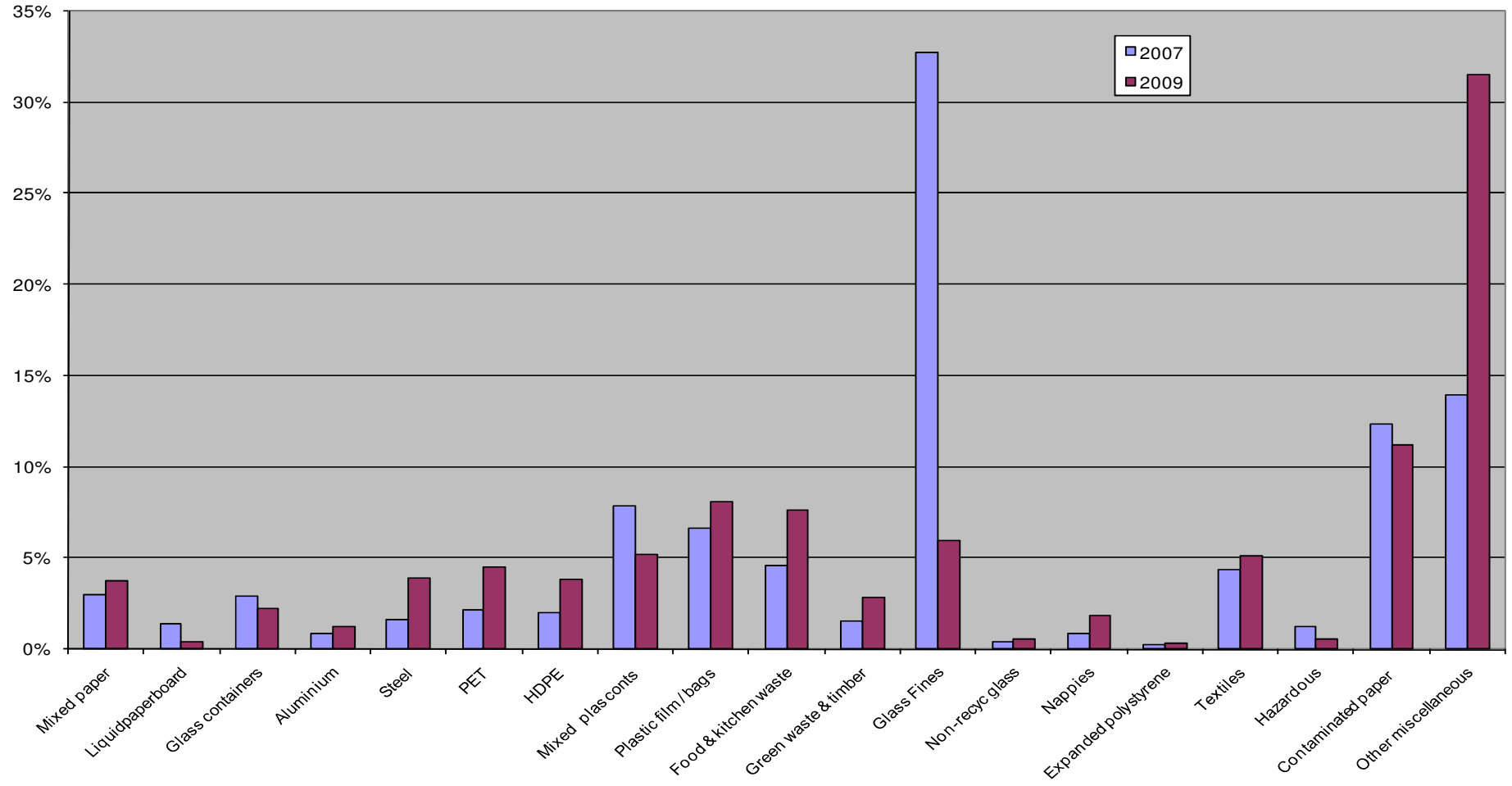
The largest change between the two most recent audits occurred in the proportion of glass fines present in the sample, which has reduced from 32.7% in 2007 to just 5.9% in 2009. This can be directly attributed to the upgrade in the processing to recover glass fines from the waste line in the MRF. An additional trommel has been installed to recover these materials, which are further processed off site but are no longer part of the residual waste stream requiring disposal.

As a result of this change, 'other miscellaneous' items increased from 13.9% to 31.5%. Other material categories had minor changes, including the proportion of plastic bags increased from 6.6% in the 2007 audit to 8.1% in 2009. Food and kitchen waste has also increased from 4.6% in 2007 to 7.6% in 2009.

There have been minor movements with recyclables with mixed clean paper/cardboard, liquidpaperboard, glass containers and mixed rigid plastic containers all decreasing while aluminium, steel, PET and HDPE had minor increases in the residual stream. These slight movements are to be expected as the feedstock changes.

The chart below shows the changes between the 2007 and 2009 audit graphically. It should be noted that in 2009 a new category, 'Glass dust and scraps of paper' was included as technically this was not glass fines and is categorised 'other miscellaneous' in Chart 5.

Chart 2 – Total Quantities of Materials Collected – Comparison with 2007 Audit



5.2 Consolidated Composition Residual Stream

The chart below shows the composition of the residual stream aggregated into some key categories compared to the findings in previous audits. Overall, 'other material' continues to be the largest component. In 2009, this stream has almost doubled from 33% in 2007 to 58.1% in 2007. Glass fines have been reduced from 23.7% to just 5.9%, which is directly attributed to the new processing technology to recover glass fines.

Paper has decreased from about 35% in 2005 and 2006 to less than half at 16.7% in 2007, and a further reduction to 14.9% has been achieved this year. However, of the paper amount only 3.7% is mixed paper and recoverable while the remaining 11.2% is contaminated and not recoverable. Other recyclable containers including aluminium, steel and glass remain relatively constant between 5.4% and 8.0% over the four audits. Plastic containers including PET, HDPE and mixed plastics have ranged from 9.6 % to 14.5% and in 2009 recorded 13.4%.

However, it should be noted that in 2009 a new category, 'glass dust and scraps of paper' recorded 9.6% and was added as technically these materials are not glass fines and are a result of the new processing technology to recover glass fines. This material has been categorised as 'other material' in the chart below.

Chart 3 – Consolidated Composition of Residual Samples Comparison with Previous Audits

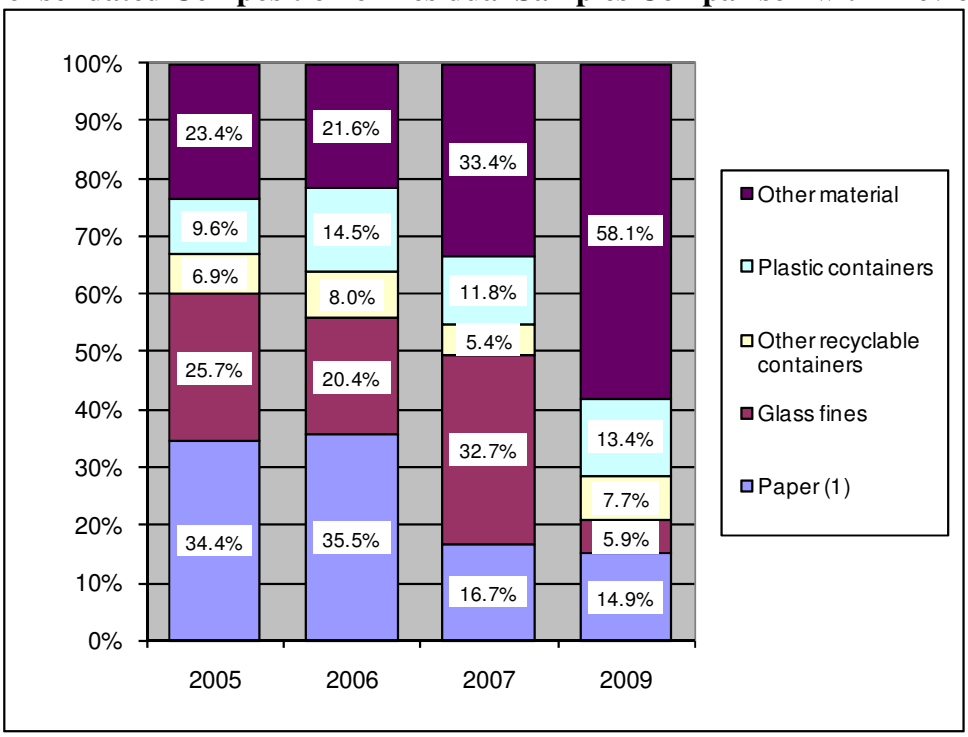


Table 7 – Consolidated Composition of Residual

Category	Amount (kgs)	Per cent
Recyclable and contaminated paper	367.7	14.9%
Glass fines	145.4	5.9%
Plastic containers	330.9	13.4%
Other recyclable containers	190.3	7.7%
Other material	1,436.8	58.1%
Total	**2,471.1**	**100.0%**

Table 9 below shows the comparison between the 2007 and 2009 waste audits when data is normalised with glass fines removed, however, the quantities of the materials are expressed in percentage terms as each year different amounts of material were sorted as is shown in Table 8 below:

Table 8 – Amounts of Residual Material Sorted 2007 – 2009 Audit

Year	Month	Total Amount (kg)	Daily Average (kg)
2007	November	2,094.7	418.8
2009	May	2,471.1	494.2

All material moved less than 3 percentage points between the 2007 and 2009 audits, except mixed rigid containers, which halved from 11.5% – 6.5% and contaminated paper, which reduced from 18.3% to 14.1%.

Table 9 – Quantities of Materials - Comparison with 2007 MRF Audit Excluding Glass Fines 2007 and 2009

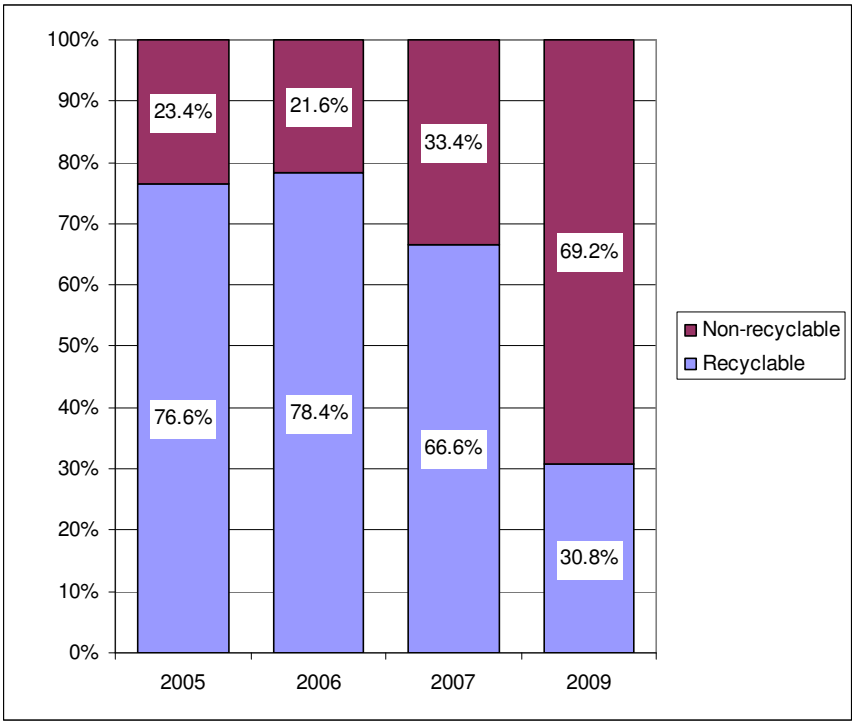
	2007	2009
Material	**Per cent**	**Per cent**
Mixed clean paper/card	4.5%	4.7%
Liquidpaperboard	2.1%	0.5%
Glass containers	4.3%	2.7%
Aluminium	1.2%	1.6%
Steel	2.4%	4.9%
PET	3.0%	4.9%
HDPE	2.9%	4.6%
Mixed rigid plastic containers	11.5%	6.5%
Plastic bags and plastic film	9.8%	10.2%
Food and kitchen waste	6.8%	9.6%
Green waste and timber	2.3%	3.6%
Non-recyclable glass/crockery	0.6%	0.7%
Nappies	1.2%	2.3%
Expanded polystyrene	0.3%	0.3%
Textiles	6.4%	6.5%
Hazardous	1.7%	0.6%
Contaminated paper	18.3%	14.1%
Other miscellaneous	20.6%	21.7%
Total	**100.0%**	**100.0%**

Notes
1: Categories glass fines and glass dust/scraps paper (2009 only) omitted for comparability purposes
2: Categories PET with liquid emptied, HDPE with liquid emptied and liquid omitted from 2009 data for comparability purposes

5.3 Recyclable to Non-Recyclable Materials – Comparison with Previous Audits

The chart below compares the proportions of recyclable and non-recyclable material found in the residual waste in 2005, 2006, 2007 and 2009. The proportion of recyclable material was similar in 2005 and 2006 but fell in 2007 with improved paper recovery, and this trend continued in 2009 with now just 30.8% of recyclable material in the residual stream due to glass fines diversion.

Chart 4 – Average Proportion of Recyclable to Non-Recyclable Materials – Comparison with Previous Audits



6. SUPPLEMENTARY AUDITS

Additional audits were requested to be carried out in 2009 to capture information about a range of materials that have been identified as potential issues of concern to the MRF process. These were:

- Items in plastic bags
- Plastic bottles containing liquid
- Long items that jam machinery
- Electrical and compound items
- Large plastic items causing breakdowns
- Big, heavy items causing breakdowns
- Mixed rigid plastics
- Black items
- Other

These additional audits included sorting, counting, weighing and photographing each type of material category concurrently with the auditing process and as often as time allowed but at a minimum once during the five-day audit period to provide indicative data. The results of these separate audits are provided in the tabled below.

6.1 Composition of Material in Plastic Bags

The audit of the contents of the plastics bags found in the residual waste bin was to determine composition. The table below presents the results of the plastic bag audit.

Table 10 – Composition of Material in Plastic Bags

Material	Amount (kg)	Per cent
Mixed clean paper and cardboard	9.7	9.0%
Liquidpaperboard	1.0	0.9%
Glass containers	3.4	3.2%
Aluminium	1.1	1.0%
Steel	3.8	3.5%
PET	2.5	2.3%
HDPE	2.0	1.9%
Mixed rigid plastic containers	3.6	3.4%
Film plastics	8.4	7.8%
Food and kitchen waste	34.0	31.6%
Green waste and timber	0.0	0.0%
Glass Fines (<50mm diameter)	0.4	0.4%
Non-recyclable glass and crockery	0.1	0.1%
Nappies	6.2	5.8%
Expanded polystyrene	0.5	0.5%
Textiles	2.6	2.4%
Hazardous	0.0	0.0%
Electrical appliances	1.0	0.9%
Automotive parts	0.0	0.0%
Other miscellaneous	4.6	4.3%
Contaminated paper	21.7	20.1%
Glass dust, small scraps of paper	0.0	0.0%
Other plastics	1.0	0.9%
Total	**107.6**	**100.0%**

All bags were separated from the remaining material, weighed and then sorted into the same agreed categories as the full audit.

The vast majority of the contents were food and kitchen waste (31.6%) and contaminated paper (20.1%). Non-recyclable material accounts for 75% of the plastics bags' contents, confirming that households are using the recycling bin for the disposal of household rubbish.

Plastic bags represent 4.4% of the residual waste stream.

6.2 Plastic Bottles Containing Liquid

Each day of the audit, plastic bottles containing liquid were emptied and the weight of both the liquid and bottles were recorded. While this was a request in the Scope of Works for the supplementary audit, APC does this as a matter of course and we would normally add liquid to the food category. Table 11 below shows the weight of recycling containers and the liquid. Bottles containing liquids are currently not recovered during the sorting process. The origins and nature of the liquid inside is unknown and may be a chemical. MRFs have been closed and staff hospitalised from toxic fumes from the inappropriate disposal of chemicals in recycling bins. The weight of the liquid represents 88% of this group. To reduce this loss of 12% bottle weight, ongoing education of consumers to remove caps is required.

Table 11 – Recyclable Containers with Liquid

Material	Total kgs	Per cent
PET after liquid emptied	14.9	11%
HDPE after liquid emptied	1.3	1%
Liquid	115.6	88%
Total		100%

Plastic Bottles Containing Liquid

6.3 Composition of Problematic Contamination by Weight

Table 12 below shows the individual weights of each item and expressed as percentage of the entire supplementary audit.

Table 12 – Composition of Problematic Contamination – by Weight

Material	Amount (kg)	Per cent
Long items that jam machinery	64.2	27.1%
Electrical and compound items	34.6	14.6%
Large plastic items causing breakdowns	21.3	9.0%
Big, heavy items causing breakdowns	45.8	19.3%
Plastic bottles containing liquid	54.8	23.1%
Mixed rigid plastics	0.7	0.3%
Black items	0.6	0.2%
Other	15.3	6.4%
Total	**237.2**	**100.0%**

Of the samples audited, 'long items' account for 27.1% of this stream and plastic bottles containing liquid make up a further 23.1%, followed by big heavy items at 19.3%.

6.4 Composition of Problematic Contamination by Number

Table 13 below presents the number of items recorded in each of the supplementary categories that was audited. In total, 688 additional items were counted of which 'other items' represented 282 or 41%, while 'long items' represent 271 items or 39.4%. These two items far exceeded any other category by 32% or 220 items.

Table 13 – Composition of Additional Material – by Number

Material	No. of items	Per cent
Long items that jam machinery	271	39.4%
Electrical and compound items	51	7.4%
Large plastic items causing breakdowns	23	3.3%
Big, heavy items causing breakdowns	23	3.3%
Plastic bottles containing liquid	26	3.8%
Mixed rigid plastics	10	1.5%
Black items	2	0.3%
Other	282	41.0%
Total	**688**	**100.0%**

The following series of photographs illustrate the types of materials found in each of the categories detailed above.

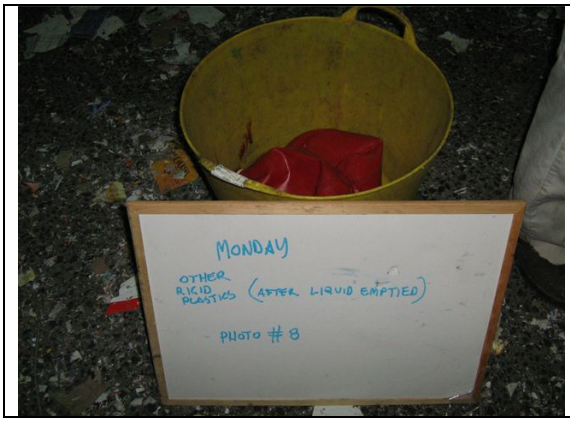
'Long Items' – Potential to Cause Breakdowns

Electrical and Compound Items

'Large plastic items' – Potential to Cause Breakdowns

'Big, heavy items' – Potential to Cause Breakdowns

Mixed Rigid Plastics



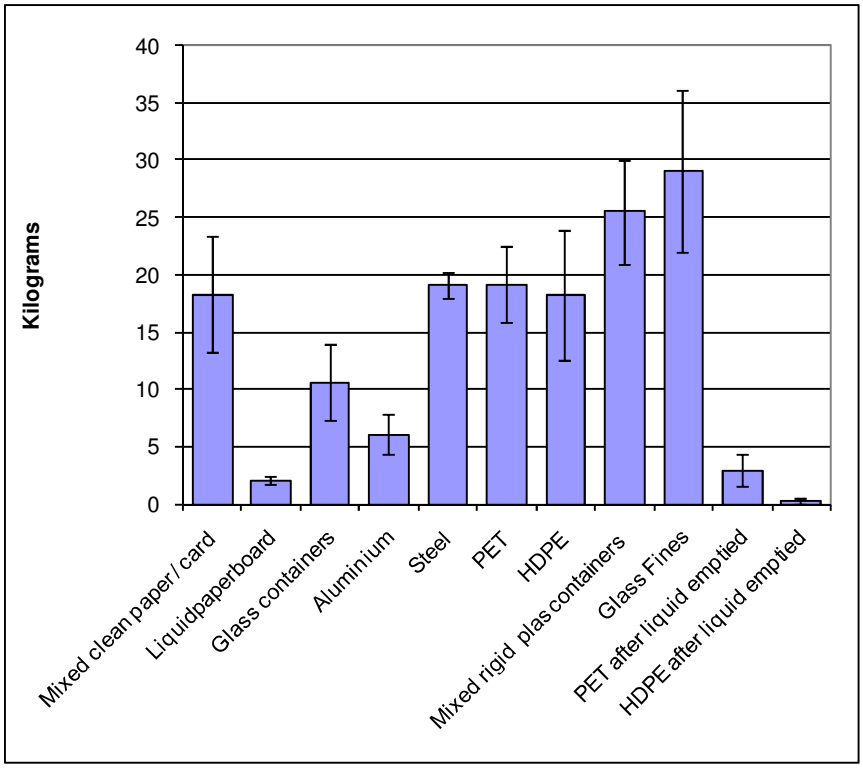
Black Items

Other

7. STATISTICAL ANALYSIS

At a 90% confidence level, upper and lower confidence intervals were calculated for the recyclable components of the sample. These are shown in the chart below, *Average Weight of Recyclable Components Showing Confidence Intervals*.

Chart 5 – Average Weight of Recyclable Components Showing Confidence Intervals



The chart shows the average weight of the recycling components of each sample and the corresponding 90% confidence intervals. The 90% confidence interval indicates that we can be 90% confident that the true value for the average weight of each component lies between the upper and lower confidence limits shown. Glass fines accounted for nearly 30kg of the sample, making this stream the single largest component. Mixed rigid plastic containers also accounted for a large proportion of the sample (25.6kg.)

The chart below, *Average Weight of Contamination Components with Confidence Intervals*, shows the proportion of contaminants found in the audited samples along with the corresponding 90% confidence interval for each component.

Chart 6 – Average Weight of Contamination Components with Confidence Intervals

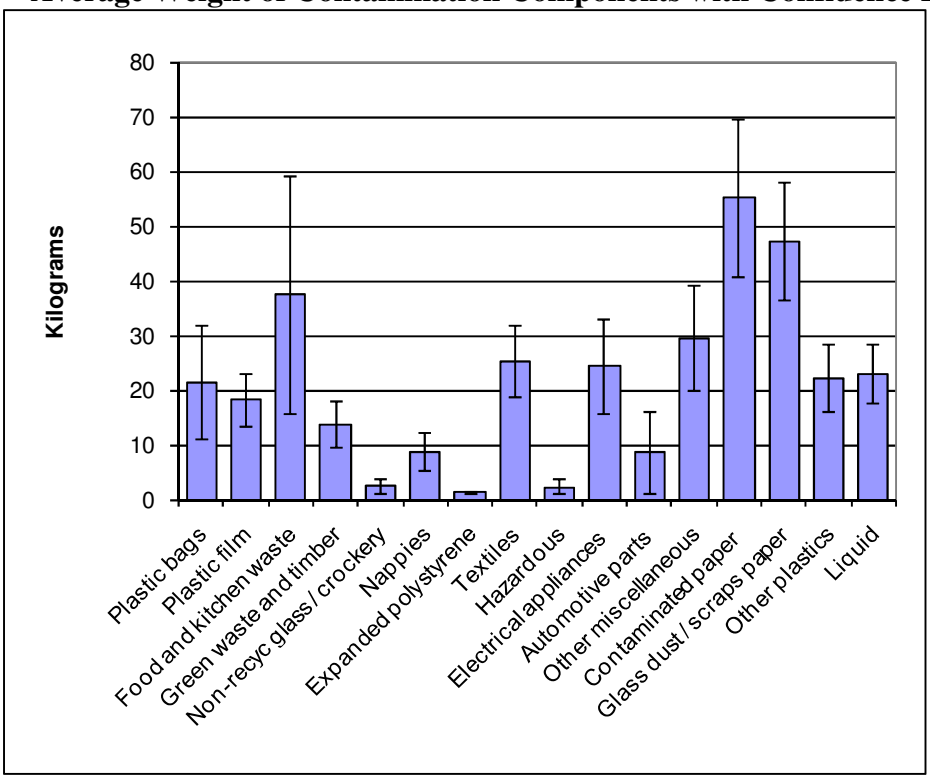


Chart 6 clearly shows that the four major contaminants were:

1. Contaminated paper
2. Glass dust/scraps of paper
3. Food & kitchen waste, and
4. Other miscellaneous.

8. STAKEHOLDER FEEDBACK

8.1 Thiess Services

Discussions with Richard Illes, MRF Manager, revealed that the Hume MRF had the best performance of any of the Thiess Services' MRFs until the new Central Coast MRF was launched last year at a cost of almost $40M, which aimed for a 3% product loss.

The company has invested in new equipment to separate glass fines from the mixed residual line and these are now separated and processed off site. The dramatic reduction in glass fines present in the residuals stream from the 2007 audit of 32.7% to just 5.9% in 2009 is testament to the success of this project.

In an email dated 3rd July 2009, Richard Illes provided background information on the waste component requiring disposal over the past four years, which is provided in the table below:

Table 14 – MRF Performance 2006 – 2009

Year	Date	Co-mingled	Waste	Per cent
		Tonnes		
2006	1/6/05 to 31/12/05	23084	2657	11.5%
2007		40759	5130	12.6%
2008		43395	4314	9.9%
2009	1.1.09 to 2/7/09	22909	1662	7.3%

It appears that the amount of waste requiring disposal is declining as a percentage of input over time.

The scope of works states that approximately 45,500 tonnes are generated from the domestic recycling service and public drop off bins and a further 12,000 tonnes from the commercial and industrial sector. Total through-put is 57,500 tonnes per annum. From our observations of the audit data, the amount of material lost to waste that is potentially recoverable is about 2.3% of input. This, in our opinion and that of the industry, is "best practice" standard, as most MRFs are operating at about 10% and in the inefficient MRFs, the losses can be greater.

The MRF processes material from three sources: a domestic recycling service, public drop off bins and the commercial and industrial sector. ACT NOWaste concentrates its focus on education and communication with residents who primarily use the kerbside recycling program.

However, both Cleanaway and Thiess Services confirm that contamination in the public drop off centres is a cause of great concern and appears to be increasing. The containers stream is also processed through the MRF and therefore the audit results for the residual stream includes all three sources. Richard Illes stated that the "commingled drop off and cardboard and paper drop off bins are badly contaminated. The contamination in the cardboard bins has resulted in us, Thiess Services, losing product from other sources. This has both an operational and direct financial impact on the company". Illes further stated that the contamination in the paper bins is so bad that it should be sorted over the MRF line to improve quality. However, due to the size and bulk of many of the items in the cardboard bins such as plasma TV boxes, whitegoods surrounds, etc, the MRF is not designed to process materials of this size and bulk and so processing to clean up the cardboard is not possible.

9. SUMMARY

The scope of works required the consultant to:

- Suggest actions that ACT NOWaste might take to achieve a reduction in contamination.
- Identify and quantify what recyclable material is not currently processed successfully. Document the reasons material is not successfully recycled and make suggestions as to how the process might be improved.
- Analyse and report on trends and opportunities to further improve recycling.

Firstly, the 2009 audit has revealed a significant improvement in the proportion of recyclable material that remains in the sample. This has reduced from 66.6% in 2007 to 30.8% in 2009. In real terms, that means a decrease from 2,772 tonnes of potentially recyclable material going to landfill in the residual stream to just more than 1,300 tonnes per year in 2009 or expressed as a percentage of through-put around 2.3%.

The major reason for this achievement is the introduction of a new process to segregate glass fines from the residual stream at the MRF. This new equipment investment is having a positive result, with the proportion of glass fines found in this year's sample just 5.9%, down from 32.7% in 2007.

To achieve any other improvement in recovery of materials, which is already at best practice standards would require a capital investment well into the millions of dollars with little if any pay back and therefore cannot be contemplated.

Contamination still remains a major issue for the MRF operators. Contaminated paper is the largest single material type now in the residual stream at 11.2%. This result would suggest that ongoing education and re-education of residents is required to differentiate between recyclable paper products and contaminated paper that cannot be recycled.

Glass dust and small scraps of paper (most likely bottle labels) was the second largest single item in the residual stream at 7.6%. This is a new category added this year as, technically, this material is not glass fines but smaller sized glass fragments and paper labels and is created as a by-product of the new sorting equipment to recover glass fines.

Food and kitchen waste was the third largest component at 7.6% and the plastic bag audit revealed that 75% of the contents of plastics bags are food and kitchen waste, indicating that householders are incorrectly or intentionally using the recycling bin either at home, work or at the drop off area as a garbage bin. Ongoing education is certainly required to ensure residents understand the correct method of disposal for the various waste streams.

Other miscellaneous (6.0%) and textiles (5.1%), electrical appliances (4.9%), liquid in bottles (4.7%), other plastics (4.5%), plastics bags (4.4%) are all material categories clearly not recyclable. Again, the presence of these items in the recycling stream would indicate incorrect usage of the service through ignorance or arrogance by the community. Only two materials – mixed plastics containers and glass fines in the top 10 materials by weight in the residual stream are recyclable.

With the exception of mixed rigid containers, all other recyclable materials are less than 4% in the residual stream. This shows the effectiveness of the MRF to target and recover the key recyclable items that the service provides.

This year was the first time supplementary audits were conducted to determine the number and weight of a range of items deemed to be problematic to the MRF process. The results clearly show that 'long items' are the greatest challenge as they are highest in actual number counted (271 actual items) or 40% and by weight with 27%, and have the potential to stop or cause serious breakdown to the equipment. Big heavy items, while just 3% by count or 23 actual items, represented 19% by weight. Again, plastic bottles containing liquid while just 26 in number account for 23% by weight, and electrical and compound items were 51 in an item count represented at 15% by weight.

From this study, it is evident that the community is placing unsuitable material in the recycling stream. The source of this contamination is unknown as it could occur at three potential points – kerbside recycling bins, public drop off bins or from commercial premises.

Given that the contamination at public drop off centres has been identified as a problem by both the collection contractor and MRF processor and both indicate the level of contamination is increasing, it is suggested that an audit of the public drop off bins be conducted to quantify the level and nature of the contamination. If the contamination is at an unacceptable high level, to be determined pre the audit process, then ACT NOWaste may need to reconsider this service offering if it is adversely impacting on the financial viability of the MRF operator.

Ongoing education of the entire community and the key messages or 'hit list' of what to educate the general public about is provided in the major non-recyclable categories found in the residual waste stream audit and the supplementary audit and includes:

- Contaminated paper
- Food and kitchen
- Textiles
- Electrical appliances
- Liquid in bottles
- Other plastics
- Plastics bags
- 'Long items'
- 'Big items'

Simple messages like "remove caps and lids" from containers will assist in reducing the amount of liquid in containers.

The issue of broken glass during the collection process and the impact this has on effective recovery at MRFs was the basis of a comprehensive study undertaken into glass breakage by APC with funding from the National Packaging Covenant (NPC). In total, 21 whole truck loads of recyclables collected under controlled conditions at different load densities were sorted into 14 material categories and six glass fine sizes to measure the effect density has on the proportion and size of broken glass. Loads of both fully commingled material and containers only were collected between February-April 2004 and March 2005.

The key outcome of the study was that load density does impact on glass breakage during collection and a recommendation of the study was that contract administrators include compaction ratios in tender documentation. However, any requirement to comply with compaction settings impacts on the number of vehicles required in a fleet and therefore the contract price and must be negotiated at the commencement of the contract, not part way through an existing contract.

The issue of glass fines generated by Cleanaway during the collection program has been largely resolved by Thiess Services by the company's investment in new equipment to recover this material for recycling as a separate stream to glass.

10. RECOMMENDATIONS

APC offers the following recommendations as a result of this audit:

1. ACT NOWaste must undertake ongoing education of the community in respect to correct use of the domestic recycling service offered. In particular, information about what not to recycle should be conveyed as the following non-recyclable materials were found in significant quantities in the recycling stream: contaminated paper, food and kitchen, textiles, electrical appliances, liquid in bottles, other plastics , plastics bags, 'long items' and 'big items'.

2. A simple message like "remove caps and lids" from containers will assist in reducing the amount of liquid in containers.

3. The community should be reminded not to put any recyclables in plastic bags, nor to use the recycling bin for the disposal of household waste.

4. ACT NOWaste should consider undertaking an audit of the public place drop off bins to determine current levels of contamination present, as both the collection contractor and MRF processor indicate that levels of contamination are high and increasing.