Wellington “waste catchment” trial: An investigation into a new model for waste monitoring

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1 Introduction

The New Zealand Waste Strategy (NZWS) was launched by the New Zealand Government in March 2002. The document established new strategies for minimising waste as well as means for improving waste recovery and management. At the strategic level, the document contains both core principles and a vision for the future; at the practical level, thirty national targets for priority waste areas are set. The Strategy states, with regards to the national targets: *"Setting targets requires good information to ensure they are realistic and to measure progress. Current information is poor, and we have no consistent, reliable information about waste flows."*

The national targets set were reviewed by Ministry for the Environment (MfE) in 2004, with the review finding that *"an effective and cost-efficient monitoring and reporting system is essential for measuring progress in implementing the NZWS and achieving the targets"*.

As well as measuring progress towards the national targets, a reliable waste monitoring and reporting system would provide useful information to assist local authorities and the waste industry with waste minimisation and waste management planning. It would also assist central government with its reporting obligations, including those to the Organisation for Economic Cooperation and Development, the Basel Convention, the Stockholm Convention, the Kyoto Protocol, and the New Zealand Packaging Accord.

In November 2005, MfE commissioned Waste Not Consulting to undertake research as part of the process of developing a framework for ongoing waste monitoring and reporting at the national level. The project was established with two objectives:

1. The compilation and analysis of all relevant existing data on waste composition and the quantity of waste being disposed of to landfills and cleanfills.
2. Development of recommendations for an ongoing monitoring programme for waste to landfill, cleanfill, and construction and demolition (C&D) waste landfill.

The resulting recommendations[1] included many that were based on the concept of monitoring "indicator waste catchments". The concept of a waste "catchment" is based on the hydrological model of a "watershed". A waste "catchment" is a geographical area within which all of the waste that is generated is also disposed of, and within which little or no waste from outside the area is disposed of. The concept of "indicator waste catchments" was developed in response to the inherent inaccuracies in monitoring waste at either the national level or the individual facility level.

In response to these recommendations, MfE has commissioned Waste Not Consulting to further the development of the "catchment" model with the research contained in this report. The primary objectives of the research are to:

- test whether "waste catchments" can be used to measure the flow of waste within geographic areas and across geographic boundaries
- assess the feasibility of using the "waste catchment" concept to monitor waste composition nationally
- determine the appropriateness of the Wellington region as an indicator catchment.

[1] Waste Not Consulting (2005) Waste Composition and Construction Waste Data, prepared for Ministry for the Environment, Wellington

Subsequent to the initiation of the research, a secondary objective of determining the effect of pricing on waste flows was included in the project.

The principle means for accomplishing the objectives would be to collate and analyse the weighbridge information for the past three years from the following landfills:

- Northern landfill (owned by Wellington City Council)
- Otaihanga landfill (owned by Kapiti Coast District Council)
- Silverstream landfill (owned by Hutt City Council)
- Southern landfill (owned by Wellington City Council)
- Spicer landfill (owned by Porirua City Council)
- Wainuiomata landfill (owned by Hutt City Council)

The weighbridge data would, if possible, be split into the following categories:

- Domestic kerbside – council and commercial collections
- General – if possible this would be split into domestic and commercial waste
- Special wastes.

From the data, any changes in quantities of each of the above categories and associated patterns, such as changes in flow from one facility to another or "leakage" to a facility outside the catchment, would be identified.

In addition, MfE would coordinate a source survey with the local government landfill operators. The source survey would be carried out at eight landfills and transfer stations in the catchment and surrounding districts. The data from these surveys would provide information on the geographic source of waste and whether the waste was of domestic or commercial origin. This information would contribute to the dataset used to determine the validity of the Wellington region as a suitable indicator waste catchment.

The report is structured as follows:

- Section 1.1, adapted from Waste Not Consulting's 2005 "Waste Composition and Construction Waste Data" report to MfE, provides a context for the current research by outlining the development of waste data collection in New Zealand.
- Section 1.2 introduces the concept of the waste "catchment" model, and examines the pros and cons of monitoring waste at different levels
- Section 2 outlines the geography of the Wellington waste catchment
- Section 3 describes the waste disposal facilities in the catchment
- Section 4 analyses data from the six landfills in the Wellington catchment for the period 2003–2005
- Section 5 analyses data collected by the MfE source surveys at four landfills
- Section 6 examines the effect of pricing on waste flows, using data provided for the primary research by the landfills in the catchment and the results of the MfE source surveys
- Section 7 assesses the results of the research and relates the results to the feasibility of using the waste catchment model for long-term waste monitoring in New Zealand.

1.1 New Zealand waste data

The development of waste data collection in New Zealand has run parallel to the development of waste management strategies and technologies. In the period prior to the 1970s, when landfills were unregulated and the objective of waste management was to protect public health, there were virtually no data gathered on waste, and none was likely to have been compiled at the national level.

With the introduction of sanitary landfills and improved waste management processes, central government set about compiling the information necessary to better understand refuse disposal in New Zealand. One of the earliest investigations was the 1971 national survey of refuse tips. This was followed by similar surveys of landfills in 1995, 1998, and 2002. These surveys were primarily aimed at assessing the technologies of the landfills to better understand the environmental effects of waste disposal. As refuse tips became more controlled, and weighbridges became more common, tonnage figures were gathered and aggregated, giving the first estimates of the quantity of waste being landfilled in New Zealand.

The most recent estimates of the tonnage of refuse landfilled in New Zealand are based on the MfE 2002 landfill audit and survey. While the estimates made for that report are more accurate than those made previously, a significant proportion of landfills were still relying on volume-based information for their data. This situation is improving as small, substandard landfills are closed, the remaining landfills become larger and more centralised, and weighbridges become standard operational equipment.

The gathering of qualitative and quantitative waste data by local authorities is improving, driven by statutory obligations under the Local Government Act 1996 and the targets for reporting set by Central Government's 2002 New Zealand Waste Strategy. There is, however, at present no coordinated national strategy for compiling and analysing waste composition data that are collected by local authorities.

The current state of knowledge about disposal of waste materials to cleanfills in New Zealand is comparable to that about landfills in the 1960s. There is no national census of cleanfills and few estimates of tonnages have been made, even at a local level. For the most part, local authorities cannot identify all cleanfill sites within their jurisdiction as most councils do not require resource consents for cleanfills. There is virtually no information publicly available on the composition of waste material being disposed of to cleanfill.

The composition of waste was investigated on a sporadic basis by various local authorities in the 1980s using a variety of methodologies. The results were not necessarily comparable. This situation was greatly improved by the introduction in 1992 of the MfE's Waste Analysis Protocol (WAP), a standardised methodology for measuring waste composition using a standardised classification system.

The WAP was most effectively put to use in a nationwide waste composition survey undertaken with MfE funding in the early 1990s. The results of these surveys were combined with the 1995 landfill census to produce the solid waste information presented in MfE's 1997 National Waste Data Report.

The use of the WAP for waste composition surveys by local authorities subsequent to this time was not widespread, with the 1997 Auckland region waste survey being the

significant exception. For the most part, councils had no pressing need for the data, and the procedure was relatively expensive, given the precision and accuracy of the results produced. The absence of experienced waste surveyors, particularly in provincial areas, was another disincentive to studying waste composition.

In 2002, MfE updated the WAP, which became the Solid Waste Analysis Protocol (SWAP). In the same year, MfE instituted the SWAP Baseline Programme to provide solid waste composition information from four indicator sites around New Zealand. The objective of the Baseline Programme was to establish generic waste composition data for a range of sites that could be used as the basis for indicative waste composition data by any local authority.

The results of the Baseline Programme surveys, and a range of other surveys of various waste streams, are available on the MfE website. The results of the Baseline Programme are presented in the form of waste composition data on spreadsheets which can be manipulated by the user to calculate waste stream composition based on a number of variables. After the two-year Baseline Programme concluded in 2004, MfE undertook the assessment of its waste monitoring programmes that has resulted in the current research.

1.2 Rationale for the "catchment model" for waste data monitoring

This section, adapted from Waste Not Consulting's 2005 "Waste Composition and Construction Waste Data" report to MfE, examines the pros and cons of the different possible scales at which waste monitoring can take place. This information is provided as an introduction to monitoring "waste catchments" and contains the basis for the recommendations that have resulted in MfE's further investigations into the concept.

One of the most important aspects of designing an ongoing waste monitoring programme is resolving the issue of scale. In New Zealand, waste data have historically been gathered on several levels, ranging from specific waste streams entering individual disposal facilities to national landfill tonnages. A comprehensive national monitoring programme, such as that needed to fulfil the monitoring requirement of MfE, requires data gathering at several levels. The uses, advantages, and disadvantages of waste data gathering at different levels are discussed in the following sections.

1.2.1 National level data

Currently, MfE endeavours to identify and monitor national trends in waste disposal by using estimates of national tonnages, based on landfill surveys, and on waste composition, based on SWAP surveys.

Landfill surveys have been completed by MfE in 1995, 1998, and 2002. The primary purpose of these surveys has been to identify trends in specific aspects of the design and operation of all landfills operating throughout the country. The surveys also gathered information on quantities of waste to landfill. As a high proportion of waste entering landfills is now weighed, the surveys provide a reliable, cost-efficient means of tracking landfill tonnages.

To ensure the accuracy of the landfill tonnage data, a consistent protocol must be used with regards to the inclusion or exclusion of cover material. Landfills account for cover

material in different ways, and these differences can substantially alter the relevance of the data gathered. No such protocol was used in the landfill survey undertaken in 2002.[2]

The SWAP Baseline Programme was initiated to provide national waste composition data by repeated surveying at individual disposal facilities. The Programme involved quarterly waste surveys at four disposal facilities over a two-year period. An estimate of national waste composition was generated by averaging the results from the four facilities.

The "snapshots" produced by the SWAP Baseline Programme can be aggregated to produce a reasonably accurate composition of waste in New Zealand. Developing national composition data using such a programme requires considerable resources and a high degree of central coordination to maximise the accuracy. The snapshots, however, taken out of context, are limited in their ability to monitor trends over time by the limitations inherent in surveying individual disposal facilities, as outlined in Section 1.2.3.

The usefulness of the SWAP Baseline Programme data for estimating national waste composition has been limited to being a series of "snapshots in time" by:

- the reliability of some of the survey methodologies, which were contracted to four different contractors
- the inconsistent use by the contractors of secondary categories that could have enabled the quantification of particular waste streams relevant to NZWS targets, such as green waste, or C&D materials
- inconsistent classification by the contractors of waste sources, such as "general wastes", "domestic collections", and "special waste loads"
- lack of reported information from the contractors about the source of waste to landfill.

1.2.2 Regional level data

Surveying of waste disposal within local government boundaries has been undertaken by a limited number of local authorities. Some of the known regional studies are:

- The Auckland Regional Waste Stream Report 1995 involved WAP surveys at all major disposal facilities in the Auckland region. The study was undertaken jointly by the regional and local councils with funding assistance from the Sustainable Management Fund.
- Rodney District Council has twice contracted Waste Not Consulting (in 2001 and 2005) to undertake SWAP surveys and gather data to estimate the quantity and composition of solid waste to landfill generated within the district.
- Christchurch City Council conducted rotating SWAP surveys at all waste disposal facilities within its boundaries in 2003–2004.

The principal problem with regional surveys as a long-term monitoring tool is the trans-boundary movement of waste. Over time, waste from outside a region may "migrate" into local disposal facilities, or waste generated within the region may be disposed of outside of the region.

Such trans-boundary movement of waste has, for example, significantly changed waste flows within the Auckland region in recent years. Thames Coromandel District and Whangarei waste streams have been transported into the region, and recently the opening of a new landfill in Waikato has seen significant quantities of waste being transported out of the Auckland region into the Waikato facility. Without constant monitoring of such

[2] Jennie Franke, MfE, 2006, personal communication

changes, time series of data taken from an individual city, district, or region are of limited usefulness, particularly for monitoring the effects of government policy on waste minimisation.

Gaining the cooperation of all private waste operators in providing tonnages and the geographical source of waste is an issue in regional level surveys. While many operators willingly give their full cooperation, some are reluctant to disclose what they consider "commercially sensitive" information, such as tonnages, that may be perceived as being of value to their competitors.

1.2.3 Facility level data

The surveying of individual waste disposal facilities is the most common level of surveying undertaken in New Zealand and was the basis for the SWAP Baseline Programme. The major disadvantage of monitoring individual facilities is the need for contextualisation of the data to understand the wider system within which the facility operates. Without knowing detailed information about the waste flows entering a facility, and how they change over time, little information can be gained regarding the effectiveness of government policy in reducing waste over time.

The waste that enters an individual facility is generally only a subset of the waste generated within the surrounding community. Waste collection and disposal, in both the commercial and council sectors, are based on limited-term contracts, and a change in contractor may result in waste flows being diverted from one facility to another. These commercially-driven changes in waste flows complicate the interpretation of facility level waste data.

Significant changes in waste flows can also occur when a new disposal facility is opened in the same community. This occurred recently in west Auckland, where an existing transfer station experienced a significant decrease in waste volume. The transfer station had undertaken SWAP surveys annually for a seven-year period, and the time-series of data that had been built up was compromised by the significant change in waste flows that occurred when the new facility opened.

1.2.4 "Catchment" level data

The concept of a waste "catchment" is based on the hydrological model of a "watershed". While not used frequently in New Zealand, the idea of a "wasteshed" is used in many areas of the USA and is defined in Oregon law as being "*an area of the state that shares a common solid waste disposal system, or an appropriate area in which to develop a common recycling system*"[3].

Waste flows are subject to forces analogous to those which define watersheds. In the same way that surface water flows downwards towards a common outlet to the ocean, so does waste tend to flow towards common "sinks", which may be transfer stations or landfills. These flows tend to be defined by economics, with waste generally being transported to the most economic disposal facility, which is generally the closest facility. "Closest" may be determined in terms of either geographical distance or, in a major metropolitan centre, travel time. In areas with competing disposal facilities in relatively close geographical proximity, differences in gate charges can over-ride transport costs, resulting in waste being transported to the less expensive facility.

[3] www.deq.state.or.us/wmc/solwaste/countycontact.html

Waste catchments will vary greatly in scale. A small rural catchment may involve no more than a single landfill. In a larger catchment, several transfer stations may feed into a single landfill. In large metropolitan areas with more than one landfill, waste flows are influenced by ownership of each landfill, but, as a whole, the multiple landfills may still comprise a distinct catchment area.

In New Zealand, waste catchments may be defined by geographical features to a greater extent than in other countries. Landfills are generally situated for their proximity to population centres, and in New Zealand these are often separated by topographical features, such as major ranges of hills, which would serve to discourage waste transport.

While watersheds can be accurately delineated, waste catchments are likely to be somewhat "fuzzy" around the boundaries, with border areas from which waste is regularly transported in different directions. As long as the "fuzzy" areas are of a relatively small size, this lack of definition will not significantly affect the overall results.

The principal advantages to monitoring at the catchment level are seen as being:

1) The ability to consistently capture data on all waste disposal within the catchment area, and not have the data subject to the changes in waste flows which reduce the reliability of facility-level study. These data can be extrapolated up to the national level, and monitored in a consistent manner to establish trends.

2) The opportunity to monitor on a scale which can be adequately resourced over the long-term. While New Zealand as a whole represents a single waste catchment, it would require substantial resources to gather the necessary detailed waste data from throughout the country.

3) The option of conducting in-depth investigations into particular elements of the waste stream that are of interest. By understanding the full picture of waste disposal within a catchment, surveys of specific materials within specific waste streams can be extrapolated more accurately. More precise data from SWAP surveys on specific waste materials is also possible by focussing the surveying on specific waste streams. For example, a material such as plastic pallet wrap could usefully be investigated by conducting a SWAP survey that includes solely commercial waste and uses specific secondary categories. The results of such a survey would be more precise than a more general SWAP survey and could be accurately extrapolated up to the overall waste stream by using the detailed information on waste sources that would be available.

4) An ability to contextualise the information by working long-term with a small number of council officers and facility operators.

1.2.4.1 Identification of "indicator waste catchments"

The 2005 Waste Not Consulting report recommended that MfE identify several "indicator catchments" that would serve as the basis for a significant portion of an ongoing waste monitoring programme in the same way that the biological sciences use indicator organisms to assess the health of ecosystems. It was suggested that it could be cost-effective and produce reliable results if MfE was to concentrate its resources on a limited number of indicator waste catchments.

The SWAP Baseline Programme was based on "indicator" facilities, with the results of the SWAP surveys being made publicly available on the basis that they were considered

representative of other facilities. The establishment of indicator catchments is a development of this concept to a more holistic level that takes into account the limitations of the facility level research.

Appropriately-selected indicator waste catchments could be treated as a microcosm of the country as a whole and be studied in-depth over time. Problematic issues, such as the quantification of cleanfill disposal, can be addressed and studied more readily at the catchment level and those results extrapolated to a national level. Specific waste streams, such as packaging in commercial waste, can be investigated with purpose-designed SWAP surveys, the results of which can be integrated with other existing data on the catchments.

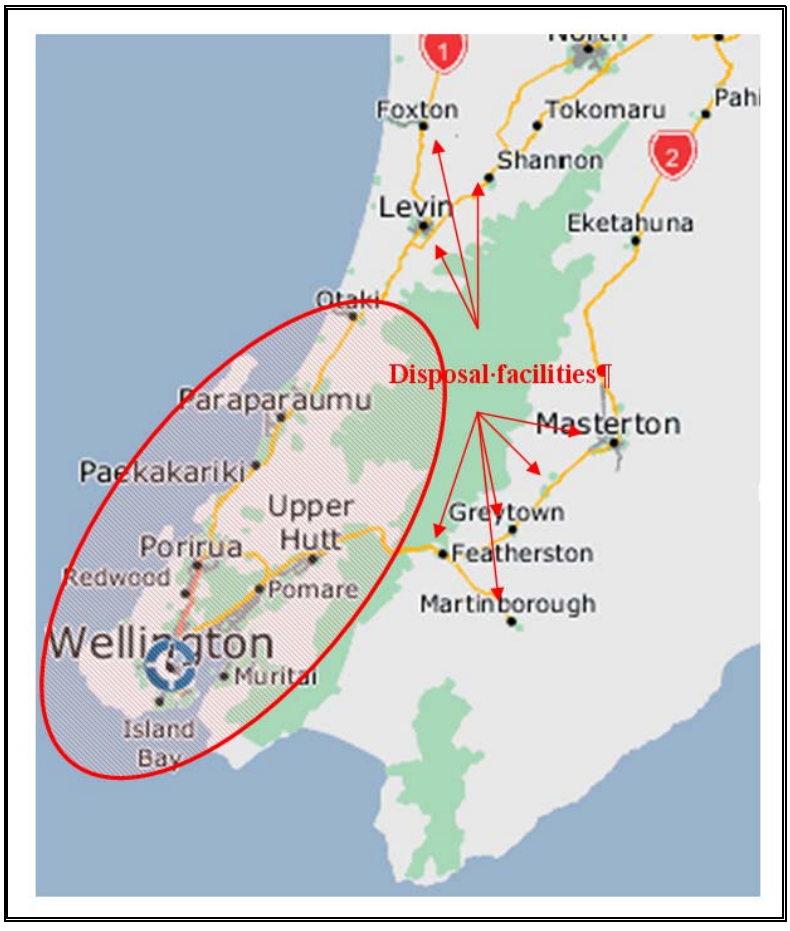
Indicator waste catchments would ideally have the following attributes:

- identifiable waste flows that are contained within a discrete area
- little "leakage" into or from surrounding catchments (i.e. movement of waste in or out of the catchment)
- cooperative local authorities within the catchment with a commitment to long-term waste monitoring
- cooperative disposal facility operators
- adequate record-keeping by the disposal facility operators
- compatible systems of record keeping
- a functional scale i.e. the number of disposal facilities being suitable for the resourcing available for monitoring.

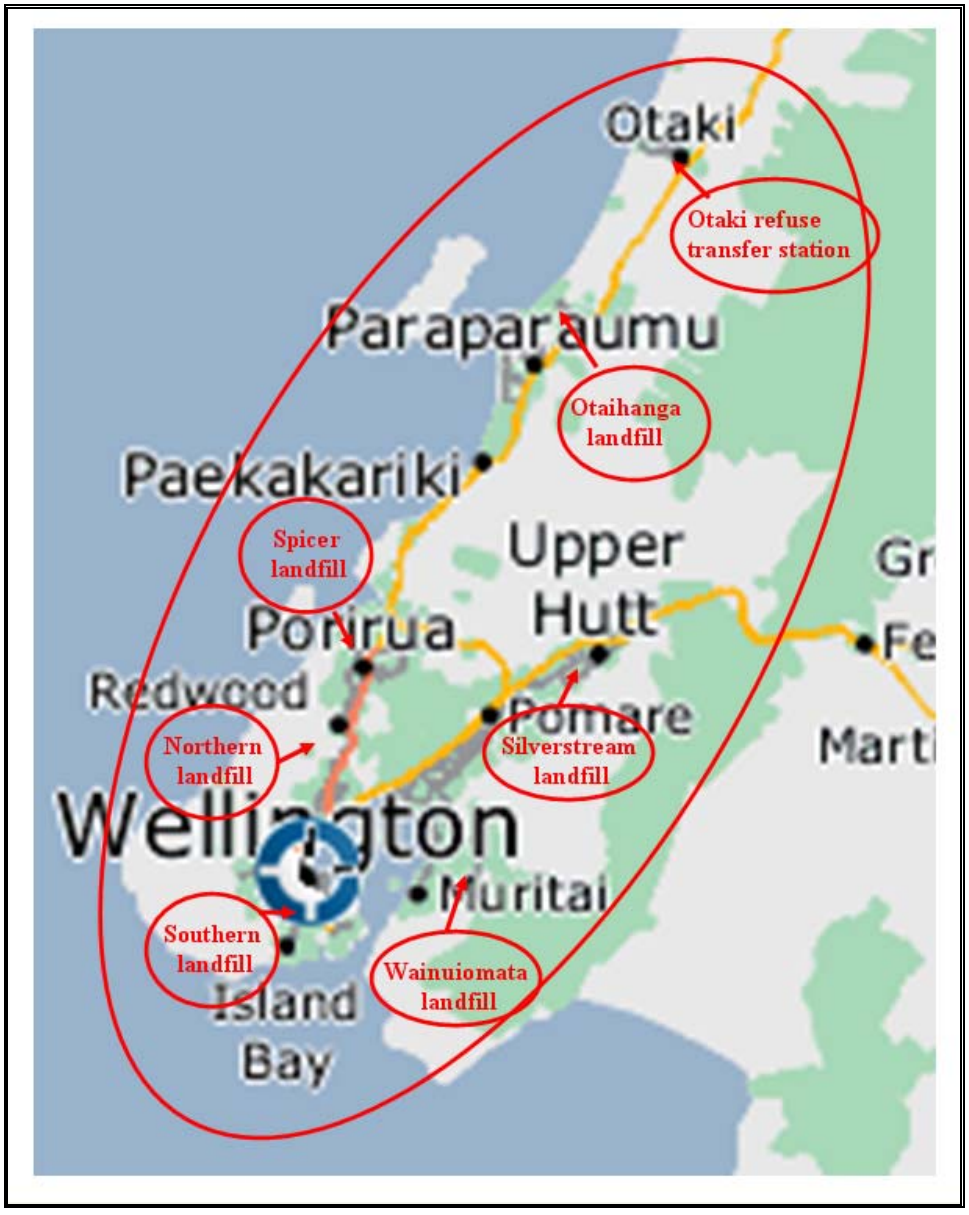
2 Identifying the Wellington waste catchment

The Wellington region was identified by MfE as being suitable for investigating the concept of monitoring waste catchments. The primary factor for its suitability is the topography of the region. The Wellington catchment, encompassing Wellington City, Upper and Lower Hutt, Porirua City, and the Kapiti Coast, is bounded by the sea on two sides and isolated from surrounding districts by the Rimutaka Range. A single highway connects the catchment to the Wairarapa district. The coastal margin on the northern end of the Kapiti Coast, which connects it to the Horowhenua District, is relatively lightly populated.

The map below outlines what was assumed to be the Wellington waste catchment. The map shows the waste disposal facilities in the adjoining Wairarapa and Horowhenua districts. It can be seen from the map that for there to be any waste "leakage" to or from the Wairarapa district, it would need to be transported across the steep and rugged Rimutaka Ranges. Given the distribution of disposal facilities in the Wairarapa and the travel time across the Rimutakas, it was considered unlikely that significant quantities of waste move between the areas. Waste "leakage" in or out of the catchment in the coastal margin between Otaki and Levin was considered likely, but given the low population and industrial base in the area, the quantities involved were not considered likely to be significant in comparison to the overall waste flows within the catchment.



A more detailed map of the Wellington waste catchment is shown below, with all of the waste disposal facilities shown. The population in the region, due to the topography, is clustered into urban areas focused on Wellington, Porirua, the Kapiti Coast, and the Hutt Valley. Landfills are situated in close proximity to each of these areas. Northern landfill was closed in February 2006.



As well as being geographically and demographically suitable for being treated as a waste catchment, a high degree of cooperation from the management of the landfills was considered to be likely. All of the landfills within the catchment are owned by the local territorial authorities.

3 Waste facilities in Wellington region

3.1 Waste disposal facilities

During the period studied for this research, 2003–2005, there were six landfills and one stand-alone transfer station in the Wellington catchment. Several of the landfills also contain "transfer stations" for the use of smaller vehicles. A brief description of the facilities is presented in the table below.

Table 3.1 – Disposal facilities in the Wellington region

Northern landfill – closed February 2006	
Owned by	Wellington City Council
Waste types	General commercial and residential wastes No hazardous wastes accepted Council domestic kerbside collections Greenwaste separated and composted
Gate charge for general waste	$71.70/tonne
Cover material	Cleanfill and imported material
Otaihanga landfill	
Owned by	Kapiti Coast District Council
Waste types	General commercial and residential wastes No hazardous wastes accepted Council domestic kerbside collections Greenwaste separated and composted Sludge from Paraparaumu wastewater treatment plant
Gate charge for general waste	$22/cubic metre
Cover material	Cleanfill
Otaki transfer station	
Owned by	Kapiti Coast District Council
Waste types	General commercial and residential wastes No hazardous wastes accepted All materials taken to Otaihanga landfill Greenwaste separated and composted
Gate charge for general waste	$22/cubic metre

Silverstream landfill	
Owned by	Hutt City Council
Waste types	General commercial and residential wastes Hazardous wastes accepted Council domestic kerbside collections Greenwaste disposed of to landfill Sludge from Te Marua water treatment plant Sludge from Seaview wastewater treatment plant
Gate charge for general waste	$68/tonne
Cover material	Sawdust
Southern landfill	
Owned by	Wellington City Council
Waste types	General commercial and residential wastes Hazardous wastes accepted Council domestic kerbside collections Greenwaste separated and composted
Gate charge for general waste	$78/tonne (reduced from $101/tonne in 2006)
Gate charge for cleanfill	$4.20/tonne on an as required basis (reduced from $10.20/tonne in 2006)
Cover material	Cleanfill and imported material
Spicer landfill	
Owned by	Porirua City Council – 78.5% Wellington City Council – 21.5%
Waste types	General commercial and residential wastes Hazardous wastes accepted Council domestic kerbside collections Greenwaste disposed of to landfill Sludge from Porirua Treatment Plant
Gate charge for general waste	$80/tonne
Cover material	Cleanfill
Wainuiomata landfill	
Owned by	Hutt City Council
Waste types	General commercial and residential wastes No hazardous wastes accepted Council domestic kerbside collections Greenwaste disposed of to landfill Sludge from Wainui water treatment plant
Gate charge for general waste	$68/tonne
Cover material	Minor amounts of sawdust

3.2 Cleanfills

The New Zealand Waste Strategy defines "cleanfills" as "*waste disposal sites that accept only inert wastes. These include materials such as clay, soil, rock, concrete and bricks.*"

The establishment and operation of cleanfills are subject to different controls by different local authorities. District plans may require land use consents for cleanfills, and regional councils may require resource consents to control the environmental effects. The monitoring and reporting of volumes and types of materials disposed of at cleanfills may or may not be required as part of the consent process.

In many district and regional plans cleanfills can be a permitted activity, depending on factors such as size and proximity to watercourses. This means that cleanfill sites, particularly relatively small, short-term operations, may not be known to councils.

The cleanfill sites in the table that follows are known to be operating in the Wellington region. The list is not likely to include all sites in the region.

Table 3.2 – Cleanfill sites

Hutt City Council
Manor Park – Dry Creek Quarry
Manor Park – Benmore Crescent
Mangaroa Valley
Wainuiomata – Waiu Street
Kapiti Coast District Council
Otaki transfer station, on closed landfill site
Porirua City Council
Three consented sites, including one at Judgeford
Wellington City Council
C&D Landfills Ltd in Careys Gulley, alongside Southern landfill
T&T Landfill in Happy Valley

3.3 Composting

There are two commercial composting operations in the Wellington region:

- Living Earth site, part of the Careys Gully complex in Wellington that includes the Southern landfill – processes sewage sludge and greenwaste
- Site at the Otaihanga landfill, operated by Composting New Zealand Ltd – processes greenwaste

4 Analysis of landfill data 2003–2005

4.1 Methodology

As all of the landfills in the Wellington catchment are owned by local district authorities, an initial request for historical landfill data was made to the relevant council officers. A summary of all data from the three calendar years 2003–2005 was requested. After the landfill data were received, several requests for further information and clarification were made to the officers.

A significant proportion of the domestic kerbside refuse is collected by commercial waste operators, rather than by councils, and this refuse is not separately identified in the landfill weighbridge records. To gather data on commercial domestic kerbside refuse collections, a letter requesting tonnage data was sent to all identified commercial operators. The purpose of the letter was twofold:

1) to complete the dataset on the total quantity of domestic kerbside refuse collected in the region
2) to gauge the reaction of the commercial waste operators to a request to voluntarily supply this information.

A copy of the letter sent to the commercial waste operators is included in Appendix 2.

Analysis of all of the weighbridge records showed that there were enough similarities in the waste categories to allow the following five classifications to be differentiated from each dataset:

1) Cover material and cleanfill
2) Domestic kerbside collection
3) General waste
4) Special waste
5) Unweighed vehicles.

Although the precise parameter for each may vary slightly from landfill to landfill, as long as each landfill is consistent from year to year, the system of waste classification would be appropriate for waste catchment monitoring over time.

Section 4.2 contains a summary of the analysis of weighbridge records for the years 2003–2005. Further analysis of each waste classification is presented in the sections that follow. Each section is ended by a discussion of the results and their relation to the use of the waste catchment concept for long-term solid waste monitoring.

4.2 Summary of weighbridge data 2003–2005

Table 4.1 below combines the historical data from the six landfills for each of the individual waste classifications. As will be discussed in subsequent sections, the general waste stream and the domestic kerbside refuse collection are inter-related, in that a significant proportion of private domestic collections are classified by landfill weighbridges as general refuse. Similarly, the waste carried by unweighed vehicles does not represent a separate waste stream to the general refuse stream. For these reasons, a subtotal of domestic kerbside refuse, general waste, and unweighed vehicles is included in the table.

Table 4.1 – Summary of Wellington catchment weighbridge data 2003–2005

Tonnes to landfill	2003	2004	2005	% of total 2005
Domestic kerbside refuse collection	**40,827**	**42,402**	**40,359**	**8.5%**
Change from previous year		3.9%	-4.8%	
Unweighed vehicles	**53,088**	**53,969**	**51,555**	**10.8%**
Change from previous year		1.7%	-4.5%	
General	**174,551**	**181,978**	**184,946**	**38.8%**
Change from previous year		4.3%	1.6%	
Subtotal	**268,467**	**278,349**	**276,860**	**58.1%**
Change from previous year		3.7%	-0.5%	
Cover material/cleanfill	**168,973**	**212,631**	**146,470**	**30.8%**
Change from previous year		25.8%	-31.1%	
Special	**47,394**	**52,766**	**52,884**	**11.1%**
Change from previous year		11.3%	0.2%	
TOTAL WASTE TO LANDFILL	**484,834**	**543,745**	**476,215**	**100%**
Change from previous year		12.2%	-12.4%	

The total tonnage of waste to landfill shows, over the short period analysed, a marked degree of volatility, increasing 12% between 2003 and 2004, and then decreasing by 12% between 2004 and 2005.

This volatility is primarily the result of volatility in the quantity of cover material/cleanfill being disposed of to landfill. Cover material/cleanfill increases 26% between 2003 and 2004, then decreases 31% between 2004 and 2005.

The domestic kerbside refuse, unweighed vehicles, and general waste streams are much more regular, varying a maximum of less than 5% from year to year. Combined, these waste streams increased 3.7% between 2003 and 2004, then decreased 0.5% between 2004 and 2005.

4.3 Analysis of weighbridge data – by waste classifications

4.3.1 Cover material and cleanfill

Each of the landfill weighbridges in the Wellington catchment uses classifications to identify cleanfill and/or cover materials. Some of these classifications relate to specific customers, and others are used for charging purposes, as cleanfill disposal is generally charged at a lower rate than other materials.

The classifications from each landfill that were included in this analysis as "cover material and cleanfill" are as follows:

- Northern and Southern landfills – "cleanfill" (various rates and attributed to various customers), "imported cover"
- Otaihanga landfill – "clean fill"
- Silverstream landfill – "sawdust no charge" (used as a cover material)
- Spicer landfill – "cleanfill" and "concrete and demolition/roading material/cover"
- Wainuiomata – "sawdust no charge" (used as a cover material).

Not all cleanfill that is weighed into the landfills is disposed of at the tip face. An unknown proportion is used for construction purposes on the site, such as road building and bund construction.

The historical weighbridge data for cover material and cleanfill for each of the landfills in the Wellington catchment is presented in the table below.

Table 4.2 – Cover material and cleanfill tonnages 2003–2005

Cover material and cleanfill (tonnes)	2003	2004	2005
Northern landfill	70,037	97,317	49,492
Otaihanga landfill	31,883	30,487	23,760
Silverstream landfill	5731	6808	5265
Southern landfill	42,307	55,512	27,358
Spicer landfill	18,975	22,450	40,551
Wainuiomata landfill	41	57	45
Total	**168,973**	**212,631**	**146,470**

The quantity of cover material and cleanfill disposed of varies considerably from year to year. The total for 2004 is 26% greater than that for 2003, while the total for 2005 is 13% less than that for 2003.

There are several plausible factors involved in the annual variation of the quantity of cover material and cleanfill disposed of at landfills in the Wellington catchment. Cleanfill generation is often associated with construction projects, and the quantity of cleanfill generated will vary considerably from project to project. The number, type, and size of construction projects can vary from year to year, resulting in greater annual variation than for other types of waste.

As well as landfills, cleanfill may also be disposed of at cleanfill sites, for which there are no data available. As cleanfill sites are not regulated as stringently as landfills, the gate charge at cleanfill sites is usually lower than at landfills. The annual variation in tonnages

disposed of at landfills may be due to a variation in the market share of the landfills compared to the cleanfills, with a higher proportion being disposed of at landfills in some years than in others, depending on gate charges.

Discussion and recommendations

The separation of the cover material/cleanfill classification of waste from the other waste classifications is, perhaps, the single most important step in understanding waste flows within a catchment over time. Due to its magnitude (about 30% of the Wellington catchment waste), variability over time, and the availability of alternative disposal pathways, cover material/cleanfill data obfuscate all combined waste data, and make the data worthless for monitoring waste data at the level of precision needed for assessing the effects of government policy.

The separation of cover material/cleanfill data is also of importance as the Government has set specific targets for the reduction of construction and demolition (C&D) wastes in the NZWS, and cleanfill comprises a significant proportion of C&D wastes. The type of data generated during this research is not sufficient for monitoring C&D waste. Significant quantities of C&D waste are disposed of at cleanfill sites and at landfills as "general" waste. These materials could be quantified using visual assessment surveys at the facilities. Conversely, while a significant proportion of cleanfill is composed of C&D waste, an indeterminate quantity is derived from infrastructure work.

It is recognised that the inclusion of cover material as a waste is a potentially contentious decision. However, it is not possible, in most instances, to use weighbridge records to distinguish between cleanfill that is needed for cover material and that which is not.

This research has been unable to address the issue of disposal of non-cleanfill material at cleanfill sites. Compared to the overall waste being disposed of to landfill, it is not likely to be significant, but further research is needed for this to be determined.

4.3.2 Domestic kerbside refuse collection

Council domestic kerbside collections are clearly delineated in the weighbridge data summaries from Spicer and Wainuiomata landfills. In the initial summary of data from Northern and Southern landfills, the council domestic kerbside collection tonnage was included in the "general" classification. A separate record of council domestic kerbside collection tonnages was made available by the weighbridge administrator. At Otaihanga landfill, the Council collection is included in a "compactor" classification, which also includes waste from the Otaki transfer station.

At Silverstream landfill, a "Refuse collections" category includes vehicles that simultaneously collect the bagged Council collection and private wheelie bins, so it is not possible to identify the Council collection.

An unknown quantity of domestic kerbside refuse is collected by private waste operators. This waste is classified as "general" waste in all of the weighbridge records, and cannot be separated out from the data summaries provided. A letter was sent to each of the waste operators requesting tonnage data on domestic kerbside refuse, but no replies were received (a copy of the letter is in Appendix 2).

In a 2005 report to MfE (Desktop Survey of Packaging Waste to Landfill), Waste Not Consulting, by using data from a range of local authorities, calculated an average disposal rate for domestic kerbside refuse of 167 kg/person/annum. Combining this figure with the provisional results of the 2006 census, Table 4.3 below compares the expected total (council and private collections) tonnage of domestic kerbside refuse with the 2005 tonnage of domestic kerbside refuse collected by the councils in the region.

Table 4.3 – Analysis of domestic kerbside refuse tonnages

	2006 population (provisional 2006 census results)	Expected domestic refuse generation at 167 kg/ person/ annum	Tonnage of domestic kerbside collection from weighbridge records (2005)	Recorded market share
Kapiti Coast District	46,000	7682	6483	84%
Lower and Upper Hutt	135,000	22,545	19,388	86%
Porirua	47,700	7966	2893	36%
Wellington	183,500	30,645	11,594	38%
Total	**412,200**	**68,837**	**40,359**	**59%**

The weighbridge data for domestic kerbside refuse collection represent a high proportion of the estimated quantity generated in Kapiti Coast District and in Hutt City (around 85%), but a much smaller proportion of the market in Porirua and Wellington (less than 40%). In Hutt City, the proportion is high because the data include vehicles that transport both the Council bagged collection and a private wheelie bin service. Several small private operators collect the remainder of the refuse generated. In Wellington and

Porirua, the data indicate that the council collections comprise less than a 40% share of the domestic kerbside refuse collection market.

These factors must be taken into consideration when assessing the historic weighbridge records for domestic kerbside refuse. Data from 2003–2005 for each landfill are presented in the table below.

Table 4.4 – Domestic kerbside refuse tonnages 2003–2005

Domestic kerbside refuse collection - tonnes	2003	2004	2005
Northern landfill	4117	4578	4205
Otaihanga landfill	5749	5949	6483
Silverstream landfill	18,350	18,897	17,214
Southern landfill	6961	7635	7390
Spicer landfill	3372	2945	2893
Wainuiomata landfill	2278	2399	2174
Total	**40,827**	**42,402**	**40,359**

The combined data for all landfills shows a 4% increase in domestic kerbside refuse disposal between 2003 and 2004, followed by a decrease in 2005 to 1.1% below the 2003 figure.

These figures could be indicative of changes in domestic kerbside refuse generation by households during this time period. However, as it has been estimated that these figures include only about 60% of the total amount of domestic kerbside refuse that is generated in the region, it cannot be assumed that these changes are not related to variations in the market share held by council collections compared to the private waste operators.

Discussion and recommendations

Without reliable data on domestic kerbside refuse disposal from the private waste operators, currently there is limited value in the data on council domestic kerbside refuse collections. However, as licensing of waste operators by local authorities and the reporting of waste tonnages as a condition of licensing becomes more widespread, the required data are likely to be provided more readily by the waste operators. At 167/kg/person/annum, domestic kerbside refuse comprises about a quarter of the combined domestic kerbside/general/unweighed vehicle waste stream. As such, it is worthwhile separating the data to obtain a better understanding of changes in that waste stream.

In addition, reduction of the domestic kerbside refuse is a priority for many local authorities. It is the waste stream householders are most familiar with, and it is one of the few for which local authorities are able to provide effective waste minimisation measures. Establishing a national waste monitoring programme based on waste catchments would, in time, provide data on domestic kerbside refuse that would be beneficial to local authorities.

4.3.3 General waste

Five of the six landfills studied used "general waste" as a weighbridge category. The Otaihanga landfill data that were provided included a "cubic metre standard rate" category, which fulfils the same function. The Otaihanga data were converted from volume to weight data for the analysis.

Table 4.5 – General refuse tonnages 2003–2005

General refuse (tonnes)	2003	2004	2005
Northern landfill	37,916	45,049	51,806
Otaihanga landfill	4825	4947	6362
Silverstream landfill	44,384	45,121	47,251
Southern landfill	34,200	22,207	13,699
Spicer landfill	35,472	39,311	35,293
Wainuiomata landfill	17,754	25,343	30,536
Total	**174,551**	**181,978**	**184,946**

The data indicate that general refuse tonnages rose 4.3% between 2003 and 2004, and then a further 1.6% in 2005.

Within this overall pattern of relative stability, there is considerable change at the individual landfills. With the closure of Northern landfill imminent, in September 2004 Wellington City Council altered gate charges at Northern and Southern landfills to increase the differential between the two (from Southern costing $15.50/tonne more than Northern to $29.30/tonne more) to encourage more waste to be disposed of at Northern. The combined tonnages are shown in the table below.

Table 4.6 – General refuse tonnages 2003–2005
Northern and Southern combined

General refuse (tonnes)	2003	2004	2005
Northern landfill	37,916	45,049	51,806
Southern landfill	34,200	22,207	13,699
Total	**72,116**	**67,255**	**65,505**

The combined tonnage at Northern and Southern decreases 7% between 2003 and 2004, and then a further 3% between 2004 and 2005. There is much less volatility when the two landfills are examined as a single functional unit rather than as individual facilities.

Discussion and recommendations

General waste is the largest single waste strata, comprising nearly 40% of all waste to landfill in the Wellington catchment. As the name implies, "general" waste comprises waste from a wide range of sources. It includes industrial, commercial, and institutional

waste as well as residential and domestic kerbside refuse carried by commercial waste operators. Other landfill and transfer station studies by Waste Not Consulting (in 2005 "Waste Composition and Construction Waste Data" report to MfE) indicate that C&D waste commonly comprises approximately 30% of the general waste stream.

"Waste minimisation" is one of the three priority waste areas in the NZWS. While the targets for waste minimisation in the NZWS address capacity-building, rather than specific waste streams, it is the general waste stream that will be most significantly affected by businesses and local authorities meeting the targets. Monitoring the general waste stream is crucial to determining the success of waste minimisation initiatives related to these targets.

The three specific waste streams identified in the NZWS in relation to waste minimisation are organic wastes, special wastes, and C&D waste. A significant proportion of these waste streams, as described in the NZWS, would be classified as "general" waste in the classification system used in this report. A more detailed understanding of the general waste stream than is provided in this report is needed to monitor the NZWS targets for these specific waste streams.

A framework for achieving this more detailed understanding is outlined in the 2005 "Waste Composition and Construction Waste Data" report to MfE. The framework involves surveys based on both visual assessment of loads (including classification into specific waste types such as "residential", "commercial", and "C&D") and SWAP sort and weigh audits for minor waste components, such as e-waste.

The general waste stream may be more closely tied to economic activity and conditions than the other waste classifications. While some waste streams, such as domestic kerbside refuse and sewage sludge, are likely to be generated at substantially the same rate regardless of economic activity, the commercial, industrial, and C&D component of the general waste stream may be more closely tied. Further research, using an appropriate indicator of economic activity, such as GDP per capita, would establish any underlying relationship.

4.3.4 Special wastes

While there is no specific legal definition for "special wastes", the NZWS defines "special waste" as "*…wastes that cause particular management and/or disposal problems and need special care. Examples include used oil, tyres, end-of-life vehicles, batteries and electronic goods*".

These criteria did not form the basis for classifying "special wastes" for this project. "Special wastes" have been labelled as such when analysing the weighbridge records on the basis of being significant, identifiable waste streams, usually from a single generator. Although many of the waste streams that have been classified as "special wastes" do require particular management techniques due to environmental considerations, this was not an over-riding consideration.

Examples of "special wastes" are lead slag from GNB Battery Technologies, a battery recycler, sewage sludge from wastewater treatment plants in the region, contaminated soils, Taylor Preston abattoir waste, and slip waste, from the cleanup after the 2004 floods in the Hutt Valley. A complete list of the weighbridge categories that have been classified as "special waste" is contained in Appendix 1.

The historical weighbridge data for special wastes for each of the landfills in the Wellington catchment is presented in the table below. No special wastes were identified at either Northern landfill or Otaihanga landfill.

Table 4.7 – Special wastes 2003–2005

Special wastes (tonnes)	2003	2004	2005
Northern landfill	0	0	0
Otaihanga landfill	0	0	0
Silverstream landfill	23,894	28,063	16,982
Southern landfill	13,850	6724	22,894
Spicer landfill	8817	8411	8221
Wainuiomata landfill	832	9567	4787
Total	**47,394**	**52,766**	**52,884**

While some of the special wastes listed in Appendix 1 are constant over time, such as sewage sludges, others are from one-off events, such as the 11,563 tonnes of slip waste disposed of at Silverstream landfill in 2004.[4] Still others, particularly industrial waste streams, vary markedly from year to year.

Despite these differing profiles, the total tonnage of special wastes is relatively consistent over the period analysed. There is an 11% increase between 2003 and 2004, due largely to the slip waste disposed of at Silverstream. The tonnage remains constant from 2004 to 2005. The absence of the slip waste at Silverstream in 2004 is balanced by a large amount of contaminated soil disposed of at Southern landfill in 2005.

Discussion and recommendations

Composed as it is of waste from a relatively small number of waste generators, the special wastes classification would be expected to exhibit a higher degree of volatility than waste streams arising from a large number of generators, such as general waste. For this reason it is important that these individual waste streams be considered separately in order that underlying patterns in the other classifications can be more readily discerned.

The number and types of waste streams that were classified as "special wastes" varied markedly from landfill to landfill. This was primarily due to the level of detail of the weighbridge records that were supplied by the landfill operator for this project. For the most part, "special wastes" could not be separated from other waste streams at landfills that supplied records at a more general level. It is recommended that, in future, landfill records at the most detailed level possible be used for catchment analysis.

4.3.5 Unweighed vehicles

All of the landfills in the Wellington catchment use a range of weighbridge categories to classify smaller vehicle loads entering the facilities. These commonly include

[4] It is understood that a relatively small proportion of slip waste entering Silverstream was recorded as such. The remainder would have been classified as "general" waste or "unweighed vehicle' waste.

combinations of categories for cars, utilities, vans, trailers of different sizes, and different types of materials, such as greenwaste.

These categories are commonly used as the basis for disposal charges, as at most facilities small loads are not weighed, and are charged at a flat fee based on load type rather than on a tonnage basis. Southern landfill is the exception, and all vehicle loads are now weighed. Most disposal facilities use an average load weight (or volume at Otaihanga landfill) for each classification to calculate disposal tonnages.

Table 4.8 – Unweighed vehicles 2003–2005

Unweighed vehicles (tonnes)	2003	2004	2005
Northern landfill	5710	4865	4495
Otaihanga landfill	5605	5663	5831
Silverstream landfill	20,751	22,645	21,660
Southern landfill	8365	7211	5919
Spicer landfill	8654	9585	9814
Wainuiomata landfill	4004	4000	3835
Total	**53,088**	**53,969**	**51,555**

The tonnage carried by unweighed vehicles increased 2% between 2003 and 2004, then decreased 4% between 2004 and 2005. The MfE source survey shows that the majority of this waste is residential in origin (see Section 5.2.8). Changes in the tonnage figures from year to year do not necessarily relate to actual changes in waste generation or disposal. These figures are measuring the transport of relatively small quantities of waste in small vehicles that are not weighed at weighbridges and, as such, these figures are actually measuring the preferred means of transport of small quantities of waste. The quantity of waste transported in small loads depends on factors such as the rate of trailer ownership and the propensity of individuals or organisations to transport their own waste rather than have it done by a commercial waste operator.

Discussion and recommendations

Waste transported to landfill in small quantities in unweighed vehicles represents approximately 10% of all waste to landfill in the Wellington catchment. It is composed of residential waste transported by householders and commercial waste from small waste generators. Very little, if any, is carried by commercial waste operators.

Statistically separating waste transported by unweighed vehicles from other waste streams is potentially useful because many local authorities are attempting to reduce this waste through the introduction of separate disposal areas at transfer stations for different materials. Small loads, transported by the waste generator, are more likely to use these facilities than commercial waste operators, hauling large, heterogeneous loads. The effectiveness of these waste minimisation measures can best be judged by monitoring waste from unweighed vehicles and the quantities of materials recovered.

5 MfE source surveys

5.1 Methodology

As an adjunct to the catchment study, MfE organised for a waste source survey to be undertaken at four of the Wellington region landfills. The survey at Wainuiomata landfill was not completed in time for preparation of this report.

For each landfill survey, a surveyor was engaged for eight hours per day over a seven day period. The surveyor asked each vehicle driver questions regarding the geographical source of the waste and whether the waste had been generated by commercial or domestic activity. The vehicle licence number and, where possible, the net load weight were recorded for each vehicle. These data were entered onto a spreadsheet for further analysis.

The complete vehicle records for the survey week were obtained from each landfill weighbridge. Waste Not Consulting matched the MfE source survey records with the weighbridge records. Every vehicle load was classified as "cover material/cleanfill", "domestic kerbside", "general", "special", or "unweighed vehicle", using the product codes in the weighbridge record as the basis for the classification.

5.2 Results of MfE source surveys

Combining the MfE source survey results with the weighbridge records provides information on the geographical source and on the domestic or commercial origin of each waste type at each landfill surveyed. This information is presented in the four sections on the following pages, and summarised in Sections 5.2.5 and 5.2.8.

All cover material/cleanfill and special waste are considered to be commercial in origin, and are excluded from that analysis. A very small proportion of cleanfill is domestic in origin, but is rarely classified "cleanfill" by the weighbridge operators. All domestic kerbside refuse is, by definition, domestic in origin and is also excluded from the analysis.

The survey at Spicer landfill was not conducted properly, and the survey results for the domestic/commercial origin are not valid. These have been excluded from the analysis.

At the landfills where greenwaste is separated and processed (Otaihanga and Southern), loads of greenwaste have been excluded from the analysis.

As the Otaihanga landfill does not have a weighbridge, the results were based on the volume of waste recorded. The results for the unweighed vehicles are based on the numbers of vehicles.

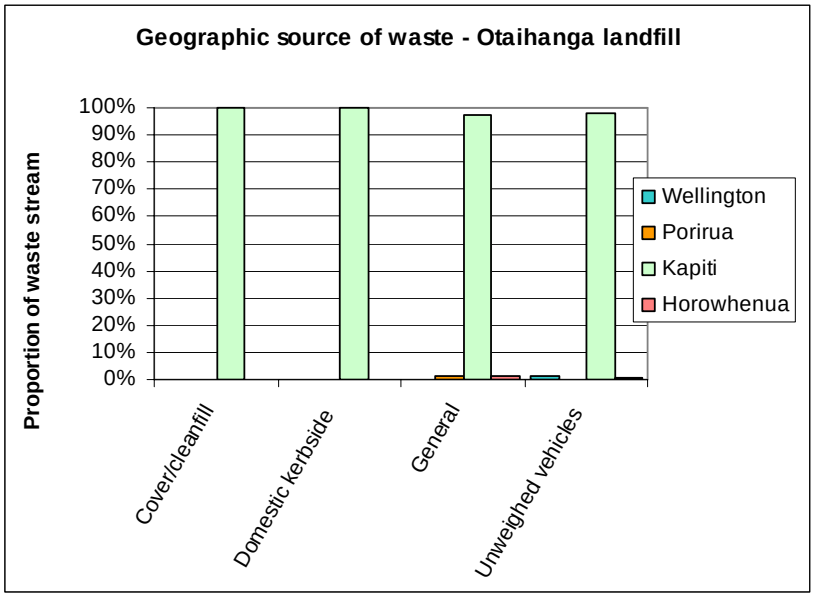
5.2.1 Otaihanga landfill

The results of the MfE source survey at Otaihanga landfill are given in Table 5.1 below and in the following figures. The calculations have been based on the volume of waste, as there is no weighbridge at the landfill.

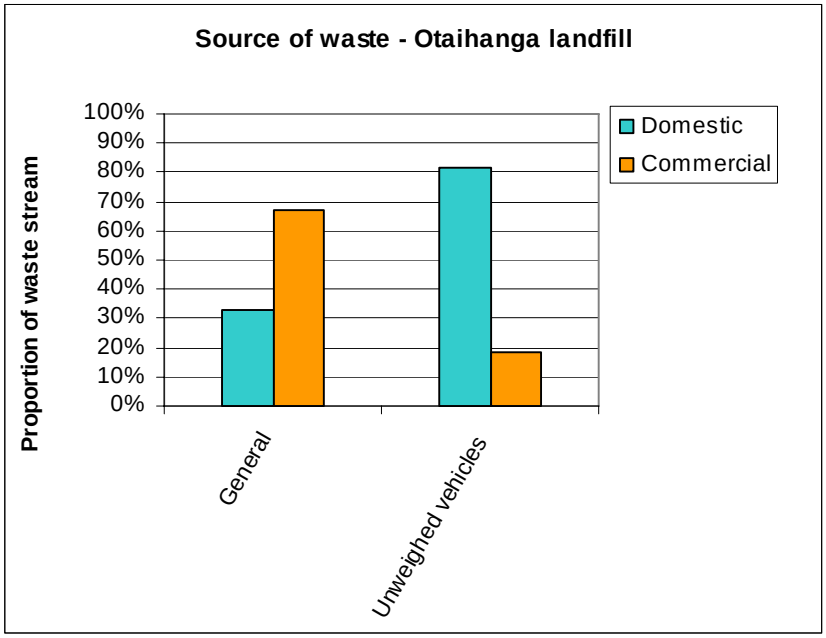
Table 5.1 – Results of source survey at Otaihanga landfill

Otaihanga landfill	Domestic	Commercial		Wellington	Porirua	Hutt	Kapiti	Other
Cover/cleanfill	0%	100%		0%	0%	0%	100%	0%
Domestic kerbside	100%	0%		0%	0%	0%	100%	0%
General	33%	67%		0%	1.2%	0%	97.5%	1.3%
Special	No special waste is disposed of at Otaihanga landfill							
Unweighed vehicles	81%	19%		1.4%	0.2%	0%	97.9%	0.5%

The geographic source of waste disposed of at Otaihanga landfill is given in the figure below.



All of the cover material/cleanfill and domestic kerbside refuse disposed of at Otaihanga landfill originates in the Kapiti Coast area. A very high proportion, over 97% by weight, of general waste and unweighed vehicle waste also originates in the Kapiti Coast.



Just under a third of the general waste stream is domestic in origin and two-thirds is commercial. Over 80%, by weight, of waste carried by unweighed vehicles is domestic in origin and 20% is commercial.

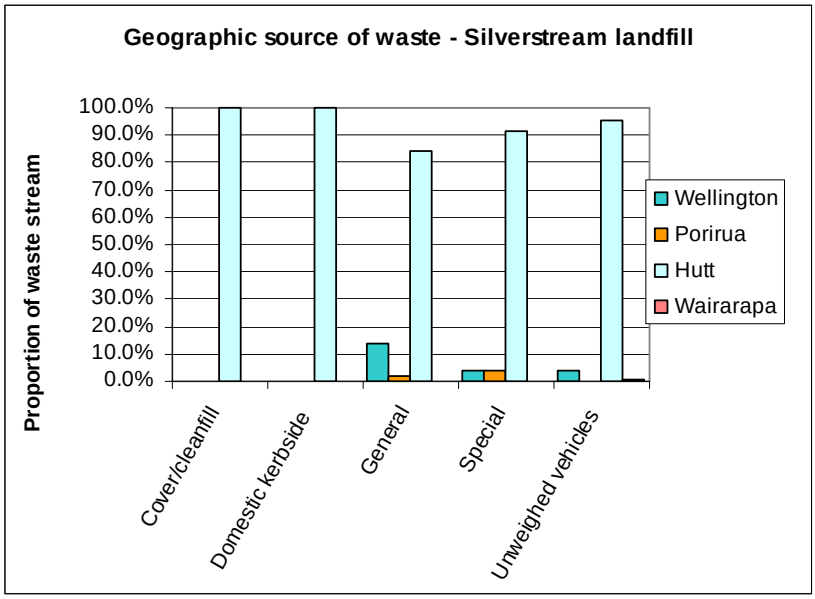
5.2.2 Silverstream landfill

The results of the MfE source survey at Silverstream landfill are given in Table 5.2 below and in the following figures. The Silverstream survey took place from 28 June – 4 July 2006. For the first three days of the survey there was a substantial price differential between Silverstream and Southern landfills. On 1 July, Southern landfill lowered its gate charge. It is likely that this had an influence on the transport of waste from Wellington to Silverstream in the second half of the survey.

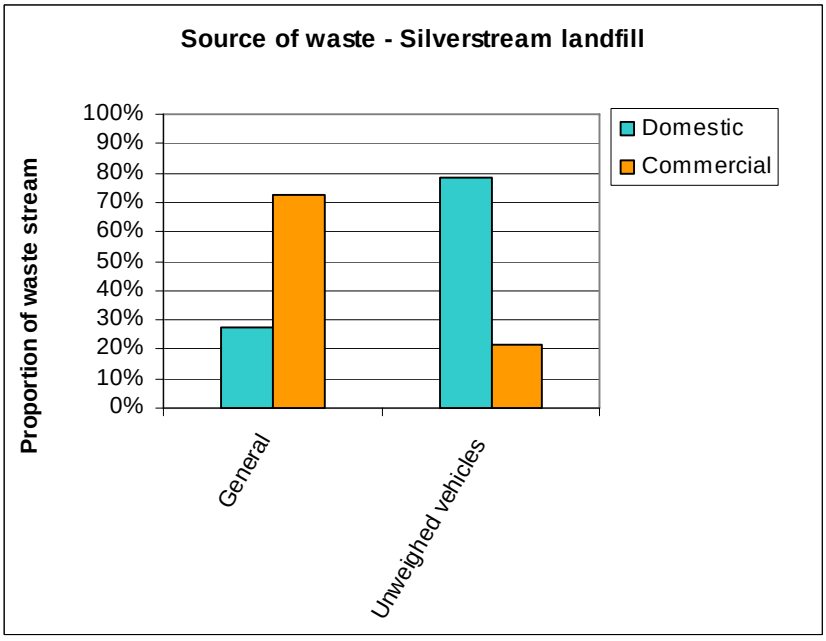
Table 5.2 – Results of source survey at Silverstream landfill

Silverstream landfill	Domestic	Commercial	Wellington	Porirua	Hutt	Kapiti	Other
Cover/cleanfill	0%	100%	0%	0%	100%	0%	0%
Domestic kerbside	100%	0%	0%	0%	100%	0%	0%
General	27%	73%	14%	2%	84%	0%	0%
Special	0%	100%	4.2%	4.2%	91.6%	0%	0%
Unweighed vehicles	79%	21%	3.9%	0.1%	95.3%	0.2%	0.6%

The geographic source of waste disposed of at Silverstream landfill is shown in the figure below.



All of the cover material/cleanfill and domestic kerbside refuse disposed of at Silverstream landfill originates in the Hutt area. A high proportion, over 84% by weight, of general waste and unweighed vehicle waste also originates in Hutt City.



Just over a quarter (27%) of the general waste stream is domestic in origin and three-quarters is commercial. 79%, by weight, of waste carried by unweighed vehicles is domestic in origin and 21% is commercial.

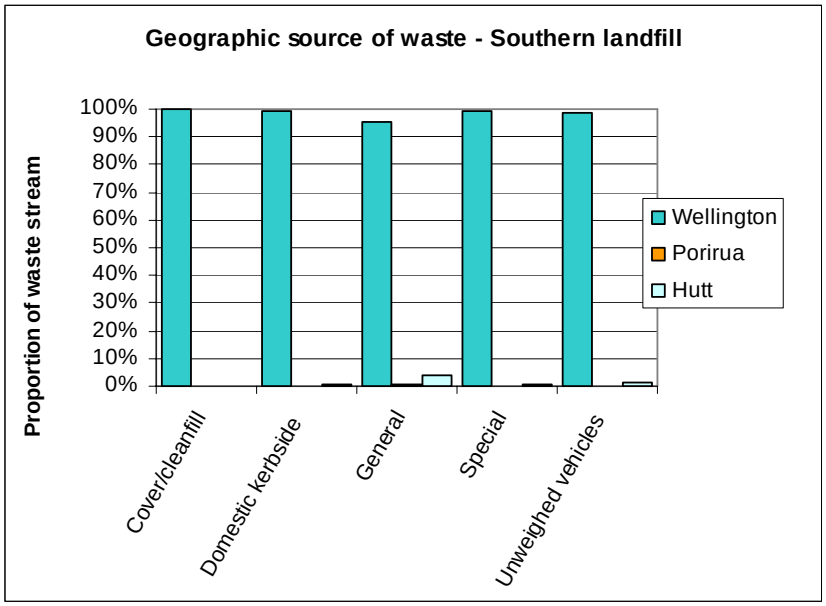
5.2.3 Southern landfill

The results of the MfE source survey at Southern landfill are given in Table 5.3 below and in the following figures.

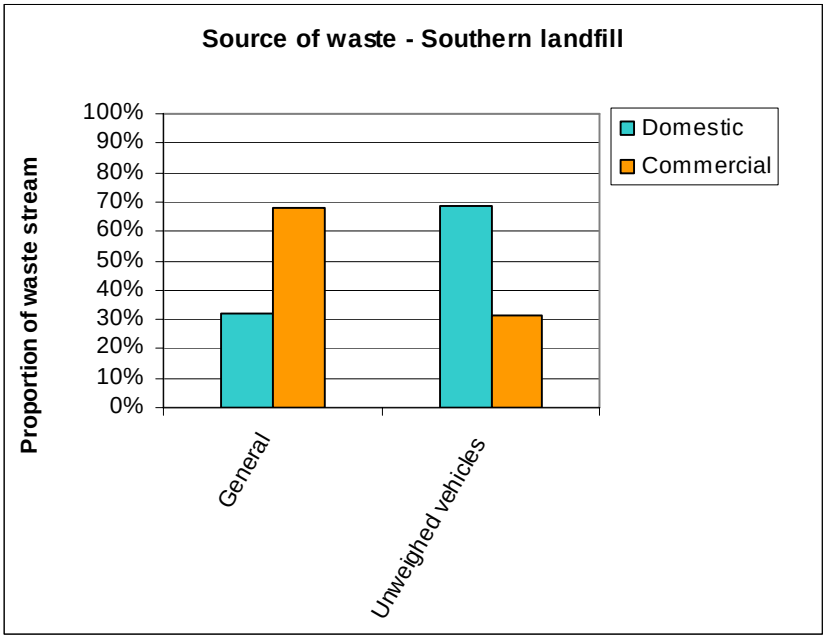
Table 5.3 – Results of source survey at Southern landfill

Southern landfill	Domestic	Commercial	Wellington	Porirua	Hutt	Kapiti	Other
Cover/cleanfill	0%	100%	100%	0%	0%	0%	0%
Domestic kerbside	100%	0%	99.6%	0%	0.4%	0%	0%
General	32.3%	67.7%	95.2%	0.7%	4.1%	0%	0%
Special	0%	100%	99.6%	0%	0.4%	0%	0%
Unweighed vehicles	68.6%	31.4%	98.7%	0.2%	1.1%	0%	0%

The geographic source of waste disposed of at Southern landfill is shown in the figure below.



All of the cover material/cleanfill and domestic kerbside refuse disposed of at Southern landfill originates in the Wellington area. Over 95% by weight, of general waste and 99% of unweighed vehicle waste also originates in the Wellington area.



Just under a third (32%) of the general waste stream is domestic in origin and two-thirds is commercial. 69%, by weight, of waste carried by unweighed vehicles is domestic in origin and 31% is commercial.

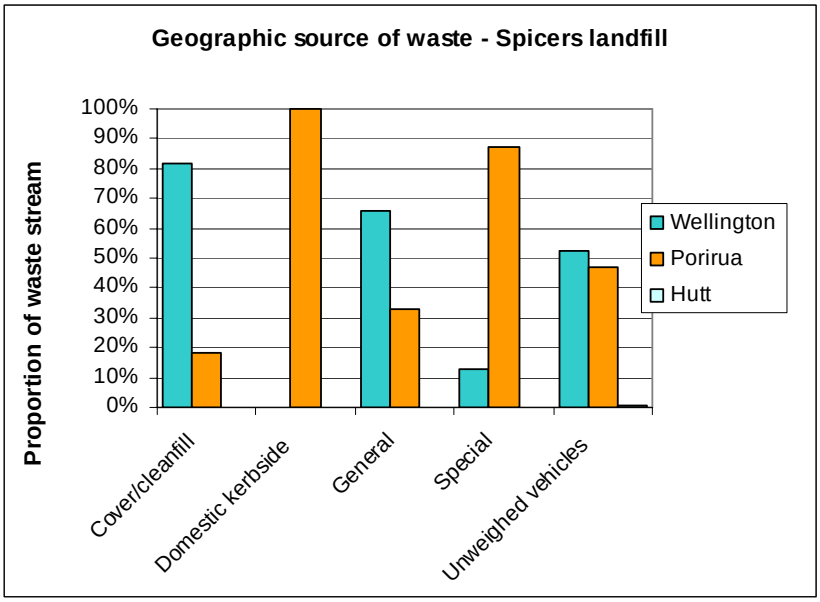
5.2.4 Spicer landfill

The results of the MfE source survey at Spicer landfill are given in Table 5.4 below and in the following figures. Due to an error in the surveying, information on the domestic/commercial origin is not available.

Table 5.4 – Results of source survey at Spicer landfill

Spicer landfill	Domestic	Commercial	Wellington	Porirua	Hutt	Kapiti	Other
Cover/cleanfill	N/A	N/A	81.4%	18.6%	0%	0%	0%
Domestic kerbside	N/A	N/A	0%	100%	0%	0%	0%
General	N/A	N/A	66.1%	33.2%	0.2%	0.1%	0.5%
Special	N/A	N/A	12.9%	87.1%	0%	0%	0%
Unweighed vehicles	N/A	N/A	52.5%	46.7%	0.6%	0.2%	0%

The geographic source of waste disposed of at Spicer landfill is shown in the figure below.



A large proportion (81%) of cover material/cleanfill disposed of at Spicer landfill originates in the Wellington area. The rest comes from Porirua. All of the domestic kerbside refuse originates in the Porirua area.

Two-thirds of general waste originates in Wellington, the remainder in Porirua. Nearly 90% of special wastes originate in Porirua, the remainder from Wellington.

Slightly more than half the waste from unweighed vehicles comes from Wellington and the rest from Porirua.

5.2.5 Summary of findings on geographic source

By combining the data from the four source surveys, the geographic source of all of the waste disposed of within the Wellington catchment can be determined. The table below contains the tonnage data from all of the landfills surveyed, broken down by geographical source. The tonnages have been taken from the weighbridge totals for the week surveyed, with the survey results being extrapolated up to that total.

The 6631 tonnes of waste during the combined survey weeks represents approximately 80% of the average weekly waste disposed of at the four landfills during 2005. The quantity of cover material/cleanfill during the survey weeks is about 50% of the average during the previous year, possibly due to the surveys being conducted during winter, when large-scale earthworks are generally not undertaken.

Table 5.5 – Geographical source of waste during survey periods – by tonne

Tonnes during survey week	Wellington	Porirua	Hutt	Kapiti	Other	Total
Cover /cleanfill	959	198	99	166	0	**1422**
Domestic	158	61	220	146	0	**586**
General	1829	413	733	90	7	**3071**
Special	503	152	159	0	0	**814**
Unweighed	250	95	264	128	2	**739**
Total	**3698**	**920**	**1475**	**529**	**9**	**6631**

Of the 6631 tonnes of waste material, only nine tonnes were recorded as coming from outside the catchment area of Wellington, Porirua, Hutt, and the Kapiti Coast (recognising that the exact boundary of the catchment along the Kapiti Coast has not been defined). The nine tonnes comprised two commercial loads at Spicer landfill (recorded as being partially from the Horowhenua district), four commercial loads and two unweighed vehicle loads at Otaihanga (also from the Horowhenua district), and eight unweighed vehicle loads at Silverstream landfill from Wairarapa district.

The tonnage data in Table 5.5 above is given as percentages in Table 5.6 below.

Table 5.6 – Geographical source of waste during survey periods – by percentage

	Wellington	Porirua	Hutt	Kapiti	Other	Total
Cover /cleanfill	14.5%	3.0%	1.5%	2.5%	0.0%	**21.4%**
Domestic	2.4%	0.9%	3.3%	2.2%	0.0%	**8.8%**
General	27.6%	6.2%	11.1%	1.4%	0.1%	**46.3%**
Special	7.6%	2.3%	2.4%	0.0%	0.0%	**12.3%**
Unweighed	3.8%	1.4%	4.0%	1.9%	0.0%	**11.1%**
Total	**55.8%**	**13.9%**	**22.2%**	**8.0%**	**0.1%**	**100.0%**

Overall, the survey results showed 99.86% of the waste, by weight, disposed of at the landfills in the Wellington catchment originated within the catchment.

The absence of data from Wainuiomata landfill is not considered to have any effect on the results. The Wainuiomata landfill is geographically isolated, and any waste loads originating from outside of the catchment area would need to travel by either Otaihanga or Silverstream landfill before reaching Wainuiomata. It is considered highly unlikely that a significant quantity of refuse from outside the catchment is being disposed of at Wainuiomata landfill.

5.2.6 Comparison of survey results to population data

As waste generation is related to population, the results of the MfE source survey can be compared to population data for the Wellington region to assess the results of the survey. In Table 5.7 below, the population data from the provisional 2006 census are compared to the geographic source survey. As the survey was not undertaken at Wainuiomata landfill, for the calculations 80% of one week's average waste generation for the landfill has been added to the total tonnage and it has been assumed that all of this waste was generated in the Hutt area (for the other landfills, the total tonnage during the survey weeks was about 80% of the average annual weekly total).

For the final column, cover material/cleanfill and special wastes have been removed from the calculations.

Table 5.7 – Comparison to % of waste generated to % of population

	2006 population (provisional 2006 census results)	% of total population	% of all waste generated in catchment	% of domestic kerbside, general, and unweighed vehicles
Kapiti Coast District	46,000	11.2%	7.3%	7.4%
Lower and Upper Hutt	135,000	32.8%	29.1%	35.9%
Porirua	47,700	11.6%	12.7%	11.5%
Wellington	183,500	44.5%	50.9%	45.2%
Total	**412,200**	**100%**	**100%**	**100%**

The total quantity of all waste categories generated in each area, as measured by the MfE source survey, closely matches each area's proportion of the population. When cover material/cleanfill and special wastes are excluded, the proportion of domestic kerbside, general, and unweighed vehicle waste generated in each area matches even more closely the proportion of population in the area. Lower and Upper Hutt generate slightly more waste per person than the average, and Kapiti generates less. This is possibly related to the differing amount of commercial and industrial activity in each area, but could also be sampling error, recording error, or misreporting by vehicle drivers.

5.2.7 Per capita waste generation

Using the data from Table 5.5 above, per capita waste generation figures can be derived. Table 5.8 below shows the per capita generation of all waste classifications for each area. The total landfill tonnage figure for 2005 from Table 4.1 is used for the calculations.

Table 5.8 – Per capita waste generation – all waste types

All waste types - 2005	2006 population (provisional 2006 census results)	% of all waste generated in catchment	Waste generated (tonnes)	Tonnes of waste/ per capita/ per annum
Kapiti Coast District	46,000	7.3%	34,715	0.755
Lower and Upper Hutt	135,000	29.1%	138,517	1.026
Porirua	47,700	12.7%	60,354	1.265
Wellington	183,500	50.9%	242,628	1.322
Total	**412,200**	**100%**	**476,215**	**1.155**

On average, 1.16 tonnes of waste were disposed of to landfill for each person in the Wellington catchment in 2005. The rate by local authority varies markedly, from 0.755 tonnes per person in Kapiti Coast District to 1.322 tonnes per person in Wellington City.

The table below presents the 2005 waste data for the combined domestic kerbside, general, and unweighed vehicle waste categories, by local authority.

Table 5.9 – Per capita waste generation – domestic kerbside, general, unweighed vehicles wastes

Domestic kerbside, general, and unweighed vehicle waste - 2005	2006 population (provisional 2006 census results)	% of specified waste generated in catchment	Waste generated (tonnes)	Tonnes of specified waste/ per capita/ per annum
Kapiti Coast District	46,000	7.4%	20,362	0.443
Lower and Upper Hutt	135,000	35.9%	99,530	0.737
Porirua	47,700	11.5%	31,830	0.667
Wellington	183,500	45.2%	125,138	0.682
Total	**412,200**	**100%**	**276,860**	**0.672**

On average, 0.67 tonnes of domestic kerbside, general, and unweighed vehicle waste were disposed of to landfill for each person in the Wellington catchment in 2005. The rate by local authority varies from 0.443 in Kapiti Coast District to 0.737 tonnes in Lower and Upper Hutt.

For all waste combined, Wellington produces the highest amount per capita, which is related to the quantity of cleanfill and special wastes disposed of at Southern landfill. The higher generation rate of residential, commercial, and industrial waste (the domestic kerbside, general, and unweighed vehicle waste classifications combined) in Upper and Lower Hutt is likely related to the large manufacturing base in the city.

Discussion and recommendations

Unless misreporting of geographic source by vehicle drivers was widespread, the strong correlation between population and waste tonnages indicates that the MfE source surveys have produced credible results. The possibility of deliberate misreporting must be recognised, however, particularly from commercial waste operators who might think it in their own best interest to lead landfill operators to believe that waste is of local origin.

The results indicate that the Wellington waste catchment is virtually self-contained with regards to waste generation and disposal. This is assuming that as little waste is transported out of the catchment as comes in, which would require source surveys at disposal facilities in Horowhenua and Wairarapa to determine. It is not considered likely that significant quantities of waste are currently being transported out of the catchment. In the opinion of Peter Ruddock, Waste Minimisation Officer, Waste Management Wairarapa, "We don't get any area leakage in or out of here due to our geographic isolation from the other councils".[5]

A potential "leakage" of waste out of the catchment is from Waste Management NZ Ltd transporting waste to its joint venture operation Bonny Glen landfill, north of Marton. Anecdotally, the company has indicated to council officers that this would be a possibility if disposal charges in the Wellington region become too high. The 150 km distance (between Porirua and Marton) would be a significant financial disincentive to this transport of waste out of the catchment.

5.2.8 Summary of findings on domestic/commercial source

During the MfE source survey, each vehicle driver was asked if the waste being transported was of either "domestic" or "commercial" origin. No definitions for the terms were provided to the vehicle drivers, so their interpretation was left to each driver.

Although all vehicle drivers were asked this question, the response is only relevant for loads of "general" waste or "unweighed vehicle" loads. All "domestic kerbside collection" loads are domestic in origin, and all "cover material/cleanfill" and "special waste" loads have been deemed to be commercial in origin.

Table 5.10 –Source of waste during MfE source survey periods

All survey results combined	Domestic	Commercial
General	30.0%	70.0%
Unweighed vehicles	76.9%	23.1%

By combining the results of the MfE source survey with the summary of 2005 weighbridge data in Section 4.3, an estimate can be made of the source of the entire waste stream. The results are presented in Table 5.11 on the following page.

[5] Peter Ruddock, personal email communication, 11 May, 2006

Table 5.11 – Domestic/commercial source of waste - 2005

	Total to landfill - 2005		Domestic		Commercial	
	Tonnes	% of total	Tonnes	% of total	Tonnes	% of total
Cover material/cleanfill	146,470	30.8%	0	0%	146,470	30.8%
Domestic kerbside refuse collection	40,359	8.5%	40,359	8.5%	0	0%
General	184,946	38.8%	55,560	11.7%	129,386	27.2%
Special	52,884	11.1%	0	0%	52,884	11.1%
Unweighed vehicles	51,555	10.8%	39,648	8.3%	11,907	2.5%
Total	**476,215**	**100%**	**135,567**	**28.5%**	**340,647**	**71.5%**

Based on the MfE source survey results and the underlying assumptions regarding the source of the cover material/cleanfill, domestic kerbside refuse, and special classifications of waste, 28.5% of all landfill waste in the Wellington catchment is domestic in origin, and 71.5% is commercial in origin.

Discussion and recommendations

The domestic/commercial distinction in classifying refuse loads originated in the 1992 Waste Analysis Protocol and was carried through into the 2002 Solid Waste Analysis Protocol. In these documents the terms "residential" and "business" are used.

The terms are not defined in either document, and were not defined in the instructions given to the surveyors undertaking the MfE source survey. During the source survey, respondents were not given definitions for the terms. Without a specific meaning being applied to the terms, some types of waste are difficult to classify, such as waste generated by commercial landscaping firms servicing residential properties, or commercial builders working on residential properties. As a result of the indeterminate meaning for the terms, the results of the source survey must be considered of an indicative nature only.

The terms "domestic" and "commercial" can only be meaningfully applied to the general waste stream. While some special wastes, such as abattoir waste, are clearly commercial in origin, others, such as sewage sludge, are generated by both commercial and residential activities. Similarly, classifying cleanfill as either commercial or residential is of little value, particularly as a significant proportion of cleanfill is generated by infrastructural activity.

Despite these shortcomings, there is still value in gathering data on the commercial/residential split in waste generation. The distinction is easily comprehended by the public, and forms an important part of the information released for public education purposes. To be able to say, for example, that "70% of waste is generated by the commercial sector" is useful in terms of raising the sector's awareness of waste issues.

6 Effect of pricing on landfill tonnages

A secondary objective of the project has been to use the accumulated data from the landfills to assess the effect of gate charges, and specifically changes in gate charges on waste flows in the Wellington catchment. The following sections examine this issue in detail by examining waste flows on four occasions when gate charges were changed.

It is important to take into account that only changes to the "advertised" gate charges for casual customers are being examined. Landfills customarily give substantial discounts on the advertised gate charge to important customers, and the extent and timing of the changes to these charges is not known.

6.1 Increase in gate charges at Northern and Southern landfills – April 2003

The gate charges for general waste at Northern and Southern landfills, owned by Wellington City Council, were both raised on 1 April 2003. The following table sets out the gate charges and the waste flows into those facilities for periods before and after the charges were increased. Data for Spicer landfill are also included, as, due to its close proximity to Northern landfill, its waste flows were also likely to be affected.

Table 6.1 – Effects of changes in gate charges at Northern and Southern landfills

Gate charges	**March 03**	**April 03**
Northern	$42.50	$50.00
Southern	$51.00	$65.50
Spicer	$52.00	$52.00
Tonnes to landfill	**1 Jan 03 – 30 June 03**	**1 July 03 – 31 Dec 03**
Northern waste excluding cover/cleanfill	23,664	26,854
Northern cleanfill	13,127	38,202
Southern waste excluding cover/cleanfill and special	27,982	23,030
Southern cleanfill	7,467	12,544
Tonnes to landfill	**1 July 02 – 30 June 03**	**1 July 03 – 30 June 04**
Spicer waste excluding cleanfill	48,285	51,996
Spicer cleanfill	3894	17,316

The data that have been used for the analysis of Northern and Southern cover six-month periods, and the change in gate charges occurred in the middle of that period. Therefore, the January–June data include three months at the old gate charge and three months at the new gate charge and the effect of the increase in gate charges is not as evident as it might be if a month-by-month analysis had been done.

Following the increase in gate charges, waste entering Southern landfill (excluding cover material/cleanfill and special waste) decreased. The decrease is matched closely by

increases in similar waste streams at Northern and Spicer. If tonnages at Southern in the three months after the increase in gate charges were equivalent to the average of the next six months, Southern would have experienced approximately a 30% decrease in waste. During this period, the gate charge at Silverstream was $55.00/tonne, and its waste flows were unaltered.

6.2 Increase in gate charges at Silverstream landfill – July 2005

In July 2005, Hutt City Council increased the gate charge at Silverstream and Wainuiomata landfills from $55.00/tonne to $68.00/tonne. The monthly tonnages for Silverstream landfill in 2005 are shown in the figure below for the "commercial" and "domestic" waste streams. These are terms used in Hutt City Council's analysis of landfill data, and are not used in necessarily the same manner as elsewhere in this report.

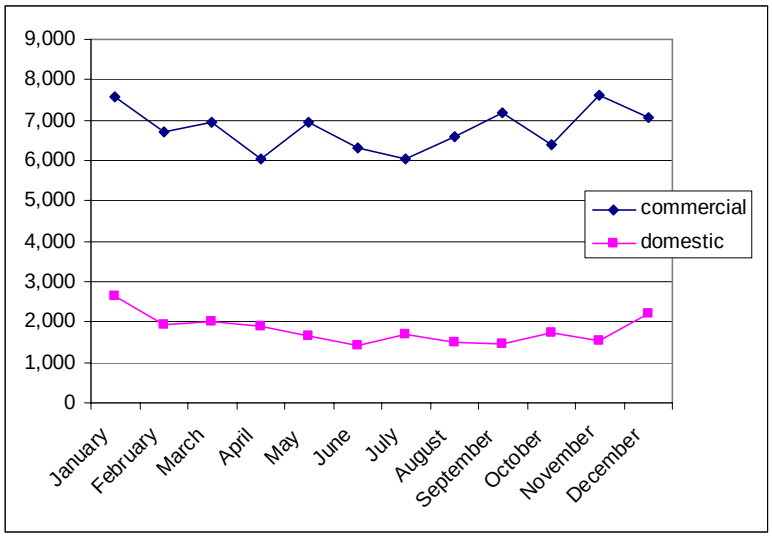


Figure 6.1 – Tonnages at Silverstream landfill – 2005

The data do not show any decrease in landfill tonnages after the increase in the gate charge on 1 July 2005. This is likely due to the Silverstream gate charge, even after the increase, still being marginally lower than other landfills in the catchment at the time.

6.3 Decrease in gate charges at Southern landfill – 1 July 2006

On 1 July 2006, Southern landfill lowered its gate charge from $101/tonne to $78/tonne. At this time, the gate charge at Silverstream landfill remained constant at $68/tonne. The MfE source survey was undertaken from Wednesday, 28 June to Tuesday, 4 July. During the three week-days prior to Southern landfill lowering its gate charge, 11.0%, by weight, of all waste that was weighed by the weighbridge (i.e. all loads other than unweighed vehicles) originated in Wellington. On the two weekdays after Southern had lowered its gate charge, 5.6% of all waste that was weighed by the weighbridge originated in Wellington.

Although the sample size is small, this could indicate that a proportion of vehicles transporting waste originating in Wellington no longer disposed of it at Silverstream after the significant price differential between Southern and Silverstream landfills had been

removed. The possibility must also be considered, however, that the decrease in waste from Wellington is related to weekly fluctuations in waste flows.

6.4 Increase in gate charges at Northern landfill – September 2004

From the period April 2003 until September 2004, Northern and Spicer landfill, which are geographically in close proximity, had similar gate charges. The gate charge per tonne at Northern landfill was $50.00/tonne and Spicer $52.00/tonne. On 1 September 2004, the gate charge at Northern was raised from $50.00/tonne to $71.70/tonne. On 11 October 2004, the gate charge at Spicer was raised to $70.00/tonne.

The figure below, adapted from a figure supplied by Eddy Klaasen, of Porirua City Council, illustrates the effect of the price change by Northern landfill during the six week period until Spicer raised its charge.

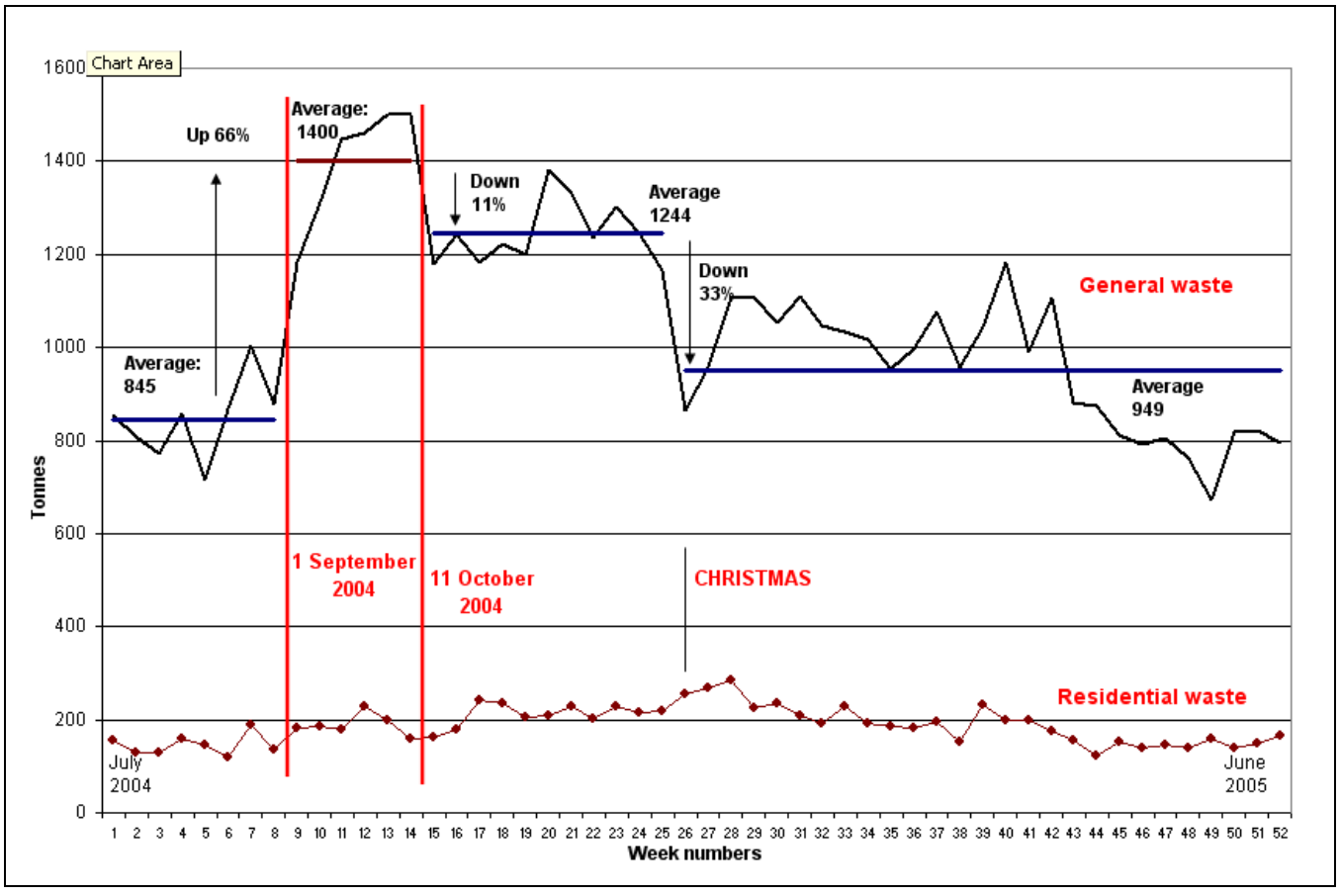


Figure 6.2 – Landfill tonnages at Spicer landfill 2004–2005

While the tonnage of residential waste remained relatively unchanged, the general waste tonnage at Spicer increased 66% during the short period where there was a marked differential in gate charges. The tonnage dropped again when Spicer increased its gate charge to the same level, but was still 47% higher than the pre-September period. After the Christmas holiday season, the Spicer tonnage dropped again, and the average for the first six months of 2005 was only 12% above the pre-September period.

6.5 MfE source survey at Spicer landfill – 2006

The MfE source survey at Spicer landfill was undertaken from 19–25 June 2006. At this time, the gate charge at Southern landfill, in Wellington City, was $101/tonne and at Spicer landfill, in Porirua City, was $70/tonne. The source survey produced the results in the table below (also presented as Table 5.4)

Table 6.2 – Results of source survey at Spicer landfill

Spicer landfill	Domestic	Commercial	Wellington	Porirua	Hutt	Kapiti	Other
Cover/cleanfill	N/A	N/A	81.4%	18.6%	0%	0%	0%
Domestic kerbside	N/A	N/A	0%	100%	0%	0%	0%
General	N/A	N/A	66.1%	33.2%	0.2%	0.1%	0.5%
Special	N/A	N/A	12.9%	87.1%	0%	0%	0%
Unweighed vehicles	N/A	N/A	52.5%	46.7%	0.6%	0.2%	0%

A significant proportion of all of the waste streams disposed of at Spicer landfill have been generated in Wellington City. While transport issues for the waste carriers, such as travel times and the distance between the generator and the landfill, are likely a factor, the pricing differential is also likely to be an incentive for waste disposal at Spicer. As the gate charge at Southern was lowered in July 2006 to $78/tonne, another source survey may show that waste flows have changed.

Discussion

It is to be expected that the waste disposal market reacts to changes in pricing structure at landfills. This is shown most clearly by the sudden increase in waste being disposed of at Spicer landfill for the short period in September 2004 when there was close to a $20/tonne differential between the gate charges at Spicer and Northern. The market's reaction to gate charges is also shown by the decrease in tonnages of general waste to Southern landfill after the increase in gate charges at Southern in April 2003.

Given the distances between the landfills in the region, however, it is not expected that substantial changes in waste flows would result without considerable differential in gate charges. The sharp increase in waste being disposed of at Spicer landfill (presumably waste that would otherwise have been disposed of at Northern landfill) in 2004 is largely due to its proximity to Northern landfill.

It would be expected that the "general" waste market would be most inclined to shift to follow changes in gate charges. The unweighed vehicle sector is generally less well-informed about pricing issues, and is likely to use a disposal facility based on its

convenience, rather than the cost. The cleanfill sector, for the most part, pays disposal rates that are markedly lower than the gate charge, and would have less financial incentive to change disposal facilities than the "general" waste market.

During the MfE source survey at Spicer landfill, the 388 vehicles, mainly trucks, carrying waste classified as "general" had an average load weight of 2.6 tonnes. For the short period when there was a $20/tonne price differential between Northern and Spicer, a vehicle carrying the average load of waste would have saved $52 by disposing of the load at Spicer. This is assuming that the full gate charge was being paid.

A saving of this magnitude must be balanced against the extra distance travelled, the extra time involved, and, for commercial waste operators, the disruption to normal collection schedules. One confidential estimate puts the total cost of running a large waste vehicle at approximately $5/km. At that cost, a $52 saving in the landfill gate charge would be offset by travelling only an extra 10 kilometres.

While the waste disposal market will doubtlessly react to large differentials in gate charges, for large commercial operators any changes to disposal pathways will be based on economic calculations involving the extra costs involved. The effect of gate charges may be greatest for small waste operators, for whom travelling extra distances may be considered worthwhile.

7 Evaluation of the waste catchment model

7.1 Overseas use of the catchment model for waste monitoring

Internet research indicates that the concept of a "waste catchment" is widespread throughout the English-speaking world. In several American states, Oregon and West Virginia for instance, "wastesheds" are legal entities that have been established to assist local government in regulating the waste industry and managing solid waste.

Following are quotes from documents showing examples of usage of the concept:

- From New Mexico's draft Solid Waste Management Plan 2006:[6]

"…a Solid Waste Facilities Map that identifies site locations as well as service areas, or "waste sheds." This map connects transfer stations and public convenience centers with destination disposal sites. Boundaries would be estimated in order to evaluate population equivalents, haul distances, etc; and most importantly, highlight areas that require new facilities and/or financial assistance. This is a more functional approach than using the six NMED Solid Waste Districts, which were established for enforcement purposes, not to reflect disposal market conditions.

- From West Virginia's Solid Waste Management Plan[7]

"The State has 55 counties and 50 Solid Waste Authorities (SWA).... The State Legislature mandated that the Solid Waste Management Board designate solid waste management sheds, or "wastesheds," to promote cooperative efforts among SWAs. In 1993, the SWMB designated seven wastesheds in West Virginia according to the geographical proximity of counties and their local solid waste management needs."

- Also from West Virginia[8]

"Some of the differences in the solid waste stream and management alternatives can be attributed to geographic region and population densities. As a result, for the purposes of analysis and because they already exist, all counties in the state are grouped and analyzed on the basis of wastesheds. First established in 1978, wastesheds are those areas which have common solid waste management problems and are appropriate units for planning solid waste management services."

- From Oregon[9]

A "wasteshed" is an area with a common solid waste disposal system or an area designated by the Environmental Quality Commission as appropriate for development of a common recycling program.

- Also relating to Oregon[10]

[6] http://www.nmenv.state.nm.us/swb/pdf/SWMPBody5.pdf
[7] http://www.state.wv.us/swmb/St%20Plan%20PDF/Chapter4.pdf
[8] http://www.state.wv.us/swmb/2005%20State%20Plan/Chapter%201.pdf #search=%22monitor%20waste%20reduction%20wasteshed%22
[9] http://www.metro-region.org/library_docs/auditor/rsfcprgm.pdf# search=%22%20monitor%20%22wasteshed%22%22
[10] http://www.p2pays.org/ref/08/07857.pdf#search=%22%20monitor%20%22wasteshed%22%22

"Oregon uses its CASE program to calculate their state and county recovery rates. The CASE program calculates each county's "wasteshed" recovery rate. The program then uses these county wasteshed profiles to calculate the statewide recovery rate profile."

Although the concept of "waste sheds" (or "wastesheds", in some instances) is widely used in America, there are few definitions provided. The most detailed definition that could be found is from an annual report of a New York waste operator, Casella:[11]

"Within each geographic region, we organize our solid waste services around smaller areas that we refer to as "wastesheds." A wasteshed is an area that comprises the complete cycle of activities in the solid waste services process, from collection to transfer operations and recycling to disposal in either landfills or waste-to-energy facilities, some of which may be owned and operated by third parties."

Outside of the USA, the term "waste catchment" is more commonly used than "waste shed". In Denmark's Solid Waste Management Plan, "waste catchments" are delineated as areas that feed into "waste regions", focused on incinerator sites. "Waste catchment", as a concept, is also used in several countries in southern Africa and in Australia.

The "waste catchment" idea is recognised and defined by Christchurch City Council in its 2006 submission on the Waste Minimisation (Solids) Bill:[12]

"Authorities cooperating regionally or in "waste catchments" (i.e. natural boundaries exist that limit the flow of waste due to demographic, geographic and economic factors) for improved waste management and minimisation……Please note the Council envisages no more than five regional groups operating in New Zealand and these groups would not necessarily reflect local government boundaries, but the natural boundaries related to the flow of waste, which may change over time and as neighbouring communities join into the various groups."

Evidence is readily available of there being widespread recognition of the need for waste management issues to be dealt with at a scale that is not necessarily related to any other functional unit. There is, however, less evidence that waste catchments are being used by government for waste policy monitoring purposes.

In Portland, Oregon, where "waste sheds" are defined by statute, extensive monitoring and reporting are undertaken, based on the waste sheds.[13] In Australia, in 2000, draft standard reporting protocols, using waste catchment as a reporting unit, were developed on behalf of the New South Wales Waste Boards.[14]

The California Integrated Waste Management Board considered using the concept as a basis for improving data for the state's mandatory diversion rate calculations.[15] While it was considered that "*establishing regions according to wastesheds and measuring disposal by region*" would increase accuracy, be verifiable, cost-effective, enforceable, and provide ease of use and flexibility, the idea was considered to be a low-priority and was not proceeded with.

[11] http://www.casella.com/files/pdf/cws_annual_2004.pdf#search=%22%20monitor%20%22wasteshed%22%22
[12] http://www.ccc.govt.nz/Council/proceedings/2006/August/CnclCover17th/Clause7Attachment1.pdf #search=%22%22waste%20catchment%22%20australia%22
[13] http://www.metro-region.org/article.cfm?articleid=585
[14] http://www.shoalhaven.nsw.gov.au/council/pubdocs/soe/region/Indicator %20Results%2000/WasteIndicatorsfuturetable%2000.htm
[15] www.ciwmb.ca.gov/Publications/ LocalAsst/34001017AppD.doc

7.2 Evaluation of the catchment model for solid waste monitoring

7.2.1 Suitability of the Wellington catchment

In Waste Not Consulting's 2005 "Waste Composition and Construction Waste Data" report to MfE, a list of attributes were identified that would determine a catchments suitability for long-term monitoring of solid waste data. The Wellington catchment is evaluated according to these attributes in the following table.

Table 7.1 – Attributes of Wellington catchment

Identifiable waste flows that are contained within a discrete area	The geographic and demographic factors affecting the Wellington catchment results in a large, largely urban waste catchment that is effectively isolated from surrounding districts. This isolation is primarily due to the economic disincentives to transporting waste out of the catchment.
Little "leakage" into or from surrounding catchments	The results of the source survey indicate a very low rate of "leakage" into the catchment from surrounding districts. Anecdotal evidence suggests there are no significant waste flows out of the catchment.
Cooperative local authorities within the catchment with a commitment to long-term waste monitoring	All of the local authority officers dealt with during the course of the project were supportive of the research and provided information as requested. The local authorities' commitment to long-term waste monitoring varies, with Kapiti Coast placing a lower priority on waste data than the others.
Cooperative disposal facility operators	All of the disposal facilities in the Wellington catchment are owned by local authorities, and all information that was sought for the project was provided.
Adequate record-keeping by the disposal facility operators	Of the five landfills currently operating in the catchment, four have weighbridges and keep detailed records. The fifth, Otaihanga, keeps records that are rudimentary, but adequate. Otaihanga landfill accepts less than 10% of waste in the catchment.
Compatible systems of record keeping	All of the landfill records were structured in such a way that the five main classifications of waste could be separated and analysed.
A functional scale i.e. the number of disposal facilities being suitable for the resourcing available for monitoring	The Wellington catchment contains a relatively high number of landfills in relation to its population. While the resourcing required for the analysis of landfill records is not large, the cost of source surveys and SWAP composition surveys for five landfills would be much greater.

7.2.2 Assessment of the Wellington catchment study

The investigations into waste flows in the Wellington catchment have produced results that appear to be accurate and reliable, and that are well-suited for long-term monitoring of the relevant targets in the New Zealand Waste Strategy. The keys for achieving this accuracy and reliability have been the method for analysing and combining the weighbridge records, particularly the separate tracking of the five waste categories, and the MfE source survey.

The single most important aspect of the research has been the statistical "unpicking" of the waste streams, particularly the separation of cleanfill from the other waste streams. The lack of availability of data regarding cleanfill disposal at cleanfill sites means, and this applies to all waste data analysis, that tracking landfill data on its own is of little value. Cover material/cleanfill comprises over 30% of waste entering landfills in the Wellington catchment. Previous research indicates that at least as much again may be disposed of to cleanfill sites.[16] Changes in cleanfill flows between the two disposal pathways, such as cleanfill sites opening or closing, or pricing changes, could result in changes to landfill tonnages that make monitoring targets in the NZWS impossible.

While it is recognised that the monitoring of waste to cleanfill sites will, ultimately, be an important element of national waste monitoring, until that can be achieved the best alternative is to analyse the waste streams separately. The monitoring of waste to cleanfill may, ultimately, determine the proportion of waste entering these facilities that is not, strictly speaking, cleanfill. There is no evidence as to how widespread such disposal is or on the magnitude of the non-cleanfill waste stream entering cleanfill facilities.

The MfE source survey has established that "leakage" to and from the catchment is insignificant, comprising less than 0.2% of total waste, by weight. While self-reporting by truck drivers is not necessarily an accurate measurement, and waste operators may perceive self-advantage in not disclosing the origin of out-of-area waste, there is a consistency in the results that suggests the data are largely reliable. This is shown particularly by the results from Spicer landfill, where a high percentage of general waste has been reported as arising in Wellington City.

The MfE source survey has also allowed the waste streams to be further "unpicked", by allowing a breakdown of each waste stream by geographic source. This allows calculation of reliable per capita generation figures, which are often produced without due attention to the actual geographic source of waste. With the use of GDP/per capita data, which are available, by district, from BERL[17] or Infometrics, underlying trends in waste generation and its relation to economic conditions could be established.

Overall, the methodology used for this research has proven to be relatively straightforward, could be readily transferred to other catchments, and has generated reliable information that would meet several of MfE's long-term monitoring objectives.

[16] Waste Not Consulting (2005) Waste Composition and Construction Waste Data, report to MfE
[17] http://www.berl.co.nz/display.aspx?pri=37&sec=88&cid=457&provider=0&tpl=0

7.2.3 Recommendations for long-term monitoring of the Wellington catchment

If MfE chooses to undertake further research on the Wellington catchment, it is recommended that:

- Commercial waste operators again be approached to supply data on domestic kerbside refuse collections. Baseline data on generation of this waste stream are still lacking.
- Landfill records prior to 2003 be analysed in the same manner as for this report to better establish baseline data. This would be contingent upon weighbridge records being available.
- That SWAP waste composition data from audits undertaken in recent years at Silverstream and Southern landfills be integrated into the existing database, if it is considered that this would provide useful information
- GDP per capita data be obtained for the districts in the Wellington catchment, and the relationships between economic activity and waste generation be established.
- Source surveys be undertaken at Spicer and Southern landfills to complement any further research. Further source surveys at Silverstream, Wainuiomata, and Otaihanga landfills are a lower priority, as it has been shown that a high proportion waste disposed of at those facilities is generated in the surrounding district.
- Consideration be given to excluding Otaihanga landfill from the catchment. The MfE source surveys found very little waste "leaking" either into or from the catchment, and the data produced from the site are of markedly lower quality than the other facilities. The Otaihanga landfill is the only one of the facilities that is likely to close in the near future, and its exclusion at the earliest opportunity would mean the data for the catchment do not have to be re-analysed at a later time.
- Waste transport to Bonny Glen landfill by Waste Management NZ Ltd be monitored.
- Long-term, cleanfill sites will need to be included in the catchment study to achieve all of MfE's monitoring objectives. Discussions with the operators will need to be entered into as soon as possible, as their cooperation is not apt to be immediately forthcoming.

7.2.4 Comparison with "*Measuring up 2005*"

The effectiveness of the methods used in this research in gaining a meaningful understanding of waste flows can be seen by comparing the results of the current research to those of "*Measuring up 2005*", the Greater Wellington Regional Council's State of the Environment report. With regards to waste disposal, the report concludes:[18]

"The volume of solid waste arriving at landfills has been dropping, mostly because a lot of green waste is now kept back for composting. If we can divert more glass, plastic and paper away from the tip and into recycling bins, solid waste volumes should come down even further."

The background report for "*Measuring up 2005*", from which this conclusion has been taken, includes the following:[19]

[18] http://www.gw.govt.nz/story13121.cfm?

[19] Forsyth (2005) – Waste management and hazardous substances – background report, report to Greater Wellington Regional Council

"There are two privately operated landfills in the region……Most waste accepted at these private landfills is cleanfill but Greater Wellington has no annual volume data from them. All references to landfills in this report are to the municipal landfills"

The traditional analysis of landfill tonnages in "*Measuring up 2005*" has resulted in what could be a markedly different conclusion to that which would have resulted if the cleanfill waste had been analysed separately. While waste to the municipal landfills may have declined over the period analysed, this information says little about waste generation or disposal in the region. The size of the cleanfill waste stream, and the presence of alternative disposal pathways which have not been measured, makes the analysis of limited value.

Further analysis of the background document supporting "*Measuring Up 2005*" demonstrates the usefulness of the MfE source survey in generating accurate data. The document contains figures on per capita waste generation, but these figures are based on every landfill serving only the residents of the city in which it is situated. As a result, the per capita figures for Wellington and Porirua are markedly different than those calculated in this report, due to the significant trans-boundary movement of waste into Spicer landfill in Porirua.

7.3 Assessment of the catchment model for national monitoring

This project has established that researching waste data at the catchment level results in all of the advantages posited in Section 1.2.4. There are no indications that the long-term study of several waste catchments throughout New Zealand would not be a cost-effective, accurate means of monitoring the relevant targets in the New Zealand Waste Strategy.

The most important information generated by this research is the per capita waste generation figures for the catchment. While these per capita waste generation figures could be extrapolated to a larger scale, the comparison of these figures to GDP/per capita data for each district would provide important information. The "uncoupling" of waste generation and economic activity is seen as a primary objective of the Government's waste minimisation policy, and this should be monitored if possible.

Identifying waste catchments for long-term monitoring would be relatively straightforward. Discussions with local council officers and landfill operators would quickly establish whether the requisite degree of cooperation would be forthcoming and whether the catchment is sufficiently "self-contained" in terms of waste generation and disposal.

Initial work in the selected indicator catchments would involve analysis of all available historic weighbridge records to establish baseline historic data. Source surveys may be needed initially, to establish the degree of "leakage" into and out of the catchment. These would not need to be repeated on a frequent basis.

The basic element of the monitoring, the analysis of weighbridge records to separate the various waste streams, has proven to be extremely resource-efficient. While the initial analysis may involve consultation with the weighbridge operators, subsequent analyses of annual records could be completed within a matter of hours.

On its own, this basic monitoring of weighbridge records in several self-contained catchments would provide more accurate information on waste disposal than is currently available. The resourcing required for this level of monitoring would be minimal.

Beyond the minimal resourcing required for the weighbridge record monitoring, MfE would have a high degree of flexibility with its monitoring programme and its resource requirements. Once a catchment monitoring programme has been established, MfE would have the option of conducting in-depth investigations into particular components of the waste stream that are of interest.

The weighbridge record analysis used for this study has been so effective and efficient that consideration should be given to attempting to do it on a national level. A five-yearly analysis of all available weighbridge records would provide a very accurate "snapshot" of waste disposal in New Zealand, and would provide a means of calibrating the data gathered through catchment monitoring.

7.3.1.1 Other possible catchments

Should MfE choose to investigate further the establishment of a national waste monitoring programme based on waste catchments, the following catchments should be considered:

1) Canterbury – The area within Canterbury Regional Council's boundaries is currently served by four landfills. For many years, Christchurch City Council has generated high-quality waste data, and, recently, Environment Canterbury has produced a report on waste flows within the region that contains many elements of the research presented in this report.[20] Although none of the research available publicly addresses the issue of "leakage" of waste in or out of the study area, it is likely, given the geography of the region, that well-defined waste catchments do exist.

2) Queenstown – The council-owned Victoria Flats landfill accepts waste from Queenstown and transfer stations at Wanaka, Cromwell, and Alexandra. SWAP audits of the landfill have been undertaken twice by Waste Not Consulting, and the District Council is currently very active in waste minimisation. The landfill produces good quality weighbridge records. Given the geography and population density of the region, it is likely that very little waste generated in the areas served by the landfill is disposed of elsewhere.

3) Southland – The AB Lime landfill, near Winton, is the new regional landfill for the Southland region, serving Invercargill and Gore. The level of cooperation that might be forthcoming from the local authorities or the landfill operators is not known, but the landfill is likely the disposal facility for a self-contained waste catchment.

4) Rotorua – The council-owned Rotorua District Landfill serves Rotorua City and four small local transfer stations. It is unlikely that any waste "leaks" in or out of the catchment. Waste Not Consulting has undertaken SWAP audits for the District Council in 2003 and 2005. The landfill produces good quality weighbridge records.

5) Rodney District – Although Rodney District is not a "waste catchment" in the same way as the other catchments, research undertaken by Waste Not Consulting for the district council has produced very satisfactory results. Redvale, the largest landfill in

[20] http://www.ecan.govt.nz/Plans+and+Reports/Waste/

the country, is in the district, and so attracts virtually all of the waste generated in the district. Redvale keeps excellent records, including the geographic source of waste loads, and is very cooperative in sharing data with local government. The recent research by Waste Not involved collecting data from all waste operators in the District, and matching this to the landfill records for the same period. The correlation was nearly perfect, suggesting the data are very accurate.

6) Auckland to Hamilton – The Auckland-Hamilton corridor contains about 1.3 million residents. The area is served by Redvale landfill, north of Auckland, Whitford landfill, east of Auckland, Hampton Downs landfill, south of Auckland, and Horotiu landfill, north of Hamilton. There are approximately 15–20 transfer stations in the area that dispose of refuse at the landfills.

   Other than waste from Whangarei that is transported to Redvale, it is understood that no other waste from out of the catchment is disposed of at the landfills. However, the boundaries of the catchment to the south and east of Hamilton are not well-defined.

   Waste Not Consulting has undertaken SWAP surveys at Redvale, Whitford, and Horotiu. All maintain excellent weighbridge records, and it would be expected that Hampton Downs does as well.

   Due to the large number of transfer stations in the Auckland–Hamilton waste catchment, it would not be well-suited to any in-depth investigations into the waste stream. However, long-term regular analysis of the weighbridge records from the four landfills would provide valuable information on the waste disposal of nearly a third of New Zealanders.

Appendix 1 – Special wastes – by landfill

Northern Landfill – special wastes (tonnes per annum)	**2003**	**2004**	**2005**
Living Earth compost to landfill	1310		

Otaihanga Landfill – special wastes (tonnes per annum)	**2003**	**2004**	**2005**
None identified	0	0	0

Silverstream Landfill – special wastes (tonnes per annum)	**2003**	**2004**	**2005**
Asbestos	606	752	390
Chemwaste material	1362	2254	1976
GNB lime sludge	1048	1281	1370
GNB lead slag special	7249	157	3
Medical waste - Nuplex	971	983	1008
Milliscreen	750	728	761
Nuplex D-Pit material	2455	3365	5453
Nuplex – Hard paint & ink etc		28	108
Sewage pellets	3561	3522	3715
Slip waste		11,563	379
Sewage cake	71	811	7
Special waste	442	1582	551
KW	505		
WRC sludge from Te Marua treatment plant	1118	1006	1240
Pine Hill Development	1907		
United Enviro sludge	911		

Southern Landfill – special wastes (tonnes per annum)	**2003**	**2004**	**2005**
TP product to tip face	2107	3551	10,390
Living Earth compost	1616		
Sewage grit, screenings, and sludge	431	349	722
Taylor Preston DAF scum	1160		
Special and contaminated waste	226	235	8753

Spicer Landfill – special wastes (tonnes per annum)	**2003**	**2004**	**2005**
Waste water treatment plant	8871	8555	8381
Special waste	219	115	94

Wainuiomata Landfill – special wastes (tonnes per annum)	**2003**	**2004**	**2005**
WRC sludge from Wainui treatment plant	626	574	463
GNB slag	207	8367	3595
Settlement pond clearings		511	652
Slip clearing		115	77

Appendix 2 – Letter to waste operators

Dear <<firstname>>,

The Ministry for the Environment is testing a new way of monitoring the flow of waste as part of its development of tools for monitoring waste. We are working with local authorities in the Wellington Region and "Waste Not Consulting" to determine the boundaries of a waste "catchment" in the Wellington Region. We are doing this by compiling and analysing all waste disposal records for the disposal facilities in the region. We hope that looking at all of the waste flows within a single region will give a more accurate picture of waste disposal trends than the monitoring of individual disposal facilities.

Domestic kerbside refuse is an important part of the waste flow in the region. Because a high proportion of domestic kerbside collections are undertaken by the commercial sector we are seeking the co-operation of commercial collectors. All information supplied will be treated as **strictly confidential**, and any results that are made public will be in an aggregated form.

Your co-operation in supplying the following information would be greatly appreciated:

1) How many tonnes of domestic kerbside refuse did your organisation collect in Hutt City for each of the last three years?

2) How many tonnes of domestic kerbside refuse did your organisation collect in Kapiti Coast District for each of the last three years?

3) How many tonnes of domestic kerbside refuse did your organisation collect in Porirua City for each of the last three years?

4) How many tonnes of domestic kerbside refuse did your organisation collect in Wellington City for each of the last three years?

The Ministry recognises the important role waste operators play in managing waste in New Zealand. We gratefully acknowledge your contribution to this project that will help us evaluate the potential of "waste catchments" as a long term monitoring tool for waste, and we will acknowledge your help in our final reports.

Please send your responses to:
Bruce Middleton (Waste Not Consulting)
Email: bruce@wastenot.co.nz

We would appreciate this information by **Monday 12 June 2006**.

If you have any questions or comments about this information please contact:
Shaun Lewis, Senior Advisor, Ministry for the Environment
Ph: 439 7520
Email shaun.lewis@mfe.govt.nz

Yours sincerely

Mary-Anne MacLeod
General Manager
Reporting and Review Group