COMPOSITION OF WASTE

McLeans Pit Landfill
SWAP Study
7 – 13 August 2005

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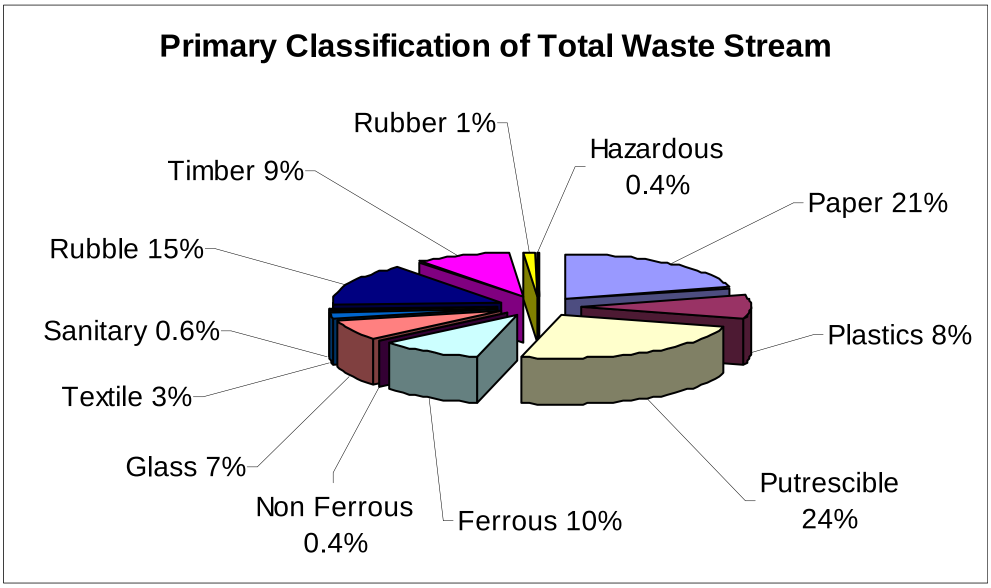
1.0 EXECUTIVE SUMMARY

This report presents the results of an initial waste analysis survey at the McLeans Pit landfill which is situated seven kilometers north of Greymouth. The results, gained using the SWAP strategy, act as a tool for the design and management of the waste stream to the landfill as well as forming an information base for future surveys.
The SWAP strategy was developed by the Ministry for the Environment in New Zealand to ensure that the information gathered on waste streams is consistent throughout the country and presented in a useable and meaningful way. The strategy allows for the categorizing of refuse into twelve primary classifications and for further division, where required, of up to 47 secondary classifications.
The McLeans Pit landfill survey was carried out over a seven day period in August 2005. The timing of the survey gives an indication of the waste stream influenced by winter seasonal factors.
All loads arriving at the site were analysed visually and the proportion of each classification assessed. Assessments were made either in terms of weight or volume. Where assessments were made by volume these values were converted to weight in line with SWAP protocol using conversion rates established both on site and from earlier surveys.
To support assessments, a number of loads were weighed by use of portable scales and the value compared with the assessment. Adjustments were made as required.
The survey determined the total waste stream into the twelve primary classifications. These values are shown in Chart 1 below.

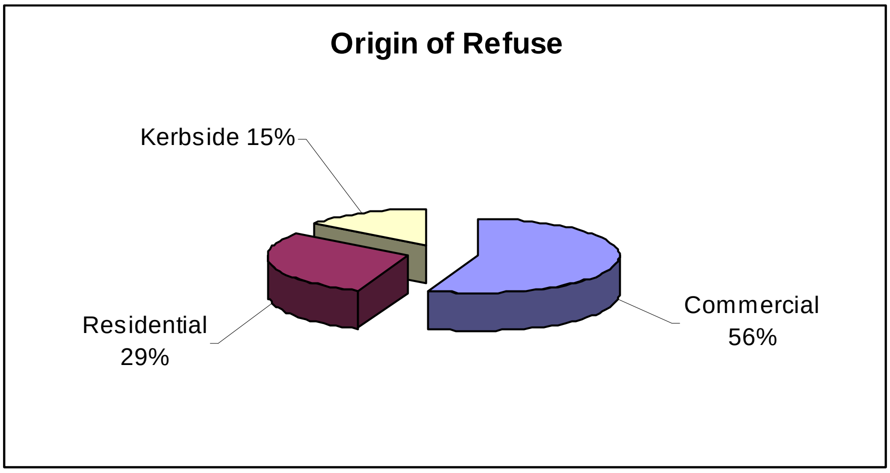
Chart 1 : Total Waste Stream Shown by Primary Classifications



There is scope for reduction in many waste streams to the landfill and this is the reason this survey looked at secondary classifications of a number of the primary components.
Secondary determinations were carried out on paper, plastics, putrescible, ferrous, glass, textiles, rubble and timber categories. Further information was also sought both on rubber, in particular the number and weight of tyres, and hazardous waste by recording the quantity and type of material received.
Cardboard made up the largest proportion of the paper classification at 43% by weight. Paper accounts for 21% of the total waste stream which is nearly twice the New Zealand mean value of 11.5% for this classification.
Plastics proved difficult to identify into secondary classifications and was only fully achieved in the analysis of kerbside bag refuse.
The secondary classification of putrescible waste showed garden material accounted for 76% of this classification, the majority of which originated from residential properties.
Cans and whiteware accounted for only 15% of the ferrous material. One major component of ferrous ‘other’ waste was the nine automobile wrecks brought in during the survey.

Glass waste at 7% of the waste stream is well above the national mean of 2.8%. There are limited opportunities to recycle glass.
Untreated timber waste accounted for 66% of this classification and tyres accounted for nearly half of the rubber wastes. A total of 33 tyres weighing 710kg were recorded during the survey.
Carpets and furnishings made up 72.5% of the textile received and clothing the remainder. Rubble included stone and concrete 43%, ash 23%, soil 16%, and plaster board 10% of this classification.
Hazardous waste consisted mainly of small items such as dry cell batteries found in kerbside bags. Some larger items were encountered in the general waste and included paints, gas cylinders, oil, garden chemicals and automotive batteries. Hazardous waste accounts for only 0.36% of landfill waste stream, which is extremely low compared to other waste disposal facilities. Provision is made on site for the collection of oil, paints, automotive batteries, and gas cylinders with a lock-up facility available for chemicals and the more hazardous waste.
Along with categorizing all refuse, the origin of all loads to the landfill was determined. The values of origin of refuse are presented in Chart 2 below.

Chart 2 : Origin of Refuse



A major influence on the management of refuse disposal is the mode of transport to the site. Transport values were recorded into five classes of vehicles, these being cars, utility vehicles, trailers, compactor vehicles and trucks. Trucks formed the largest component delivering 38% of the refuse by weight.
Kerbside bag refuse was examined in detail with the contents of 65 bags, containing 391kg of refuse, being analysed into primary and nominated secondary classifications. It was predetermined that a minimum of 60 bags required analysis to give an acceptable level of accuracy on the major components of the waste stream. Secondary classifications fall outside this accuracy.
Further values on kerbside bags were established including an average bag weight of 5.62kg, and a mean volume of 28 litres.
A total of 451 vehicles used the landfill, disposing of 703m3, or approximately 151 tonne, of refuse during the survey period.
These values have, with caution, been extrapolated into annual quantities for reporting purposes only. These values are given in Table 1 below.

Table 1 : Survey and Annual Values

	Survey Period	Annual Value
Volume	703 m3	36,600 m3
Weight	150,893 kg	7,850 tonne
Density	215 kg/m3	

There is scope for waste reduction at the McLeans site and this should concentrate on the single large volume components of the waste stream, i.e. cardboard, paper and putrescible materials.

2.0 INTRODUCTION

This report presents the results of a waste analysis survey on the composition of the refuse waste stream recorded at the McLeans Pit landfill which is located approximately 7 kilometers north of Greymouth.
Such surveys, when undertaken over a period of time, can build up a reliable record on the quantity and type of material being disposed to landfill. The results can be used to assist with the constructive planning and management of the district's waste. They also may become a tool for measuring the changes to the waste stream and for gauging the effects of various strategies. The timing of this survey, 7th to 13th August 2005, should show any winter seasonal influence on the waste stream.

2.1 Background

Traditionally, rubbish has been dumped and forgotten.
However, growing awareness of environmental effects has increased the expectations of communities for enhanced standards of waste disposal. As a result, parties responsible for waste management have come under pressure to respond to waste issues. But to enable effective decisions to be made, consistent and reliable data is required.
Therefore, in response to the need of operators and managers, and the need for information on a national basis, the Ministry for the Environment in 1992 released a strategy for measuring the components of the waste stream. This strategy was known as the "Waste Analysis Protocol" (WAP) which contained a methodology for categorising and collecting data on waste.
The strategy was revised in March 2002 and renamed the "Solid Waste Analysis Protocol" (SWAP).
It is under the revised protocol that this survey has been conducted.

2.2 Waste Classification System

The SWAP strategy provides for two methods of classification, these being:-

Primary Classification
Secondary Classification

The purpose of the two classification systems is to allow quick coverage of the full waste stream and also detailed analysis of any particular component or source of waste.
Primary classification divides the waste into 12 categories with secondary classification further dividing these categories into a total of 47 sub categories.
Secondary classification requires considerable time for analysis and is used more for the analysis of a particular component in the waste stream, such as investigating a material for recycling.
This survey is based on primary classification analysis with additional analysis of selected items to meet objectives.

2.3 Objectives

The primary objective of this survey is to gauge by weight the primary classification of the waste stream.

Secondary objectives are to:-

- define paper into secondary classifications of newspaper, cardboard and other paper
- define plastics into seven categories of plastics
- define putrescibles as either kitchen or garden waste
- define ferrous waste into cans, whiteware and other type
- define glass by colours of clear, green and brown
- define textiles into clothing and other categories
- define rubble into ash, soil, concrete and stone, plaster board, and other rubble

- differentiate between treated and non-treated timber wastes
- differentiate between tyres and other rubber wastes and to take note of the number of tyres
- record the quantity and type of hazardous waste received

2.4 The New Zealand Waste Strategy

Reducing New Zealand's waste has become the cornerstone of the Government's commitment to sustainable development.
The Ministry for the Environment released The New Zealand Waste Strategy in March 2002. This document outlines the Government's vision to minimize and manage waste resources as part of an overall goal to form a sustainable society. To achieve the waste reduction aim the New Zealand Waste Strategy has three core goals:

- lowering the social cost and risks of waste
- reducing the damage to the environment from waste generation and disposal
- increasing economic benefit by more efficient use of materials

Through the Ministry for the Environment waste programmes and guidelines, national targets will be set for regions to achieve. Target areas include organic wastes, special wastes, construction and demolition wastes, hazardous wastes including contaminated sites and organochlorines, trade wastes and lastly, waste disposal.
The results from SWAP studies are one tool that can be used to measure both the performance of a region and the government's achievement towards a sustainable society. On a local level the results assist Council with planning management and performance of the waste stream.

2.5 Previous Surveys

There was no record found of previous waste analysis studies carried out on the waste stream to the Mcleans Pit landfill.

3.0 SURVEY DESIGN and METHODOLOGY

3.1 Design Format

The survey format is based on the Solid Waste Analysis Protocol (MfE 2002).
In line with the protocol recommendations, supporting data is to be captured over a one week period.
The landfill operates for seven days a week.
With an expected low number of vehicle movements at the landfill the survey is to include a visual analysis of all loads arriving. These loads are to be defined into the 12 primary classifications by volume or weight and converted to weight for reporting.
The survey is also to capture supporting data on the type of transport to the site. As all types of vehicles are permitted on site the following categories are to be used:-

Cars including station wagons and SUVs
Utes and vans
Trailers
Compactor Vehicles
Trucks

The origin of refuse is to be recorded as one of three categories:-

Residential	This includes domestic household and property type wastes produced by residents.
Commercial	This includes wastes from commercial operations, building sites, shops factories, accommodation and commercial waste operators.
Kerb Collection	This covers domestic and commercial wastes collected through a kerbside bag system.

A minimum of 60 kerbside collected refuse bags are to be taken at random and analysed, with some bags taken from each load to the landfill.
The contents of refuse bags are to be sorted into the 12 primary classifications and weighed.
Similarly, a minimum of 120 bags are to be collected at random and weighed to determine an average weight for refuse bags, also their volume assessed and a mean density for refuse bags established.
Paper, plastics, putrescibles, ferrous, glass, textile, rubble, timber and rubber categories are to be analysed into certain secondary classifications.
Supporting data is to be gained by the weighing of selected vehicles by portable scales and also the weighing of representative samples from loads of a single classification material.

3.2 Survey Limitations

Several factors occurred that served to limit the final results.
Weight and density of material varied from exposure to rainfall and absorption of water. Where possible mean values were established for certain materials to minimize the influence of water. Such items included sawdust and ash.
Likewise the density of loads for green waste varied by any effort made to pack or consolidate the material. These differences were minimised by weighing of loads.
The portable scales used were limited to single and dual axel vehicles only.

3.3 Methodology

The survey was predetermined for, and carried out, over the week of 7th to 13th August 2005 on site at the McLeans Pit landfill.
Survey forms capturing the required data were developed and used to ensure sufficient information was recorded on site.
Two working areas were established on site. The first area was adjacent to the landfill tip face and the second alongside the recently established transfer pit, which was used by the public and smaller commercial vehicles.

These were set up in line with Health and Safety requirements, and provided a safe working area away from the movement of machinery.
All sample analysis, weighing of samples and analysis classification work was carried out at the station established adjacent to the tip face.
The site by the transfer bin also controlled the recording of materials disposed to separate collection areas for green waste, ferrous items, tyres, rubble, timber, furniture and paper recycling.
Weighing of vehicles was carried out on a level area between the entry and the site office.

Visual classification analysis was carried out both at the tip face and also the transfer area, if possible, as loads were being discharged.
Two staff were involved on site while the landfill was open to the public. This required moving between the tip face, the weighing station and the transfer area as required.
A hazards assessment was carried out prior to the event and staff involved received safety training and were made aware of the likely hazards on site.
Checks on accuracy of evaluation were carried out during the survey by team members, individually assessing load components. These values were then discussed to ensure consistency of assessment and coverage of all classifications.
Loads were evaluated as soon as possible after being discharged so to avoid contamination or covering by other loads.
Volumes were recorded, as measured or assessed or from values given by drivers. Drivers were also requested information on the origin of the load.
Samples were removed for analysis.
As bags from kerbside collections were delivered on site, staff carried out analysis of the samples taken. They were sorted into primary and secondary classifications. The bags were selected at random from each load.
Certain vehicles, representative of vehicle type and load, were weighed on portable scales. Other loads were sampled and samples weighed to determine unit values for particular materials.
All site data was converted into weight basis to conform to the protocol and allow direct comparison with any future studies.
Hazardous materials were removed from the waste stream and placed in appropriate storage.

4.0 RESULTS

4.1 Origin of Refuse

For this survey the origin of the waste stream has been recorded into three categories, Commercial, Residential and Kerb Collection. This information was obtained from the drivers as vehicles accessed the landfill.
These categories allow a better understanding on the production of waste and, through further studies, will show trends and influences affecting each waste source.
Kerbside bags contain both residential and commercial wastes. No attempt was made to define the proportions of the mix.
There are also some areas with undefined boundaries between residential and commercial sources, in particular with property maintenance. Where the material from a residential property is generated by a commercial activity then the material was classified as commercial.
The origin was not influenced by the mode of transport to the landfill. Transport is discussed in Section 4.5.

Chart 3 : Waste Stream - Origin of Refuse

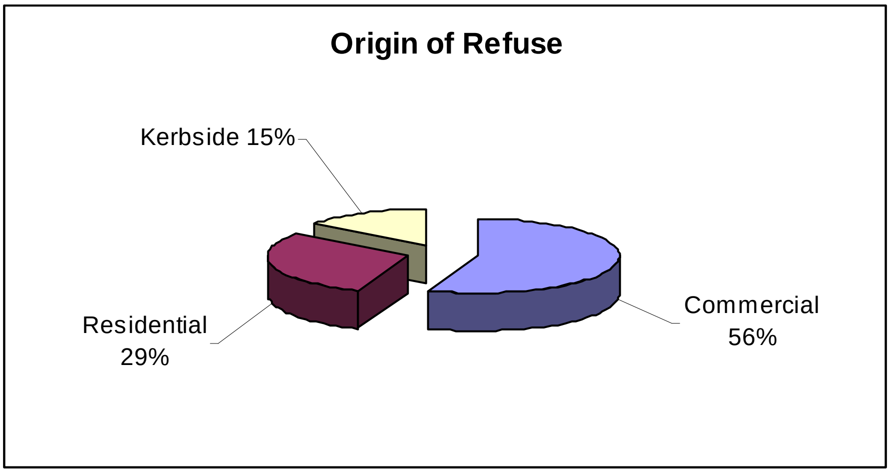


Table 2 : Origin of Refuse – Numerical Values

Origin	Weight kgs	Percentage
Commercial	84,261	55.8 %
Residential	44,352	29.4 %
Kerbside	22,280	14.8 %
Total	**150,893**	**100.00**

4.2 Primary Classification of the Waste Stream

Primary Classification involves defining waste into twelve categories. For this survey the Primary Classification results are shown both for the total waste stream and also for each of the three origins of refuse.
The classification values are likely to vary greatly between the three origins of waste and the understanding of these values will assist with the targeting of waste recovery or waste minimization programmes.

4.2.1 Primary Classification of the Total Waste Stream

A Summary of the Primary Classifications of the total waste stream, for the period of the survey, is shown below in Chart 4 and Table 3.

Chart 4 : Primary Classification Values of the Total Waste Stream

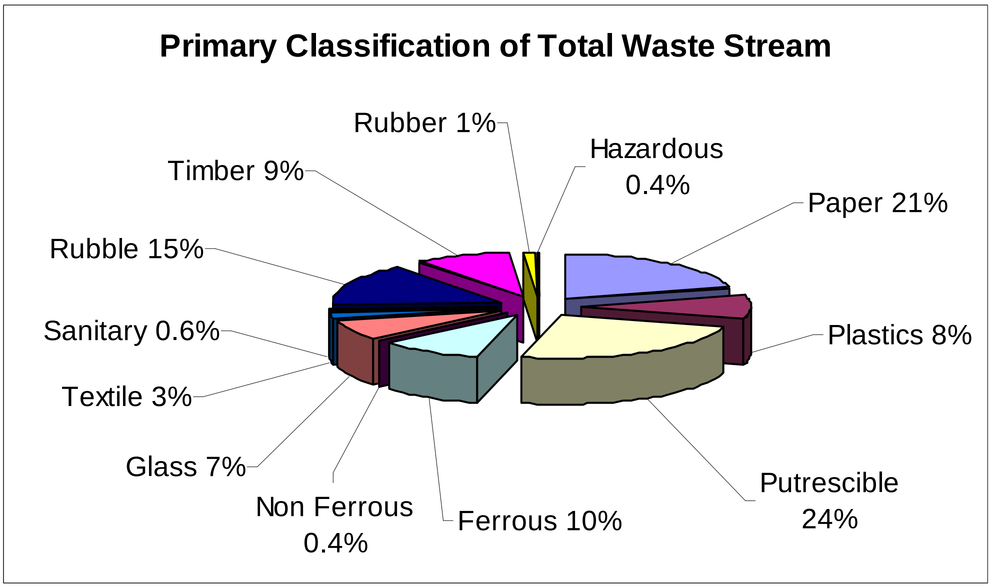


Table 3 : Total Waste Stream Analysis - Primary Classification Values

Classification	Total Kgs	% Total
Paper	32,034	21.2
Plastic	12,413	8.2
Putrescible	36,735	24.3
Ferrous	14,682	9.7
Non Ferrous	603	0.4
Glass	10,849	7.2
Textile	3,784	2.5
Sanitary	892	0.6
Rubble	23,002	15.2
Timber	13,893	9.2
Rubber	1,470	1
Hazardous	536	0.4
Total	**150,893**	**100.0**

4.2.2 Primary Classification of the Commercial Waste Stream

The commercial waste stream is defined as waste generated by industrial and commercial operations no matter where these operations are situated.
The primary classification values of commercial waste are shown in Chart 5 and Table 4.

Chart 5 : Primary Classification Values of Refuse from Commercial Origin

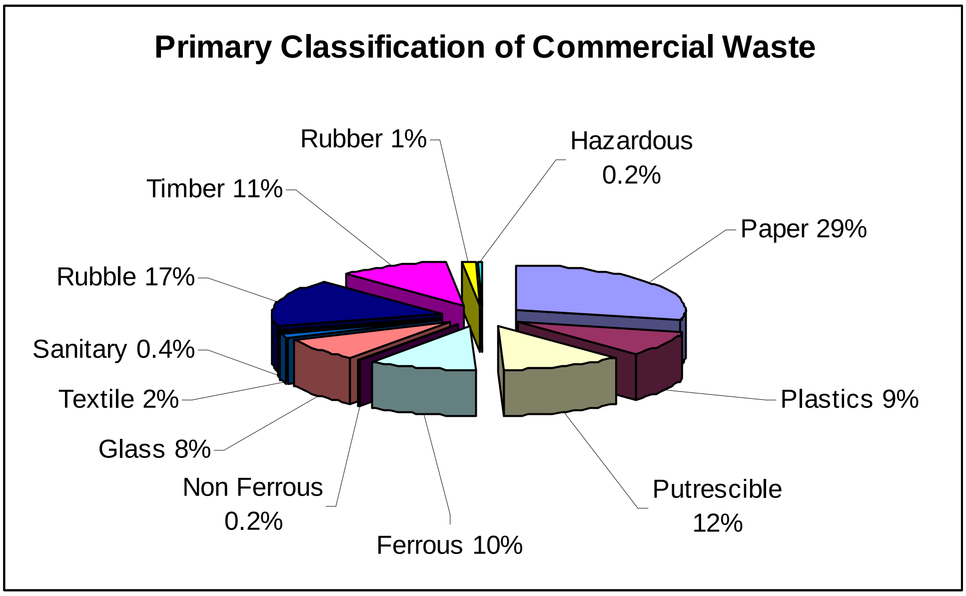


Table 4 : Commercial Waste Stream Primary Classification Values (by weight)

Classification	Total Kgs	% Commercial	% Total Waste
Paper	24,466	29.0	16.2
Plastic	7,455	8.8	4.9
Putrescible	9,832	11.7	6.5
Ferrous	8,669	10.3	5.7
Non Ferrous	184	0.2	0.1
Glass	6,874	8.2	4.6
Textile	1,587	1.9	1.1
Sanitary	322	0.4	0.2
Rubble	14,558	17.3	9.6
Timber	8,985	10.7	6.0
Rubber	1,128	1.3	0.7
Hazardous	201	0.2	0.1
Total	**84,261**	**100.00**	**55.8**

4.2.3 Primary Classifications of the Residential Waste Stream

The primary classifications for residential waste are presented in Chart 6 and Table 5 below. Whereas the chart depicts the classification as a percentage of the residential waste stream, Table 5 presents the values for each classification as both a percentage of the residential waste stream and also of the total waste stream.

Chart 6 : Primary Classification Values of Refuse from Residential Origin

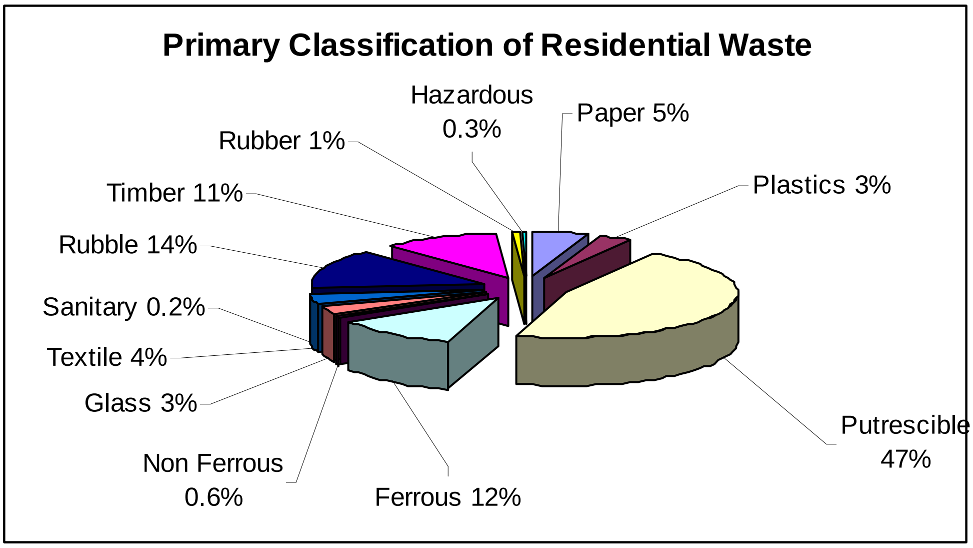


Table 5 : Residential Waste Stream Primary Classification Values (by weight)

Classification	Total Kgs	% Residential	% Total Waste
Paper	2,330	5.3	1.5
Plastic	1,324	3.0	0.9
Putrescible	20,669	46.6	13.7
Ferrous	5,205	11.7	3.4
Non Ferrous	254	0.6	0.2
Glass	1,306	2.9	0.9
Textile	1,602	3.6	1.1
Sanitary	91	0.2	0.1
Rubble	6,327	14.3	4.2
Timber	4,781	10.8	3.2
Rubber	322	0.7	0.2
Hazardous	141	0.3	0.1
Total	**44,352**	**100.0**	**29.4**

4.2.4 Primary Classification of the Kerb Collection Waste Stream

The kerbside collection is carried out by a contractor on weekdays and covers both residential and commercial properties in Greymouth and some small rural settlements in the district. It covers the material collected by one dedicated vehicle targeting specified refuse bags. It does not cover bags included in other waste streams such as commercial skips or bins from transfer stations. Kerbside refuse during the survey period weighed 22,280 kg which equates to 14.8 % of the total waste stream.
Where visual classification is quickly carried out on open refuse, refuse bags pose a problem, especially bags from residential origin, as the contents can vary greatly both in type and quantity.
The design of the survey took this issue into account and allowed the analysis of contents from sufficient refuse bags to give an acceptable confidence level on the major classification values.
The analysis of refuse bag contents was carried out using the SWAP primary and secondary classification procedure. The values gained from the sample bag analysis were extrapolated to give the full weight values for kerb refuse.
A summary of the classification values is given in Chart 7 and Table 6 below and a summary of individual samples is attached in Appendix 2.

Chart 7 : Primary Classification Values of Refuse from Kerb Collection

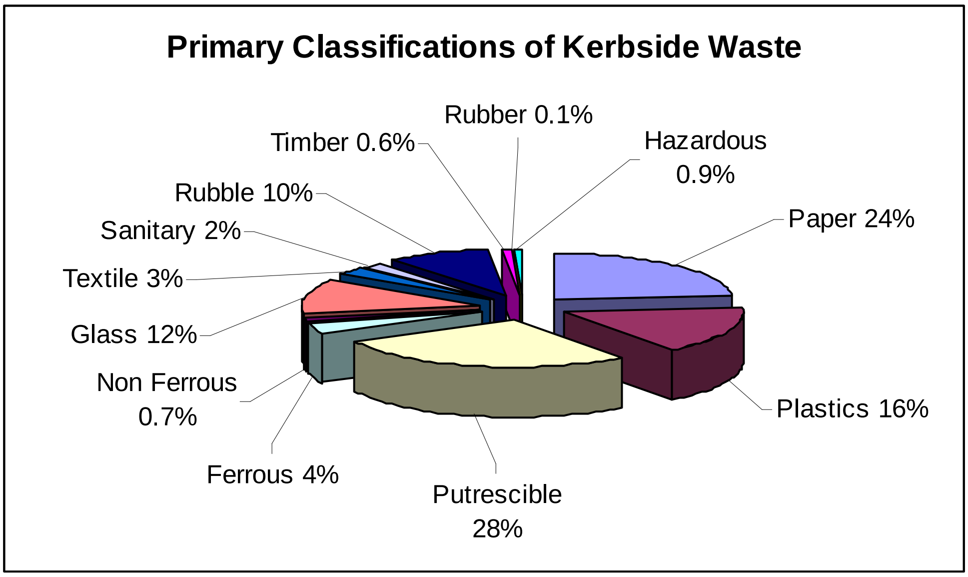


Table 6 : Primary Classification of Refuse from Kerb Collection

Classification	Sample Analysis kgs	% Kerbside	% Total Waste	Total Kerb Weight kgs
Paper	91.94	23.5	3.5	5,238
Plastic	63.77	16.3	2.4	3,634
Putrescible	109.45	28.0	4.1	6,234
Ferrous	14.20	3.6	0.5	808
Non Ferrous	2.90	0.7	0.1	165
Glass	46.85	12.0	1.8	2,669
Textile	10.45	2.7	0.4	595
Sanitary	8.40	2.1	0.3	479
Rubble	37.10	9.5	1.4	2,117
Timber	2.20	0.6	0.1	127
Rubber	0.35	0.1	0.0	20
Hazardous	3.40	0.9	0.1	194
Total	**391.01**	**100**	**14.8**	**22,280**

4.2.5 Summary of Primary Classification Values of the Waste Stream

Table 7 presents a summary of the primary classification values by origin and also as a total of the waste stream.

Table 7 : Summary of Primary Classification Values of the Waste Stream (By weight kgs)

Classification	Commercial	Residential	Kerb	Total	% Total
Paper	24,466	2,330	5,238	32,034	21.2
Plastic	7,455	1,324	3,634	12,413	8.2
Putrescible	9,832	20,669	6,234	36,735	24.3
Ferrous	8,669	5,205	808	14,682	9.7
Non Ferrous	184	254	165	603	0.4
Glass	6,874	1,306	2,669	10,849	7.2
Textile	1,587	1,602	595	3,784	2.5
Sanitary	322	91	479	892	0.6
Rubble	14,558	6,327	2,117	23,002	15.2
Timber	8,985	4,781	127	13,893	9.2
Rubber	1,128	322	20	1,470	1
Hazardous	201	141	194	536	0.4
Total	**84,261**	**44,352**	**22,280**	**150,893**	**100.0**

4.3 Secondary Classification of the Waste Stream

Secondary classifications were carried out to gain a better understanding on the types of waste for selected primary classifications.
These were:-

Paper	into newspaper, cardboard and other categories
Plastics	into grades 1 to 7
Putrescible	into kitchen and garden origins
Ferrous	into cans, whiteware and other
Glass	into clear, green and brown
Textile	into clothing and other
Rubble	into ash, soil, concrete, plaster board, and other
Timber	into treated and untreated
Rubber	into tyres and other

4.3.1 Secondary Classification of Paper

Paper makes up 21.2% of the total waste stream.
The division into secondary classifications was easily carried out as the categories of paper were readily identified. Much of the paper came in bulk quantities.
Chart 8 and Table 8 show the values of the secondary classifications for paper.

Chart 8 : Secondary Classification Values for Paper Waste

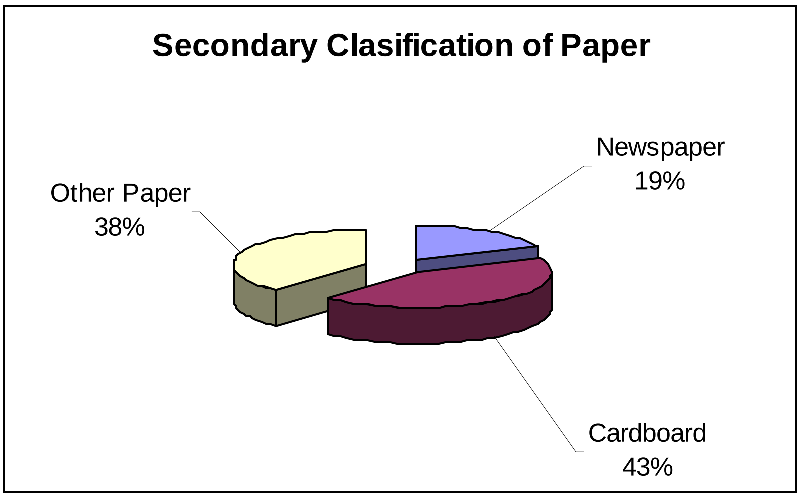


Table 8 : Secondary Classification Values for Paper Waste

Category	Weight Kgs	% of Category
Newspaper	5,999	18.7
Cardboard	13,811	43.1
Other	12,224	38.2
Total	32,034	100.00

Further analysis of the secondary classification by the origin of material shows clearly where the greater proportion of material is originating from.
Chart 9 and Table 9 below show the secondary classifications for the three origin categories.

Chart 9 : Secondary Classification Values for Paper by Origin of Waste

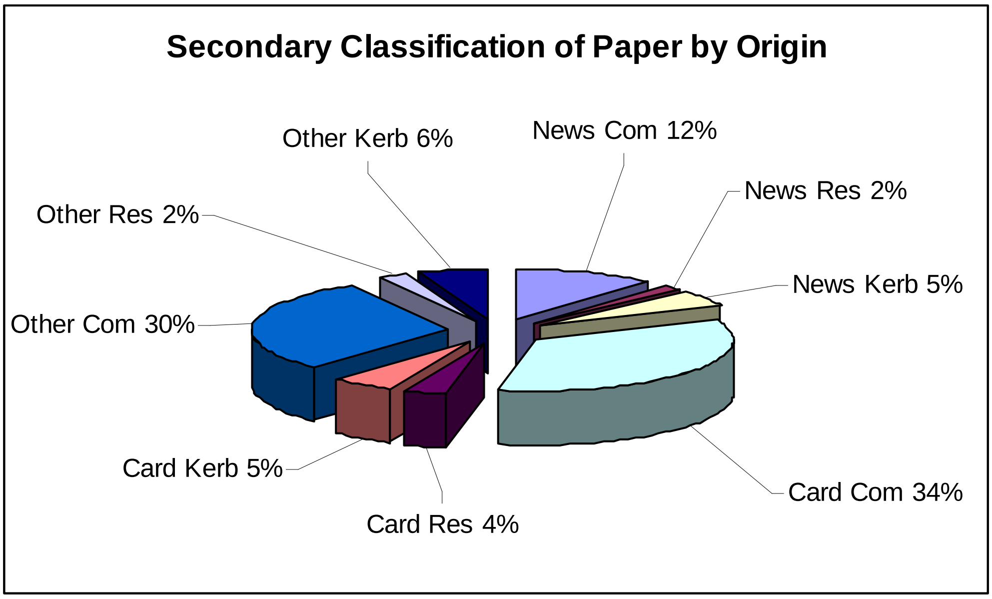


Table 9 : Secondary Classification Values for Paper by Origin of Waste

Category and Origin	Weight kgs	% of Category
Newspaper - Commercial	3,765	11.8
Newspaper - Kerb	525	1.6
Newspaper - Residential	1,709	5.3
Cardboard - Commercial	11,016	34.4
Cardboard - Kerb	1,146	3.6
Cardboard - Residential	1,649	5.1
Other – Commercial	9,685	30.2
Other – Kerb	659	2.1
Other - Residential	,880	5.9
Total	32,034	100.0

4.3.2 Secondary Classification of Plastics

Plastics were classified into the 7 categories used for recycling purposes.
These are:-

1	PET	polyethylene terephthalate
2	HDPE	High density polyethylene
3	PVC	Poly vinyl chloride
4	LDPE	Low density Polyethylene
5	PP	Polypropylene
6	PS	Polystyrene – expanded styrene
7	Other	All other plastics

There was great difficulty identifying grades of plastics especially as items often have no identifying marks. Consequently most of the plastic was graded as Type 7.
One exception is the plastic packaging used for household items as found in the kerbside bags. With the analysis of kerbside bags all plastics were separated into grades and recorded.
Chart 10 and Table 10 below show the secondary classifications for the full waste stream.
These values have also been further divided in Table 11 to show the secondary classifications of plastics by the origin of the waste.

Chart 10 : Secondary Classification Values for Plastic Waste

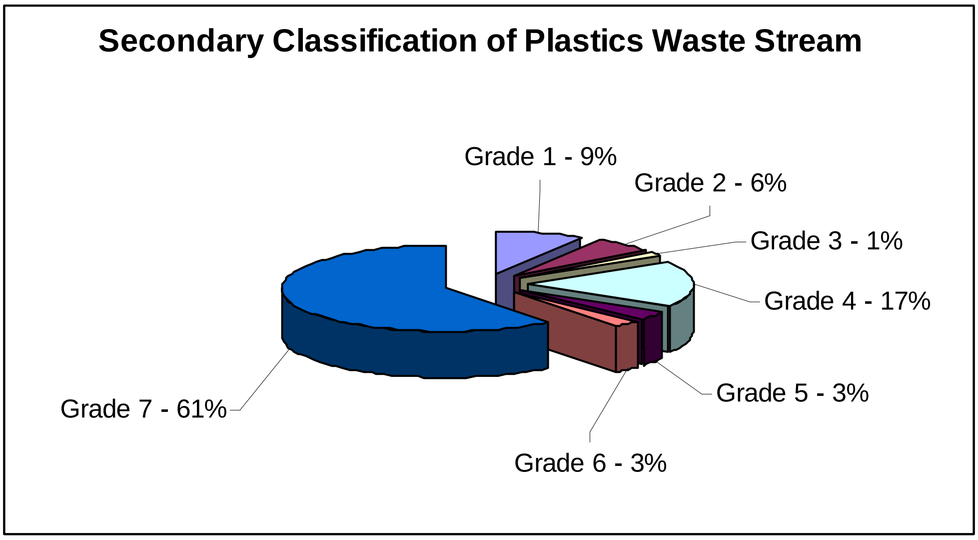


Table 10 : Secondary Classification Values for Plastic Waste

Grade of Plastics	Weight kgs	% of Plastics waste stream
1	1,064	8.6
2	775	6.2
3	172	1.4
4	2,151	17.3
5	386	3.1
6	351	2.8
7	7,514	60.5
Total	**12,413**	**100.00**

Table 11 : Secondary Classification Values for Plastic Waste by Origin (By Weight Kgs)

Grade	1	2	3	4	5	6	7	Total
Commercial	352	256	121	723	128	136	5,739	**7,455**
Residential	115	84	51	236	42	50	746	**1,324**
Kerb	597	435	0	1,192	216	165	1,029	**3,634**
Totals	**1,064**	**775**	**172**	**2,151**	**386**	**351**	**7,514**	**12,413**

The kerbside waste stream was the only origin category of refuse where a full secondary classification of plastic was achieved. These results taken on the analysis of kerbside bag refuse are shown in Chart 11 and Table 12 below.

Chart 11 : Secondary Classification Values for Kerbside Bag Plastics

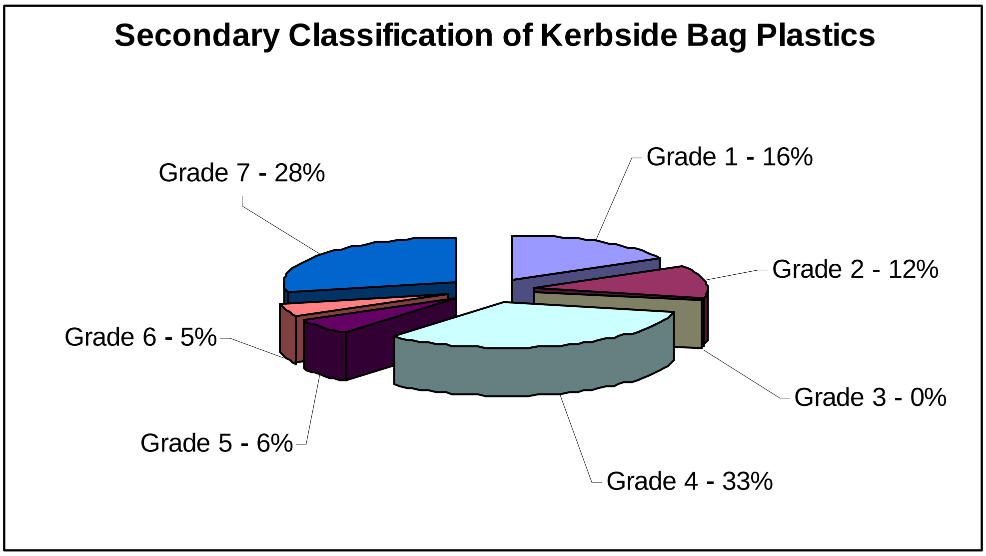


Table 12 : Secondary Classification Values for Kerbside Bag Plastics

Plastic Grade	Sample Analysis kg	Estimated Kerb Plastics Weight kg	% of Plastics waste stream
1	10.47	596	16.4
2	7.61	434	11.9
3	0	0	0
4	20.93	1,193	32.8
5	3.81	217	6.0
6	2.88	164	4.5
7	18.07	1,030	28.4
Total	**63.77**	**3,634**	**100.0**

4.3.3 Secondary Classification of Putrescible Material

All loads containing putrescible wastes were recorded by secondary classifications of either kitchen or garden origin.
The results are shown in Charts 12 &13 and Table 13 below.

Chart 12 : Secondary Classification Values for Putrescible Waste

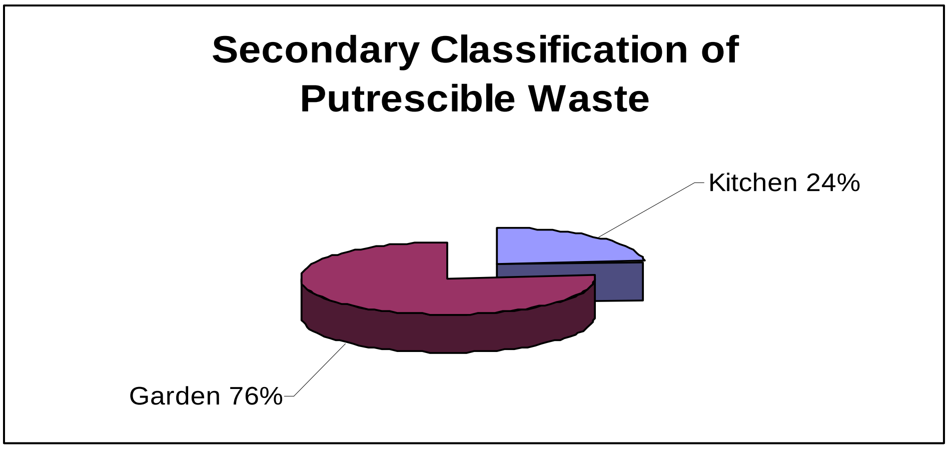


Chart 13 : Secondary Classification Values for Putrescible Waste by Origin

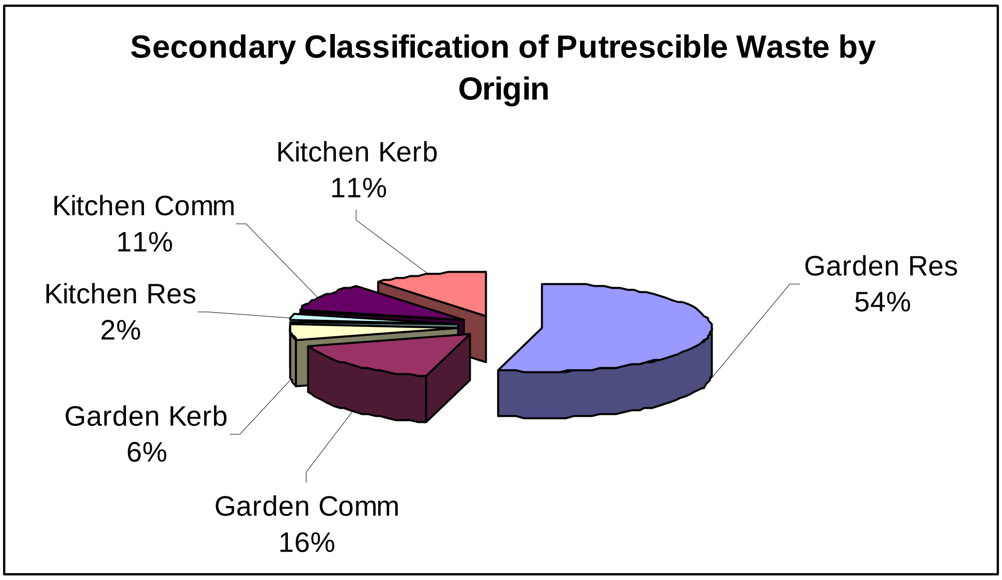


Table 13 : Secondary Classification Values for Putrescible Waste by Origin

	Kitchen		**Garden**		**Totals**	
	Kg	%	Kg	%	**kg**	**%**
Commercial	3,815	10.4	6,017	16.4	**9,832**	**26.8**
Residential	820	2.2	19,849	54.0	**20,669**	**56.2**
Kerb	4,097	11.2	2,137	5.8	**6,234**	**17.0**
Totals	**8,732**	**23.8**	**28,003**	**76.2**	**36,735**	**100.00**

4.3.4 Secondary Classification of Ferrous Waste

Three categories of ferrous materials were recorded.
These were :-

Cans
Whiteware
Other

The values recorded are shown in Chart 14 and Table 14 below.
Within the ‘Other’ category one major component of steel was identifiable and consisted of nine automobile bodies estimated at a total of 6,300 kg. Based on the number of vehicles accumulated on site it is likely the number received during the survey is greater than expected in an average week’s disposal.

Chart 14 : Secondary Classification Values for Ferrous Waste

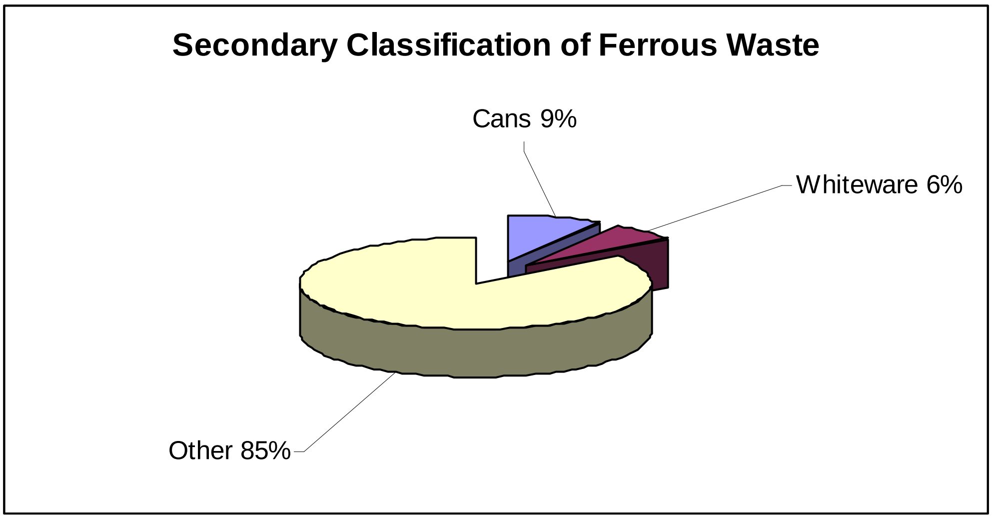


Table 14 : Secondary Classification Values for Ferrous Waste

	Weight Kg	% of Ferrous Waste
Cans	1,292	8.8
Whiteware	911	6.2
Other	12,479	85
Total	**14,682**	**100.00**

4.3.5 Secondary Classification of Glass

All loads of glass were assessed by weight and colour. The results are shown in Chart 15 and Table 15 below.

Chart 15 : Secondary Classification Values for Glass Waste

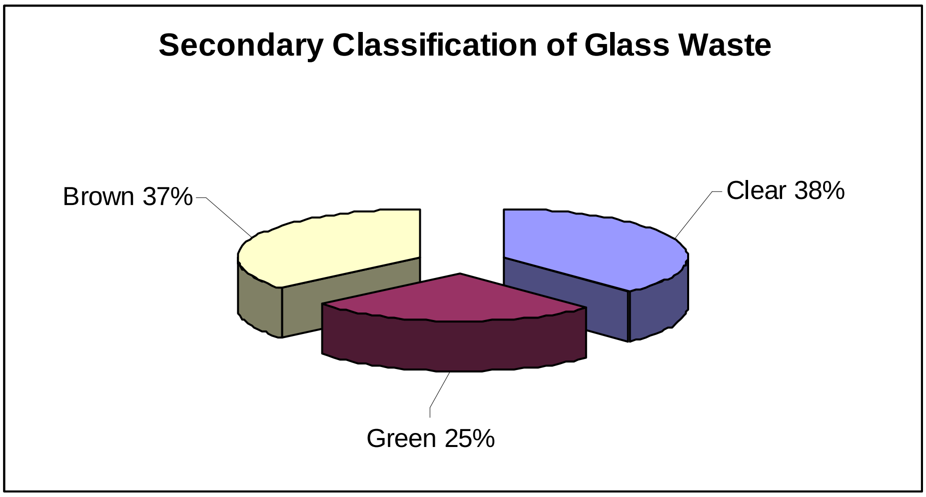


Table 15 : Secondary Classification Values for Glass Waste

	Weight kgs	% of Glass Waste
Clear	4,140	38.1
Green	2,752	25.4
Brown	3,957	36.5
Total	**10,849**	**100.0**

4.3.6 Secondary Classification of Textiles

Textiles were divided into two secondary classifications, clothing and other.
The greater quantity of other textiles consisted of carpets and furnishings.

Chart 16 : Secondary Classification Values for Textile Waste

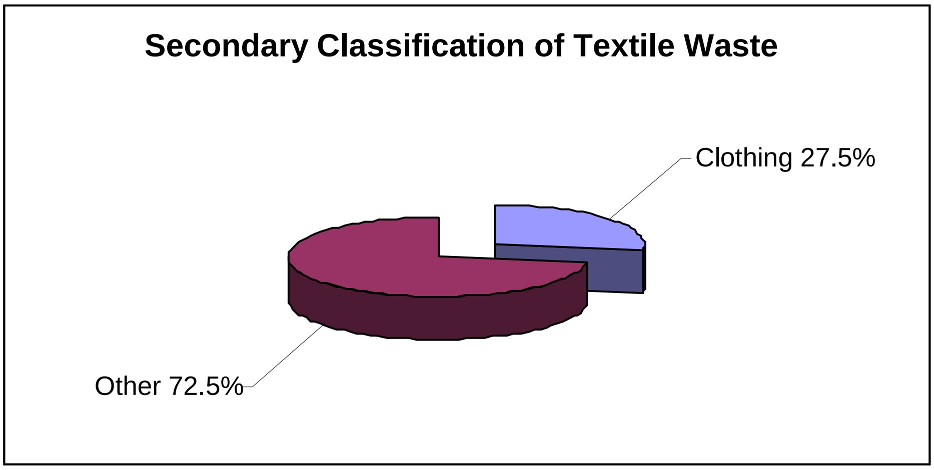


Table 16 : Secondary Classification Values for Textile Waste

	Weight Kg	% of Textile Waste
Clothing	1,039	27.5
Other	2,745	72.5
Total	**3,784**	**100.0**

4.3.7 Secondary Classification of Rubble Waste

Rubble was requested in five secondary classifications, ash, soil, concrete including rock, plaster board and other.
Chart 17 and Table 17 show the values for the secondary classifications for rubble.

Chart 17 : Secondary Classification Values for Rubble Waste

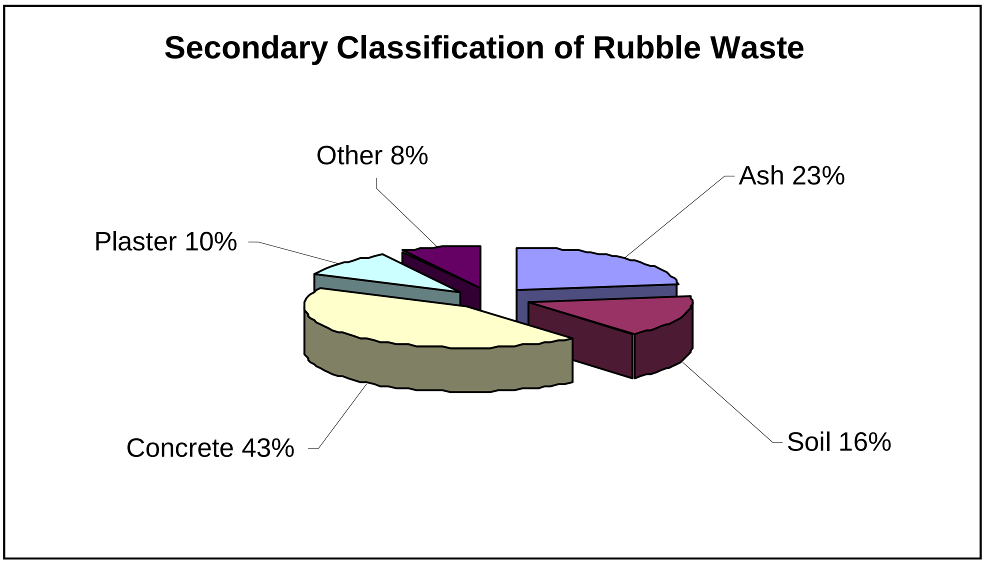


Table 17 : Secondary Classification Values for Rubble Waste

	Weight kgs	% of Rubble Waste
Ash	5,266	22.9
Soil	3,684	16.0
Concrete	9,974	43.4
Plaster board	2,228	9.7
Other	1,850	8.0
Total	**23,002**	**100.00**

4.3.8 Secondary Classification of Timber Waste

Timber wastes were assessed as being either treated or untreated material. The results are shown in Chart 18 and Table 18 below.

Chart 18 : Secondary Classification Values for Timber Waste

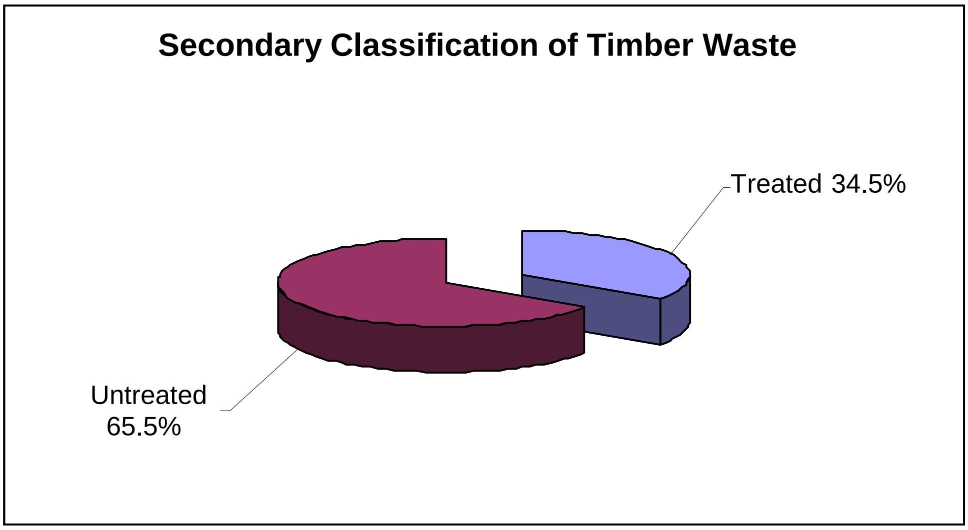


Table 18 : Secondary Classification Values for Timber Waste

	Weight kgs	% of Timber Waste
Treated	4,795	34.5
Untreated	9,098	65.5
Total	**13,893**	**100.0**

4.3.9 Secondary Classification of Rubber Waste

Secondary classification of rubber wastes required the identification of rubber tyres in the waste stream. The remaining rubber was classified as other rubber and consisted mainly of rubber carpet underlay, rubber mats, rubber tubing, foam rubber and small household rubber items.
A total of 33 tyres were recorded during the survey. Six of these were from heavy machinery and weighed approximately eighty kilograms each.
No commercial tyre suppliers disposed of tyres during the survey, however they have disposed of tyres to landfill in the past and it is likely they will continue this practice.
It is considered the value for tyres and rubber is not representative of an average week's refuse disposal.

Chart 19 : Secondary Classification Values for Rubber Waste

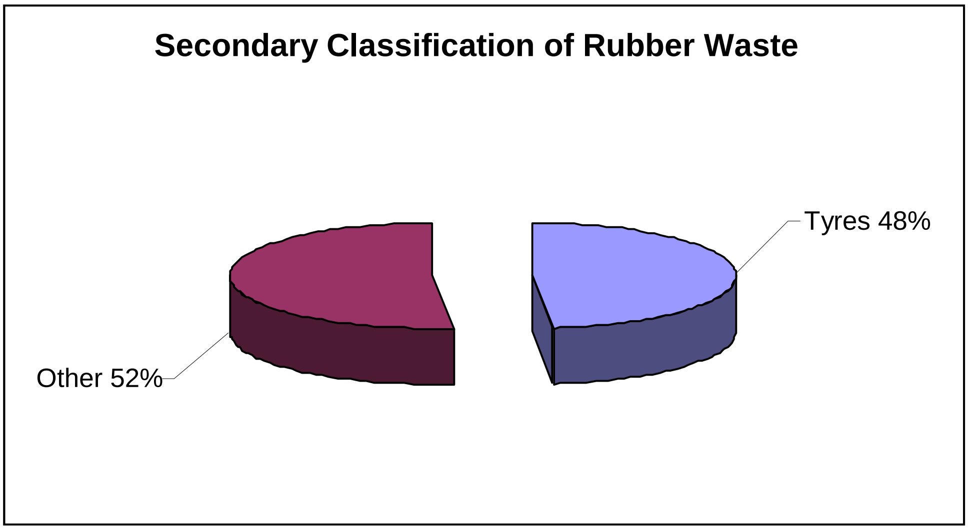


Table 19 : Secondary Classification Values for Rubber Waste

	Weight kgs	% of rubber Waste
Tyres	710	48.3
Other	760	51.7
Total	**1,137**	**100.0**

4.4 Kerb Collection Bag Analysis

4.4.1 Kerb Collection Accuracy of Analysis

The sample size required to obtain an acceptable degree of accuracy generally escalates rapidly as the relative proportion of the component decreases.
Based on information from surveys of similar sized communities it was determined that analysing the contents of 60 refuse bags should give a confidence level of plus or minus 15% for items greater than 15% of the waste stream.
This survey analysed a total of 65 bags containing 391 kg of refuse.

4.4.2 Kerb Bag Weight, Volume and Density

A total of 156 bags were weighed and an average weight calculated from the total.
This equated to a mean value of 5.62 kg.

Table 20 : Average Bag Weight (kgs)

Sample No	No of Bags	Weight kg	Average kg
Total	**156**	**876.7**	**5.62**

Bag volume and density was gauged by two methods.

Firstly a number of bags were measured in an uncompacted state by placing contents into a 200 litre drum and recording the number of bags to fill a series of 6 drums.

The second method was based on the total values gained from the kerbside collection. Whereas some loads were weighed and provided and accurate indication of weight values there were no accurate records of the number of bags collected and this information relied on approximate values given by the driver.

The results of the calculations are shown in Table 21 below.

Table 21 : Bag Volume and Density

	Volume	Density
Bag measure	27.9 litre	201.4 kg/m3
Total Kerb Collection	26.9 litre	208.8 kg/m3

4.5 Transport

4.5.1 Vehicle Counts

A total of 451 vehicles transported refuse to the landfill during the survey.

4.5.2 Transport of Refuse

As the site is open to both the public and commercial operators the number of categories of vehicles was set at five, which accommodated the normal type of vehicles encountered.

These categories being:-

Cars
Utility vehicles
Trailers
Compactor Vehicles
Trucks

The category for cars includes vehicles such as station wagons and SUVs. They were found to generally these have only small loads.
Utility vehicles included utes and vans, often the loads were comparable to loads on small trailers.
Trailers were generally small with loads around one cubic metre, however there were a few larger trailers used by commercial operators such as builders and contractors that carried significant loads both in size and weight.
Compactor vehicles can usually achieve a two to one compression ratio and their loads are not directly comparable with other 'loose' refuse. The compactor vehicle category included the kerbside bag collection vehicle. Generally these vehicles were weighed so the true value of the load was known.
The five categories of transport service both the residential and commercial sectors.
Chart 20 and Table 22 show the values for the survey period.

Chart 20 : Refuse Weight by Transport Category

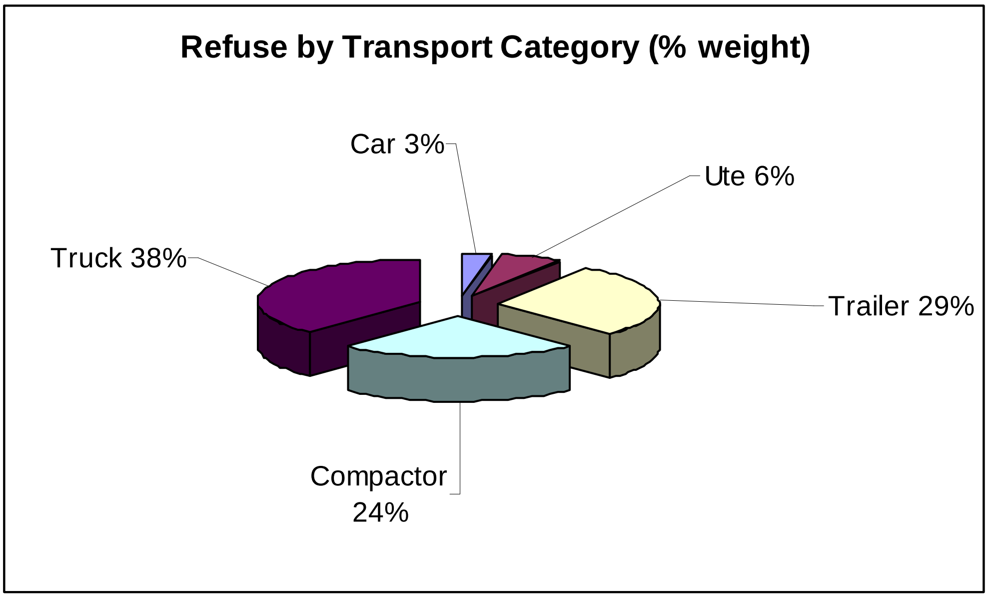


Table 22 : Refuse Weight by Transport Category

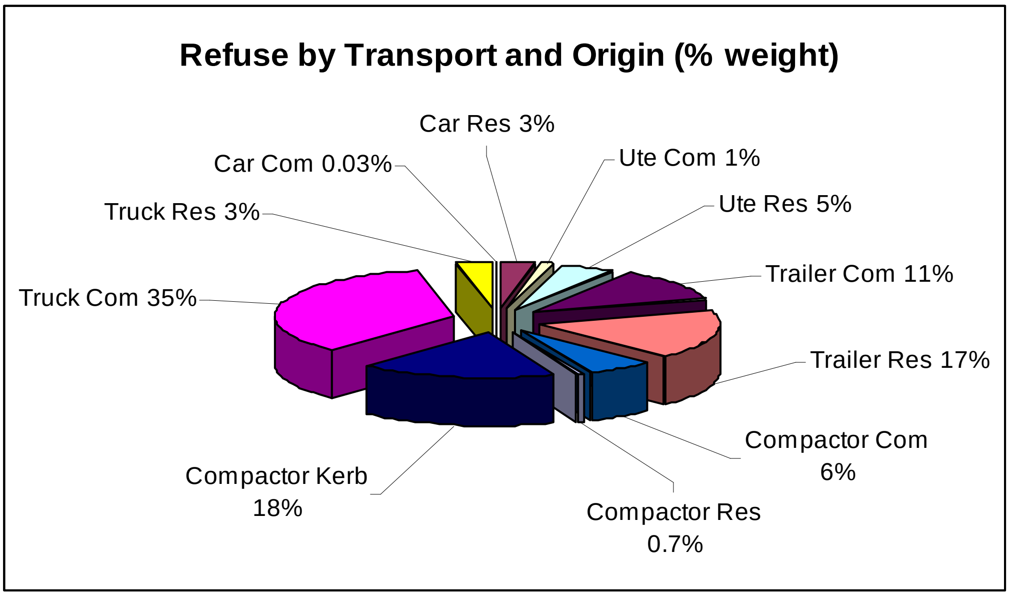
Category	No of Vehicles	Weight kgs	% total weight
Car	124	4,781	3.1
Ute	93	9,015	6.0
Trailer	145	43,254	28.7
Compactor	19	36,480	24.2
Truck	70	57,403	38.0
Total	451	150,893	100.0

The transport category, when combined with "Origin' information, gives a wider view on how refuse is managed for collection and transport.
Values are given in Table 23 and Chart 21 below. The weight for each division is also expressed as a percentage of the total waste stream.

Table 23 : Refuse Weight by Transport Category and Origin of Source

	Commercial	Residential	Kerb	Total
Car	41 0.03 %	4700 3.1 %	0 0 %	4781 3.1 %
Ute	1525 1.0 %	7490 5.0 %	0 0 %	9015 6.0 %
Trailer	17200 11.4 %	26054 17.3 %	0 0 %	43254 28.7 %
Compactor	8700 5.8 %	1100 0.7 %	26680 17.7 %	36480 24.2 %
Truck	52395 34.7 %	5008 3.3 %	0 0 %	57403 38 %
Total	79861 52.9 %	44352 29.4 %	26680 17.7 %	150893

Chart 21 : Refuse Weight by Transport and Origin



4.6 Refuse Volume and Weights

4.6.1 Annual Volume and Weight of Refuse

Refuse data was recorded by volume and converted to weight for presentation of results. The values obtained are accurate only for the survey period and extrapolation of results from these values may not be reliable. However as refuse quantities are often expressed in annual values, the results from the survey have been extrapolated to this format. No adjustments or correction factors, such as seasonal influences, have been applied so these values should be used for indicative purposes only.

Table 24 : Estimated Annual Volume and Weight Values

	Survey Period	Estimated Annual Value
Volume (loose)	703 m3	36,600 m3
Weight kgs	150,893 kgs	7,850 tonne

4.6.2 Density of Loose Refuse

A value was determined from the summary survey data. This value is shown in Table 25.
It has been calculated on the basis of loose volume.

Table 25 : Average Density of Loose Refuse During Survey Period

Total weight kgs	150,893
Total volume m3	703
Average Density	**215 kg/m3**

4.7 Conversion Factors

All loads were generally assessed visually by percentage volume into the 12 primary and nominated secondary classifications. These values were later converted to weight values using one of four methods.

1. Using conversion factors gained from sampling or earlier surveys.
2. Selected loads were weighed on site by means of portable scales with the final weight for each classification being adjusted to match the total weight of the load.
3. Samples were taken from loads of one classification type material, measured and weighed and unit rates established, eg ash, glass and soil.
4. Bag samples were analysed and each classification weighed.

Conversion factors used are shown in Appendix 1.

4.8 Baseline data

The Ministry for the Environment maintains a data base on results from WAP and SWAP studies completed at a number of sites throughout New Zealand. This information is available on their website. Table 26 presents relative data from this site along with the results from recent SWAP surveys at Marlborough and Westport landfills.

Table 26 : Baseline Data – By Percentage of Waste Stream

	NZ mean	**Hutt**	**Kaikoura**	**Marlborough**	**Westport**	**McLeans**
	2004	Dec 2004	Sept 2004	Jan 2005	July 2005	Aug 2005
Paper	11.5	11.0	9.0	11.5	25.5	21.2
Plastic	7.6	7.6	12.8	11.1	7.6	8.2
Putrescible	22.0	21.2	24.9	26.0	16.2	24.3
Ferrous	6.0	8.0	3.5	1.6	7.7	9.7
Non ferrous	0.9	1.1	2.6	0.1	0.2	0.4
Glass	2.8	2.3	1.5	3.7	8.3	7.2
Textiles	5.6	9.0	2.7	0.7	1.8	2.5
Sanitary	1.8	0.8	3.3	0.2	2.0	0.6
Rubble	19.1	16.4	22.3	37.6	21.0	15.2
Timber	11.7	15.5	14.6	7.4	8.6	9.2
Rubber	1.8	1.6	2.5	0.2	0.8	1.0
Hazardous	9.2	5.5	0.3	0.03	0.3	0.4

5.0 DISCUSSION

The following comments are made from observations by members of the survey team in an effort to offer constructive advise on improvements to the waste stream management and in particular towards waste reduction to landfill by recycling and recovery.

5.1 Paper Wastes

Paper, which makes up 21% of the waste stream, is mostly a readily recyclable product. Of all the paper 43% was assessed as cardboard of which an estimated one tenth is recovered through an existing recycling incentive, the rest, mainly in commercial loads, goes direct to the landfill.
A further 19% of paper waste is in the form of newspaper. Again, an attempt is made to recover some of this resource, however the self service facility lacks maintenance and is not capable of accepting large quantities by commercial operators. Of note were two large loads of newsprint material landfilled during the survey and it is this type of mainly single product load that needs to be targeted for recycling.
The ‘other paper’ category included office paper and, although no quantities were recorded, there were sufficient quantities to be noticeable. Office paper is readily recyclable.
As much of the paper is commercially generated, any recovery plan should look at the options of recovery at source rather than at the landfill. This would help with separation of product and also minimise effects of the weather ruining product.
It was noted that a commercial operator runs the paper recovery scheme in the Greymouth area which includes the self service bins at McLeans Pit landfill. It is not known the extent of capture of paper in the district, however during the survey it was noticeable the lack of large loads of cardboard packaging being landfilled. The overall proportion of paper in the waste stream remains high compared to the New Zealand mean value.
The effort made by site staff of Westroads Ltd. to recover paper and cardboard from the public refuse disposal area was also noted. Education on the management of paper could assist staff with this task and boost the recovery rate.

5.2 Plastics

A breakdown of plastics into the 7 nominated grades was requested for this survey. This is a very difficult task as most plastics articles have no identification and without some form of testing a satisfactory result was not achievable. In analysis of loads where known plastics were encountered, such as PVC and polystyrene, these were recorded in the appropriate category and all unknown plastics were classified as Grade 7.
It was only in the full analysis of refuse bag waste that an indication on the mix of grades was achievable as most plastics found in household refuse are marked with a recycling logo and the grade of plastic. Kerbside plastics account for only 2.4% of the total waste stream and their values cannot be extrapolated to the general waste stream.
There was no one large source of plastic observed during the survey.
It is suggested that any plastic recycling system should be based on market requirements, such as grades 1, 2 and 4, expanded as demand is created.
Surveys on waste streams at other landfills have found around 60% of plastics are recyclable although not always recoverable.
Other opportunities for better plastics disposal may occur in the future with technology available to convert plastics into fuels. Trials are currently being carried out in New Zealand.

5.3 Putrescible Material

Putrescible material during the survey accounted for 24%, or 36.7 tonne, of the total waste stream. Garden waste made up 76% of this value and was generally stockpiled separately as most of this material arrived at the landfill in single classification loads.
At least a 95% capture of green waste should be achievable.
Green waste is partly used as a cover material over the landfill, however as new sections of the landfill are opened it is likely this option will no longer be acceptable and alternatives will be required for

disposal. Options include composting or mulching with disposal by sales or by use as a surface restoration material for finished landfill areas.
Kitchen wastes can also be composted but usually requires a closed process that excludes vermin and birds. Recovery of this waste stream is not easy as kitchen wastes are generally mixed with other materials. Education and recovery at source are the best options to capture this resource.
Contractors at Kaikoura Landfill have developed a cheap tunnel method of composting these wastes, which may be of interest should disposal other than landfill be considered.

5.4 Ferrous Material

All ferrous materials are recyclable. An effort is made to stockpile these separately for recovery however it is considered the management of the stockpile area could be improved both to assist with the recovery of the steel and for the safety of the public and staff.
Staff of Westroads Ltd. were recovering as much of this material as possible and the siting of a skip at the public refuse pit would assist this effort.
Generally steel found at the tip face was included in commercial loads.
It is estimated that 90% of ferrous material is recovered.
For safety reasons steel is best stockpiled in an area with limited public access. There are some concerns with the state of the car body stockpile but it was good to see that cars were separated from other scrap steel.
Greater returns can be made by separation of certain grades of steel and advice should be sought from the scrap metal merchant purchasing the ferrous scrap.

5.5 Non Ferrous

Non ferrous materials are generally readily recycled, and an effort was being made by site staff to separate this material. A cage is also provided on site for recovery of aluminium cans.
Further education could assist recovery.
The analysis of refuse bag rubbish revealed very few alloy cans which could indicate aluminium can collection centers operate elsewhere in the district.

5.6 Glass

For the survey glass was recorded by colour. Nearly all glass was bottles.
No recovery on site is made of glass and the future of glass recycling throughout New Zealand is not good owing to the lack of opportunities requiring glass as a raw material.
Glass, being inert, is probably best left in the landfill until a suitable alternative becomes viable.

5.7 Textiles

Textile values are low compared to the New Zealand mean. The source of textiles is both from clothing, 27%, and soft furnishings, such as carpets and upholstery.
Apart from reuse of clothing other opportunities include disposal to rag suppliers and possible use of natural fibre materials in a composting mix.
Textiles are a problem if they become wet. In many cases the material observed was wet when brought to the site.

5.8 Sanitary

Sanitary wastes were mainly disposable nappies which were found in the analysis of refuse bags.
Bulk solid sanitary waste was delivered from a sewerage screening plant and buried in the landfill.
No industrial sanitary wastes were observed during the survey.

5.9 Rubble

Rubble wastes were generally stockpiled in a separate area for recovery and use as landfill cover, however mixed loads and items such as plaster boards were disposed direct for landfilling.
Plaster board is recovered at other waste facilities both as a source of lime in compost mixes and in some cases for reprocessing into new product.
There is opportunity to do the same at this landfill.

5.10 Timber

Timber wastes were recorded as either treated or untreated material and were predominantly untreated, being 65% of this waste stream.
Most timber wastes were stockpiled separately, apart from commercial loads that accessed the tip face directly. Some casual recycling did occur, such as firewood supply and furniture manufacturing.
Untreated timber wastes in other areas are a sought after source of fuel for boilers or drying plants or, on a smaller scale, a source of firewood for members of the community.
Treated timber wastes are more difficult to recycle as they have the potential to cause environmental damage. It is essential that treated timber wastes are not burnt as the process releases chemicals directly to the environment. The only known opportunity for recycling treated timber wastes is for reuse of the product.

5.11 Rubber

Tyres make up the major single type of rubber wastes. These are currently removed from the waste stream and stockpiled separately waiting to be processed. It is understood that the tyres are to be shredded and then landfilled.
There is currently no profitable process in New Zealand to recycle tyre casings. A small number are required on farms to hold down silage covers and a few may be used in retaining walls or for other purposes, however the majority of tyres throughout the country are disposed to landfill. In whole form they are a problem as they do not compact and to achieve a high standard of landfilling the current proposal of shredding must be pursued.
Tyres can be used as a fuel source, however the technology is not available at present in New Zealand.
A total of 33 tyres weighing 710kg were recorded during the survey.

5.12 Hazardous Wastes

Hazardous waste covers a variety of materials most of which are not suitable or permitted for disposal into landfill. Treated timber has not been classified in this survey as hazardous waste.
Very low levels of hazardous wastes were recorded in the waste stream and it was noted that an effort was made by the site contractor to remove larger items when seen.
An historic drop off area exists for material such as paints, oil, fuels and gas bottles. It also acts as a self service recycling area with customers removing material unsupervised. It is suggested that this area be relocated to within the refuse drop off area controlled through the attendant’s office.
The hazardous waste area also houses a small lock up shed which was suitable for certain materials but not sufficient for large quantities or for situations where non compatible materials are encountered. It is suggested that a second lockable facility be made available.
Staff on site indicated the relocation of the hazardous waste drop off and storage area may occur and was subject to land used by a contractor becoming available.
It was positive to see that all gas cylinders were stored in open conditions, which lessens any risk associated with fire.
It is likely that hazardous waste at times is buried unnoticed. Items such as small batteries are disposed of in refuse bags and other packaging and cannot be easily recovered. Commercial loads dropped directly at the tip face can go unchecked apart when operators spreading and compacting the material notice hazardous items.
Staff look for the obvious materials to remove. To extend their knowledge on the recognition, handling and management of hazardous waste, some form of training may be beneficial. This could be further enhanced by education of customers on the acceptance and correct disposal for hazardous materials.
A schedule of hazardous waste recorded during the survey is attached as appendix 3.

6.0 ACKNOWLEDGEMENTS

I would like to thank the following:

The landfill staff of Westroads Ltd. who willingly assisted with survey activities and allowed disruption of activities at the tip face to permit completion of load analysis.

Mike Mackie, who willingly assisted with all parts of the field work.

7.0 REFERENCES

Ministry for the Environment, March 2002, *Solid Waste Analysis Protocol*. Ministry for the Environment : Wellington.

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8.0 APPENDIX

8.1 : Appendix 1: Conversion factors for volume to weight calculations

Classification	Standard kg/m3	Range kg/m3
Paper	200	100 loose, 200 compactor, cardboard boxes flattened 380
Plastic	200	100 – 370, 17.5 polystyrene, 410 nets
Putrescible	250	610 mussels, 310 kina 300 compactor, 400 greenwaste, 580 offal, 425 garlic,1100 olives
Ferrous	500	250 appliances, 500 mixed / heavy Individual fridges 45 – 80kg Stove standard type 55kg Microwave 20 -35kg Car shell 700kg ave.size
Non Ferrous	100	loose
Glass	420	400 - 420 bottles
Textile	130	Carpet 250, clothing 120
Sanitary	300	
Rubble	1000	800 shells, 1200 concrete, 1600 gravel, gib 680, builders loose 400, fullers earth 1150, ash 750,
Timber	350 - 450	215 – 492 sawdust, 517 particle board, 450 wet shavings, 250 builders loose, 400 transfer bins packed, 180 battens,
Rubber	200	Car tyre 8, ute 10, SUV 20, small truck 30, large truck 80 (kg each)
Hazardous	-	Weighed individually
Compactor trucks	500	or 250 x loose volume
Top loader	210	Envirowaste

8.2 : Appendix 2: Kerb Bag Analysis (weight in kgs)

Date		**9/8/05**	**10/8/05**	**11/8/05**	**12/8/05**	**Total**	**% of total waste**	
No of Bags		15	20	18	12	**65**	**Secondary**	**Primary**
Paper	News	6.26	6.64	8.25	8.85	30.0	7.67 %	
	Cardboard	8.95	5.15	7.96	6.86	28.92	7.4 %	
	Other	6.89	7.31	9.08	9.94	33.02	8.44 %	
Total paper						**91.94**		**23.51 %**
Plastics	1	2.48	3.14	2.88	1.97	10.47	2.68 %	
	2	1.8	2.28	2.1	1.43	7.61	1.95 %	
	3	0	0	0	0	0	0	
	4	4.96	6.27	5.76	3.94	20.93	5.35 %	
	5	0.9	1.14	1.05	0.72	3.81	0.97 %	
	6	0.68	0.86	0.8	0.54	2.88	0.74 %	
	7	4.28	5.42	4.97	3.4	18.07	4.62 %	
Total Plastics						**63.77**		**16.31 %**
Putrescible	Kitchen	19.15	24.9	19.8	8.1	71.95	18.39 %	
	Garden	1.5	19	10.3	6.7	37.5	9.59 %	
Total Putrescible						**109.45**		**27.98 %**
Ferrous	Cans	2.1	3.5	3.0	2.3	10.9	2.79 %	
	Whiteware	0	0	0	0	0	0	
	Other	0.4	0.3	0.9	1.7	3.3	0.84 %	
Total Ferrous						**14.2**		**3.63 %**
Non Ferrous		0.65	1.3	0.8	0.15	2.9	0.74 %	
Total Non Fer						**2.9**		**0.74 %**
Glass	Clear	7.95	3.0	4.3	0.4	15.65	4.0 %	
	Green	5.7	4.6	4.9	2.5	17.7	4.53 %	
	Brown	3.25	3.3	3.7	3.25	13.5	3.45 %	
Total Glass						**46.85**		**11.98 %**
Textiles	Clothes	1.15	3.15	1.9	0.7	6.9	1.76 %	
	Other	0.1	1	1	1.45	3.55	0.91 %	
Total Textiles						**10.45**		**2.67**
Sanitary		4.7	1.4	2.3	0	8.4	2.15 %	
Total Sanitary						**8.4**		**2.15 %**
Rubble	Ash	5.6	13.45	9.5	6	34.55	8.84 %	
	Soil	0.1	0	0.1	0.1	0.3	0.08 %	
	Concrete	0	0	0	0	0		
	Plaster	0	0	0	0	0		
	Other	0	1.65	0.6	0	2.25	0.58 %	
Total Rubble						**37.10**		**9.5 %**
Timber	Treated	0	0.2	0.1	0	0.3	0.08 %	
	Untreated	0	1.4	0.5	0	1.9	0.49 %	
Total Timber						**2.20**		**0.57%**
Rubber	Tyres	0	0	0	0	0		
	Other	0	.25	0.1	0	0.35	0.09 %	
Total Rubber						**0.35**		**0.09 %**
Hazardous *		0.1	1.9	0.9	0.5	3.4	0.87 %	
Total Hazardous						**3.4**		**0.87 %**

- all hazardous waste consisted of small batteries

8.3 : Appendix 3: Schedule of Hazardous Waste (weight in kgs)

Date	Item Description	Weight
7/8/05	Paint, oil and acrylic	60
8/8/05	PCB Ballasts x 2 (Polychlorinated biphenyls)	12
8/8/05	LPG cylinder 9kg size	6
9/8/05	LPG cylinder	6
10/8/05	Paint	5
10/8/05	Oil	8
10/8/05	oil	10
10/8/05	paint	5
11/8/05	Paint	4
11/8/05	LPG cylinder	6
11/8/05	Paint	2
11/8/05	Paint	4
11/8/05	LPG cylinder x 2	12
13/8/05	Automotive batteries x 2	25
13/8/05	Automotive battery	11
Kerbside bag	Small batteries, household cleaners etc.	194
Residential bins	Small batteries, household cleaners etc.	144
Residential bags	Small batteries	22
	Total	**536**