



Ministry for the
Environment
Manatū Mō Te Taiao

The 2006/07 National Landfill Census

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Table 1: Summary results from the National Landfill Census (1995, 1998/99, 2006/07) and Landfill Review and Audit (2002)

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Executive Summary

The aim of the National Landfill Census is to review the progress that has been made against previous National Landfill Census results in 1995 and 1998/99, and the Landfill Review and Audit in 2001/02. The information was gathered using a survey, which was sent out to landfill site operators and some regional authorities. The questionnaire has remained relatively unchanged from previous years to ensure continuity of time-series data. The focus of the questionnaire was on the siting, design, monitoring and operation of landfills.

The results show that New Zealand landfills continue to improve and move towards generally accepted best practice. The survey found that the total number of operating landfills continued to decrease, down 48 per cent from 2002. All landfills now have the appropriate resource consents to operate. Landfill design has shown significant progress: over half of all landfills have an engineered liner in place to prevent leachate, and over three-quarters of landfills collect leachate. Over 80 per cent of landfills require documentation when hazardous waste is disposed of, and over 90 per cent measure and charge for the disposal of waste.

The survey also identified areas that need to improve. Although the proportion of landfills collecting landfill gas has doubled since 2002, this still only occurs in one-fifth. The percentage of landfills sited on low-permeability underlying material has stayed the same since 1998/99.

Additional progress in some areas is hindered by various factors, the most problematic being the length of consent periods granted under the Resource Management Act 1991 (RMA) (up to 35 years). In some cases, landfills that received consent to operate soon after the introduction of the RMA could still have consent to operate until after 2020 even though they do not meet present best practice. Upgrading these landfills to comply with best practice before the consent period is up can be considered impractical because the cost is high.

With landfill numbers decreasing and improvements in landfill design and operation, the 2006/07 National Landfill Census shows that the smaller, substandard landfills are making way for larger landfills more in line with best practice. Cooperation among local authorities has helped this process. There is likely to be further opportunity for change when existing resource consents for landfills come up for renewal.

To ensure progress continues the Ministry will:

- continue to promote and update the existing guidance for landfill siting, design, operation and closure
- review the Landfill Census process to ensure data collection is effective.

1 Background

1.1 Purpose

The National Landfill Census brings together information on all operating landfill sites in New Zealand. The census is undertaken at regular intervals, with previous surveys in 1995, 1998/99 and 2002. The reports are used to indicate the state of play of landfill operations in New Zealand.

Survey information feeds directly into work to assess whether targets in the New Zealand Waste Strategy (NZWS) (Ministry for the Environment, 2002b) are being met. The NZWS sets the strategic direction for waste policy in this country. The goals of the Strategy are to:

- lower the costs and risks of waste to society
- reduce environmental damage from the generation and disposal of waste
- increase economic benefit by using material resources more efficiently.

The most recent assessment of progress towards the NZWS targets is provided in the report *Targets in the New Zealand Waste Strategy: 2006 Review of Progress* (Ministry for the Environment, 2007). Information from this census was used in the preparation of the targets in the 2006 Review of Progress report.

1.2 Good practice for landfills in New Zealand

Six documents endorsed by central government provide guidance on good practice in managing New Zealand landfills. Three of these guidelines are especially important for operating landfills, and they are briefly described below.

1.2.1 Landfill guidelines

The Ministry for the Environment endorses the *Landfill Guidelines* (Centre for Advanced Engineering, 1992) as good practice in landfill design, siting and operation in New Zealand. There have been a number of updates to these guidelines, the most recent in 2000. The guidelines advocate:

- siting landfills on a clay base
- using an engineered liner system
- collecting, treating and/or using leachate, stormwater and landfill gas
- having controls on the types of waste accepted for disposal
- monitoring the discharges from the site
- ensuring adequate separation from sensitive receiving environments (such as surface water and groundwater).

1.2.2 Hazardous waste guidelines

The Hazardous Waste Guidelines: Landfill Waste Acceptance Criteria and Landfill Classification (Ministry for the Environment, 2004a) are used to determine whether a waste is acceptable for disposal at a specific landfill. The guidelines offer two things: a method for classifying landfills into two classes based on the level of natural and engineered containment, and best practice guidance on waste acceptance criteria for these two landfill classes (that is, what hazardous waste can be accepted at each class).

1.2.3 Landfill full cost accounting guide

The Landfill Full Cost Accounting Guide for New Zealand (Ministry for the Environment, 1996) helps decision-makers implement a full cost accounting approach to landfills. Landfill planning, development, operation, closure and after care are all taken into consideration. In 2004 the guide was updated to include:

- provision for multiple liner designs
- the ability to ramp charges over time
- the ability to forecast annual waste quantity
- additional reporting tools (Ministry for the Environment, 2004b).

The other good practice guidelines for landfills include:

- *The Hazards of Burning at Landfills* (Ministry for the Environment, 1997a)
- *A Guide to the Management of Closing and Closed Landfills in New Zealand* (Ministry for the Environment, 2001b)
- *A Guide to Landfill Consent Conditions* (Ministry for the Environment, 2001a).

1.3 Previous reports

1.3.1 1995 National Landfill Census

The 1995 National Landfill Census Report (Ministry for the Environment, 1997b) was the first of its kind. It was undertaken four years after the RMA came into effect, which meant many landfill sites had yet to transfer from former legislative controls.

The following were identified by the Census as areas for future attention:

- address RMA compliance
- develop a definition and acceptance criteria for hazardous and special wastes
- further develop national landfill guidelines
- provide more information on the effects of, and means to control, landfill burning
- training programmes for landfill operators.

As a result of the 1995 census, the Ministry for the Environment developed the following additions to the 1992 landfill guidelines:

- the *Landfill Full Cost Accounting Guide for New Zealand*
- *The Hazards of Burning at Landfills*.

1.3.2 1998/99 National Landfill Census

The 1998/99 National Landfill Census Report (Ministry for the Environment, 2000) showed improvements in landfill practice from the 1995 census. More landfills had consent to operate, there was less open burning at landfills and an increase in operator training. However, there were also some gaps in hazardous waste management, levels of compliance and management of closed sites.

To address these issues, the Ministry for the Environment produced a number of guidance documents, including:

- *A Guide to the Management of Closing and Closed Landfill in New Zealand*
- *A Guide to Landfill Consent Conditions*
- *A Guide to the Management of Cleanfills* (Ministry for the Environment, 2002a)
- updates to *The Landfill Full Cost Accounting Guide*
- updates to *The Landfill Guidelines*.

1.3.3 2002 Landfill Review and Audit

The 2002 Landfill Review and Audit (Ministry for the Environment, 2003) took a different approach from the previous two surveys. In addition to the usual questions, a landfill rapid-screening system was used to assess the risks associated with landfills across New Zealand. It found there was a trend towards improved siting, design and operation of landfills across the country. In addition to this, older operations had improved their practices and there was a gradual replacement of older landfills with modern facilities.

However, the audit also found that some landfills given resource consent to operate before the RMA came into effect could legally operate until after 2020, regardless of siting, design and operation.

Since the 2002 audit the Ministry for the Environment has produced the following guidance:

- updates to the *Landfill Full Cost Accounting Guide for New Zealand*
- *Hazardous Waste Guidelines: Landfill Waste Acceptance Criteria and Landfill Classification*.

2 The 2006/07 National Landfill Census

2.1 Aims

The 2006/07 National Landfill Census has two main aims:

- to build on the results from the previous National Landfill Census reports in 1995 and 1998/99 and the Landfill Review and Audit in 2002
- to check on progress towards landfill-related targets in the New Zealand Waste Strategy.

In doing this, it aims to help identify areas where guidance is required or where further attention is warranted by the Ministry.

2.2 Method

Core questions from previous surveys were retained in the 2006/07 Census in order to ensure comparisons could be made over time. The majority of questions focus on the design of the landfills, but there are also questions on the siting, monitoring and operation of landfills.

Data for the 2006/07 Census were collected using a survey completed by site operators and some regional authorities (60 responses in total). Some surveys were followed up by telephone conversations to improve completeness. The content of the survey questionnaire is contained in Appendix 1.

2.3 Results

A comparison of the summary results from the National Landfill Census (1995, 1998/99 and 2006/07) and Landfill Review and Audit (2002) is shown in Table 1. Further discussion of the results follows the table. Overall, the results indicate that landfill design and operation in New Zealand has continued to improve.

- The total number of operating landfills continues to decrease.
- All landfill sites in operation have the appropriate consent to do so.
- The management of leachate, landfill gas and hazardous waste has improved.
- The large majority of landfills now weigh or measure waste disposed of, and charge for disposal.

Table 1: Summary results from the National Landfill Census (1995, 1998/99, 2006/07) and Landfill Review and Audit (2002)

	1995	1998/99	2002	2006/07
Total number of operating sites	327	209	115	60
Sites with consent to operate	– ^a	157	104	60
Low-permeability underlying material	–	10%	15%	12%
Leachate management system				
Engineered liner	–	4%	20%	54%
Leachate collection system	13%	35%	47%	77% (47) ^b
Leachate recirculation	–	7%	10%	–
Stormwater management system				
Stormwater diversion	41%	67%	74%	–
Stormwater monitoring	–	23%	50%	–
Stormwater treatment	9%	27%	36%	–
Landfill gas management system				
Landfill gas monitoring	3%	11%	27%	–
Landfill gas collection (flaring or beneficial use)	–	5% (10)	10% (12)	22% (13)
Landfill fires	52%	24%	17%	0% ^c
Hazardous waste management				
Hazardous waste accepted	33%	20%	–	50% (30) ^d
Documentation required	–	33%	53%	83%
Quantifying waste and disposal charges				
Measuring the quantity of waste	39%	63%	83%	93%
Charging for the disposal of waste	–	45%	82%	93%

Notes

- a A dash (–) indicates that information was not requested in the survey.
- b Two landfills replied that a natural collection of leachate occurs at their respective landfills. These two landfills have been included as having a leachate collection system.
- c Landfill fires are now banned under the National Environmental Standards for air quality.
- d Five landfills replied that the only hazardous waste they accept is wrapped asbestos or special waste. These five landfills have been included as accepting hazardous waste.

Note: figures in brackets represent the total number of landfills discussed.

2.3.1 General

Numbers of consented landfills

The number of operating landfills in New Zealand continues to decrease. There were 327 operating landfills in 1995, 209 in 1998/99, 115 in 2002 and 60 in 2006/07. One hundred per cent of landfills operating in New Zealand now have consent to operate. This has increased from 90 per cent (104 sites) in 2002 and 75 per cent (157 sites) in 1998/99.

Landfill siting

Twelve per cent of landfills (seven sites) are situated on low-permeability underlying material. This has decreased from 15 per cent (17 sites) in 2002, but is an increase from 10 per cent (20 sites) in 1998/99. Clay is the only material in New Zealand considered low permeability for landfill sites. Other common underlying materials include alluvial gravels, greywacke and sandstone/siltstone, which are permeable.

2.3.2 Landfill design

Leachate prevention

Fifty-four per cent of landfills (33 sites) have some form of engineered liner. This has increased from 20 per cent (23 sites) in 2002 and 4 per cent (eight sites) in 1998/99. The liner of choice is an engineered clay layer (26 sites). Other systems use a high-density polyethylene/geomembrane design (21 sites) or a geosynthetic layer (15 sites). Many landfills use more than one system of liner.

Leachate collection

Seventy-seven per cent of landfills (47 sites) have a system in place to collect leachate. This has increased from 47 per cent (54 sites) in 2002, 35 per cent (73 sites) in 1998/99 and 13 per cent (42 sites) in 1995. There are various systems in place to do this. The majority of landfills use an under-drain (34 sites) and many use cut-off drains (17 sites). Other systems include collection ponds, cut-off walls and perforated pipes feeding into sewer lines. Two landfills indicated that a natural collection of leachate occurs at their respective landfills. These two landfills have been included as having a leachate collection system.

Leachate treatment

Eighty per cent of landfills (48 sites) treat their leachate. The majority send it off-site to local wastewater treatment plants or settling ponds (30 sites). On-site leachate treatment occurs at 19 sites. Two landfills treat leachate on-site before sending it off-site for further treatment.

The most common on-site treatment system is settling ponds (17 sites), with a small proportion choosing irrigation to land (five sites). Other on-site treatments include leachate recirculation through landfill (two sites) and leachate dispersal to enhanced wetland (one site). Some landfills use more than one form of on-site treatment.

Gas treatment

Twenty-two per cent of landfills (13 sites) collect gas for flaring or beneficial use. This has increased from 10 per cent (12 sites) in 2002 and 5 per cent (10 sites) in 1998/99. Beneficial uses include reticulating the gas for industrial use and electricity generation. In total, 14 sites collect gas, 11 flare it and six generate electricity from it. A handful of sites do all of these. Three sites have indicated they are moving towards implementing some form of gas usage system.

2.3.3 Landfill operation

Quantifying waste

Ninety-three per cent of landfills (56 sites) measure the amount of waste they dispose. This has increased from 83 per cent (95 sites) in 2002, 63 per cent (132 sites) in 1998/99 and 39 per cent (128 sites) in 1995. Two privately owned and operated landfills indicated that this information was commercially sensitive. These sites were included as measuring the amount of waste disposed.

Disposal charges

Ninety-three per cent of landfills (56 sites) charge for the disposal of waste, up from 82 per cent (94 sites) in 2002 and 45 per cent (94 sites) in 1998/99.

2.3.4 Hazardous waste

Acceptance

Fifty per cent of landfills (30 sites) accept hazardous waste. This has increased from 20 per cent (41 sites) in 1998/99 and 33 per cent (108 sites) in 1995. This may reflect the increasing number of new sites that are designed to accept hazardous materials. Five landfills replied that the only hazardous waste they accept is wrapped asbestos or special waste. These five landfills have been included as accepting hazardous waste.

Documentation

Of the 50 per cent of landfills (30 sites) that accept hazardous waste, 83 per cent (25 sites) require documentation. This has increased from 53 per cent in 2002 and 33 per cent (14 sites) in 1998/99.

3 Discussion

These results show that improvements have been made in landfill design and operation compared to previous years. The number of landfills continues to decrease, down 48 per cent from 2002. The proportion of landfills collecting leachate and requiring documentation for hazardous waste disposal has increased substantially. Only four landfills do not measure and charge for the disposal of waste.

Improvements can still be made in the siting and design of landfills in New Zealand, particularly in relation to underlying material, engineered liners and landfill gas collection. The following discusses these areas for improvement.

3.1 Underlying material

Because engineered liner systems have a finite lifetime, the ability of the underlying materials to minimise the potential for liquids to migrate out of the landfills into the environment if the liner degrades, tears or cracks needs careful consideration (Centre for Advanced Engineering, 2000).

Having low-permeability underlying material is important at landfill sites because it ensures a high level of natural leachate containment. This reduces the reliance on engineered liner systems (which have a finite lifetime), allows for more efficient and effective site management, and can result in savings in development and operating costs (Centre for Advanced Engineering, 2000).

However, since the 1998/99 survey the percentage of landfills with low-permeability underlying material, as recommended in the landfill guidelines, has remained at between 10 and 15 per cent. Progress has been hindered by the following factors.

- Many landfills sited on high-permeability underlying material have consent to operate until past 2020.
- In more remote locations, small landfills are often built on local sites to avoid high transfer/transport costs, and these local sites may be on high-permeability underlying material.
- Suitable geology can be absent or rare in some areas of New Zealand.
- When a low-permeability site is found, community resistance (the NIMBY effect) can make it unworkable.

3.2 Engineered liners

The migration of leachate into aquifer systems is a major cause of concern for landfills. To prevent this, landfills need to ensure there is an appropriate level of retention of leachate. At some sites the underlying material provides this retention, but as we have seen many sites do not have appropriate underlying material. For these sites, the alternative is to use an engineered liner (Centre for Advanced Engineering, 2000).

Progress in this area has been positive, with a 50 per cent increase since 1998/99. It is important that this trend continues, especially if new landfills cannot be built on sites with low-permeability underlying material. However, there are issues slowing progress, including:

- some sites without engineered liner systems have consent to operate until past 2020
- where landfilling has already commenced, the cost of retrofitting an engineered liner is often considered too high (especially when it is not required by the consent) and impractical.

3.3 Landfill gas collection

Landfill gas is produced in almost all landfills as an end product of biological decomposition. In the latter stages of this decomposition phase the gas has a high methane content, which can be generated in commercial quantities. The problems with these gases include risks to human health, odour nuisance, and detrimental effects on soils and vegetation in the immediate vicinity (Centre for Advanced Engineering, 2000). In addition, methane gas is a powerful greenhouse gas.

In 1998, 5 per cent of landfills had a landfill gas collection system. This has now increased to 22 per cent in 2006/07 as a result of the National Environmental Standard, which requires landfills of over 1 million tonnes to collect and flare or reuse landfill methane gas. However, as with landfill siting and engineered liners, there are a number of barriers to progress. The cost of retrofitting with a landfill gas collection system when landfilling has already commenced is often considered too high, especially when it is not required by the consent. This is particularly the case at smaller landfills, where the quantities of landfill gas are simply not economic to collect and reuse. It can also be practically difficult to collect very small quantities of landfill gas at small, newer landfills.

4 Conclusions and future work

4.1 Progress since previous surveys

The 2006/07 National Landfill Census has shown improvements in landfill design and operation compared to previous years. The total number of operating landfills continues to decrease, with numbers almost halving each time the survey has been undertaken. Cooperation among local authorities has helped the closure of small, substandard landfills, making way for larger landfills more in line with best practice (OECD, 2007). All landfills operating in New Zealand now have consent to do so, and only four sites do not measure or charge for the disposal of waste.

The Census has also highlighted areas needing improvement. The percentage of landfills sited on low-permeability underlying material has stayed the same. One-fifth of landfills collect landfill gas and half of all landfills have an engineered liner in place to prevent leachate. The lack of appropriate landfill sites and engineered liners could result in undesirable environmental impacts. This makes progress in these areas especially important.

However, progress is likely to be limited by many existing consents being valid until after 2020. This means that the greatest opportunity for improvements is likely to occur when existing resource consents for landfills come up for renewal.

4.2 Future work

To ensure further progress is made, the Ministry will:

- continue to promote and update the existing guidance for landfill siting, design, operation, and closure
- review the National Landfill Census process as necessary to ensure data collection is effective.

Appendix 1: Landfill Survey 2006

Section 1 – Landfill details

Name of landfill
Owner of landfill
Landfill address
Map reference
Locality the landfill serves
Name of organisation that manages the landfill
Contact name
Contact phone
Contact email
Contact address
Regional council

Section 2 – Landfill hydro-geological context

Underlying material – SHALLOW
Underlying material – DEEP
Depth to groundwater in metres

Section 3 – Landfill design

Liner design – tick all materials used
HDPE/geomembrane
Geosynthetic layer
Clay layer
Thickness of clay layer in mm
Other, please specify

Section 4 – Leachate

Collection system

Under-drain
Cut-off drain
Other, please specify

Management (on-site treatment, off-site)

On-site treatment
Off-site treatment – please specify location

How is the material treated?

Pond system
Irrigation/hard application
Other, please specify

Section 5 – Landfill gas

Do you have a gas collection system? Yes/ No

Management

Flaring
Electricity generation
Other, please specify

Estimated collection efficiency as percentage (%)

Section 6 – Landfill operation

How are quantities measured?

Volume estimate (cubic metres)
Weight estimate (tonnes)
Weigh-bridge

Do you use Landfill 3000? Yes/No
If no, which programme do you use?

Yearly quantity in tonnes (t)

Quantity
In financial year

What is the total site capacity in tonnes and/or cubic metres?

Of the total capacity, how much is currently unfilled?

What percentage of the waste is of business/commercial and residential?

Business/commercial (%)
Residential (%)

Section 7 – Landfill waste acceptance criteria

Does the site accept liquid waste? Yes/No

Are the Landfill Waste Acceptance Criteria (LWAC) consistent with the Ministry for the Environment Guideline? Yes/No

Is the Ministry for the Environment Guideline used for hazardous waste acceptance? Yes/No

What documentation is required for hazardous waste loads?

Section 8 – Plans for the site

When did the landfill open?

When will the current resource consents for the landfill expire?

Will the consent be extended beyond this date? Yes/No

Section 9 – Solid Waste Analysis Protocol (SWAP)

Have you undertaken a SWAP in the last two years? Yes/No

When was your last SWAP survey?

Can you provide copies of this survey to the Ministry for the Environment?

Section 10 – Comments

Please enter any further comments you wish to make.

Glossary

Documentation	The documentation required when disposing of hazardous waste loads at a landfill. This can come in a number of forms, including hazardous manifesto sheets, loading/substance/handling/identity docket, or special waste applications.
Engineered liner	An impermeable membrane which is laid down under engineered landfill sites. The membrane prevents leachate permeating down into the underlying aquifers or nearby rivers.
Hazardous substances	These include, but are not limited to, any substance defined in section 2 of the Hazardous Substances and New Organisms Act 1996 as a hazardous substance.
Hazardous wastes	Materials that are flammable, explosive, oxidising, corrosive, toxic, ecotoxic, radioactive or infectious. Examples include solvents and cleaning fluids, medical waste, unused agricultural chemicals, and many industrial wastes.
Landfill	An area used for the controlled disposal of solid waste.
Leachate	The liquid produced from water percolating through a landfill. It is composed of water, and organic and inorganic chemicals from the decomposition of waste. In the early years of operation the leachate also contains a lot of rainwater.
Leachate treatment	Leachate is often polluted, so it must be treated before it can be passed into the environment. Landfill leachate is often treated at wastewater treatment plants or settling ponds.
Liquid waste	Waste generated in, or converted to, a liquid form for disposal. It includes point and non-point source discharges, stormwater and wastewater.
NIMBY	An acronym of Not In My Back Yard, which describes the phenomenon whereby residents oppose the development of a landfill as inappropriate for their local area.
Organic waste	This includes garden waste (more commonly known as “green waste”), food scraps, biosolids and commercial organic wastes such as paunch grass and food-processing waste. It can sometimes include other wastes that may biodegrade in landfill, such as paper, cardboard and untreated wood.
Recycling	Recycling describes the action of the consumer when collecting and depositing materials that can be recycled (e.g. glass, plastic containers and bottles, aluminium and steel cans, paper and card) and the action of industry when reprocessing recycled materials.
Solid waste	All waste generated as a solid or converted to a solid for disposal. It includes paper, plastic, glass, metal, electronic goods, furnishings and organic wastes.
Stormwater	Stormwater results from rainwater runoff that is channelled through drains from roads and urban properties into waterways and the sea.
Underlying material	The matter beneath the landfill. Its composition determines how permeable it is. Landfills are better placed on low-permeable underlying material to minimise the potential for liquids to migrate out of the landfill.
Waste	The New Zealand Waste Strategy defines waste as any material – solid, liquid or gas – that is unwanted and/or unvalued and discarded or discharged.
Waste disposal	The final placement of material (solid, liquid or gas) that is unwanted and/or unvalued and discarded or discharged.

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