Canterbury regional waste data technical report 2002-2008

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Executive summary

Environment Canterbury collects and analyses data on the amount of solid waste disposed of in Canterbury and the solid waste management practises employed in the region. Most data was collected from territorial authorities, but other sources include: regional councils, waste exchanges, international publications and commercial waste management operators. There is no additional verification by ECan of the accuracy of the data provided.

This report analyses solid waste amounts for the financial years 2002/03 until 2007/08. Over this time total measured waste (sum of all waste streams except cleanfill) has peaked and begun to decrease. Most individual waste streams have shown a similar trend to total measured waste. Only reuse, that is waste exchanges and reuse stores, has increased each year.

All measurements of waste amounts, percentages and percentage increases are by weight.

Excluding cleanfill, residual waste continues to be Canterbury's largest waste stream (73%). In 2007/08 Cantabrians each sent on average 615kg of waste to landfill, less than in any of the previous four years. At the same time each person diverted on average 216kg of material from landfill, primarily via recycling or organics collections. The overall rate of diversion has increased from 18% in 2002/03 to 23% in 2006/07 and 2007/08; while 52% of kerbside waste was diverted in 2007/08. New incentives to reduce the amount of material landfilled could see the diversion rate increase, as more material is diverted via reuse, recycling or composting.

The *Waste Minimisation Act (2008)* aims to minimise the amount of waste going to landfill and places responsibilities on territorial authorities to achieve this. Territorial authorities' ability to change waste management practises is related to the amount of control they have over the way waste is disposed of in their districts. Territorial authorities typically have a lot of control over domestic waste through kerbside collections, but limited control over commercial waste. In most districts less than 25% of residual waste is collected at the kerbside. Territorial authorities may find it difficult to achieve the same high diversion rates for general waste because they have less control over the way most waste is managed.

The incentives to reduce waste are not just environmental but also financial. From July 1 2009 the *Waste Minimisation Act (2008)* will introduce a $10/tonne levy on all waste going to municipal landfills. Nationally territorial authorities will receive 50% of the levy money collected. Canterbury's territorial authorities are expected to receive $2million dollars in 2009/10. This money must be used on waste minimisation activities, and is expected to aid the development and/or improvement of waste services in the long term.

A second incentive to divert waste from landfill is the potential cost of purchasing carbon credits to off set greenhouse gas emissions from landfills. Organic materials produce methane when they breakdown in landfills. Waste deposited in the five landfills in Canterbury and the Waitaki District in 2007-08 is estimated to generate between 15.28Gg and 18.37Gg of methane. Halving the amount of food, greenwaste, wood and textiles sent to landfills could prevent 7.4Gg/year of methane being generated by Canterbury's landfills. This equates to a potential saving of between $3.6million and $7.4million per year in future carbon credit costs.

The data shows Canterbury has a strong tendency to bury what we no longer want or value. However, the waste levy and potential carbon credit costs give us both the opportunity and incentives to change our waste habits from mainly burying material to mainly diverting it to a better use.

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Glossary

Cleanfill/cleanfill material: inert materials disposed of into or onto land, at a consented cleanfill. Materials typically include construction and demolition waste such as concrete, uncontaminated soil and rock. Hardfill and cleanfill are distinguished in this report by their disposal points.

A cleanfill/cleanfill site: a site, or part of a site where cleanfill material is disposed of into or onto land

Composting: the controlled biological decomposition and stabilisation of organic material to produce a final product that is stable, free of pathogens and plant seeds, and can be beneficially applied to land [1]

Degradable Organic Material: material that breaks down in a landfill to produce methane gas. Includes the waste streams: wood/timber, textiles, food waste, green waste and organic waste paper and cardboard.

Diversion/ Diverted Materials: are any items or materials that are no longer required for its original purpose and would be disposed of to landfill if it were not for some waste minimisation activity, such as reuse stores, recycling, or composting. It includes the waste streams reuse stores, recycling, organics and hazardous waste.

Emissions: greenhouse gases released into the atmosphere by human activities.

Financial year: the financial year for government departments in New Zealand; this is the 12 months from 1 July of one year until 30 June of the next year. For example, 2005/06 is from 1 July 2005 until 30 June 2006.

Greenhouse Effect: the effect caused when gases trap infra-red or heat radiation in the Earth's atmosphere, causing the Earth's surface temperature to rise. A detailed explanation is available in Section 8.1.1.

Greenhouse Gas (GHG): one or more of the four gases, and two groups of gasses from the Kyoto Protocol: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (NO_2), sulphur hexafluoride (SF_6), hydroflurocarbons (HFC's) perflurocarbons (PFC's).

Hardfill: inert materials disposed of in a municipal solid waste landfill. Materials typically include construction and demolition waste such as concrete, soil and rock. Hardfill and cleanfill are distinguished in this report on the basis of their disposal points.

Hazardous waste: waste that is potentially harmful to human and /or environmental health. It typically has one or more of the following hazard properties: explosive, flammable, oxidising, corrosive, radioactive, toxic or ecotoxic. Or it may react with air or water to have one of these properties. Hazardous waste includes used oil, unwanted agrichemicals, paint and vehicle batteries.

Landfill: a site where waste is disposed of onto or into land. In this report the term landfill is used to describe municipal solid waste landfills and the term cleanfill is used to describe sites that accept only cleanfill material.

Municipal solid waste landfill: a waste disposal site, used for the controlled deposit of solid wastes onto or into land. In this report municipal solid waste landfills are refereed to as landfills.

Non-primary industry: Any industry other than agriculture, mining, fishing or forestry. Non-primary industries include but are not limited to: manufacturing, retail trade, hospitality, education, finance, real estate, health, professional, scientific and technical services

Organics: food scraps and green or garden waste

Rates: taxes and fees charged a council; can be made up of compulsory charges targeted charges and fees for specific services.

Recyclables: materials that are able to be recycled and are collected for this purpose. Typically includes glass containers, plastic containers and film, paper, cardboard, and metal items.

Recycling: a resource recovery method involving the collection, separation and processing of unwanted materials and their use as raw materials for manufacture into new products.

Residual waste: the material left over after all potentially useful material has been removed from the waste stream; and which is disposed of in landfill or by incineration.

Resource Recovery Park (RRP)/ transfer station: a site where waste is collected to be processed, sorted and transferred for disposal or processing. A site may have separate collections for different waste types, and either storage and transfer to other sites for processing or disposal and/ or storing, processing, or composting on site.

Reuse stores: items that are salvaged or diverted from the waste stream undergo little or no modification and are sold at stores run by the community or territorial authorities.

Solid Waste Analysis Protocol: a study to determine the composition of residual waste, carried out by sampling residual waste over a period and measuring the percent composition.

Waste Levy: a tax paid on each tonne of material sent to a municipal solid waste landfill.

Waste management hierarchy: is the hierarchy of preferred waste management methods, also known as the 5R's. First or preferred is reducing waste, then reusing items or materials, third recycling, then recovery, typically energy recovery through incineration with heat and/or electricity generation, and finally residual management or disposal, such as to landfill.

Units

kg	kilogram
t	tonne = 1000 kilograms
Gg	gigagram = 1000 tonnes
L	litres
m^3	metres cubed/ cubic metres

Abbreviations

ACM	asbestos containing material/s
CH_4	methane
CO_2	carbon dioxide
DHWDO	domestic hazardous waste drop off (point)
DOC	degradable organic carbon
DOM	degradable organic material
GHG	greenhouse gas
GWP	global warming potential
HFC	hydroflurocarbon
MfE	Ministry for the Environment
MSW	municipal solid waste
NO_2	nitrous oxide
PFC	perflurocarbon
RRP	resource recovery park
SF_6	sulphur hexafluoride
SWAP	solid waste analysis protocol
TA	territorial authority

1 Introduction

Waste is a by-product of our society. It illustrates the material inefficiency of our society, our wealth and how we value resources as we readily discard the old in favour of the new. So what does our waste say about us?

Environment Canterbury collects and analyses data on the amount of solid and hazardous waste collected and disposed of in Canterbury. Knowing what waste we produce and how it is managed in our region can help identify waste minimisation needs and gauge the effectiveness current waste minimisation activities.

This report has collected waste data from Canterbury's territorial authorities, and will analyse the amounts of waste recorded for the financial years 2002/03 to 2007/08. Section 3 examines regional trends and compares districts overtime and to each other. Section 6 expands to compare Canterbury's waste amounts with Auckland's and Denmark's.

In recent years national legislation and international agreements have provided incentives to reduce waste to landfill. Nationally the *Waste Minimisation Act (2008)* was introduced to encourage waste minimisation and decrease the amount of waste disposed of. To achieve this, the Act introduced a levy on waste disposed of in a municipal solid waste landfill. Proceeds from the waste levy will be used to fund waste minimisation activities. In this report the term landfill refers to municipal solid waste landfills, while sites accepting only cleanfill material are referred to as cleanfills. The waste levy is discussed in Section 7.

The Waste Minimisation Act charges territorial authorities (TAs) with responsibilities for waste minimisation in their districts. The amount of control TAs have over waste disposal in their district affects their ability to influence change in waste management practises. Territorial authorities have the most control over the disposal of domestic waste because they operate kerbside collections, resource recovery parks (RRP) and disposal facilities. However, they have limited control over commercial waste because businesses are often serviced by private waste collectors. Domestic and commercial waste will be discussed in Sections 4 and 5 respectively.

Internationally New Zealand has committed itself to reducing its greenhouse gas (GHG) emissions. Organic material breaking down in landfills produces methane, one of the six gases earmarked for reduction by the Kyoto Protocol. As a signatory to the Kyoto Protocol New Zealand must either reduce its GHG emission or off set them with GHG sequestration projects. The potential emissions from Canterbury's landfills and the estimated cost of off-setting them is discussed in Section 8.

2 Methodology

Data on the amounts of waste generated in each district were collected from territorial authorities. Territorial authority staff were emailed a template spreadsheet and asked to fill in the amounts of different waste types in tonnes. The data were compiled in one spreadsheet then summed to give regional amounts. Data were analysed using Microsoft Office Excel 2003 to show trends over time and between districts.

In this report waste amounts are often shown as kilograms per person because population size varies between districts and years. Larger districts will produce more waste than smaller districts because there are more people generating waste. Analysis on a per person basis eliminates the effect of population variation and allows comparisons to be drawn between districts of differing sizes.

All waste measurements are by mass, amounts, percentages, and percentage changes are by weight. No figures are shown which measure waste by volume. All amounts reported to ECan as volumes have been converted using the conversion factors below. .

2.1 Conversion factors

Conversion factors were included on the reporting spreadsheet for items typically not recorded in tonnes (or kilograms), such as waste oil or vehicle batteries. The conversion factors used were the same as those from the *Canterbury Waste Data Addendum Report (2001-2007)*[2], and are shown in Table 2.1.

Table 2.1 Conversion factors used

Material	Original Unit	To convert to tonnes
Asbestos/ asbestos cement	Cubic meters (m^3)	m^3 x 0.6184
Waste oil	Litres (L)	(L x 0.95)/1000
Cooking oil	Litres (L)	(L x 0.92)/1000
LPG bottles	Number of	Number of bottles x 6.5 $x10^{-3}$
Vehicle batteries	Number of	Number of batteries x 1.297 x 10^{-2}
Reuse stores material	Cubic meters (m^3)	m^3 x 0.5567

2.2 Population data

Data from the 2001 and 2006 Census were used to calculate the annual rate of change in population for each district. A linear rate was used to calculate the inter-census year populations for each district and the populations each year since the last census. This method smoothes the population change between census years and allows different rates of population growth to be used for each district.

The 2006 census was taken in March 2006 so has been used as the 2005/06 population.

2.3 Waitaki data

Geographically, part of Waitaki District is in the Canterbury Region but the majority is in Otago, and most of Waitaki's population (92%) live in the Otago part of the district. Waste statistics for the two parts of Waitaki district cannot be separated. So Waitaki's data have not been included in the regional waste amounts in Sections 3, 5 or 6 because this would overestimate the amount of waste produced in Canterbury. However, Waitaki is shown on by-district graphs in Section 3, and included in all analysis in Sections 4, 7 and 8.

2.4 Greenhouse gas emission calculations

Estimated greenhouse gas emissions were calculated using the Tier 1 method from *IPCC Good Practise Guidance and Uncertainty Management in National Greenhouse Gas Inventories, Chapter 5* [3] A full explanation of the equations and factors used is given in Section 8.

2.5 Accuracy and limitations of the data

District waste data are provided by the territorial authorities and only includes data available to them. It does not include data from most commercial sources, such as recycling companies dealing directly with businesses; nor does it include onsite disposal such as farm dumps and home composting. Kerbside data only includes material collected by council kerbside collections, not waste collected from the kerbside by private operators. This limitation means the amount of waste recorded in most categories is an underestimate of the amount actually produced.

Some waste amounts are under estimated because not all districts measure all waste collected. This is often the case for hazardous waste where the amounts of paint or garden chemicals received at domestic hazardous waste drop off points (DHWDO) are small and records are not kept. Cleanfill waste is also underestimated because most cleanfills are privately operated and are not obliged to report the amount of waste received to the local or regional council. Only Christchurch City has a complete data set for cleanfill material because they have the *Cleanfill Licensing Bylaw (2003),* which requires waste data reporting from licensed cleanfills.

There are a number of gaps in the Solid Waste Analysis Protocol (SWAP) or composition data, because TA's only conduct this study every few years, and some have not done a SWAP study in the years covered by this report (since 2002).

Data collected from territorial authorities is taken as correct and is not validated by Environment Canterbury staff. However, where data reported was unusually high or low, the information is clarified with the appropriate territorial authority staff.

2.5.1 Hurunui reuse data

Before 2006/07 the amount of reuse store material collected in Hurunui was estimated by district council staff. Anecdotal evidence suggests the amount of material collected remained relatively steady between 2002/03 and 2006/07, but estimates for 2004/05 and 2005/06 were approximately twice the amount recorded in 2006/07. The 2004/05 and 2005/06 amounts are considered large overestimates and have been removed from the dataset.

2.5.2 Kerbside collections

Direct comparisons of districts' of kerbside collected waste are limited because territorial authorities record the level of access to kerbside collections differently. Some districts record the number of properties that have access to the service, others the number of households or bins in service. Kerbside waste cannot be compared based on the whole population of a district because not everyone has access to the service and access levels vary between districts. Also not all territorial authorities measure the amount of kerbside waste collected.

Kerbside waste amounts have been used as an indicator for domestic waste in the past, but this approach is limited because some territorial authorities also collect from businesses. Most territorial authorities do not know the proportion of properties with access to kerbside collections that are residential, and the proportion that is commercial.

Waimakariri and Waimate were the only districts that reported the number of businesses with access to their kerbside collections. Although, businesses in Christchurch, Ashburton and Timaru are known have access to kerbside collections, the number of businesses is either not known or not reported. It is not known if businesses have access to council operated kerbside collections in Kaikoura, Hurunui, Selwyn, Mackenzie or Waitaki.

Where businesses contribute to kerbside waste the amount contributed by businesses is not measured separately from that collected from residential properties, as this would be impractical. In addition estimating the amount of kerbside waste from businesses based on business numbers would give an unfair estimate because a business does not necessarily produce the same amount, or type, of waste as a household.

2.5.3 Variation between reports

Total waste amounts reported each year in this report may differ slightly to those reported in previous reports for the same category and year, due to improved data collection and checking. For example, waste exchange amounts have been added for all past years, so the amounts for reuse materials in this report for 2002/03 -2006/07 are larger than those reported in previous waste data reports. In the hazardous waste and recycling categories some districts' amounts have been adjusted so the total amount reported for each waste stream is the same as the sum of the subcategories for each waste stream. For instance total recycling is the sum of all subcategories of recycling.

2.5.4 Earlier data excluded

Environment Canterbury has data for the years 1998/99 until 2001/02 which are not shown in this report. These data were excluded because we have less confidence in its accuracy and completeness than for later data. Data for 1998/99 -2004/05 were provided in 2006, but information was not always kept from earlier years.

3 Summary of waste trends

3.1 Total measured waste

Table 3.1 Amount of waste (tonnes) measured in Canterbury between 2002/03 and 2007/08

	Financial Year					
Waste Stream	**2002/03**	**2003/04**	**2004/05**	**2005/06**	**2006/07**	**2007/08**
Residual Waste	289 253	326 953	340 443	354 282	328 805	330 069
Hazardous Waste	337	270	404	637	540	677
Recycling	21 358	27 784	33 502	37 551	56 599	55 684
Reuse Materials	1328	4439	5239	7049	8672	9591
Organics	42 618	36 802	39 729	40 630	51 236	49 689
Hardfill	10 043	11 621	11 947	12 202	11 260	7 766
Total Measured Waste	364937	407869	431265	452351	457113	453476
Cleanfill	45 242	372 607	826 745	648 541	610 680	954 295
Total Measured Waste Including Cleanfill	**410179**	**780475**	**1258010**	**1100892**	**1067793**	**1407771**
Contributing Population	482 170	504 125	512 208	520 290	528 374	536 457

Table 3.1 shows the amount (tonnes) of measured waste recorded in Canterbury each year between 2002/03 and 2007/08. This is the total amount of waste, it has not been adjusted for population increases over time. All waste streams have been shown including those that divert waste from landfill, because this gives the most comprehensive view of the material discarded in Canterbury. Definitions of each waste stream can be found in the glossary.

Cleanfill has been separated from other waste streams and not included in total measured waste, because it is a very large waste stream which would mask trends in other waste streams if included. Section 5.2 examines the amounts and trends in cleanfill.

Data for 2002/03 does not include Hurunui or Mackenzie District as they did not provide data for these years. Consequently the 2002/03 contributing population does not include the population of these districts. All districts contributed data for 2003/04 - 2007/08.

The main trends shown in this table are:

- Residual waste increased between 2006/07 and 2007/08, but in 2007/08 was still less than the amount recorded in 2004/05 or 2005/06.
- Less recycling and organics were recorded in 2007/08 compared to 2006/07, but more than other previous years.
- Reuse materials have increased compared to previous years.
- Hardfill has decreased each year since 2005/06; but in 2007/08 this is off set by the increase in cleanfill.
- 2007/08 has the largest amount of cleanfill recorded to date; cleanfill amounts had been decreasing after peaking in 2004/05.

Total measured waste peaked in 2006/07 at 474 222t, although Canterbury's population has been increasing during the years measured and this affects the amount of waste generated in the region. Figure 3-1 shows the amount of total measured waste per person for 2002/03 to 2007/08.

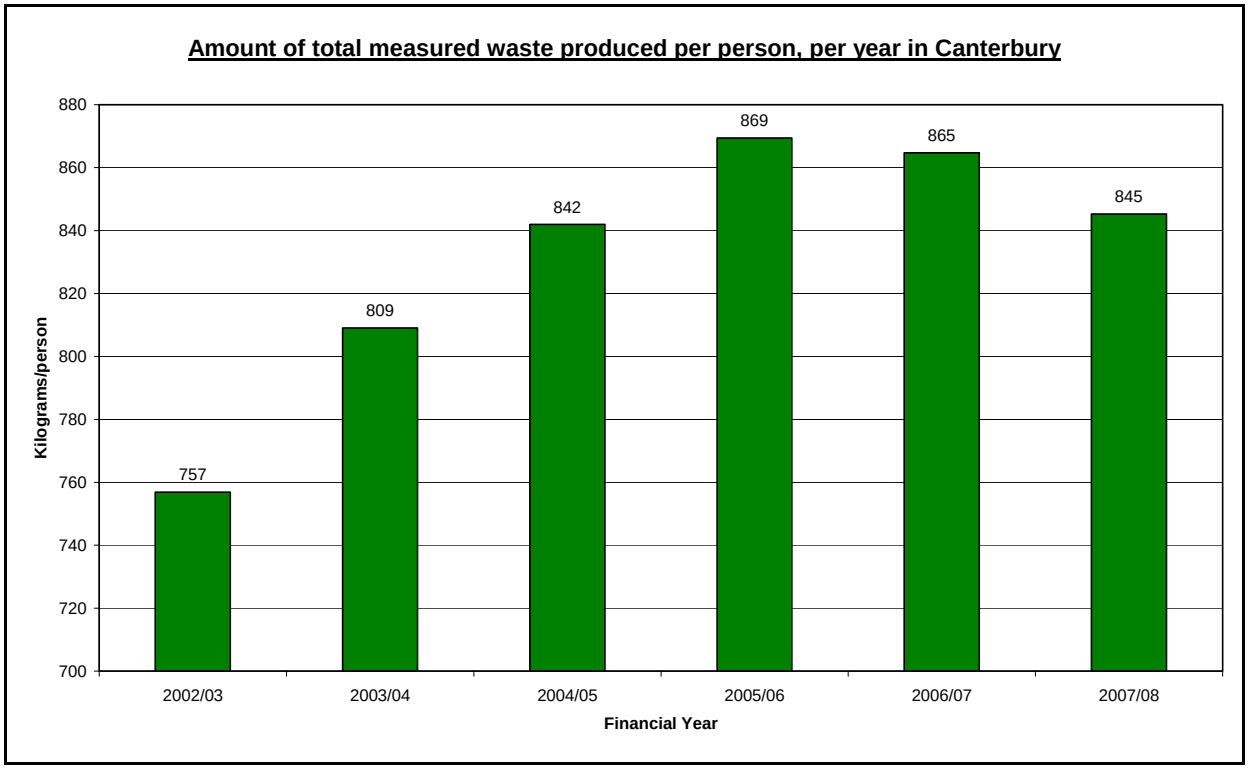

Figure 3-1 Total measured waste per person per year in Canterbury

Total measured waste per person peaked in 2005/06 at 869kg/person, and has decreased each year in 2006/07 and 2007/08. On a relative scale, 12% more waste was recorded in 2007/08 than in 2001/02. The year 2001/02 has been used as the benchmark in this section to make this data consistent with that presented in previous reports [2].

Table 3.2 shows the increase in total measured waste per person between 2001/02 and each year, shown as a percentage of the amount recorded in 2001/02. In 2001/02 754kg/person of waste was recorded.

Table 3.2 The percent change in total measured waste per person from 2001/02

Financial Year	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08
Percent change from 2001/02	0.4%	7.3%	11.7%	15.3%	14.7%	12.1%

The trends in total measured waste vary between districts. Figure 3-2 shows the amount of total measured waste recorded per person each year by territorial authority.

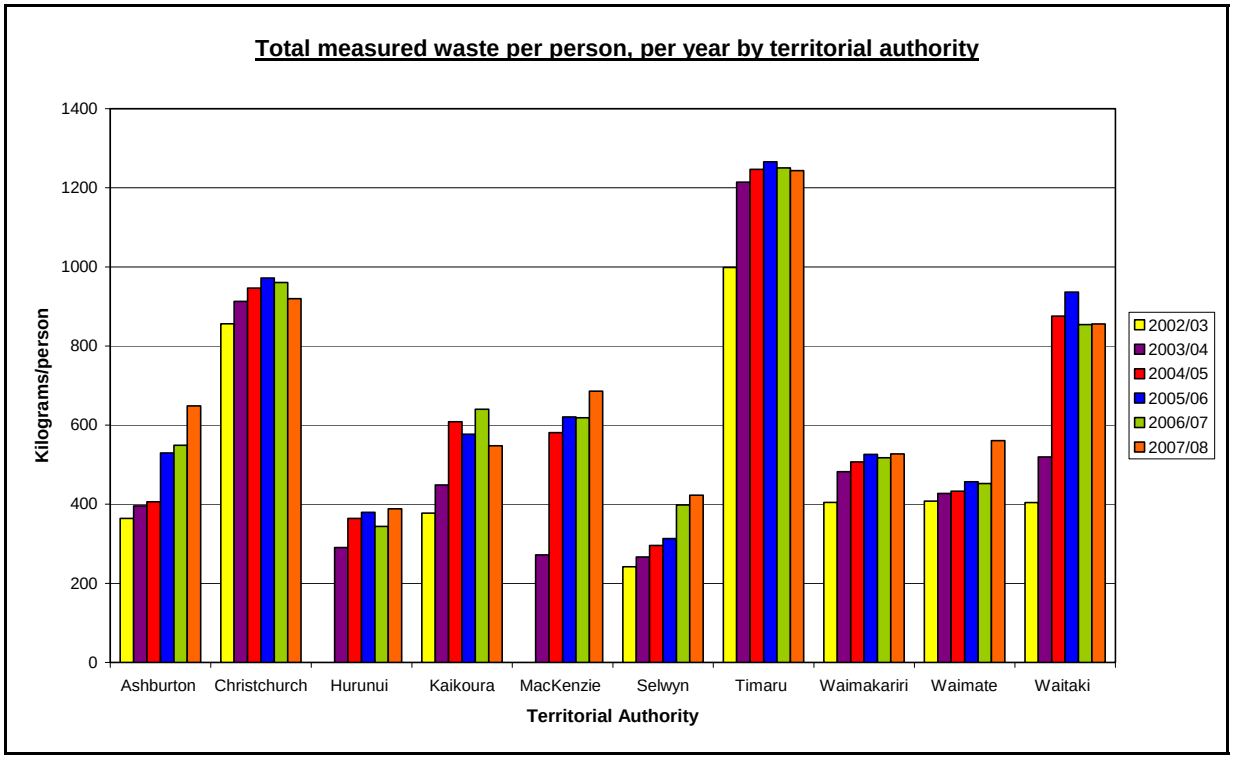

Figure 3-2 Total measured waste per person per year by territorial authority

Figure 3-2 shows Christchurch City, Timaru and Kaikoura Districts recorded less waste in 2007/08 than in 2006/07. All other districts recorded more waste.

Total measured waste is made up of other waste streams, so it is affected by changes in those waste streams.

In the districts where less total measured waste was recorded in 2007/08 than in 2006/07, less or the same amount of residual waste, recycling, organics, hazardous waste and hardfill were recorded. Except Timaru which had an increase in residual waste and Kaikoura which recorded more hazardous waste. Timaru only reported hardfill data in 2005/06 so there is not enough data to show a trend in this waste stream.

Between 2006/07 and 2007/08 total measured waste increased slightly in Hurunui, Selwyn Waimakariri and Waitaki Districts and significantly in Waimate, Mackenzie and Ashburton Districts. The increases in Mackenzie and Ashburton Districts were due to more diverted materials being collected. In Waimate it was due to more residual waste being collected.

Recycling and organics increased or remained steady in Ashburton, Selwyn, Waimakariri and Waimate Districts. In all districts reuse material amounts increased or remained steady between 2006/07 and 2007/08. Hazardous waste has increased significantly in Waimakariri and Ashburton, and decreased in Mackenzie, Selwyn and Waimate. Hazardous waste data for Hurunui is too variable to show a trend. There was not enough hardfill data for these districts to show trends.

Changes in total measured waste can be due to the same change in all waste streams (a decrease or increase) or a very large change in one or two waste streams. For 2007/08 regional changes in total measured waste are generally due to the same change occurring in all or most waste streams within a district.

3.2 Residual waste

Residual waste is the material left over, and disposed of, after all useful material has been removed from the waste stream. In Canterbury final disposal is by landfilling, in other regions and overseas it may include incineration. In theory all reusable, recyclable and compostable materials would be removed from the residual waste stream before disposal, but SWAP studies show about two thirds of our residual waste is potentially divertible. Section 3.3 looks at diverted materials; this section looks at the amount of material sent to landfill in Canterbury.

The amount of residual waste produced by the region is important because it not only indicates the level of inefficiency in the way we use resources, but also an increasing financial cost of disposing of this material. From 1 July 2009 each tonne of waste disposed of to landfill will incur a $10 waste levy fee. The levy for 2007/08's 330 069t of residual waste would have been over $3 million. The waste levy is discussed in Section 7.

In 2007/08 1264t more residual waste was disposed of than in 2006/07, although Canterbury's population increased during this time resulting in an average decrease of 5kg/person, shown in figure 3-3.

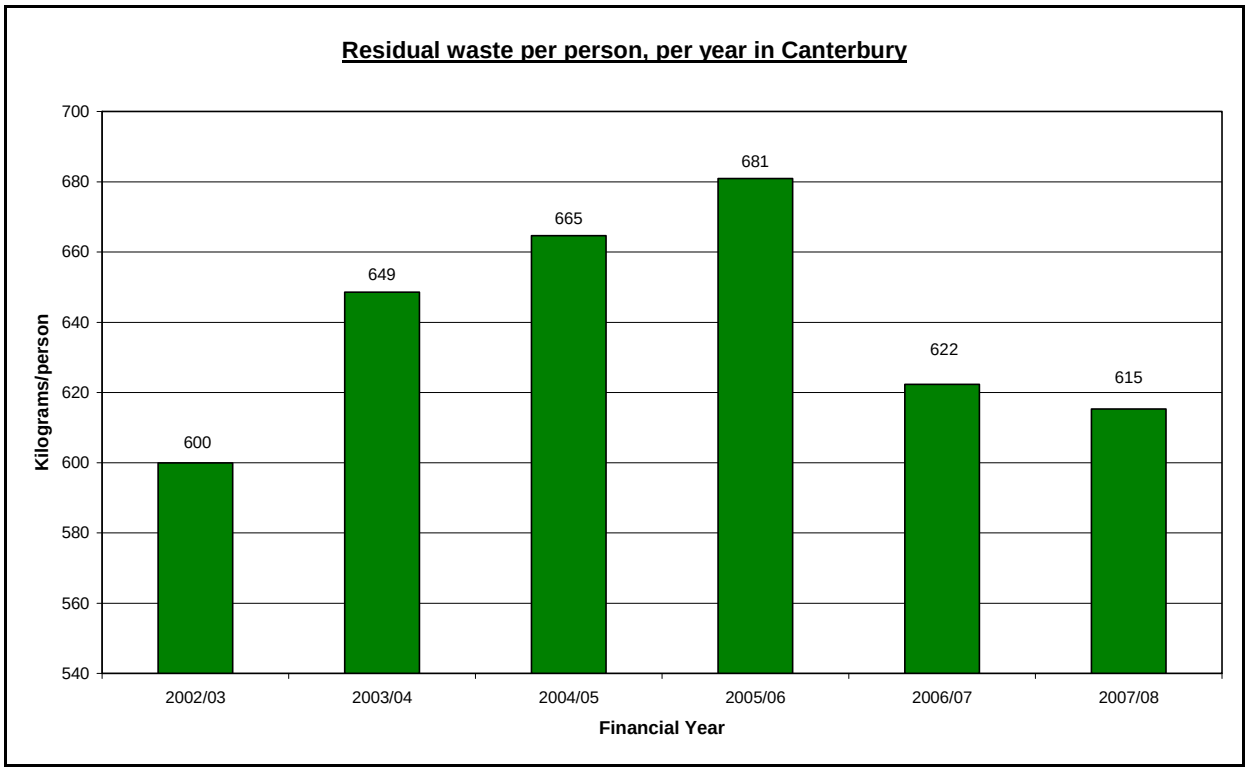

Figure 3-3 Mean amount of residual waste collected per person, per year in Canterbury

Figure 3-3 shows a change from residual waste increasing between 2002/03 and 2005/06 to it decreasing or levelling off from 2006/07. Table 3.3 shows this as a relative change from 2001/02 levels of 599 kg/person. In 2007/08 2.7% more residual waste per person was generated than in 2001/02. When residual waste peaked in 2005/06 13.7% more waste was generated than in 2001/02.

Table 3.3 Percent change in residual waste per person from 2001/02

Financial year	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08
Percent change from 2001/02	0.2%	8.3%	11.0%	13.7%	3.9%	2.7%

As with total measured waste the trends in residual waste amounts vary between districts. Figure 3-4 shows the amount of residual waste recorded per person, per year by territorial authority.

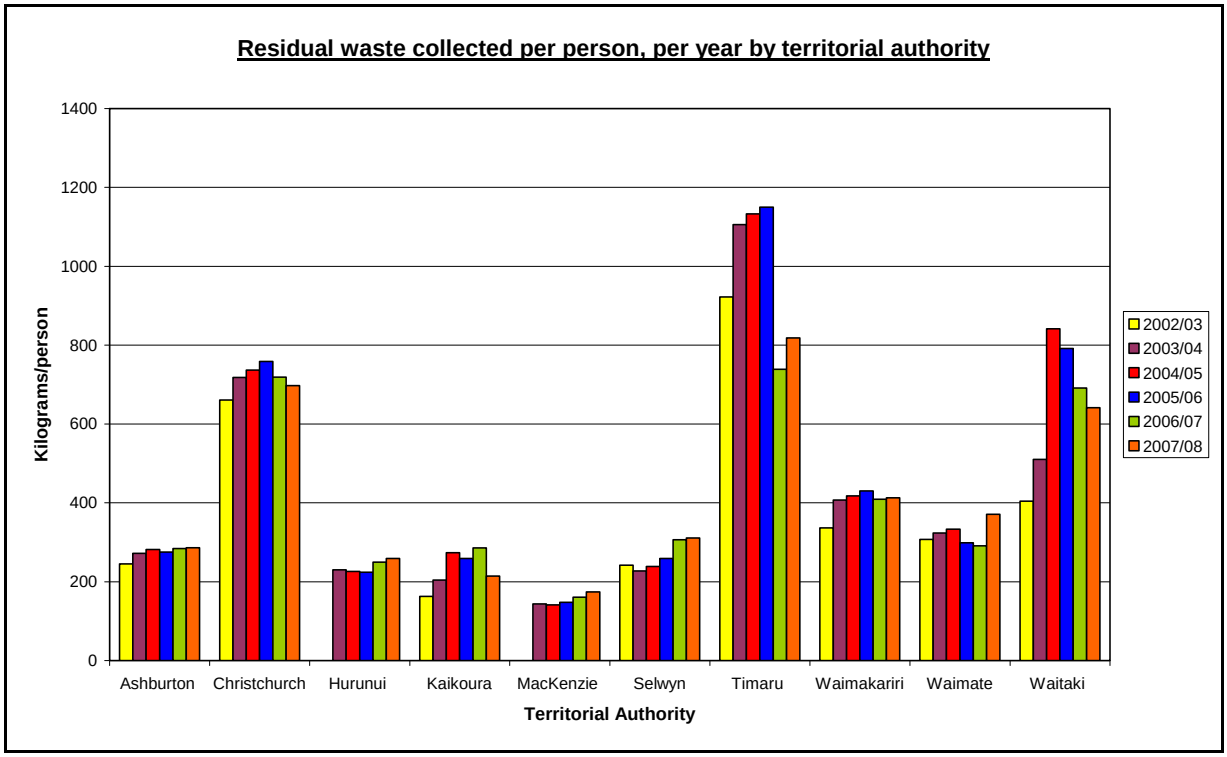

Figure 3-4 Mean amount of residual waste collected per person, per year by territorial authority

Mackenzie District collected the least residual waste per person in 2007/08, 174kg/person. However, the amount of residual waste increased 9% between 2005/06 and 2006/07 and 8.8% between 2006/07 and 2007/08. This trend of low but increasing residual waste amounts is also observed to a lesser extent in Hurunui and Selwyn Districts.

The largest amounts of residual waste per person were recorded in Christchurch City, Timaru and Waitaki District, which each had over 600kg/person in 2007/08.

Past reports have cited a larger amount of business and industry in Timaru and Christchurch as the cause of the larger amounts of waste. To test this hypothesis basic business statistics from the five largest districts were compared. The number of people employed in each district was compared rather than the number of businesses, because businesses can exist in name only, and can be of varying sizes.

Christchurch has the largest number of employees, 194 190 people or 54% of the resident population, most of who work in non-primary industries (99%). So Christchurch is expected to have a larger amount of waste per person than districts with little business and industry, if industry is the cause of the larger amounts of waste. This expectation generally fits the data for Christchurch.

Timaru and Waimakariri have similar populations 42 873 and 42 823 respectively (2006 Census) and similar proportions of employees employed in non-primary industry 92% and 90% respectively; although, more people are employed in Timaru (20 8200) than in Waimakariri (10 567). This may

explain why Timaru's waste per person is higher than Waimakariri's but not why it is higher than Christchurch's.

In Christchurch the number of employees employed in non-primary industry is equivalent to 54% of the population, while in Timaru it is equivalent to 44%. Therefore, the presence of business and industry does not fully explain the larger amounts of waste generated in Timaru. However, neither the number of employees nor number of businesses can indicate the efficiency of those businesses. If the larger amounts of waste generated per person in Christchurch and Timaru are due to more waste from business and industry the efficacy rather than the size or number of businesses could be the cause. Future investigations may try to determine why waste amounts are higher in these districts, than in others.

Table 3.4 shows the change (kg) in the amount of residual waste disposed of per person for each district between 2006/07 and 2007/08. Timaru and Waimate had the largest increases in residual waste with 80kg/person (11.3%) and 79kg/person (27.7%) respectively. In Timaru this may be a levelling out effect after a large decrease of 411kg/person (36%) between 2005/06 and 2006/07, after the introduction of a new kerbside collection system. The largest decrease in residual waste was in Kaikoura, where residual waste decreased 24.4% to 214kg/person in 2007/08.

Table 3.4 Percent change in the amount of residual waste disposed of per person between 2006/07 and 2007/08, by territorial authority

Ashburton	Christchurch	Hurunui	Kaikoura	Mackenzie
2.0%	-1.7%	5.0%	-24.4%	8.8%
Selwyn	**Timaru**	**Waimakariri**	**Waimate**	**Waitaki**
5.3%	11.3%	3.5%	27.7%	-7.1%

Note: Negative values indicate a decrease in residual waste.

Residual waste amounts are affected by the land use and waste services available in a district. In districts with large rural areas, farm dumps may be used to dispose of household and farm waste. Waste going into farm dumps is not counted by territorial authorities because each dump is on private property and only services that property. In districts with large industrial areas, businesses and industry contribute to the residual waste stream and may contribute more per person than households.

Territorial authorities operate kerbside collections, rural collection points, transfer stations and RRP for the collection of residual waste. All districts also have a variety of diversion services such as green waste drop offs and recycling services that encourage diversion and discourage disposal of material as residual waste.

3.3 Diverted materials

In Canterbury there are a number of options for diverting useful items and materials from landfill to including reusing (selling or exchanging items), recycling (composting) and recovery (burning waste oil). In fact SWAP studies indicate 40-70% of residual waste could be diverted [4].

In 2007/08 SWAP studies in Waitaki and Kaikoura Districts found 32% (Kaikoura) and 35% (Waitaki) of material was potentially recyclable and 24% (Kaikoura) and 13% (Waitaki) potentially compostable. Potentially hazardous material made up 1.1% (Kaikoura) and 0.3% (Waitaki). No other districts completed SWAP studies since the last waste data technical report. Waitaki also conducted a SWAP study in 2003/04, when 38% of waste was potentially recyclable and 41% potentially compostable. This indicates Waitaki District has reduced the amount of divertible materials going to landfill. Figure 3-5 shows the mean amount of material diverted per person each year in Canterbury.

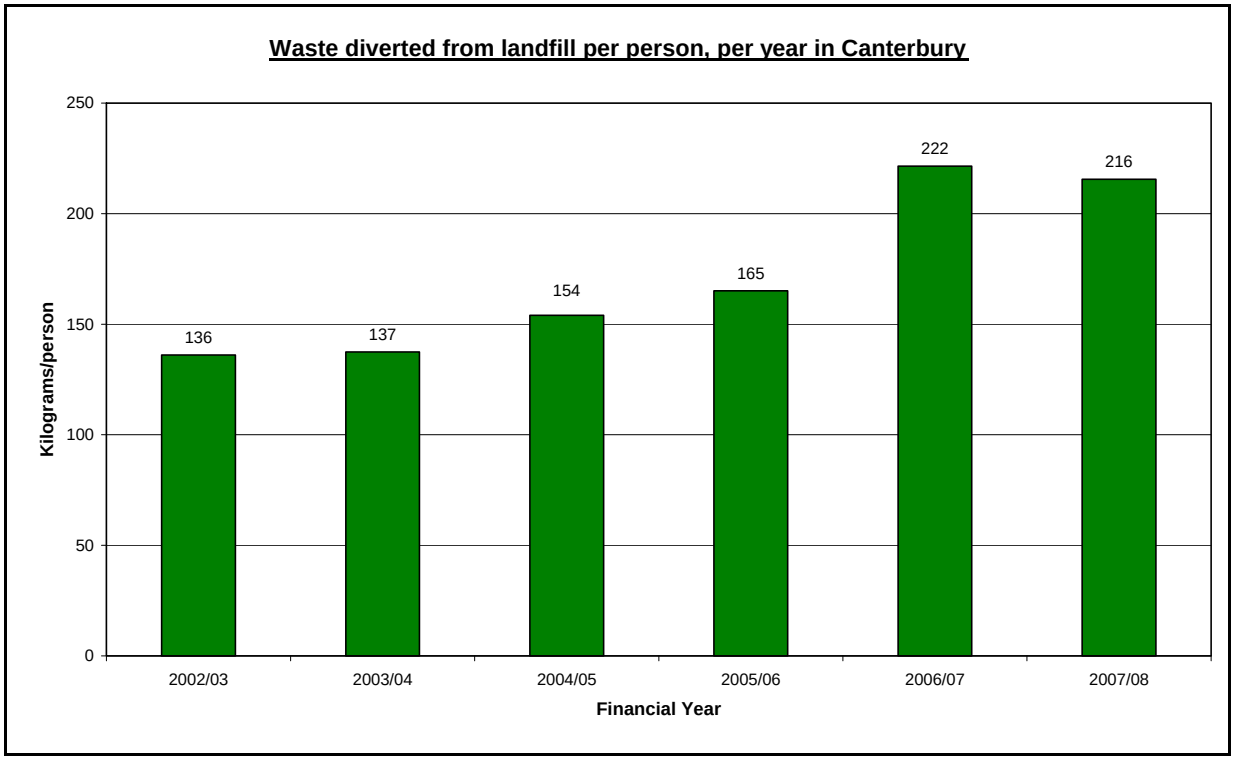

Figure 3-5 Mean amount of material diverted from landfill per person, per year in Canterbury

Figure 3-5 shows diversion amounts have increased each year between 2003/04 and 2006/07, but decreased slightly between 2006/07 and 2007/08. Table 3.5 shows the increase in diversion as a percent of the amount collected in 2001/02. In 2001/02 121kg/person of diverted materials were recorded.

Table 3.5 Percent change in diversion per person from 2001/02

Financial year	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08
Percent change from 2001/02	12.5%	13.6%	27.3%	36.4%	82.7%	78.2%

In 2007/08 78.2% more waste was diverted per person than in 2001/02. Although, the amount of material diverted decreased slightly between 2006/07 and 2007/08 the proportion of waste diverted from landfill remained steady at 23%. Table 3.6 shows the amount of waste diverted from landfill each year as a percentage of total measured waste. Increased diversion rates over the years measured are due to an increased uptake of services and more diversion services, such as kerbside collections, green waste collections at RRP, hazmobiles and waste exchanges.

Table 3.6 Percentage of total measured waste diverted from landfill each year in Canterbury

Financial year	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08
Percent of total waste diverted	18%	17%	18%	19%	26%	26%

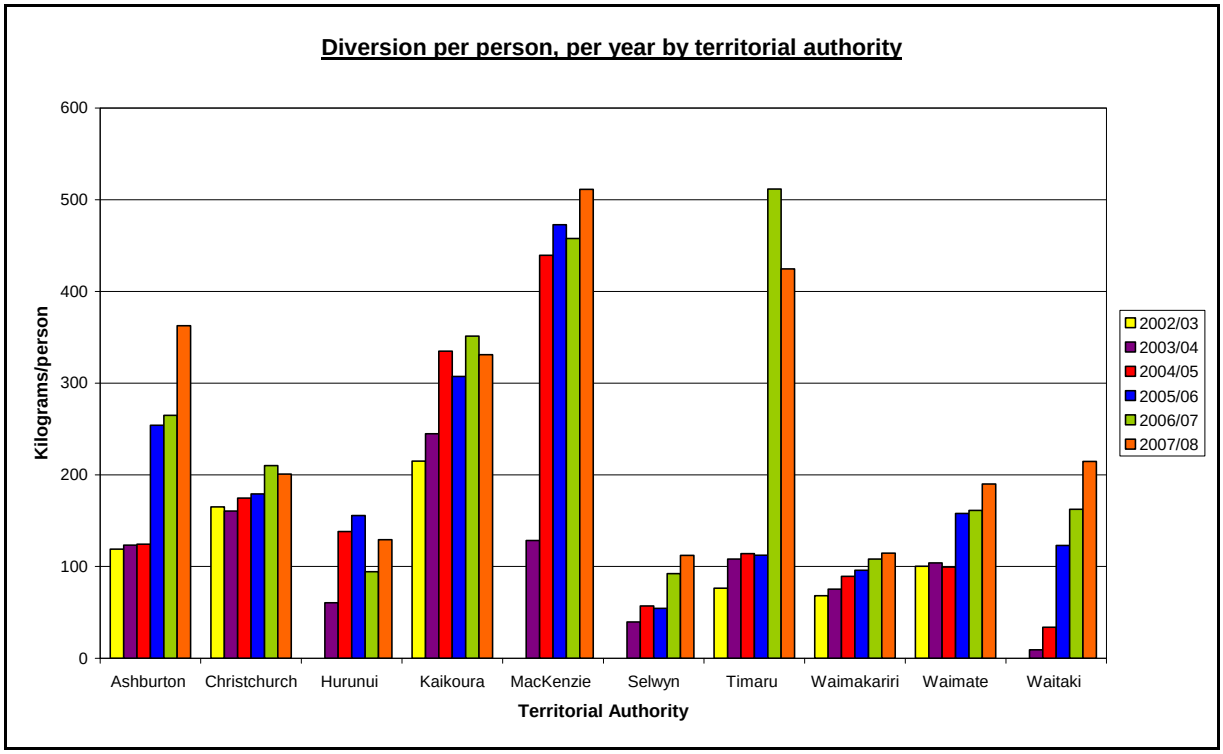

Figure 3-6 The average amount of material diverted from landfill per person per year by Territorial authority

Diversion amounts have increased in most districts between 2006/07 and 2007/08 but decreased in Christchurch, Timaru and Kaikoura. In Christchurch and Kaikoura the decrease in diverted material coincided with a decrease in residual waste, so it is part of an overall decrease in waste rather than more divertible material going to landfill. In Timaru an 87kg/person decrease in diversion coincided with an 80kg/person increase in residual waste, which could mean more divertible materials are being landfilled.

The largest amounts of diversion are in Timaru and Mackenzie, which use a 'three bin' system[i] to collect residual waste, recycling and organics from the kerbside. Kerbside collections are discussed in full in Section 4.1. Kaikoura also has high diversion; they encourage diversion by only collecting recycling from the kerbside. Ashburton's large increase in diversion in 2007/08 is because more material was sold or given away through the reuse store. Lower diversion rates in Ashburton between 2002/03 and 2004/05 were because reuse material was not measured before 2005/06.

Hurunui District had a lower diversion rate in 2006/07 because glass was not collected for recycling.

[i] Mackenzie District use bags for collection. Selwyn also collect residual waste, recycling and organic waste but the organic collection is only available to residents in certain areas and they must opt into the scheme and pay extra for the collection.

3.3.1 Recycling and organics

Recycling and organic material make up 90% of diverted material in Canterbury. These materials are collected via kerbside collections, separate collections at RRP, and collection points such as bottle banks. Figure 3-7 shows the average amount of recyclables and organic material collected per person each year in Canterbury.

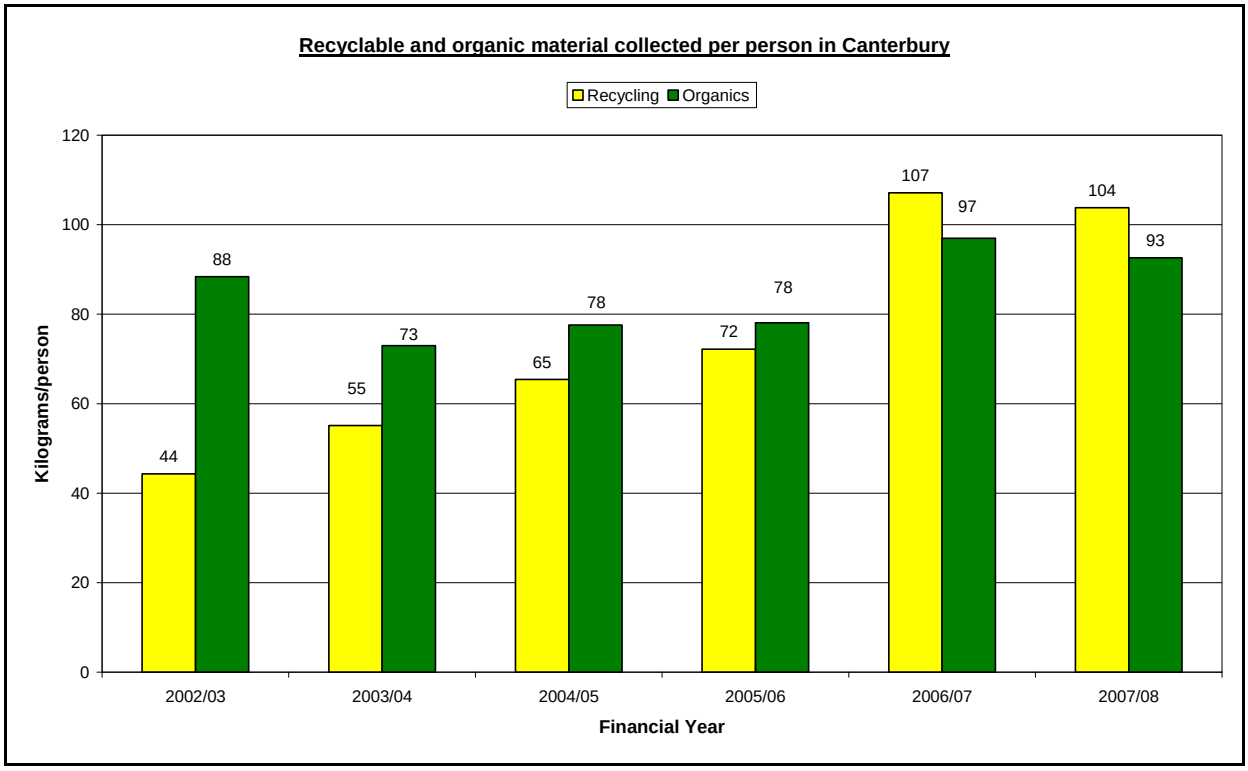

Figure 3-7 Mean amount of recyclable and organic material collected per person per year in Canterbury

Figure 3-7 shows the amount of recycling collected increased steadily between 2002/03 and 2006/07; and has remained steady or slightly decreasing between 2006/07 and 2007/08. Organic waste has been relatively steady over the years measured.

The decrease in recycling and organics of 3-4kg/person between 2006/07 and 2007/08 is similar to the decrease in residual waste of 7kg/person for the same time. This suggests overall waste is decreasing rather than recycling and organic material being sent to landfill.

The amount of recycling and organics vary between districts, Figure 3-8 shows the amounts recorded per person for 2004/05 to 2007/08. The years 2002/03 and 2003/04 have not been shown on Figure 3-8 to reduce the number of bars and make it easier to read.

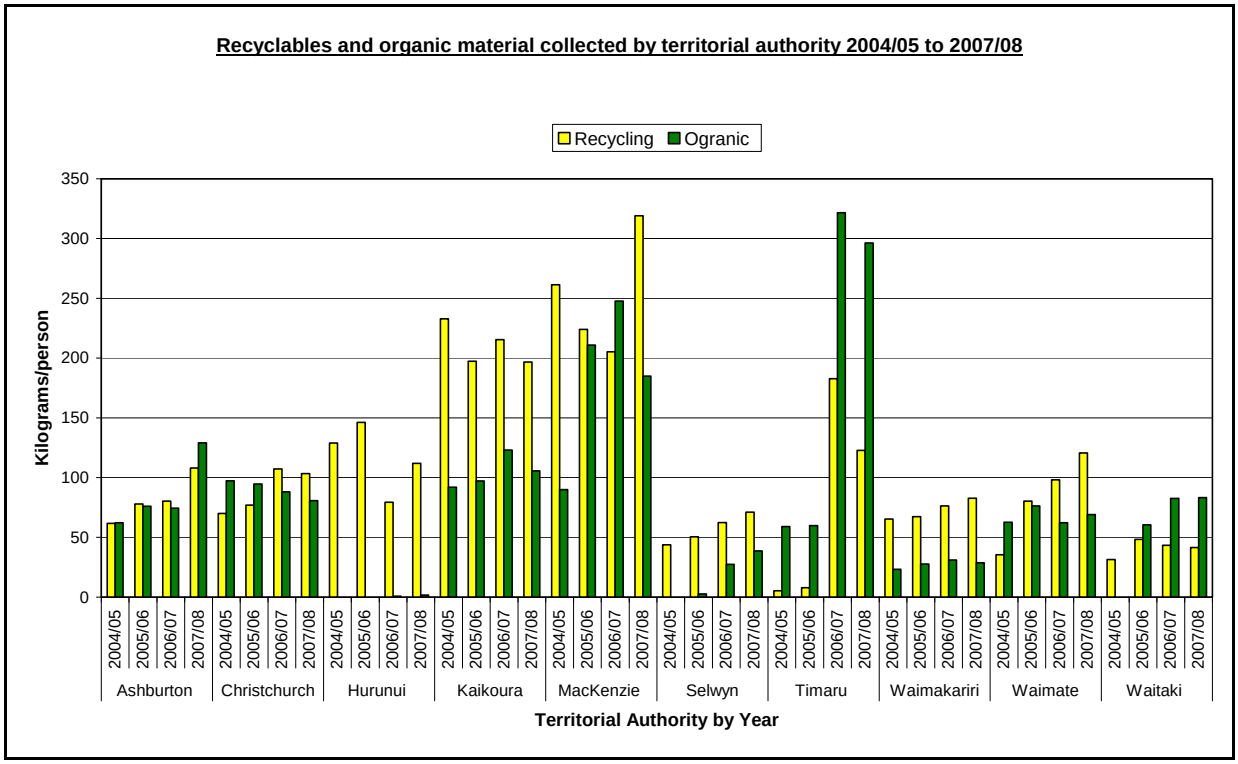

Figure 3-8 Mean amount of recyclable and organic material collected per person per year between 2004/05 and 2007/08 in each territorial authority

Figure 3-8 shows the trends in the amount of recycling and organic material collected in each district varies greatly across the region.

In Ashburton, Timaru and Selwyn, recycling and organics amounts have increased or decreased together. In Waimakariri and Waimate organics have been steady while recycling has increased, while Waitaki has the opposite trend with recycling steady and organics increasing.

The amount of material collected in each district also varies greatly. Most districts (Ashburton, Christchurch, Hurunui, Selwyn, Waimakariri, Waimate and Waitaki) collect <150kg/person of recycling and <150kg/person of organics; two of these districts collected <100kg/person of recycling and <50kg/person of organics. Meanwhile, Mackenzie collected >300kg/person of recycling in 2007/08 and Timaru >300kg/person of organics in 2006/07.

In Timaru the large increase in material collected in 2006/07 compared to 2005/06 marks the introduction of their new kerbside collection system.

3.3.2 Reuse

Reuse materials include a wide range of items and materials such as: furniture, building materials, tools, clothing, fabric off cuts, books, toys, plants, packaging material, appliances and electronics. This variety of items means it is often not practical to weigh or measure the amount of material reused, resulting in some amounts of reuse items being based on estimates.

There is some variation in the way districts measure the amount of reuse material collected. In some districts the number of items or cubic metres of material is converted to kilograms using conversion factors from the *Waste Exchange Conversion Projec*t [5] others convert cubic metres of items and material to kilograms based on a conversion factor for the dominant material type.

The amount of reuse material recorded is small compared to other waste streams, - 17.9kg/person in 2007/8; but, many forms of reuse are not recorded by councils. For example, councils do not measure

the amount of material or items sold, exchanged or given away at garage sales, second hand stores, through the Buy Sell and Exchange, TradeMe or newspaper classifieds. Councils only record the amount of reuse items sold or given away at reuse stores at RRPs or exchanged via waste exchanges.

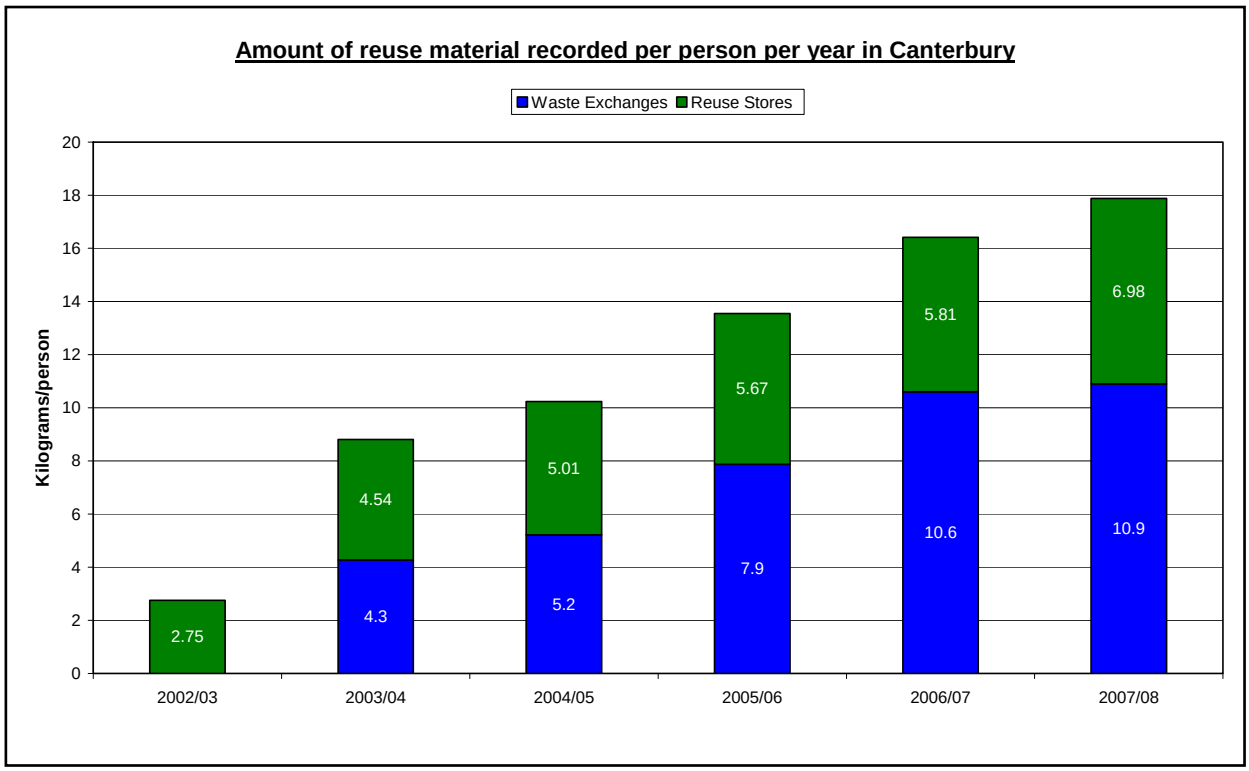

Figure 3-9 The amount of reuse material per person, per year sold through council operated reuse stores and exchanged through waste exchanges

In should be noted that in 2002/03 Canterbury's waste exchanges recorded three tonnes of material, calculated per person this is too small to show on Figure 3-9. Full reporting of waste exchange material began in 2006/07, after a project to produce a set of conversion factors for exchanged material [5].

Waste exchanges often arrange ongoing exchanges between businesses which may not continue to be recorded by the waste exchange after the first year. So, it is likely that more material was exchanged because of waste exchange activities than is shown here.

The amount of reuse material recorded per person has been steadily increasing during the years measured. This is a positive sign for the region because reuse is the second stage in the waste management hierarchy, behind reducing waste but preferable to recycling.

4 Domestic waste services

Domestic or household waste is collected from the kerbside, at resource recovery parks (RRP) and at recycling drop off centres. The public are encouraged to separate recyclables, hazardous wastes and organic waste from their residual waste and dispose of these at designated facilities, which are often parts of a RRP. All districts offer lower disposal fees for recycling and organic waste; most districts do not charge for recycling.

Some districts also offer drop-off sites for residual waste and/ or recycling. These facilities are smaller than RRP and may consist of skips and bins and have limited opening hours. Drop-off facilities are typically found in rural towns which do not have kerbside collections and/or are a long way from a RRP.

4.1 Kerbside collection

This section only analyses waste collected from the kerbside by council operated or contracted services, it does not include private commercial kerbside collected waste. Council kerbside waste collections predominantly service residential properties, although many also collect from commercial properties in urban areas. Territorial authorities offer kerbside collections in most urban areas; some districts also have collections in rural areas. In rural areas the collection may be optional, or only available if a property is on a collection route. The cost of collection is covered by rates[ii], which are charged to all properties in the collection area, unless a service is optional.

The type of kerbside collection service available varies throughout the region. Table 4-1 shows the type of service offered in each district in 2007/08. Most districts have weekly collection of each waste stream, although some have fortnightly collections on alternating weeks. For example, Timaru collects organics weekly but alternates recycling and residual waste.

[ii] This may be general rates, a targeted rate or service fee

Table 4.1 Kerbside collection services offered by territorial authorities

Territorial Authority	Residual Waste		Recycling		Organic Waste	
	Collected in	Cost covered by	Collected in	Cost covered by	Collected in	Cost covered by
Ashburton	Bags	Purchase	Crates	Purchase (crate) Rates (collection)	None	
Christchurch	Bags	First 26 in rates	Crates	Rates	None	
Hurunui	Bags	Supplied by residents	Reuse Bags	Rates	None	
Kaikoura	None		Bags	Supplied by residents	None	
Mackenzie	Bags	Purchase	Bags	Purchase	Bags	Purchase
Selwyn	Bags or	Purchase	Crates	Rates	Wheelie bin	Extra Rate
	Wheelie bin	Extra Rate				
Timaru	Wheelie bin	Rates	Wheelie bin	Rates	Wheelie bin	Rates
Waimakariri	Bags	Purchase	Crates	Rates	None	
Waimate	Urban bags	Purchase	Crates	Rates	None	
	Urban wheelie bin	Extra rate				
	Rural wheelie bin	Extra rate				
Waitaki	Bags	Purchase	None		None	

Purchase = residents must purchase a council bags, crate or bin for collection
Extra rate = extra targeted rate charged when this option is chosen.
Supplied by residents = Residents can put out any bag for collection, but they must supply the bag.

The proportion of a district's waste that is picked up through kerbside collections varies between districts, and is affected by the proportion of people or households and businesses who have access to the collection. Table 4.2 shows the percentage of each districts' residual waste that came from kerbside collections in 2007/08.

Table 4.2 Percentage of residual waste from kerbside collections in 2007/08

Ashburton	Christchurch	Hurunui	Selwyn	Timaru	Waimakariri	Waimate	Waitaki
25%	13%	22%	61%	14%	12%	54%	5%

The amount of residual waste coming from kerbside collections varies from 5% in Waitaki to 61% in Selwyn. Of the eight districts where data are available, half receive less than 15% of their residual waste from kerbside collections, and most receive less than 25%. Two districts Selwyn and Waimate get more than half of their residual waste from the kerbside. This shows that changes in kerbside residual waste will have a greater effect on total residual waste in Selwyn and Waimate Districts. While in other districts changes that encourage reduction of non-kerbside residual waste would have a greater impact on total residual waste amounts, than changes to kerbside collected waste.

4.1.1 Amounts of kerbside collected waste

Kerbside waste can be measured in a number of ways, as the amount per person, per household, per service (bin) or per property. Districts measure kerbside waste differently, making it difficult to compare amounts between them. Districts do report total tonnes of kerbside waste, but this is not comparable because there are different access levels and large population differences between districts. Future work will look at standardising the way kerbside collected waste is reported.

Figures 4-1 to 4-5 show the trends in kerbside waste for five districts. Other districts did not provide data for enough years to show a trend[iii].

In Christchurch (Figure 4-1), Waimakariri (Figure 4-2) and Waimate (Figure 4-3) kerbside residual waste has decreased and recycling has increased over the years measured. In Ashburton (Figure 4-4) recycling has increased and residual waste remained steady.

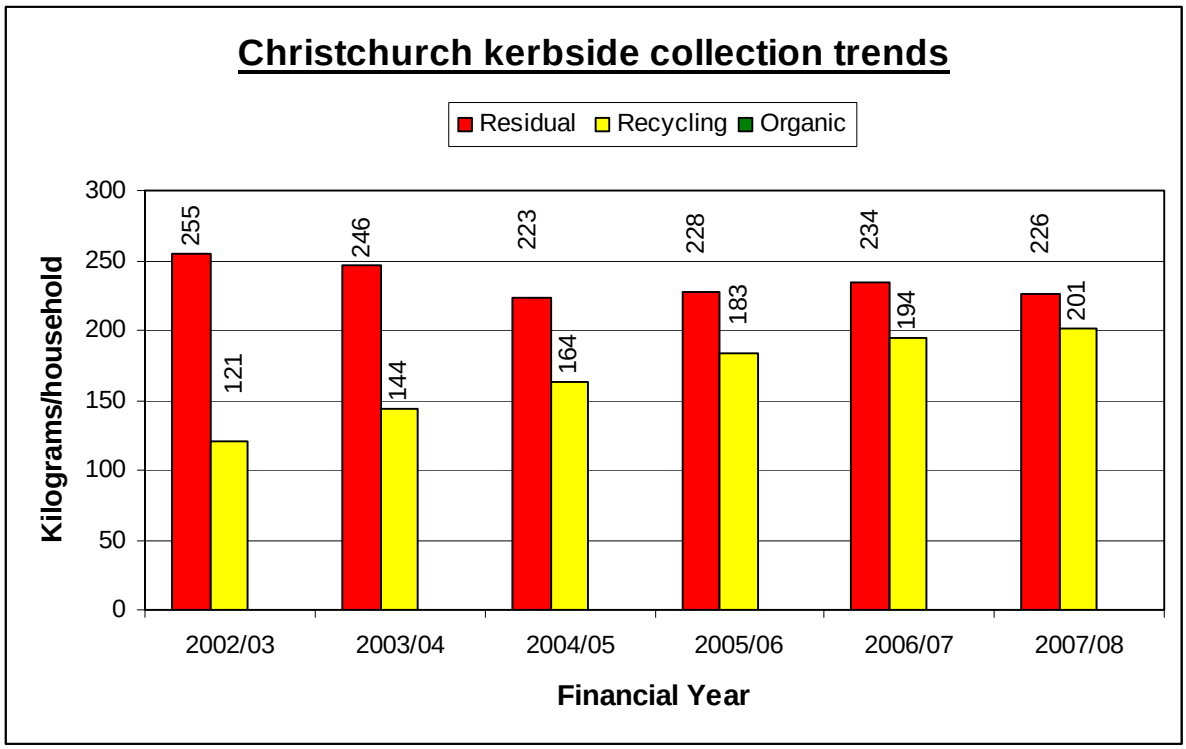

Figure 4-1 Christchurch City kerbside waste

[iii] Kaikoura, Selwyn and Waitaki Districts only supplied data for one year, Hurunui for two years. Mackenzie District did not supply data for amounts of kerbside collected waste in these years.

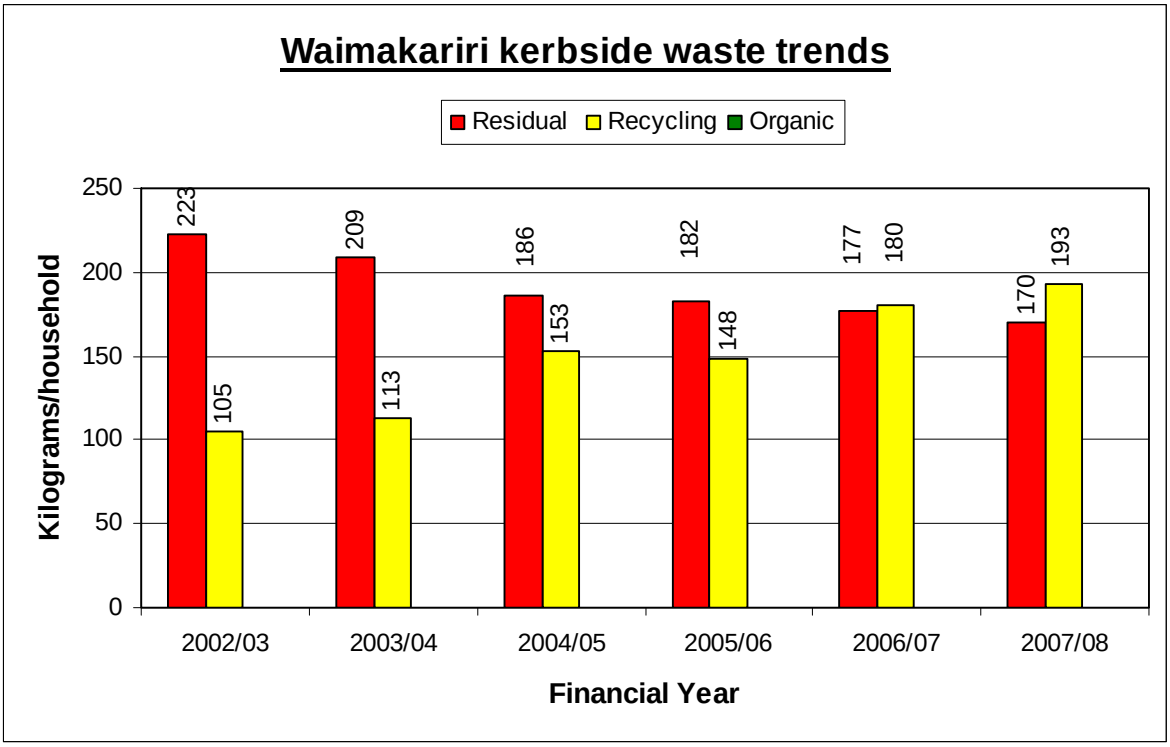

Figure 4-2 Waimakariri District kerbside waste

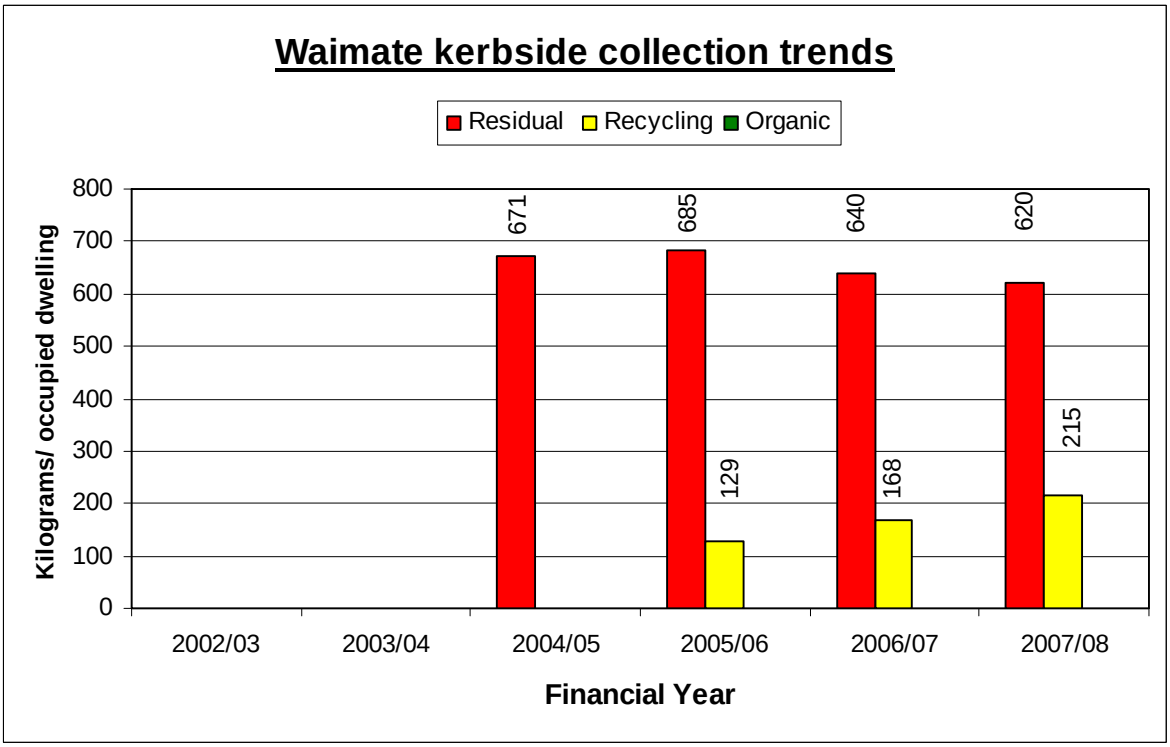

Figure 4-3 Waimate District kerbside waste

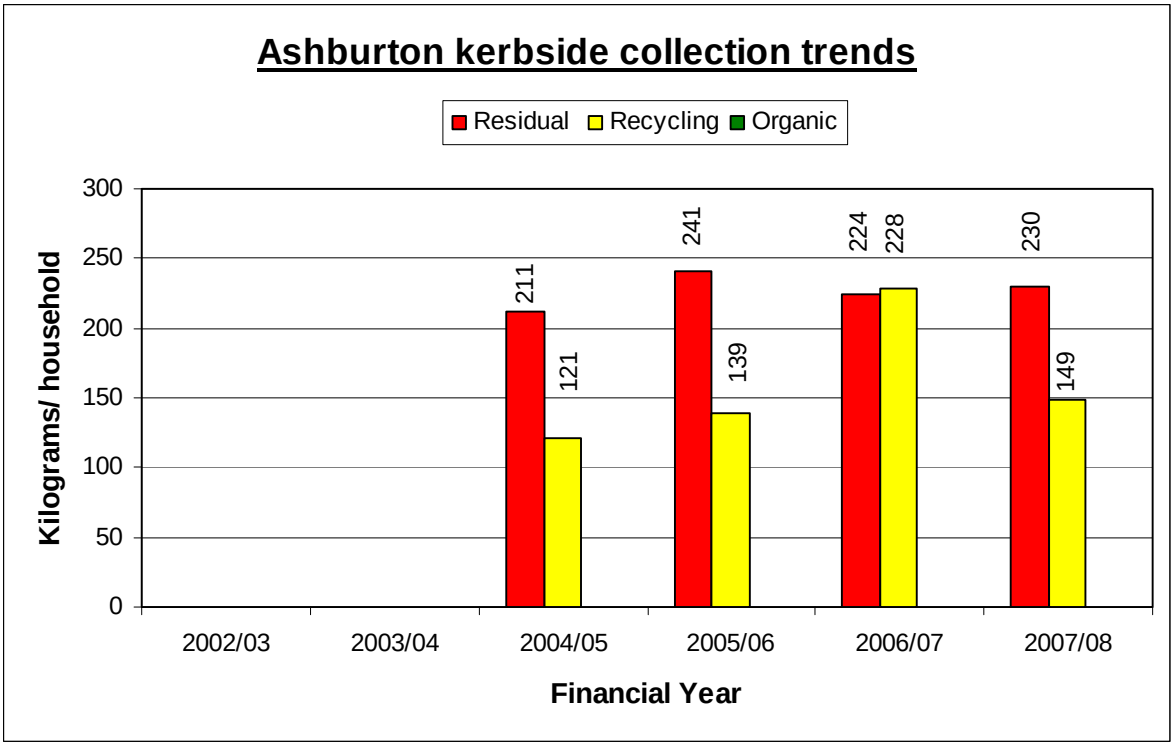

Figure 4-4 Ashburton District kerbside waste

In Ashburton (Figure 4-4) 228kg of recycling was collected per household in 2006/07. This spike in recycling amounts is considered an anomaly because the increase in recycling does not correspond to an expected decrease in residual waste. In 2006/07 recycling from bottle banks and drop off-points was included with kerbside recycling, which explains this peak. The figures for kerbside and bottle bank collections could not be separated.

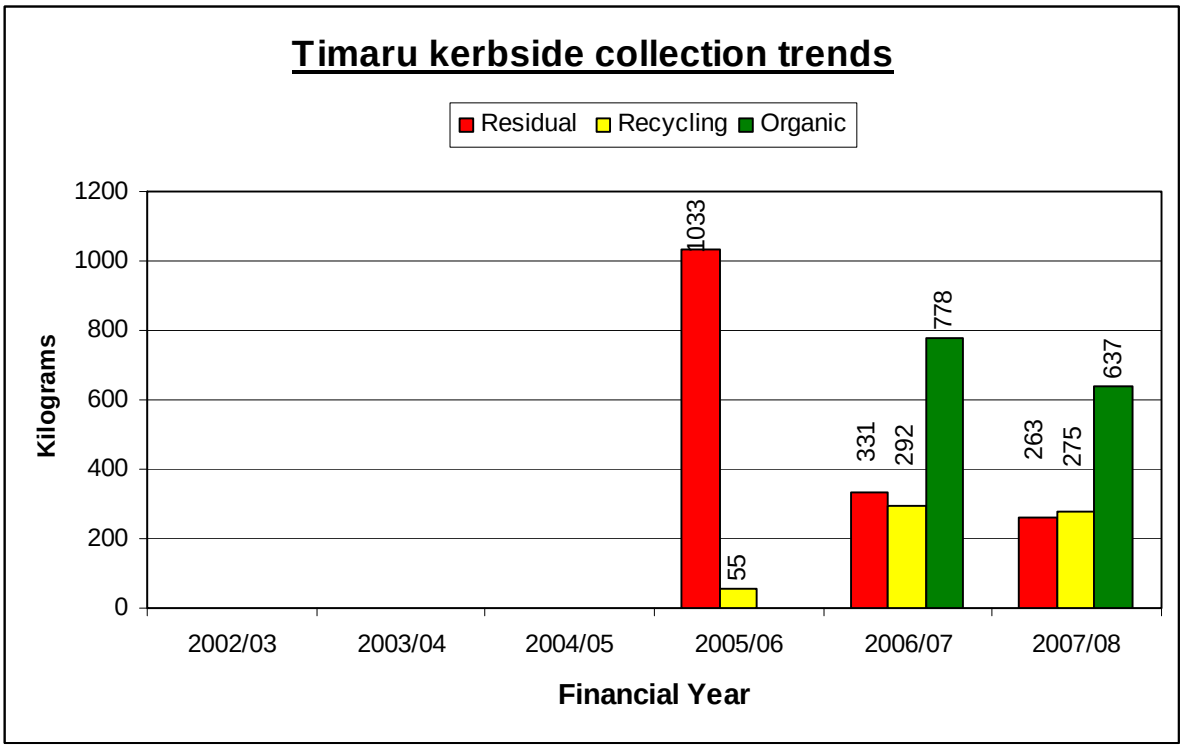

Figure 4-5 Timaru District kerbside waste (2005/06 and 2006/07 amounts are in kg/property; 2007/08 kg/bin in service)

In Timaru (Figure 4-5) a three bin collection system was introduced in 2006. This resulted in a significant decrease in residual waste between 2005/06 and 2006/07, with a corresponding increase in recycling and organic waste. Between 2006/07 and 2007/08 all kerbside waste streams in Timaru decreased, this corresponds to a decrease in total measured waste in Timaru.

4.1.2 Kerbside diversion

A key way for households to divert waste from landfill is through kerbside recycling and organics collections. Figure 4-6 shows the proportion of total kerbside which is collected thought separate recycling, organic and residual waste services in Canterbury in 2007/08.

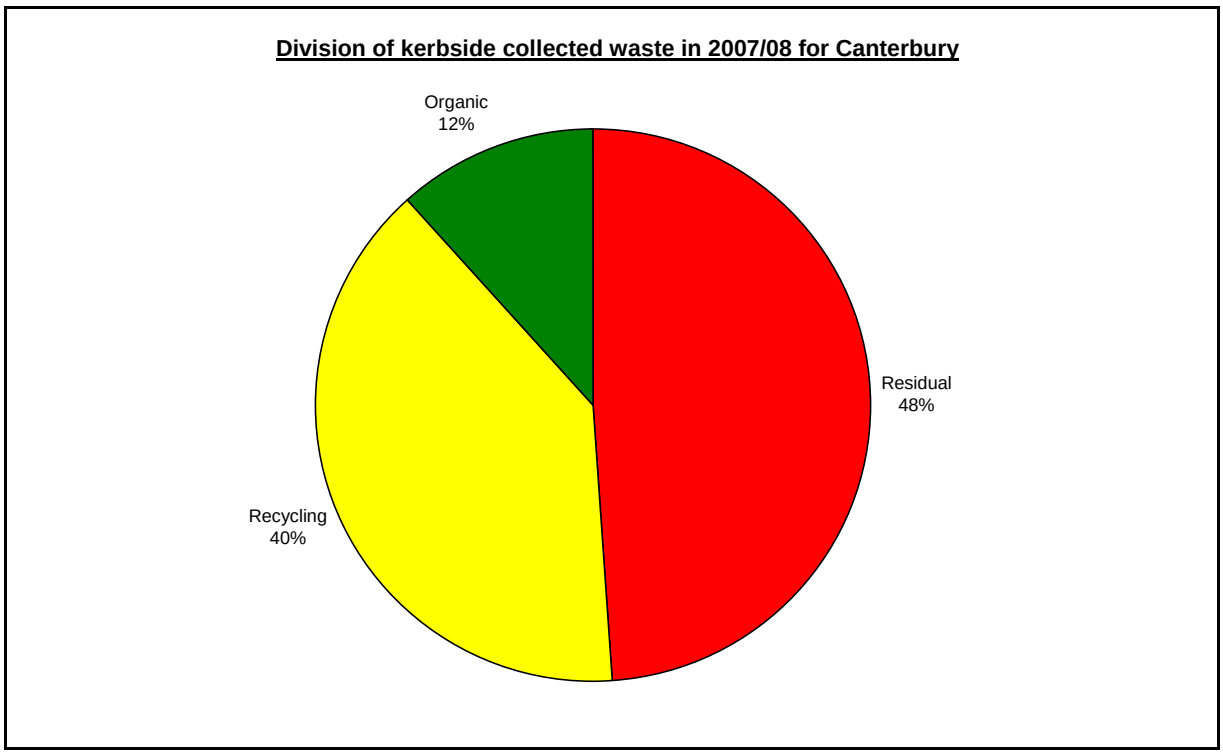

Figure 4-6 Percentage of Canterbury's total kerbside waste collected as recycling, organics or residual waste in 2007/08

In 2007/08 52% of kerbside waste was diverted from landfill, as either recycling or organic waste. This is twice the regional diversion rate for total measured waste, which was 26% in 2007/08. The higher kerbside diversion rate is due to councils providing services that encourage and allow people to divert waste from landfill via kerbside collections.

4.2 Domestic hazardous waste collections

All districts, except Selwyn and Waimate have Domestic Hazardous Waste Drop Off points (DHWDO) at a RRP. Waimakariri District also runs an annual hazmobile, where the public can bring domestic hazardous waste to drive through events in Kaiapoi and Rangiora.

Hazmobiles and DHWDO points allow the public to dispose of domestic quantities[iv] of hazardous wastes safely and without charge. They typically accept: used oil, petroleum products, pool chemicals, pesticides, household cleaners, solvents, chemicals, vehicle batteries and LPG cylinders.

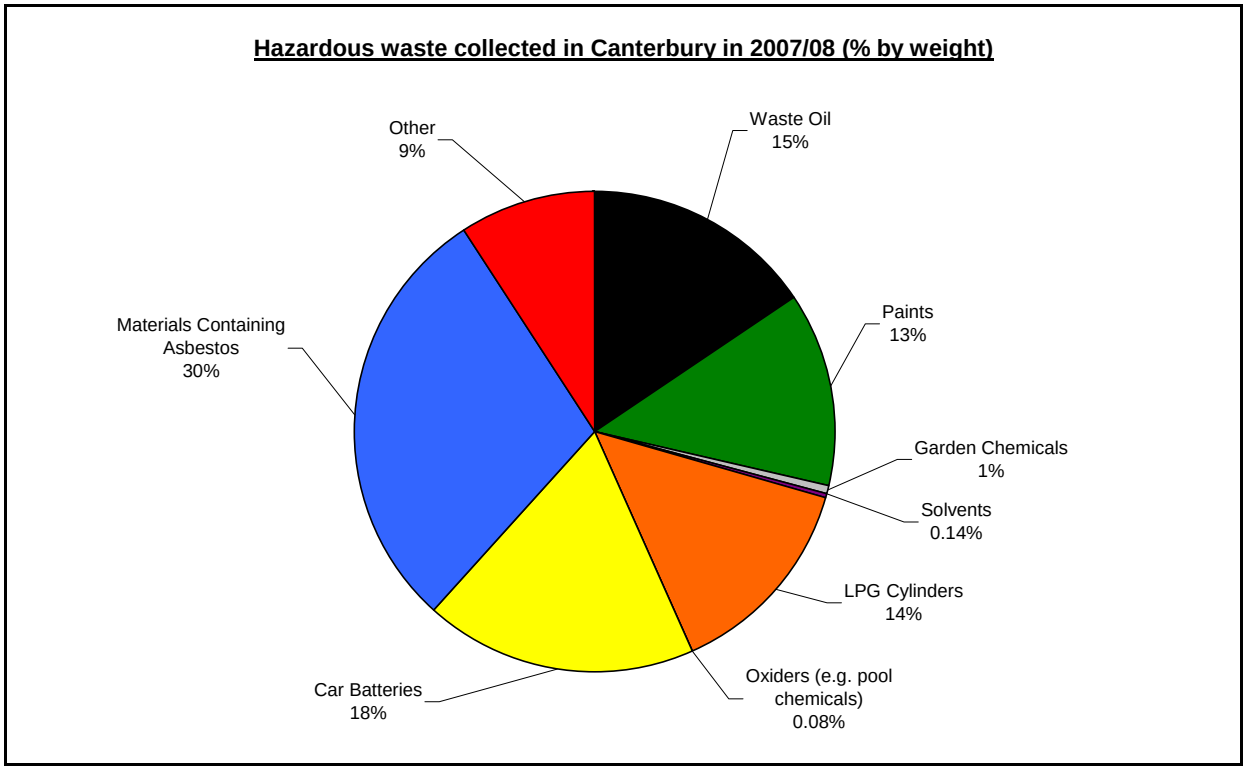

Figure 4-7 The proportion, by weight, of different hazardous wastes collected in Canterbury in 2007/08

Figure 4-7 shows the proportion of different hazardous waste types collected in Canterbury, calculated by weight. The sources of these hazardous wastes are not recorded, but most items are dropped off at DHWDO or hazmobiles, which are targeted at householders. The exception is asbestos containing materials (ACM) which may be from commercial operations that are too small to dispose of the ACM directly to Kate Valley as special waste. All reported ACM (299 tonnes) were collected in Christchurch, although Timaru and Mackenzie Districts also accept asbestos at designated sites [6].

Table 4.3 shows the types of domestic hazardous waste accepted in each district.

[iv] Up to 20l or 20kg

Table 4.3 Hazardous waste types accepted for collection by each territorial authority

Territorial Authority	Used oil	Car batteries	Paint	LPG containers	Oxidisers, solvents, and/or garden chemicals
Ashburton	Accepted	Accepted	Accepted	Accepted	Accepted
Christchurch	Accepted	Accepted	Accepted	Accepted not reported	Accepted
Hurunui	Accepted not reported	Accepted	Accepted not reported	Accepted not reported	Not accepted
Kaikoura	Accepted	Accepted	Accepted	Accepted	Accepted not reported
Mackenzie	Accepted	Accepted not reported	Accepted not reported	Accepted not reported	Accepted not reported
Selwyn	No DHWDO				
Timaru	Accepted	Accepted not reported	Accepted	Accepted not reported	Accepted
Waimakariri	Accepted	Accepted	Accepted	Accepted	Accepted
Waimate	Accepted not reported	Accepted	Not Accepted	Accepted	Not accepted
Waitaki	Accepted	Accepted not reported	Accepted not reported	Accepted not reported	Collected not reported

In Table 4.3 that statement “Accepted not reported” indicates this waste type was accepted for collection, but the amount of material collected in 2007/08 was not reported in the waste data survey. It is not known whether none of these materials were accepted, or the amount of material accepted was not recorded. Resource recovery park operators may not record the amount of some types of hazardous waste because the amount they receive is very small.

The most widely accepted materials in 2007/08 were used oil, car batteries and LPG containers.

5 Commercial waste

Waste from commercial sources is estimated to make up 80% Canterbury's residual waste. Figures from Section 4.1.2 suggest this is a reasonable estimate. Business and industry's contribution to recycling and organic waste however, is less well known. Most businesses use private contractors to collect and process their recycling and organic waste, but only limited data is available from commercial recycling or composting companies.

This section will examine one example of a commercial waste diversion service, then discuss cleanfill disposal amounts. Future investigations may include other commercial recyclers and composters, and council waste minimisation programmes such as target sustainability.

5.1 Commercial diverted materials

Becon Canterbury Ltd has operated a sorting plant for commercial waste in Christchurch since March 2008. In the four months to June 2008 they achieved monthly diversion rates of 30-65% [7]. The lower diversion rates in some months were because some material received was too contaminated to be sorted and had to be landfilled. Educating companies about reducing contamination is expected to increase overall diversion rates. Of the material that was suitable for sorting 70-100% of a load was typically able to be recovered for diversion [8].. This shows it is possible to divert a large proportion of commercial waste from landfill.

5.2 Cleanfill

Cleanfill is material that does not undergo physical, chemical or biological transformations which could cause adverse environmental or health effects once it is placed in a cleanfill [9]. Cleanfill material typically includes concrete, glass, soil, rock, brick, tiles, cured asphalt and ceramics. Some cleanfills may be consented to take untreated timber, low level contaminated soil, gib-board, plastics and tyres [9] Organic material, household waste, treated timber; woodchips, foundry sand, asbestos and metals are not acceptable cleanfill material [**Error! Bookmark not defined.**]. These wastes are unacceptable because they degrade in the cleanfill producing leachate, methane gas and/or may contain or produce hazardous substances when they break down.

Environment Canterbury issues resource consents for the type of material disposed of at cleanfills sites in Canterbury. The material cleanfill sites are allowed to accept depends on their resource consent.

Cleanfill disposal can have beneficial uses. In Canterbury cleanfill material has been used to fill in old shingle pits, where aquifers have been exposed. This reduces the potential for contamination of groundwater through exposed aquifers.

Cleanfill is Canterbury's largest waste stream. In 2007/08 it accounted for 66% of all waste measured that is, 919 189 tonnes of cleanfill. Figure 5-1 shows the trends in cleanfill for 2002/03 to 2007/08 on top of the amount of total measured waste for the same period.

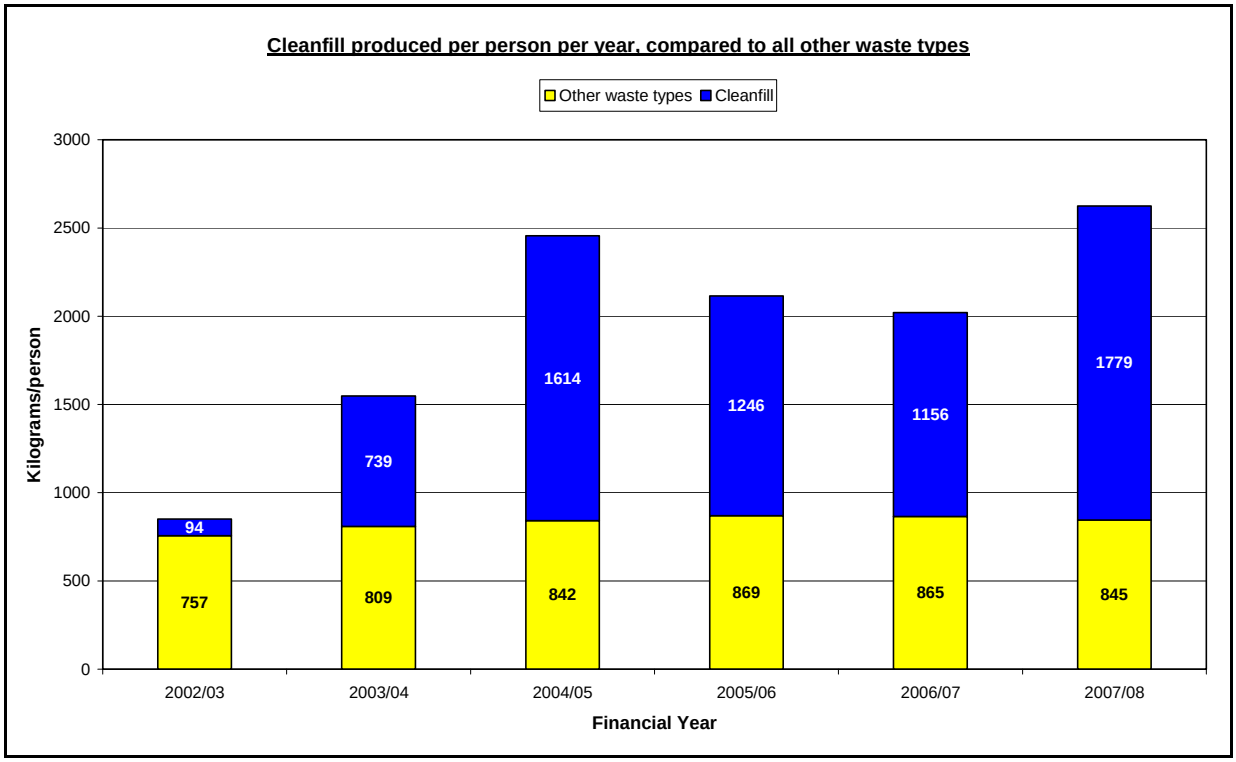

Figure 5-1 The amount of cleanfill compared to other waste produced per person, per year between 2002/03 and 2007/08

Figure 5-2 shows the amount of cleanfill produced per person each year compared the amount of all other waste. All other waste types are the same as total measured waste from Section 3. This amount per person is based on the whole population of Canterbury. However, not all districts reported cleanfill data in these years. Table 5.1 shows which districts report cleanfill data in each of the years shown.

The increase in cleanfill between 2002/03 and 2004/05 is due to better measurement of waste amounts rather than more cleanfill being produced. In March 2004 the Christchurch's *Cleanfill Licensing Bylaw (2003)* came into effect, it required licensed cleanfill site operators to report the amount of waste they accepted to the Christchurch City Council. The bylaw was in effect for one third of the 2003/04 year (the first year Christchurch contributed cleanfill data), then the full year in 2004/05, hence the large increase between 2002/03 and 2004/05.

Cleanfill data from outside Christchurch is limited because most cleanfill sites are privately owned or operated, and there are few requirements to report cleanfill amounts to councils. The cleanfill data currently reported usually only relate to cleanfills councils control.

Cleanfill material typically comes from construction and demolition activities. The amount of cleanfill material produced is thought to be related to the economic activity, but is also influenced by the waste minimisation practises of the construction industry. However, a suitable economic indicator to test this hypothesis was not found. Past reports have used regional gross domestic profit (GDP) but these figures are not longer published by Statistics New Zealand.

Table 5.1 Territorial authorities contributing cleanfill data

Territorial Authority	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08
Ashburton		✓	✓	✓	✓	✓
Christchurch		✓	✓	✓	✓	✓
Hurunui						
Kaikoura	✓	✓	✓		✓	✓
Mackenzie						
Selwyn				✓		
Timaru	✓	✓	✓	✓	✓	✓
Waimakariri	✓	✓		✓	✓	✓
Waimate				✓		
Waitaki				✓	✓	✓

✓= data supplied

6 Comparison to other places

Other regional councils in New Zealand do not collect and analyse waste data in the same way Environment Canterbury does, so comparison of all waste streams is not possible. However, other regional councils have access to residual waste data from landfill consents they monitor. Part 6.1 compares Canterbury's residual waste amounts to Auckland's.

The Danish Environmental Protection Agency, part of their Ministry of the Environment, collects and analyses data on waste amounts and sources. Part 6.2 compares Canterbury's and Denmark's residual waste and diverted material amounts.

6.1 Auckland

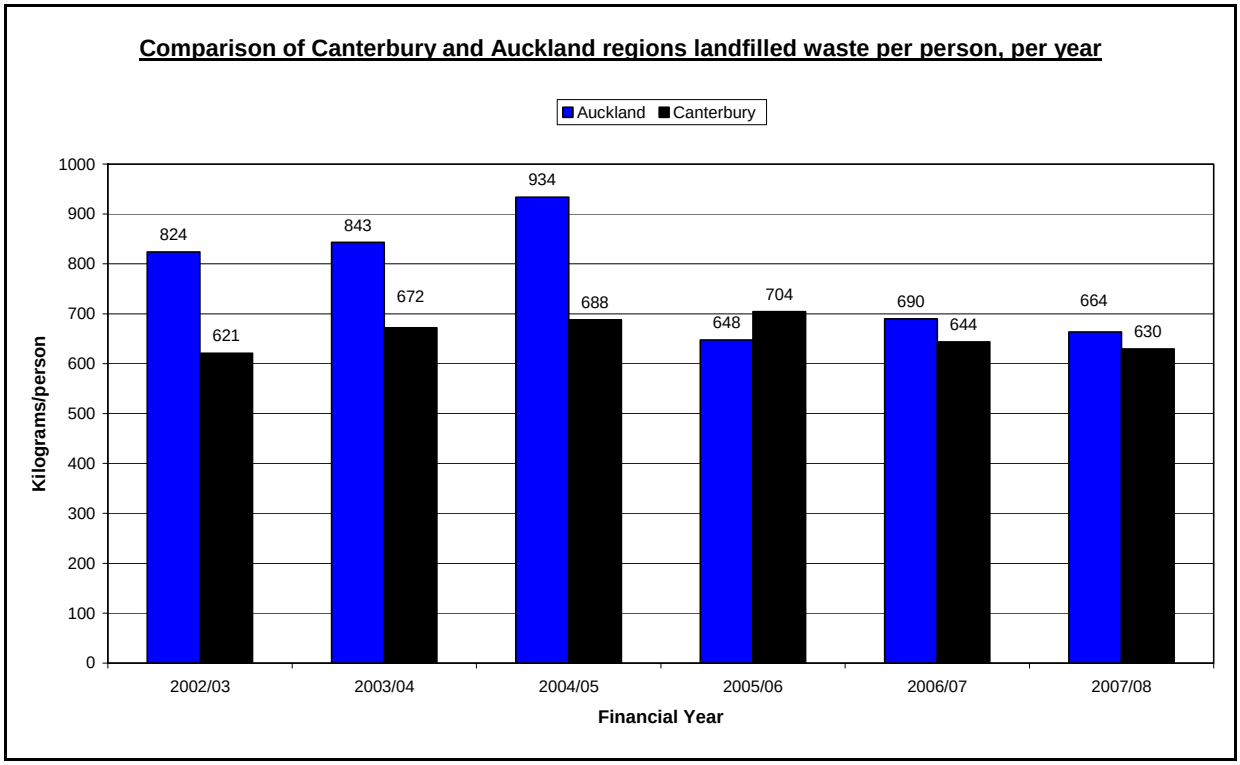

Figure 6-1 Comparison of Canterbury and Auckland Regions' landfilled residual waste per person per year

Figure 6-1 shows the amount of waste landfilled per person per year in Canterbury and the Auckland Region. Waste landfilled includes residual waste and hardfill waste from Table 3.1. Both regions show a similar pattern of waste increasing then decreasing over time. Canterbury's waste peaked at 678kg/person in 2005/06, Auckland's peaked a year earlier at 934kg/person in 2004/05. This difference may reflect a lag between the economies of Canterbury and Auckland. Although it is likely changes in waste disposal facilities in Auckland between 2004/05 and 2005/06 had a greater effect on waste amounts than economic factors. The decrease in Auckland between 2004/05 and 2005/06 coincides with the closure of two major landfills in Auckland, and the opening of the Hampton Downs landfill in Waikato, which receives waste from the Auckland Region [10]. This means a proportion of Auckland's waste is leaving the region so it is no longer accounted for in the regional waste figures. The amount of waste going into the Hampton Downs landfill is reported to Environment Waikato in cubic meters [11] so it is not directly comparable with these figures.

6.2 Denmark

In Denmark waste management is considered a public sector task, with an aim to maximise recycling [12]. The Danish Environmental Protection Agency(EPA) can therefore collect data on all waste disposed of. Local authorities are responsible for managing all waste streams, but often partner with private enterprise to deliver services, build infrastructure or develop technology.

In Denmark high national waste taxes are placed on landfilling and incineration to discourage the use of these disposal options and encourage recycling (including composting) which is not taxed. Danish waste taxes are 375kr/tonne ($NZ120/tonne)[v] for landfilling and 330kr/tonne ($NZ105/tonne)[v] for incineration with energy recovery. Packaging taxes are used to minimise excess packaging, and all beverage bottles and cans have deposit schemes to encourage reuse. Money from waste levies is directed back into waste education, infrastructure, research and development. As a result Denmark now has one of the lowest landfill, and residual waste rates in the European Union. Figure 6-2 compares Denmark's waste amounts per person to Canterbury's.

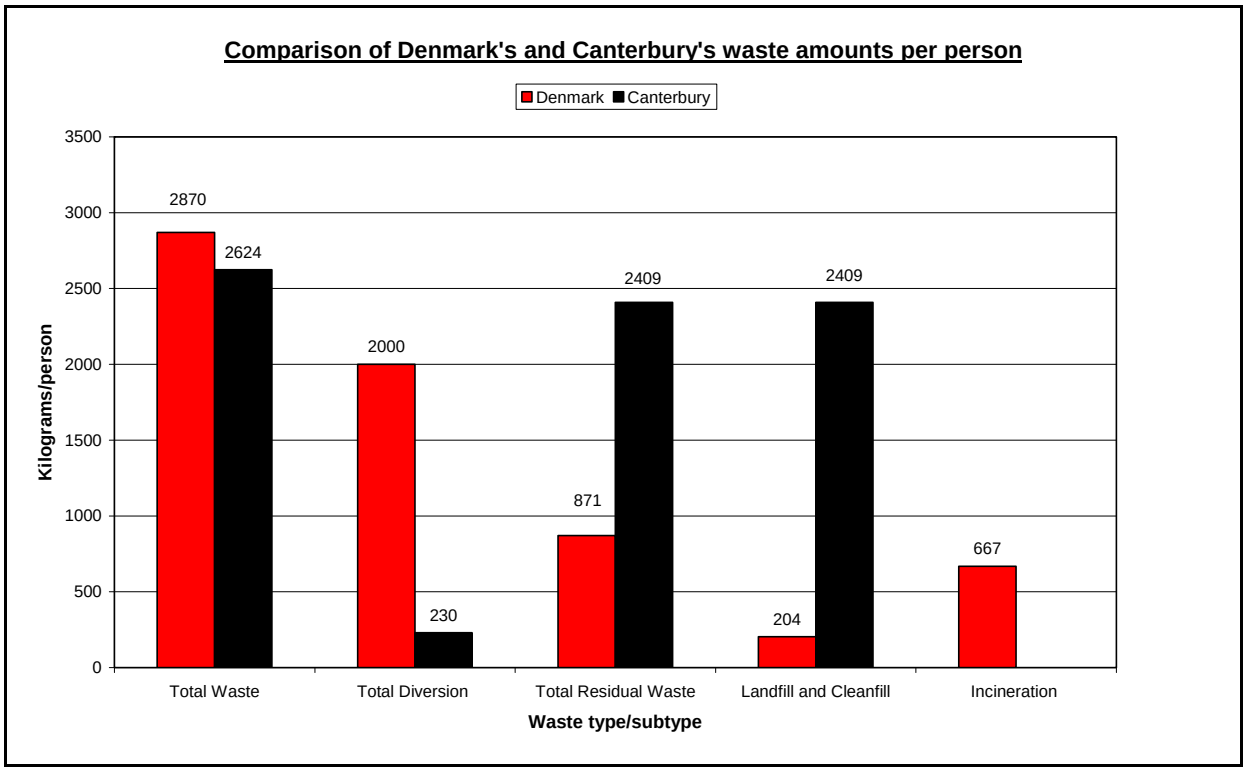

Figure 6-2 A comparison of waste amounts per person for Denmark and Canterbury. Data for the latest available year: Canterbury 2007/08, Denmark 2006

Canterbury's total waste per person includes cleanfill waste because the Danish data does not separate cleanfill from other buried (landfilled) waste; removing cleanfill from Canterbury's waste would give an unequal comparison. Cleanfill makes up 68% of Canterbury's waste, construction and demolition sources contribute 40% of Denmark's waste.

Figure 6-2 shows less waste per person was recorded in Canterbury than in Denmark. However, Canterbury's waste amounts are an underestimate of the true amount of waste produced, because not all waste in Canterbury can be measured. Of the waste recorded most of Denmark's is diverted, while most of Canterbury's is cleanfilled. Canterbury's diversion rate is 11% of Denmark's. While Canterbury's residual waste is 280% of Denmark's.

[v] Exchange rate of 3.127kr to $NZ 1, from the Bank of New Zealand purchase cash rate 2/2/2009. sourced from http://www.bnz.co.nz/Rates_and_Fees/1,1184,20-189-513,00.html

7 Waste levy

7.1 Introduction

The *Waste Minimisation Act (2008)* introduced a $10/tonne levy on all waste disposed of to landfills that accept municipal waste. In 2007/08 there were three landfills in Canterbury and two in the Waitaki district that accept municipal waste. Waste to landfill includes the categories residual waste and hardfill from Section 3.

The waste levy will be collected by central government from 1 July 2009. The first 50% of the money will be divided between territorial authorities based on their population at the last census. The remainder will be used for administration costs and be put into a contestable fund. Levy money given to territorial authorities, or awarded from the contestable fund, must be spent on waste minimisation activities.

The cost of the levy will be met by waste generators as they dispose of their waste, or pay to have it collected. Ratepayers will only pay levy fees for waste they dispose of at transfer stations and through rates for kerbside collected waste, litter and waste from public bins disposed of by councils. In most Canterbury districts the majority of waste levies will not be paid by the ratepayers because they only manage a small proportion of the district's waste.

This section will estimate the potential amount of levy collected based on the waste sent to landfill by each district in 2007/08. It will also calculate the predicted amount of money each TA will be allocated from the fund.

7.2 Levy amounts

Table 7.1 shows the predicted amount of money received by each TA and the amount of levy fees due by each district. These figures are based on 2007/08 waste amounts and the TA allocation of $3.77/person for 2009/10 predicted by the Ministry for the Environment (MfE). The amount of levy money received as been calculated based on the 2006 census population as this is how the fund will be divided between TA's nationally.

7.3 Analysis

Table 7.1 Predicted waste levy amounts by Canterbury district based on 2007/08 waste amounts

District	Kaikoura	Hurunui	Waimakariri	Christchurch	Selwyn	Ashburton	Timaru	Mackenzie	Waimate	Waitaki	Canterbury
Tonnes of waste to landfill 2007/08	799	2 776	18 659	257 534	11 260	8 056	35397	667	2 688	13 000	350 835
Amount of levy collected	$7 990	$27 760	$186 590	$2 575 340	$112 600	$80 560	$353 970	$6 670	$26 880	$130 000	$3 508 350
2006 census population	3 627	10 479	42 834	348 435	33 666	27 375	42873	3 795	7 206	20 223	540 513
Amount of levy money allocated to council	$13 674	$39 506	$161 484	$1 313 600	$126 921	$103 204	$161 631	$14 307	$27 167	$76 241	$2 037 734

Table 7.1 shows the amount of levy money collected from each district and the amount allocated to that district's council. In six districts the council will receive more money than the district pays in waste levy.

Nationally 50% of levy money collected will be allocated to TA's. In Canterbury (including Waitaki) the amount of levy money allocated to the TA's is 58% of the money collected in the region. The proportion of money allocated to TA's does not vary between regions; rather Canterburys' TAs may receive a higher proportion of the levy back because they are better at waste minimisation than the national average. The levy is an incentive to decrease waste to landfill, because districts with less landfilled waste per person receive a larger proportion of the waste levy, paid from their district, back as funds allocated to the city or district council.

8 Climate change

8.1 Introduction

Climate change is a significant international issue. Changes to the Earth's climate can alter weather patterns causing more frequent and/ or severe floods, droughts and other natural disasters. It can also stress ecosystems, impact upon agricultural systems and infrastructure. The Earth's climate has warmed and cooled many times over its history, the ice ages are one example. Now there is a growing international consensus that human activity (via greenhouse gas emissions) is significantly contributing to global warming, better referred to as global climate change[vi].

To address the issue of human induced climate change the United Nations Framework Convention on Climate Change (UNFCCC) was formed. The Kyoto Protocol was signed at the 1997 UNFCCC conference, and identified four greenhouse gases (GHG) and two groups of gases to target for reduction. These were: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (NO_2), sulphur hexafluoride (SF_6), hydroflurocarbons (HFCs) and perflurocarbons (PFCs). New Zealand is a signatory to the Kyoto Protocol and has committed to reducing emissions of these gases to 1990 levels by 2012[vii].

8.1.1 Background - greenhouse effect and climate change

About 1-2% of the Earth's atmosphere is naturally occurring 'greenhouse gases' (mainly water vapour, carbon dioxide, nitrous oxide and methane) which absorb infra-red radiation radiated from the Earth. This helps warm our planet to a liveable 15°C (average global temperature). Without the natural greenhouse effect the Earth's average temperature would be about -15°C,, not suitable for life as we know it.

Growing evidence internationally suggests human activities are adding large amounts of GHG to the atmosphere and pushing the Earth's average temperature up, resulting in altered weather patterns, ocean currents and sea levels. The Earth's climate systems are complex and naturally variable with long time scales, so there is some debate about the extent and even presence of human-induced climate change.

8.1.2 Greenhouse gas from the waste industry

Methane is the main GHG for the waste industry; it is produced in landfills when organic material breaks down under anaerobic conditions. Landfill emissions account for about 2% [13] of New Zealand's estimated GHG emissions, while the agriculture and energy sectors collectively account for about 92% [13].

This chapter examines the potential GHG emissions from landfilled waste in Canterbury and Waitaki District. In this section references to Canterbury include all of the Waitaki District within the Canterbury Region.

8.2 Calculation method

This report uses the Tier 1 calculation method from *IPCC Good Practise Guidance and Uncertainty Management in National Greenhouse Gas Inventories* [3] (IPCC guidelines) to calculate Canterbury's GHG emissions from landfill. The IPCC guidelines contain two methods for calculating emissions, the default or Tier 1 method and the first order decay (FOD) or Tier 2 method. The Tier 1 method was chosen because Environment Canterbury does not have the historical data required for the Tier 2 method.

Where constants, default values and MfE values for New Zealand were used these are shown in brackets next to each factor below. The equations for the method used are:

[vi] Climate change is about an increase in extreme events (warm and cool periods, droughts, storms - not just about 'warming').
[vii] New Zealand's emissions trading legislation is currently undergoing review.

8.2.1 Equations

Calculation of methane emissions from landfills

$$CH_4 \text{ emissions (Gg/year)} = [(MSW_T \times MSW_F \times L_0) - R] \times (1 - OX) \quad \text{(Equation 1)}$$

MSW_T = Total municipal solid waste (MSW) generated (Gg/yr)
MSW_F = Fraction of MSW disposed of to landfill (=1 all residual waste in this data set is landfilled)
L_0 = Methane generation potential (see Equation 2)
R = Recovered CH_4 (=0 see explanation below)
OX = Oxidation factor (=0.1 from MfE national GHG inventory [13]

The R value is the amount of methane collected at landfills by gas capture systems for energy recovery or flaring. The IPCC method states only known amounts of gas should be used, not estimates of gas recovery potential. A value of R=0 has been used because Canterbury's landfills either did not capture gas or did not measure the amount of gas captured.

Calculation of the methane generation potential of the waste

$$L_0 = MCF \times DOC \times DOC_F \times F \times 16/12 \text{ (Gg } CH_4\text{/Gg waste)} \quad \text{(Equation 2)}$$

MCF = Methane correction factor (=1 all landfills in the data set are managed)
DOC = Degradable organic carbon (see Equation 3)
DOC_F = Fraction DOC dissimilated (=0.5 from MfE national GHG inventory [13])
F = Fraction by volume of CH_4 in landfill gas (=0.5 from MfE national GHG inventory [13])

Calculation of the degradable organic carbon (DOC) proportion of the waste

$$DOC = (0.4 \times A) + (0.17 \times B) + (0.15 \times C) + (0.3 \times D) \quad \text{(Equation 3)}$$

A = Fraction of MSW that is paper or textiles
B = Fraction of MSW that is green waste
C = Fraction of MSW that is food waste
D = Fraction of MSW that is wood
Fractions are based on percent composition, from SWAP studies.

8.2.2 Regional data used

In this section municipal solid waste is all waste going to landfill, and includes the categories residual and hardfill waste. Table 8.2 shows the values for MSW_T.

Table 8.1 Total Municipal Solid Waste (MSW_T) per year in Canterbury

	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08
t	307 440	348 868	369 390	382 929	354 066	350 835
Gg	307	349	369	383	354	351

Note: these amounts include Waitaki's data which is not included in Table 3.1

In Equation 3 the fraction of MSW of each waste type is taken from SWAP data. The most recent SWAP studies in Canterbury were in Christchurch and Waimakariri were in 2003/04, and Waitaki in 2007/08. DOC values are not varied between years or used to represent individual districts. Three DOC values are calculated based on SWAP data from the three districts, each DOC value is used to calculate emissions from the Canterbury region. Christchurch's data will be used for regional Estimate 1, Waimakariri's for Estimate 2 and Waitaki's for Estimate 3.

Table 8.2 SWAP data from three Canterbury districts

Waste Type	Christchurch (Estimate 1)	Waimakariri (Estimate 2)	Waitaki (Estimate 3)
Paper and Cardboard	16.2%	9.6%	15.8%
Plastics	22.6%	18.2%	6.1%
Glass	3.2%	1.7%	2.8%
Metals	5.3%	5.9%	4.3%
Food Waste	11.8%	13.0%	18.2%
Green Waste	8.7%	0.0%	20.9%
Hardfill	10.5%	12.9%	12.4%
Wood	7.4%	32.8%	10.7%
Rubber/Textiles	6.5%	4.1%	4.1%
Nappies/Sanitary	2.6%	1.2%	3.1%
Soil	4.5%	0.0%	0.0%
Potentially Hazardous	0.9%	0.3%	1.5%
Other	0.0%	0.0%	0.0%

Highlighted values are used to calculate DOC

8.3 Assumptions and limitations

8.3.1 Choice of method

The main difference between the Tier 1 method used and the alternative Tier 2 method is the way the time scale is represented. The Tier 2 method spread the emissions from waste disposed of in year one across a number of subsequent years to represent a true gas curve from landfill. The Tier 1 method allocated all gas generated by year one's waste will be emitted in year one. The Tier 1 method could alternatively be seen as calculating GHG generation potential rather than emissions.

Because the method used assumes all potential methane is released in the same year the waste is deposited in the landfill, only waste deposited in operating landfills are considered. Emissions from closed landfills would be considered emitted in previous years when the waste was disposed of.

This method produces a reasonable estimate of emissions, if the amount or composition of waste has been constant or only slowly changing over the previous decades [3]. Data for Canterbury is only available from 1998, so changes over the last few decades cannot be measured. This model is the most applicable for the data available and it is assumed to be a fair model for Canterbury.

Waste composition data (SWAP) is limited because many districts have not conducted SWAP studies between 2002/03 and 2007/08. It has been assumed that the composition of waste to landfill has not changed significantly over the time measured. If composition has changed rapidly emissions may be under or over estimated. A decrease in organic material to landfill would mean this method underestimates emissions and overestimates reductions.

8.3.2 Landfill gas recovery values (R)

Five landfills have been used in this report, three in Canterbury: Kaikoura, Kate Valley, and Redruth, and two in Waitaki District: Palmerston and Oamaru. Kaikoura, Palmerston and Oamaru landfills do not have gas capture systems. Gas capture was investigated for Palmerston and Oamaru landfills but the landfills were considered too small for this to be economic. Redruth landfill has a gas capture system but the amount of gas captured is not recorded. Also, not enough gas is captured to sustain a flare off, so it is likely gas is escaping from the landfill. Kate Valley is a relatively new landfill its gas collection system is being installed in 2009, but no gas has been detected yet. Kate Valley is expected to have a slow gas generation rate because the waste it receives contains only about 20% organic material and Canterbury has a dry climate. No gas was captured at Kate Valley in the years included in this report.

8.3.3 SWAP study data

Only Waitaki and Kaikoura Districts completed SWAP studies in 2007/08. However, Kaikoura did not report a complete set of values (percentages added up to 79%) so their SWAP data could not be used for this analysis.

The SWAP study categories reported do not exactly match the categories used in the IPCC guidelines method. Table 8.1 compares the categories used in this report to those used in the IPCCC method.

Table 8.3 Comparison of IPCC guideline categories with New Zealand SWAP study categories

IPCC Guideline Category	SWAP Study Category
Paper	Paper and cardboard
Textiles	Rubber and textiles
Garden waste, park waste and other non-food putrescibles	Green waste
Food waste	Food waste
Wood or straw	Wood and timber

8.3.4 CH_4 estimates

These calculations only account for methane generated in operating landfills, they do not account for emissions from cleanfills where wood or organic material is disposed of. This may underestimate the amount of methane produced in Canterbury by landfilled/ buried waste. Methane generated from closed landfills is considered emitted in the year the waste was deposited. For example, methane currently being generated by the closed Burwood landfill, in Christchurch, is considered emitted in the years the landfill was open and accepting waste. .

8.4 Estimated emissions calculations for Canterbury

The calculations are for estimate 1 2007/08 emissions. Table 8.4 shows a full set of calculated values for all estimates. Unrounded figures have been used in all calculations, although this document shows rounded figures, so some differences due to rounding may be observed.

8.4.1 Calculation of DOC

$$DOC = (0.4 \times (0.065 + 0.162)) + (0.17 \times 0.087) + (0.15 \times 0.118) + (0.3 \times 0.074)$$
$$DOC = 0.1451$$

8.4.2 Calculation of L_0

L_0 = 1.0 x 0.1451 x 0.5 x 0.5 x (16/12)
L_0 = 0.0484 $GgCH_4/Gg$ waste

8.4.3 Calculation of CH_4 emissions

CH_4 emission = [(350.85$Gg_{(waste)}$ x 1 x 0.0484$GgCH_4/Gg_{(waste)}$) – 0 $GgCH_4/y$] x (1 – 0.1)
CH_4 emission = 15.28Gg/y

Table 8.4 Three estimates of GHG emissions from Canterbury's landfills

	Regional emissions estimates based on SWAP data from different districts		
	Estimate 1	**Estimate 2**	**Estimate 3**
DOC	0.1451	0.1745	0.1727
L_0 (Gg/y)	0.0484	0.0582	0.0576
Emissions ($GgCH_4$/y) 2002/03	13.39	16.10	15.93
Emissions ($GgCH_4$/y) 2003/04	15.19	18.27	18.07
Emissions ($GgCH_4$/y) 2004/05	16.08	19.34	19.14
Emissions ($GgCH_4$/y) 2005/06	16.67	20.05	19.84
Emissions ($GgCH_4$/y) 2006/07	15.42	18.54	18.34
Emissions ($GgCH_4$/y) 2007/08	15.28	18.37	18.18

Note: emissions are shown in gigagrams (1000 tonnes) of methane (CH_4) per year

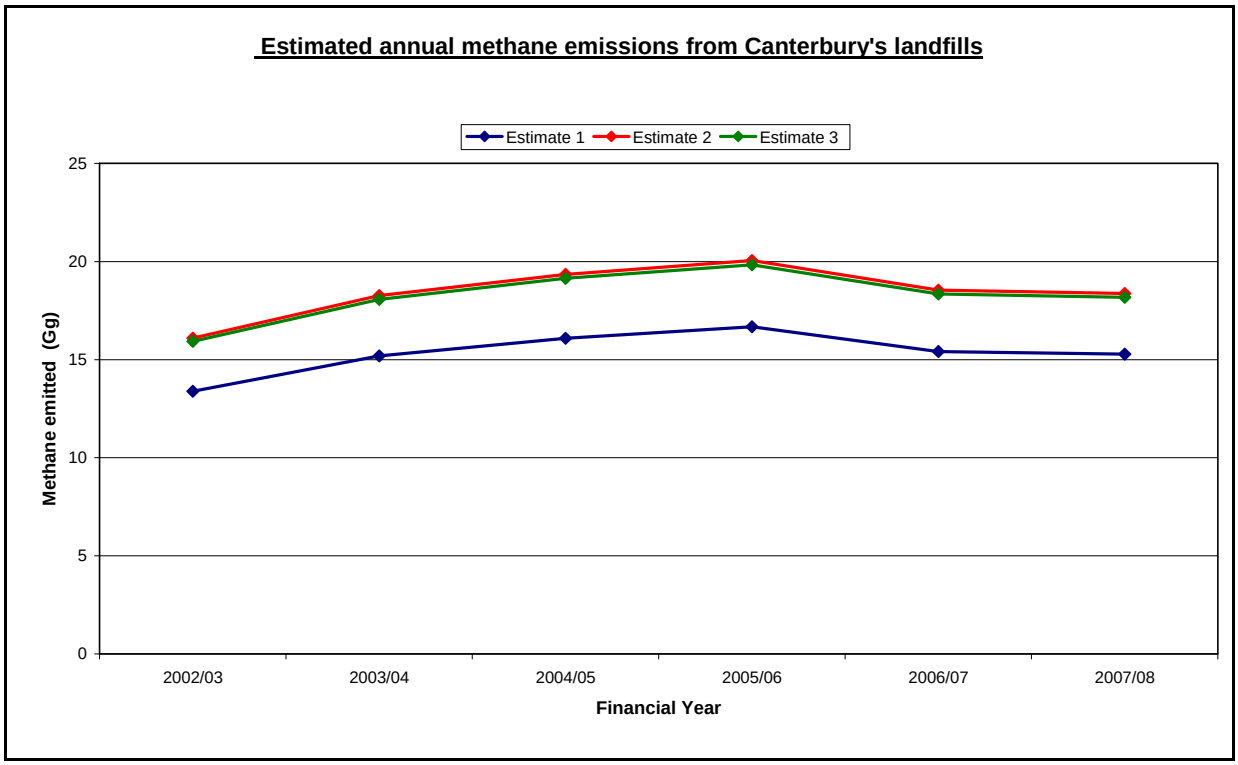

Figure 8-1 Trends in GHG emissions from Canterbury's landfills

Figure 8.1 shows the estimated amount of methane generated by landfills in Canterbury between 2002/03 and 2007/08. All three regional GHG emission estimates show the same trend. Emissions gradually increased between 2002/03 and 2004/05, when they peaked, then decreased in 2006/07 and levelled out between 2006/07 and 2007/08.

Figure 8.2 compares GHG emission trends to landfilled waste.

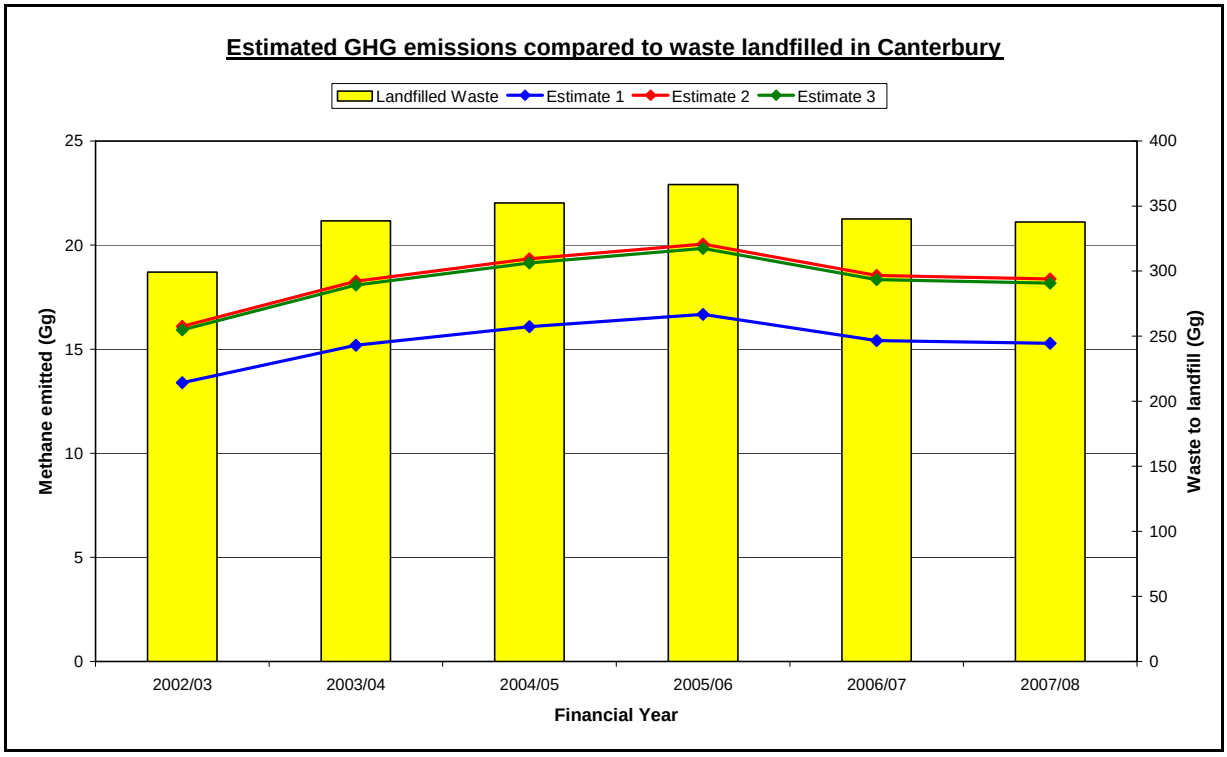

Figure 8-2 Estimated GHG emissions compared to the amount of waste landfilled in Canterbury

The trend in GHG emissions is the same as the trend for waste to landfill. This is expected because the major factors in the calculation of GHG emissions are the amount of waste to landfill and the DOC value, which is based on SWAP data. Due to limited SWAP data the DOC value for each estimate has been kept constant for all years; hence the changes in GHG emission reflect change in the amount of waste landfilled.

8.5 Reduction potential

Canterbury could reduce its landfill GHG emissions by either reducing the amount of methane producing material going to landfill and/or capturing methane emitted from landfills. This section estimates the impact both these methods could have on Canterbury's methane emissions from landfills.

The amounts shown are based on Estimate 1, 2007/08 emission amounts.

Table 8.5 Estimated GHG reductions if landfill gas is captured

% Methane Recovered	Estimated amount of methane recovered (Gg)	Estimated regional methane emissions (Gg)
0%	0.00	15.28
5%	0.85	14.51
10%	1.70	13.75
25%	4.24	11.46
50%	8.49	7.64
75%	12.73	3.82
100%	16.97	0.00

Figure 8.5 shows the amount (Gg) of methane recovered and the amount emitted if a percentage of methane were recovered. The amount recovered if 100% of the gas is recovered is greater than the amount emitted if 0% is recovered because of oxidation; factor OX in Equation 1.

Table 8.6 Reduction in estimated regional methane emissions from landfill if the amount of degradable organic material is reduced

Degradable organic material (% of 2007/08 levels)	Total waste to landfill (Gg)	Methane generation potential (L_0)	Estimated regional emissions (Gg)
100%	351	0.0484	15.28
75%	307	0.0415	11.46
50%	262	0.0324	7.64
25%	218	0.0195	3.82
0%	174	0.0000	0.00

Table 8.6 shows the reduction in methane emissions if the amount of degradable organic material (DOM) going to landfill was reduced. For instance if the amount of degradable organic material was halved, regional emissions would be 7.64 Gg or half the 2007/08 estimated level. To affect methane emissions the amount of food, wood, textile, paper and greenwaste in landfilled waste must be reduced. Reduction of plastics, glass or rubble will not affect emissions as these waste streams do not produce methane when they breakdown.

Gas capture and reducing methane generating waste streams have a similar effect on emissions, but preventing DOM going to landfill is probably the more practical way to reduce emissions. Although there have been few studies on landfill gas capture rates it is generally considered unfeasible to capture all gas from a landfill with current technology [14]. Dutch field studies of landfill gas capture suggest instantaneous capture rates are10-55% with an average of 25% [14]. Studies from the United States suggest landfill lifetime gas capture rates are about 19% [14]. Gas capture systems also require significant capital investment and may not be cost effective at all landfills. A feasibility study by

Waitaki District Council found its landfills were too small to make gas capture economic. However, methane generating wastes such as paper, food and wood can be diverted from landfill in a number of ways, some of which require little capital investment. Therefore, preventing methane generating waste going to landfill is preferable to landfilling DOM and later trying to capture the gas generated by it.

8.6 Cost of emissions

The Kyoto Protocol set binding emissions targets for 37 industrialised nations including New Zealand. Countries meet their targets mainly though national measures, but the protocol also contains three market-based mechanisms for achieving targets:

- Emissions trading
- Clean development
- Joint implementation

Clean development and joint implementation projects allow signatory countries to off set their emissions by partnering with developing countries to implement emissions reduction, or GHG sequestration projects.

Emissions trading allows people to trade credits, gained for GHG sequestration and reduction projects, as commodities. This method has been proposed for New Zealand to allow people trade carbon credits within New Zealand and internationally. Carbon credits use CO_2 as the base unit of measure; other GHGs are converted to their CO_2 equivalent or global warming potential (GWP). Table 8.7 shows the GWP of the six Kyoto Protocol gases.

Table 8.7 Global warming potential (GWP) in CO_2 equivalents of Kyoto Protocol gases [15]

Gas	Atmospheric life (years)	GWP over 20 years	GWP over 100 years	GWP over 500 years
Carbon dioxide	1.2 – 179 (64)	1	1	1
Methane	12	72	25	7.6
Nitrous oxide	114	289	298	153
HFC	1.4 -270 (62)	273 - 12 000 (3704)	777 - 14 800 (2650)	24 -12 200 (1512)
PFC	1000 – 50 000 (9588)	5210 – 8630 (6550)	7390 - 12 200 (9193)	11 200 – 18 200 (13150)
Sulphur hexafluoride	3200	16 300	22 800	32 600

Note: Mean in brackets where more than one value reported. Value for methane highlighted.

International calculations typically use the GWP over 100 years (highlighted) to convert other GHG gases to CO_2, this has been done in these calculations. The 100 year GWP for methane is 25 so each tonne of methane is equivalent to 25 tonnes of CO_2.

8.6.1 Price of carbon credits

Carbon credits are traded as a commodity so their price fluctuates like currency rates. Some carbon credits are already traded in New Zealand, but there is currently no legal requirement to off set carbon emissions. Five carbon credit prices have been used in this analysis, two from New Zealand, two from the European market and one from the United States. Carbon credit values are from the following sources:

- The two New Zealand prices were from carbon credits currently (20/1/09) being sold on the TradeMe[viii] auction website. The asking prices were \$NZ20/t CO_2 and \$NZ18/t CO_2.
- The European prices were taken from different sources. The first from the ICIS Heren sample daily report showing data for 19 August 2008[ix]. The daily settlement price was €23.74/tonne CO_2 or \$NZ57[x]. The second is €13.69/tCO_2 or \$NZ 33[x] from the European Climate Exchange, this is the average December value for volumes of certified emissions reductions from the December 2008 monthly report[xi].
- The US value is for a Standard Carbon Unit, which are traded on the Chicago Climate Exchange and audited by the National Association of Securities Dealers (NASD). Each unit is currently (20/1/09) being sold for \$US15/ tonne or \$NZ27[xii] [xiii].

Table 8.8 shows the cost (\$NZ millions) of purchasing carbon credits to off set methane emissions of 1-25 Gg of methane and for the estimated amount of methane produced from Canterbury's landfills (highlighted).

Table 8.8 Potential cost in (\$NZ millions) of methane emissions from Canterbury's landfills

Methane emissions	Equivalent CO_2 emissions	Total cost \$NZ million based on different average prices		
Gg	t	Average (\$NZ31)	New Zealand average (\$NZ19)	International average (\$NZ 39)
1	25000	\$0.78M	\$0.48M	\$0.98M
10	250000	\$7.75M	\$4.75M	\$9.75M
15	375000	\$11.63M	\$7.13M	\$14.63M
20	500000	\$15.50M	\$9.50M	\$19.50M
25	625000	\$19.38M	\$11.88M	\$24.38M
15.28	381919	\$11.84M	\$7.26M	\$14.89M

The cost of methane emissions from Canterbury's landfills is shown based on Estimate 1, 2007/08 values. The cost of purchasing carbon credits has been estimated using three different prices: the average of the five prices listed, the average New Zealand price and the average international price.

[viii] http://www.trademe.co.nz/Business-farming-industry/Carbon-credits/
[ix] ICIS Heren European daily carbon market, daily report EDCM 3.161 19 August 2008; Published by ICIS Heren www.icis.com/heren daily settlement price. ICIS Heren is a UK based company that published information on commodity markets, including the EU emissions trading scheme market.
[x] December 2008 monthly midrate exchange rate of €0.4146 = \$NZ1, http://www.rbnz.govt.nz/statistics/exandint/B1/data.html
[xi] European climate exchange ICE futures Europe European climate exchange monthly report December 2008. http://www.ecxeurope.com/uploads/documents/ECXMonthlyReport-December2008.pdf
[xii] December 2008 monthly midrate exchange rate of \$US 0.5569 = \$NZ1 http://www.rbnz.govt.nz/statistics/exandint/B1/data.html
[xiii] http://www.standardcarbon.com/ecatalog/index.php?main_page=product_info&products_id=1

Off setting Canterbury's landfill methane emissions is estimated to cost $NZ 7.26million per year if New Zealand or cheaper carbon credits were purchased. However, MfE predicts a shortfall in New Zealand carbon credits; requiring GHG generators to purchase credits from other countries. Offsetting the same emissions with only international credits is estimated to cost NZ$14.89million. The average cost of credits from all sources analysed is NZ$31/t CO_2 at this price Canterbury's landfill emissions would cost $11.84million per year at 2007/08 waste levels.

In this analysis international carbon credits are about twice the price of New Zealand carbon credits; this is mainly due to the current exchange rate between the Euro or US dollar and the New Zealand dollar. Higher prices for carbon credits on the European market may be due to demand in Europe to off set emissions from industry and thermal power generation. It is important to note that this analysis does not cover all available credits and cheaper New Zealand or international credits may become available. This also does not account for activities on landfill sites, such as forestry, being used to off set emissions.

One way to prevent future costs of methane emissions from landfills, is to prevent food, greenwaste, paper, cardboard, wood and fabrics going to landfill. If 50% of the degradable organic material currently being landfilled was diverted, future methane emissions could be reduced by 7.64Gg equating to a regional saving of between $3.6 and 7.4million per year.

9 Conclusion

So what does our waste say about us? That we are wasteful for each throwing out the equivalent of 845kg of material a year (excluding cleanfill)? Resourceful for diverting 26% of this to other uses? Or maybe with 1.3 billion tonnes of material landfilled or cleanfilled in 2007/08 we just have a passion for burying things.

Both the mean amount of total measured waste per person, and mean amount of residual waste per person peaked in 2005/06 and have decreased each year since. While the amount of diversion peaked a year later in 2006/07 then decreased slightly in 2007/08. However, there is a lot of variation between districts, both in the amount of waste disposed of and whether those amounts are increasing or decreasing. The one waste stream that has constantly increased is reuse, with more material exchanged through the waste exchanges and sold at reuse stores each year.

The slight decrease in diversion between 2006/07 and 2007/08 reflects an overall decrease in waste rather than more divertible material being landfilled. Despite diversion amounts decreasing the proportion of total measured waste diverted increased each year until 2006/07, and remained steady in 2007/08 at 26%.

While overall diversion was 26% in 2007/08, 52% of material from kerbside collections was diverted. The higher kerbside diversion rate shows we divert more recyclable and organic material when it's easy to do so. This does not mean that sophisticated kerbside collections are the only way to increase diversion, rather increasing awareness and access to non-kerbside diversion services could increase overall diversion. Improving and developing non-kerbside diversion services may be particularly important for Canterbury as most districts receive less than 25% of their residual waste from kerbside collections.

The introduction of the waste levy could help territorial authorities to improve diversion rates. Not only will the levy provide a small financial incentive to divert waste from landfill, it will also provide funding to develop facilities, improve access and encourage the use of services. Denmark has been operating under a similar waste levy system for a number of years, and they are diverting 70% of their waste.

A second incentive to decrease landfilled waste is to prevent future greenhouse gas emissions from landfills. Degradable organic material in residual waste, such as wood, textiles, food and greenwaste, breaks down in landfills producing methane, a greenhouse gas. If we halved the amount of degradable organic material landfilled, we could prevent 7.6Gg of methane being emitted from landfills. If carbon credits had to be purchased to off set emissions this reduction would equate to a regional saving of between $NZ3.6million and $NZ7.4million per year. Halving the amount of degradable organic material in residual waste would also mean about 25% less waste would be landfilled, saving a further $885 000 (approximately) per year in waste levies regionally.

Our data shows we have developed a strong tendency to bury what we no longer want or value. But via the waste levy and potential carbon credit costs we have both the opportunity and incentives to change our waste habits from mainly burying material to mainly diverting it to a better use.

10 Further investigations and monitoring

Environment Canterbury recognises the value of collecting and analysing regional waste data. Addendums to this report will be published in the 2009/10 and 2010/11 financial years; the next technical report will be published in the 2011/12 financial year. The following recommendations for future work may be undertaken in the next technical report an additional focus report. These recommendations include:

- Standardising the way kerbside collected waste is measured and reported. Including reporting the number of people, businesses and/or households that have access to the collection.
- Investigating good economic indicators for Canterbury's waste, and comparing trends in waste amounts to economic trends.
- Investigating why Timaru, Christchurch and Waitaki have much higher residual waste amounts per person than other districts.
- Investigating how households dispose of their waste across the region; that is investigating use of kerbside collections, reuse stores, RRP, cleanfill and farm dumps.
- A review of disposal options in different districts and how disposal methods differ between predominantly urban and predominantly rural areas.
- Continuing to investigate commercial recycling amounts, and investigating the level of access to commercial recycling services
- Gathering more information on the true amount of cleanfill disposed of in Canterbury.
- Monitoring the effect of the waste levy
- Updating potential greenhouse gas emissions, and activities to reduce emissions

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