Ministry for the Environment
Manatū Mō Te Taiao

A Technical Guide to New Zealand's Environmental Indicators

New Zealand Government

Published in March 2009 by the
Ministry for the Environment
Manatū Mō Te Taiao
PO Box 10 362, Wellington, New Zealand

ISBN: 987-0-478-33158-5 (electronic)
Publication number: ME 925

This document is available on the Ministry for the Environment's website:
www.mfe.govt.nz

Ministry for the
Environment
Manatū Mō Te Taiao

Contents

Tables

Figures

1 Introduction

State of the environment (SoE) reporting is an important means of providing environmental information. Its key function is to communicate accurate, timely, and accessible information about the condition of the environment to people in central and local government, businesses, iwi, and communities who make decisions about natural resource use and management.

Under the Environment Act 1986, the Ministry for the Environment (MfE) is required to "solicit and obtain information from any source, and to conduct and supervise research, so far as it is necessary for the formulation of advice to the Government on environmental policies" (section 31(b)).

In large part, the Ministry meets its obligations in this respect through its national environmental reporting programme. The programme was established in 2006 to communicate accurate, timely and accessible national-scale information about the condition of the New Zealand environment.

Notwithstanding decisions to be taken on the future environmental architecture in New Zealand, the Ministry's environmental statistics programme is presently scheduled to deliver an indicator-based state of the environment (SoE) report every five years. In the interim, the programme will produce regular (in many cases, annual) updates of indicator information, as well as other occasional reports, to generate regular snapshots of the state of and pressures on the New Zealand environment.

To date, the national environmental reporting programme has produced a number of national-scale environmental reports, surveys and national monitoring data-sets. It has also produced *Environment New Zealand 2007*, New Zealand's second comprehensive national-scale SoE report and the first to use a core set of national environmental indicators to report on 10 key environmental domains (consumption, transport, energy, waste, air, atmosphere, land, fresh water, oceans, and biodiversity).

It is important to note that the *Environment New Zealand 2007* report included comprehensive information on the core set of national environmental indicators and variables. This included background information on the environmental, health, social and/or economic impacts of the indicator/variable under discussion, why it was important to measure, and what information the indicator provided to decision-makers. The limitations of each indicator/variable were also discussed in the report.

The present report aims to avoid duplication of information contained within *Environment New Zealand 2007*. As such, it should be read in conjunction with that report.

2 Purpose of this Document

Following the launch of *Environment New Zealand 2007* on 31 January 2008, a variety of work-streams were established to strengthen the underpinning systems and processes for the environmental reporting programme. These include:

- an independent review of the Environment New Zealand 2007 report
- a review of national indicator reporting in New Zealand
- a review of regional state of the environment reporting in New Zealand
- a review of OECD member country state of the environment reporting
- a comparison of the OECD core set of environmental indicators with New Zealand indicator reporting
- data stocktakes for the set of national environmental indicators and their associated variables (parameters)
- analysis of how the research, science and technology system might better support national-scale state of the environment reporting in New Zealand
- development of an environmental reporting framework to document the strategic direction and scope of the Ministry's environmental reporting work programme and record the key principles that underpin it
- ongoing work to strengthen data-sharing arrangements with reporting partners who generate or collate national-scale environmental data.

A technical guide to New Zealand's environmental indicators is a further piece of work to ensure that the national environmental reporting programme will be both robust and durable into the future.

The guide is a 'working document'. This means that as new data sources become available, new monitoring methodologies become established, or new reporting formats are agreed, the document can be reviewed and updated as necessary to guide the Ministry in its environmental reporting work.

The primary objective of the guide is to record current specifications for the core set of national environmental indicators and their associated variables (see section 4). In addition, the report presents a suggested reporting format for each variable to ensure consistency by Ministry staff in the presentation of data over time.

As the Ministry is committed to continuous improvement in its environmental reporting programme, we welcome any feedback on this working document to: environmental.reporting@mfe.govt.nz.

3 National Environmental Indicators

This section discusses the 22 national environmental indicators and the 68 associated variables reported in *Environment New Zealand 2007* (see Table 1 below). These constitute New Zealand's core set of national environmental indicators and associated variables.

The section does not include any discussion of the additional 50 or so variables reported in *Environment New Zealand 2007* which fall outside of the core set. In some cases, it is not possible to report on these variables again (there was only one data point in time), or it is not known whether monitoring data will continue to be collected. In other cases, it is expected that reporting on these variables will occur in the third (2012) national-scale state of the environment report, should data be available.

As data sources improve, it is important to bear in mind that both indicators and variables in the core set may change, as may information sources and reporting partners. Any proposed amendments to the core set will require a formal evaluation against set criteria (see *Criteria for selection of Environmental Indicators*) which have been developed with reference to both international best practice, and the selection criteria employed in New Zealand for other indicator sets (eg, the Social Indicators).

Table 1: New Zealand's national environmental indicators and associated variables

Domain	National Environmental Indicator	Variables	Reporting partner
Consumption	Household consumption expenditure	Household consumption expenditure across seven categories: • Food and beverages • Clothing and footwear • Housing • Household goods and services • Transport • Hotels and restaurants • Other goods and services	StatsNZ
Transport	Vehicle kilometres travelled (VKT)	Vehicle kilometres travelled (VKT) by road: • By fuel type (petrol or diesel) • By vehicle age • By vehicle type	MoT
Energy	Energy supply	Total primary energy supply (by fuel type) Electricity generation (by fuel type)	MED
	Energy demand	Total consumer energy demand (by fuel type and by sector) Consumer energy demand compared to gross domestic product	
Waste	Solid waste disposal	The quantity (by weight) of solid waste disposed of to landfill The composition of solid waste disposed of to landfill	Regional councils, territorial authorities

Domain	National Environmental Indicator	Variables	Reporting partner
Air	Air quality	Concentrations of the following pollutants in managed airsheds: • PM_{10} • nitrogen dioxide • carbon monoxide • sulphur dioxide • ground-level ozone.	Regional councils
Atmosphere	Greenhouse gases	Emissions of: • carbon dioxide • methane • nitrous oxide • sulphur hexafluoride • hydrofluorocarbons • perfluorocarbons. Greenhouse gas emissions removed from the atmosphere as a result of absorption by forestry	MED, MoT
	Stratospheric ozone	Average yearly ozone levels over New Zealand	NIWA
Land	Land cover	Land cover across nine land-cover classes: • exotic forest • exotic shrubland • native forest • native vegetation • other native land cover • primarily horticulture • high-producing exotic grassland • low producing grassland • artificial surfaces.	DoC, MAF, regional councils
	Land use	Land use by 18 land-use classes and four land-cover classes: • dairy • intensive sheep and beef • hill-country sheep and beef • high-country sheep and beef • deer • other animals • ungrazed • urban • planted forest • arable crops • vegetables • berryfruit • pipfruit • grapes • summer fruit • tropical fruit • kiwifruit • flowers • tussock • native forest • rivers, lakes, snow, and ice • scrub.	DoC, MAF, regional councils

Domain	National Environmental Indicator	Variables	Reporting partner
	Soil health	Soil health as detailed below: • total carbon content • total nitrogen content • pH in water • olsen phosphate • mineralisable nitrogen • macroporosity. Across seven major land-use categories: • arable cropping • mixed cropping • drystock pasture • dairy pasture • tussock grasslands • exotic forestry • native forests.	Regional councils, MAF, CRIs
	Erosion risk	Hill country pasture at risk of erosion, by three categories of erosion potential: • severe • very severe • extreme	Regional councils, MAF, CRIs
Fresh water	River water quality	Concentrations/measurements of: • nutrients (total and dissolved concentrations of nitrogen and phosphorus) • *e. coli* • visual clarity • water temperature • dissolved oxygen • macroinvertebrate richness in rivers (MCI and/or %EPT	Regional councils, NIWA
	Lake water quality	Trophic Level Index (TLI): • total nitrogen • total phosphorus • visual clarity • algal biomass	Regional councils, NIWA
	Groundwater quality	Concentrations of: • nitrate • *e. coli*	Regional councils, GNS
	Recreational water quality	Concentrations of: • *e. coli*	Local authorities
	Freshwater demand	The volumes of water allocated to consumptive uses	Regional councils, NIWA
Oceans	Marine protected areas	The proportion of New Zealand's territorial sea in marine reserve The proportion of each class of the Coastal Biogeographic Regions Classification protected by marine reserve	DoC

Domain	National Environmental Indicator	Variables	Reporting partner
	Fisheries activity	Fish stocks under the Quota Management System: • total commercial catch (by weight) from fish caught both inside and outside of the Quota Management System • the status of assessed fish stocks under the Quota Management System.	MFish
		Seabed trawling in deep waters: • the area 'swept' by commercial trawlers required to report position by latitude and longitude • the types of fish expected to be found in areas that have been swept.	MFish
	Recreational water quality	Concentrations of Enterococci bacteria levels at coastal swimming spots	Regional councils, territorial authorities
Biodiversity	Native land cover	Area of native land cover by Land Cover Database (LCDB) class Area of native land cover by Land Environments of New Zealand (LENZ) class Area of native land cover under legal protection	DoC, QEII, regional councils, territorial authorities
	Indicator species	Distribution of selected native indicator species: • Kiwi • Lesser short-tailed bat • Kaka • Kokako • Yellowhead/mohua • Wrybill • Dactylanthus	DoC, OSNZ

Source: Ministry for the Environment.

4 Indicator Specifications

This section briefly describes the core set of national environmental indicators and their associated variables, calculation and measurement methodologies, and data sources. The section also provides information on how the indicator/variables discussed compare to other indicator sets used internationally and in New Zealand.

In addition, this section presents a suggested reporting format for each variable to ensure consistency by Ministry staff in the presentation of data over time. While the Ministry will always seek raw data from its reporting partners (ie, agencies which generate or collate environmental data which supports national-scale state of the environment reporting), it is useful to formally record the format in which the Ministry will be presenting summary-level data in its reporting products.

The sample reporting format is provided as an illustration rather than a prescription. The Ministry for the Environment welcomes discussion about the best way to graphically present indicator and variable data.

4.1 Household consumption

Household consumption has a number of environmental impacts. As an example, the production of goods and services almost always involves the use of energy, transport, and raw materials, and creates waste. Household consumption can be a key driver of production patterns. For some consumables, households may represent the largest consumer sector in the economy (eg, energy, if transport fuels are included). Consumer behaviour in households is therefore an important driving force behind environmental pressures.

4.1.1 Indicator and variable description

Expenditure by households on goods and services can be treated as equivalent to the levels of consumption of these goods and services by households.

The household consumption indicator tracks changes in total (national) Household Consumption Expenditure (HCE). Two types of change can be distinguished: changes in magnitude and changes in consumption pattern, ie, how total HCE is distributed among seven different categories of goods and services (variables) (Table 2).

Table 2: Household consumption expenditure indicator and variables

Indicator	Variable	Includes
Consumption expenditure by households	Food and beverages	Purchases of retail food, and both alcoholic and non-alcoholic drinks.
	Clothing and footwear	Clothing, footwear, and footwear repairs.
	Housing	Rental payments and imputed rent.*
	Household goods and services	Fuel and energy for the home; furniture and major appliances (eg, purchases and repairs), textiles (eg, curtains) and tableware (eg, crockery).
	Transport	Vehicle operation (eg, petrol, vehicle parts and repairs), purchased transport (eg, taxi fares, bus, rail and aeroplane tickets), and vehicles purchased.
	Hotels and restaurants	Accommodation, takeaways, and food and beverages purchased in restaurants.
	Other goods and services	Personal goods and services, post and telephone, and services not classified elsewhere.

* Imputed rent is where a cash value is ascribed to the services gained from housing that are not usually exchanged for money. Imputed rent is used because mortgage payments are not classified as consumption expenditure and therefore are not included in any of the categories in this table.

By combining this indicator with population data (number of inhabitants and households), it is also possible to show state and trends in household consumption expenditure on a per capita and per household basis. Showing household consumption on a per capita basis is important as it filters out the effect of population growth. Showing expenditure per household is of interest because the average size of New Zealand households has shown a reduction over recent decades. Such a reduction has environmental consequences, because smaller households are generally less efficient than larger ones in terms of resource use.

4.1.2 Indicator calculation and measurement

Sampling frequency: Annual National Accounts figures.

Data needed to compile the indicator: The National Accounts dataset provides information on quarterly and annual household spending for the categories listed above.

Data sources: Per capita information for HCE can be calculated using Statistics New Zealand (StatsNZ) National Accounts population estimates of resident population. Per household figures can be calculated using National Accounts estimated household population data, as obtained from StatsNZ. Data from the three-yearly StatsNZ Household Economics Survey may also provide supporting information of value. For more information on data sources refer to the Ministry for the Environment's document *Data stock-take for the core set of national environmental indicators and associated variables*.

Spatial coverage and length of record: Information at the national level only. Household consumption expenditure data published from June 1987 quarter. Backdated National Accounts population and household population data is available by request.

Measurement methods: Standard Statistics New Zealand methodology.

Method for variable calculation: The display of this indicator as trends over time requires nominal dollar values to be inflation-adjusted by way of the Consumer Price Index (CPI).

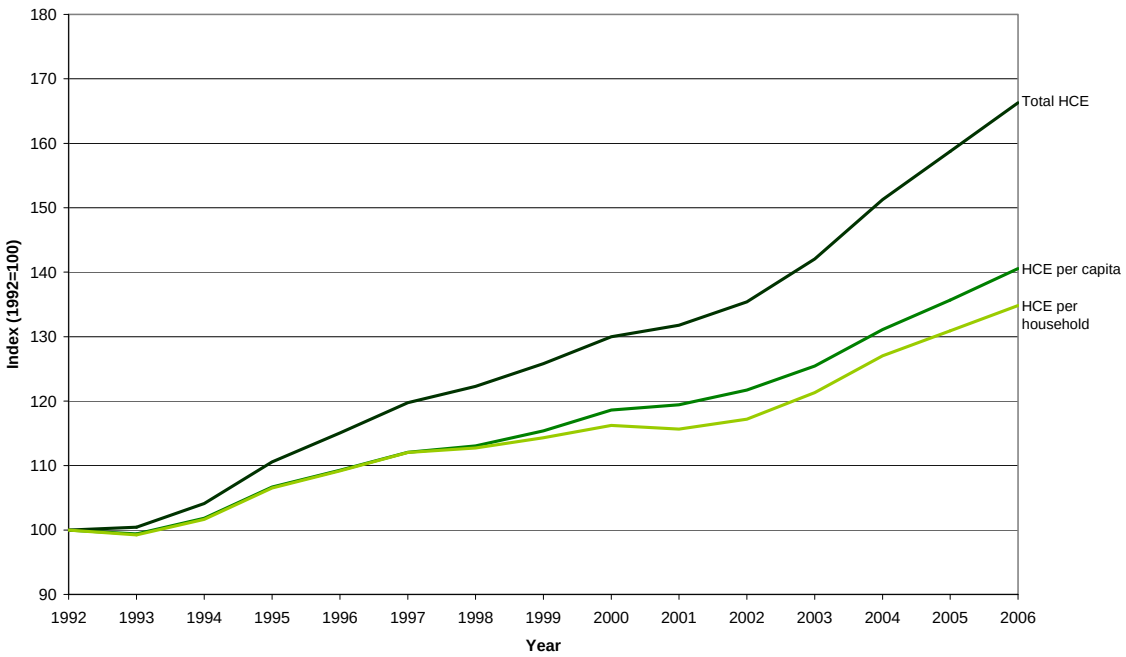
4.1.3 Sample reporting formats

Table 3: Household consumption expenditure in real figures, year ended 31 March 2008, 1995/96 prices

Category	Total household consumption expenditure ($ million)	Per household expenditure ($)	Per capita expenditure ($)
Food and beverages	13,990	9,196	3,299
Housing	13,583	8,928	3,203
Transport	12,790	8,407	3,016
Household goods and services	11,056	7,267	2,607
Other goods and services	9,153	6,016	2,158
Hotels and restaurants	5,969	3,924	1,407
Clothing and footwear	4,406	2,896	1,039
Recreation and education and Health and medical combined	12,899	8,479	3,041
Less net tourist expenditure	*-1,518*	*-998*	*-358*
Total	82,328	54,116	19,412

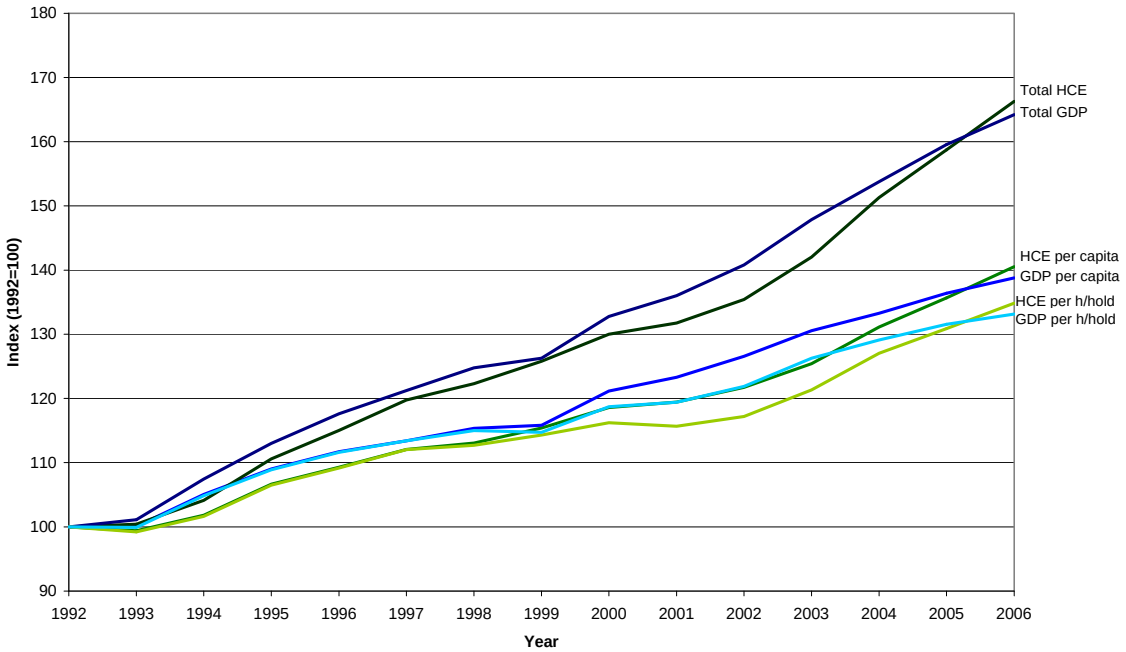
Data source: Statistics New Zealand.

Figure 1: Household consumption expenditure, 1992–2006 (year ending March, 1995/96 prices, 1992=100)



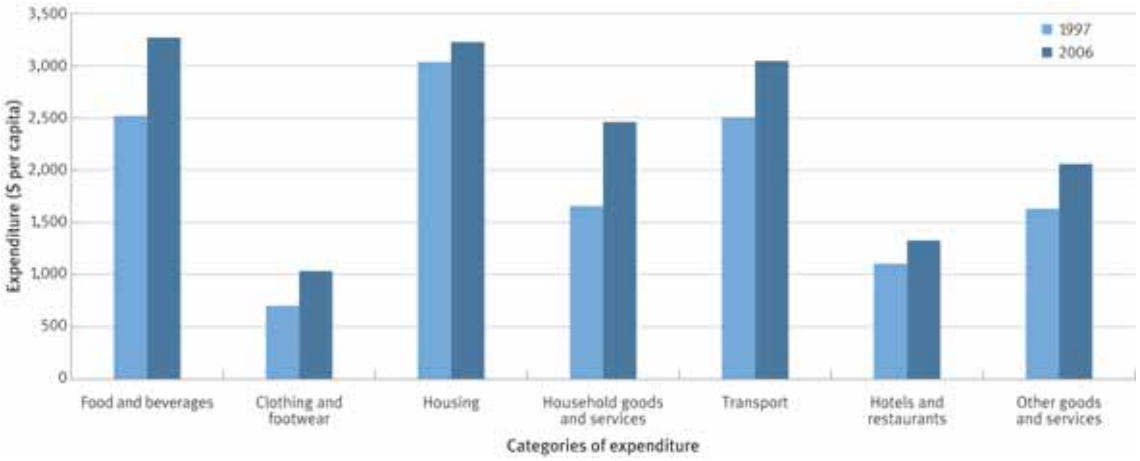
Data source: Statistics New Zealand.

Figure 2: Household consumption expenditure and GDP, 1992–2006 (year ending March, 1995/96 prices, 1992=100)



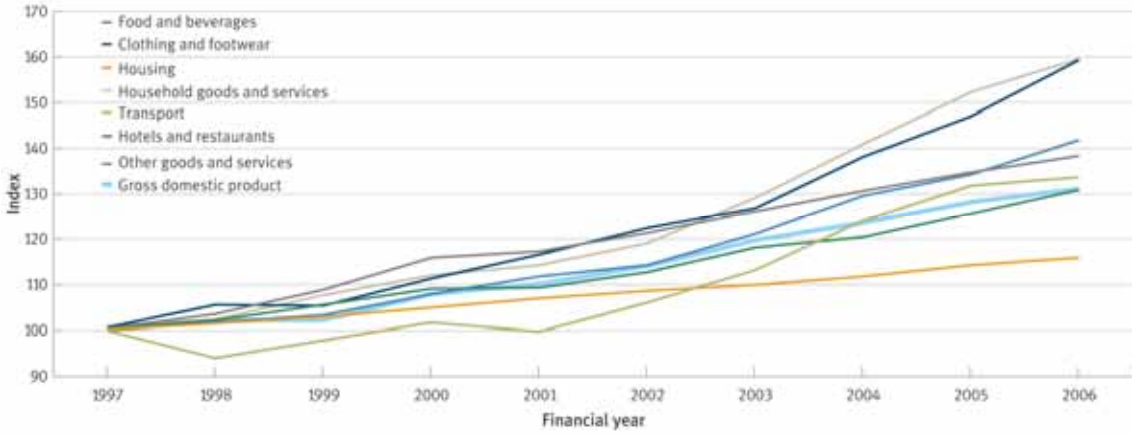
Data source: Statistics New Zealand.

Figure 3: Household consumption expenditure per capita by consumption category, 1997 and 2006 (year ending March, 1995/96 prices)



Data source: Statistics New Zealand.

Figure 4: Household consumption expenditure per capita by consumption category, 1997–2006 (year ending March, 1995/96 prices)



Data source: Statistics New Zealand.

4.1.4 Compatibility with other indicator programmes

National indicator sets	International indicator sets	
Statistics NZ linked indicators	OECD Core Environmental Indicators	United National Commission of Sustainable Development sustainable development indicators

Note: Small differences may exist in the way these variables are represented in other indicator sets.

Source: Web sites of Statistics New Zealand, UN Division of Sustainable Development, OECD.

4.1.5 References

Organisation for Economic Co-operation and Development (OECD). 1999. *Towards More Sustainable Household Consumption Patterns: Indicators to Measure Progress*. ENV/EPOC/SE(98)2/FINAL, OECD, Paris.

Ministry for the Environment. 2007. *Environment New Zealand*. MfE, Wellington. ISBN 978-0-478-30192-2.

Statistics New Zealand (StatsNZ). 2002. *Monitoring Progress Towards a Sustainable New Zealand*. StatsNZ Catalogue Number 16.001, Wellington. ISBN 0-478-26904-8.

4.2 Transport

The environmental impact of transport is among the most significant of the main sectors of the economy. Road transport is the mode of transport with the greatest effect on the environment and human health through the emission of air pollutants and greenhouse gases, runoff of contaminants from roads into waterways, noise, wastes such as end-of-life vehicles and used oils and tyres, accidents, and use of land for infrastructure. In New Zealand, due to the country's shape and low population density, private road transport is more predominant –compared to other modes – than in many other developed countries.

4.2.1 Indicator and variable description

This indicator tracks vehicle kilometres travelled (VKT) on New Zealand roads. The indicator can be disaggregated by vehicle type, vehicle age, and fuel type to show a more useful break-down of what parts of the vehicle fleet are contributing most to VKT. As an example, older vehicles tend to be less fuel-efficient and contribute more to air pollution than newer cars, so disaggregated information of this sort can show important trends.

4.2.2 Indicator calculation and measurement

Sampling frequency: Annual.

Data needed to compile the indicator: Vehicle-kilometres travelled (VKT) by each category of vehicle.

Data sources: Data prior to 2001: Web-based data files from Ministry of Economic Development's (MED) New Zealand's Energy Outlook to 2030. Data from 2002 onwards: Ministry of Transport's (MoT) Research and Statistics section. For more information on data sources refer to the Ministry for the Environment's document *Data stock-take for the core set of national environmental indicators and associated variables*.

Spatial coverage: The data covers all vehicles registered for use on the road.

Length of record: VKT by vehicle type: 1980 onwards; VKT and number of vehicles by vehicle age: latest year available; VKT by fuel type: 2001 onwards.

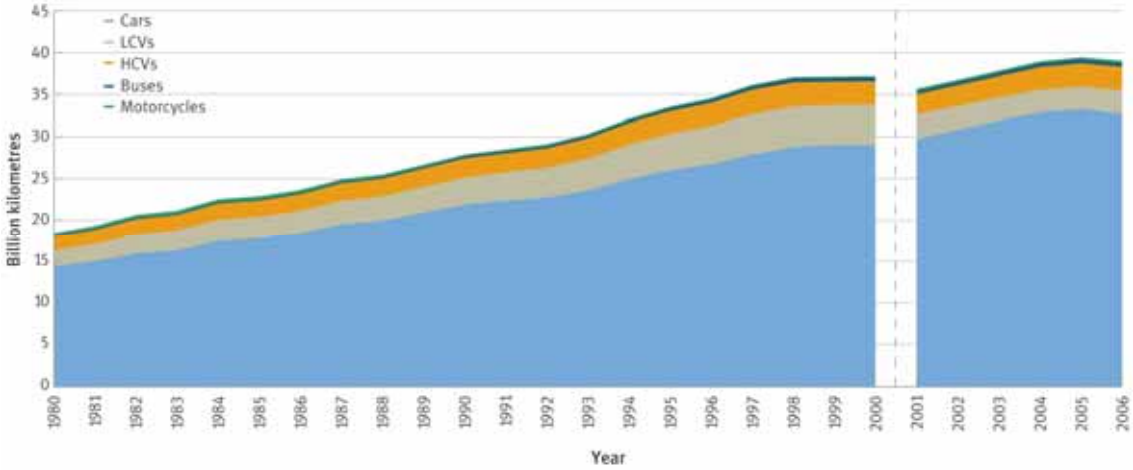
Measurement methods: Prior to 2001, VKT data were MoT estimates of the kilometres travelled by the entire on-road vehicle fleet. The estimates were determined from traffic count surveys, which were then extrapolated over the entire road network (MED, 2006 p 54).

From 2001, VKT data is compiled from odometer readings taken at vehicles' Warrant/ Certificate of Fitness inspections.

Method for variable calculation: Simple addition of the distance travelled in one year by all vehicles in the New Zealand road fleet.

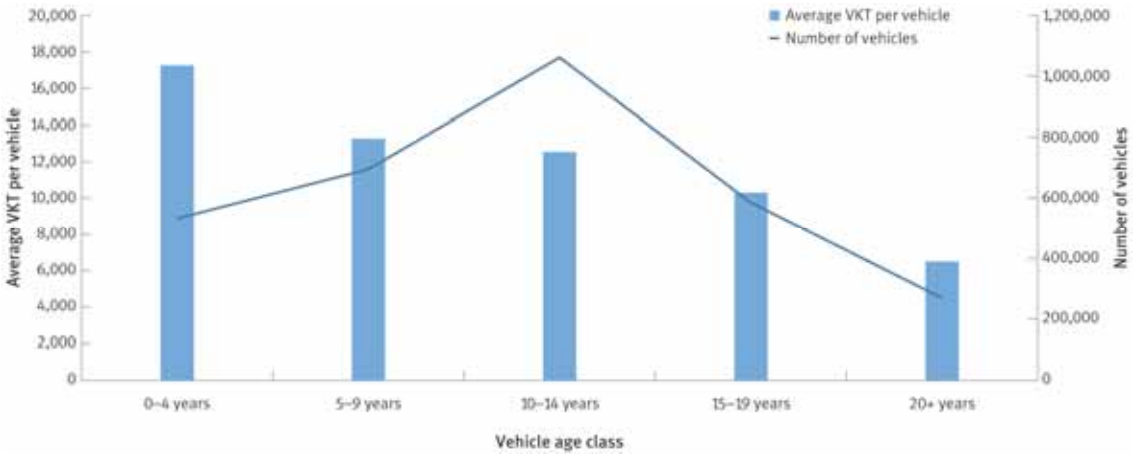
4.2.3 Sample reporting formats

Figure 5: Trends in vehicle kilometres travelled (VKT) by vehicle type, 1980–2006



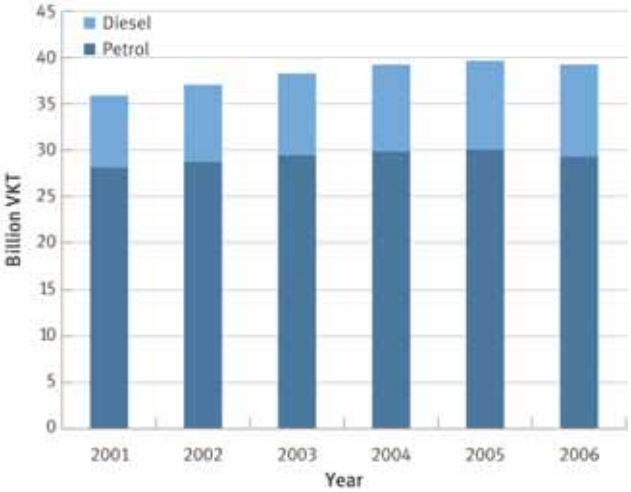
Source: Ministry of Economic Development, 2006 and Ministry of Transport.

Figure 6: Average vehicle kilometres travelled (VKT) per vehicle and total number of vehicles in each age class, 2006



Source: Ministry of Transport.

Figure 7: Vehicle kilometres travelled (VKT) by fuel type, 2001–2006



Source: Ministry of Transport.

4.2.4 Compatibility with other indicator programmes

National indicator sets	International indicator sets
Statistics NZ linked indicators	OECD Core Environmental Indicators. While the United Nations Commission on Sustainable Development and European Environment Agency indicator sets include indicators on transport, these are not directly comparable with the New Zealand indicator.

Note: Small differences may exist in the way these variables are represented in other indicator sets.

Source: Web sites of Statistics New Zealand, UN Division of Sustainable Development, OECD, European Environment Agency.

4.2.5 References

Ministry for the Environment (MfE). 1999. *Summary of proposed indicators of the environmental effects of transport*. Signposts for Sustainability. MfE, Wellington. ISBN 0-478-09061-7.

Ministry for the Environment. 2007. *Environment New Zealand*. MfE, Wellington. ISBN 978-0-478-30192-2.

4.3 Energy – supply and demand

All forms of energy generation and use have an impact on the environment. For example, our growing consumption of non-renewable energy contributes to increased greenhouse gas and particulate emissions, which have negative impacts on the environment and human health.

It is useful to track energy supply and consumption over time to assess what sectors of the economy are using most energy, how efficiently we are using our energy, whether we are becoming more or less reliant on fossil fuels, and how closely our economic growth relies on energy consumption.

4.3.1 Indicator and variable description

Table 4: Variables of the energy indicators

Energy supply variable	**Disaggregated by:**
Total Primary Energy Supply (TPES)	*Fuel type* (gas, coal, hydro, geothermal, other renewables, indigenous oil, imported oil and oil products)
Electricity generation	*Fuel type* (hydro, gas, coal, geothermal, wind, others {waste heat, biogas, wood}) Efficiency of electricity generation, by fuel type
Energy demand variable	**Disaggregated by:**
Total Consumer Energy Demand (TCE)	*Fuel type* (oil, electricity, gas, coal, geothermal, other renewables) *Sector* (domestic transport, industrial, commercial, residential, agriculture)
Consumer energy demand compared to gross domestic product	Total consumer energy per unit of Gross Domestic Product (TCE/GDP)

4.3.2 Indicator measurement

Sampling and analytical protocols: Statistics New Zealand and the Ministry of Economic Development collect comprehensive energy statistics.

Sampling frequency: Energy statistics are usually available on a quarterly basis, but for environmental purposes, data are mostly reported annually.

Data needed to compile the indicator: See Table 4:[1]

[1] All information is available from the New Zealand Energy Data file published by the Ministry of Economic Development and electronically accessible at: http://www.med.govt.nz/templates/ContentTopicSummary____20511.aspx

Data sources: Energy supply and demand data are obtained from national energy balances compiled by Statistics New Zealand (eg, electricity, end uses, supply and production, prices), the Ministry for Economic Development (supply data), and the Energy Efficiency and Conservation Authority (end uses). Sectoral consumer energy data are organised according to the Australian New Zealand Standard Industrial Classification 1996, New Zealand Use (ANZSIC96, superseded by ANZSIC06 in 2008). Gross Domestic Product (GDP) figures are calculated by Statistics New Zealand from the National Accounts. For more information on data sources refer to the Ministry for the Environment's document *Data stock-take for the core set of national environmental indicators and associated variables*.

Spatial coverage and length of record: Energy statistics cover the entire economy. Some types of data (eg, those about supply) span several decades, in other areas the record is shorter.

Length of record: Total consumer energy demand by fuel type and by sector, 1995 onwards; total primary energy supply by fuel type 1974 onwards; consumer energy demand compared to gross domestic product, 1990 onwards; electricity generation by fuel type, 1974 onwards.

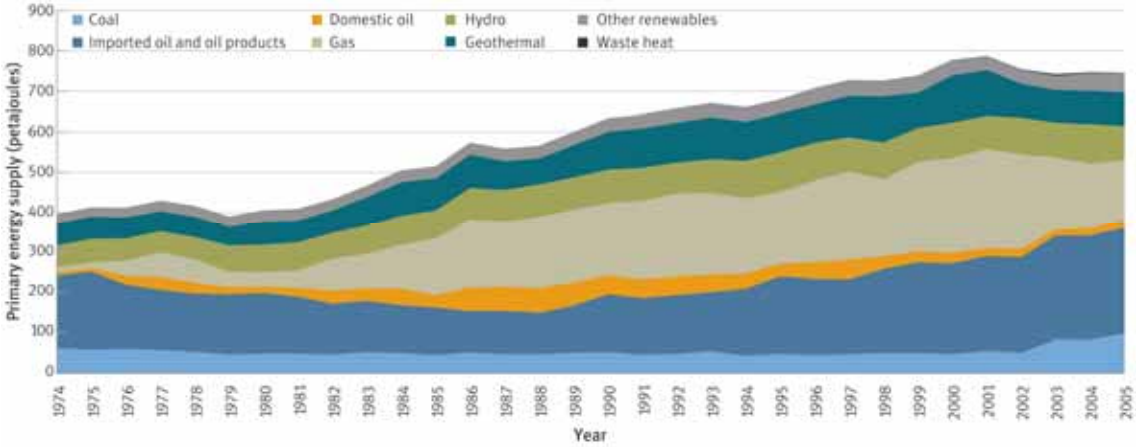
Measurement methods: The indicator is based on the following expressions underlying the MED energy balances, and follows international conventions:

- total primary energy = indigenous production + imports – exports – stock change – international transport
- energy transformation = electricity generation + cogeneration + oil production + losses and own use
- consumer energy (calculated) = total primary energy – energy transformation – non-energy use
- consumer energy (observed) = agriculture + industrial + commercial + residential + domestic transport.

Method for variable calculation: When using GDP figures in international comparisons, care should be taken to make sure all figures relate to the same year, that the correct exchange rates are used, and that purchasing power parity (PPP) is applied where necessary.

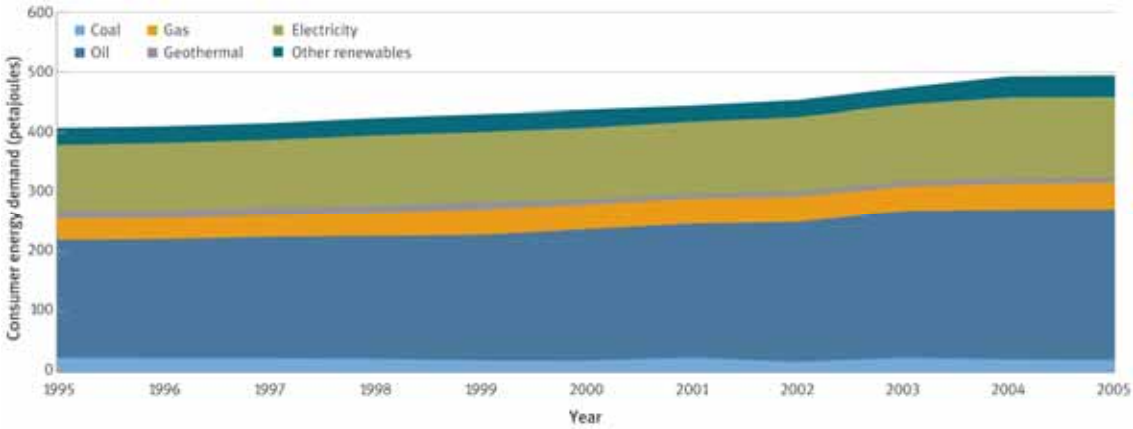
4.3.3 Sample reporting formats

Figure 8: Primary energy supply, 1974–2005



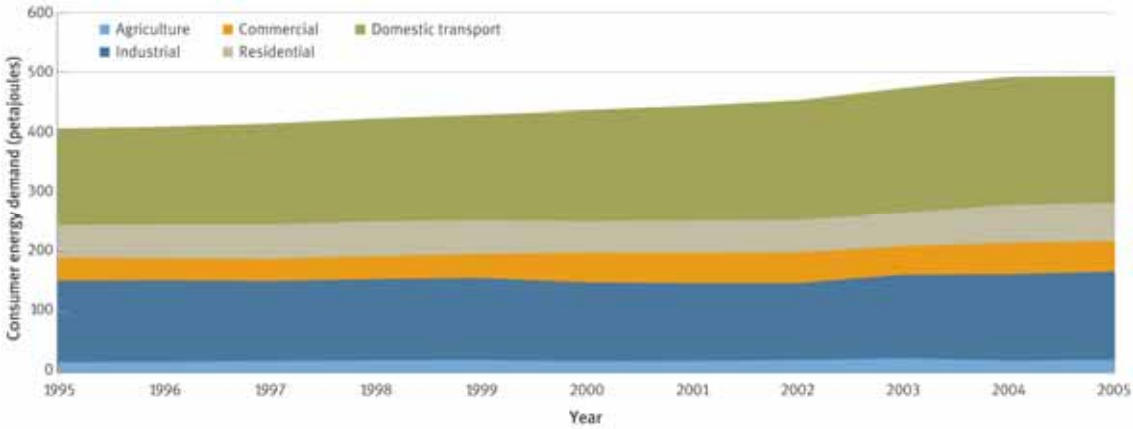
Source: Ministry of Economic Development, 2006.

Figure 9: Consumer energy demand by fuel type, 1995–2005



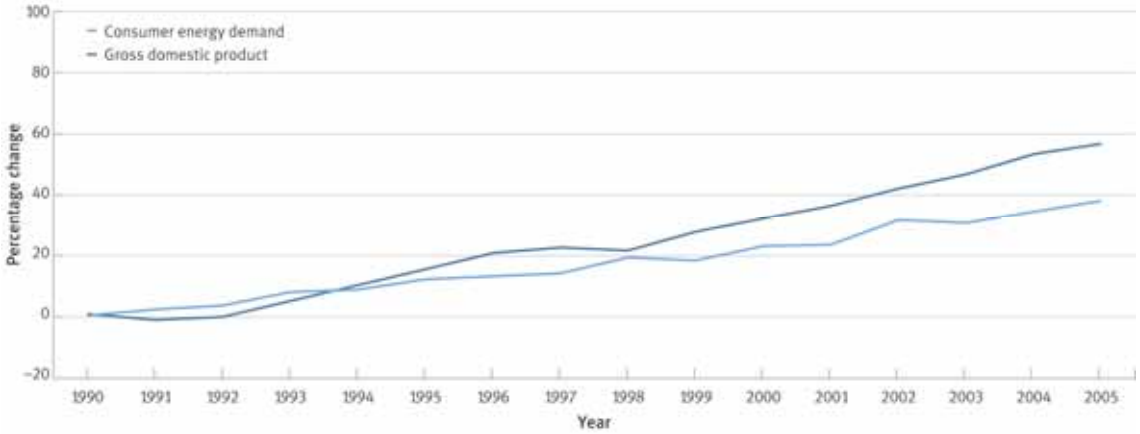
Source: Ministry of Economic Development, 2006.

Figure 10: Consumer energy demand by sector, 1995–2005



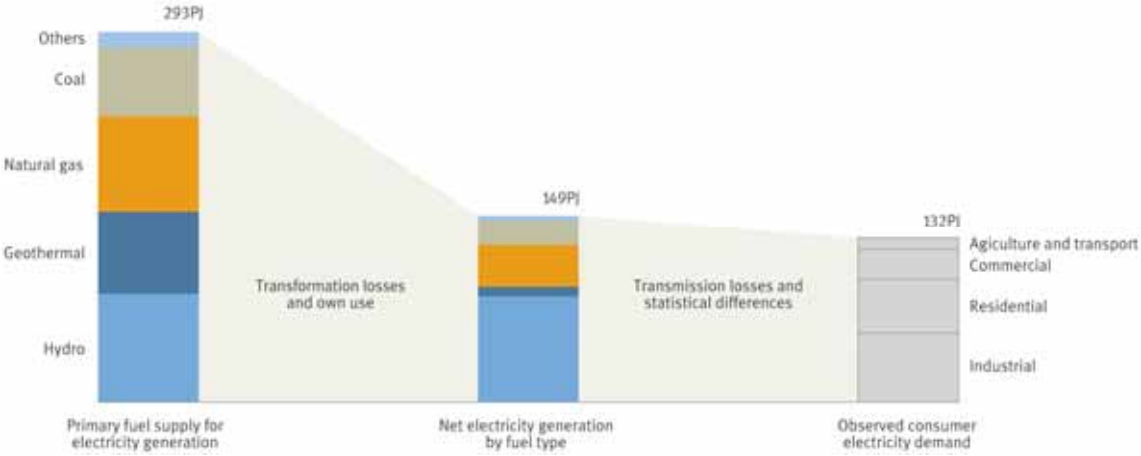
Source: Ministry of Economic Development, 2006.

Figure 11: Consumer energy demand compared to gross domestic product, 1990–2005 (% change)



Source: Ministry of Economic Development, Energy Data File 2006 and Statistics New Zealand.

Figure 12: Relative efficiency of fuel types for electricity generation, 2005



Source: Adapted from Ministry of Economic Development, 2006.

4.3.4 Compatibility with other indicator programmes

National indicator sets	International indicator sets	
Statistics NZ linked indicators	United Nations Commission on Sustainable Development core set of indicators	United Nations Commission on Sustainable Development Indicators of Sustainable Development
New Zealand Energy Indicators (MED)	OECD Key Environmental Indicators	European Environment Agency Core Set Indicators (CSI 027, CSI 029)

Note: Small differences may exist in the way these variables are represented in other indicator sets.

Source: Web sites of Statistics New Zealand, UN Division of Sustainable Development, OECD, European Environment Agency.

4.3.5 References

Ministry for the Environment (MfE). 2000. *Proposed indicators for the environmental effects of energy*. Signposts for Sustainability, ME number 343. MfE, Wellington. ISBN 0-478-09059-5.

Ministry for the Environment. 2007. *Environment New Zealand*. MfE, Wellington. ISBN 978-0-478-30192-2.

Ministry of Economic Development (MED). 2006. *Energy in Brief*. MED, Wellington. ISSN 1177-2824. http://www.med.govt.nz/upload/32800/2006.pdf

Statistics New Zealand (StatsNZ). 2006. *Domain Plan for Energy Sector 2006–2016*. MED, Energy Efficiency and Conservation Authority (EECA) and StatsNZ, Wellington.

4.4 Waste

Waste can be harmful to human health and the environment. The generation of waste represents a loss of resources in the form of both materials and energy. The amount of waste produced can therefore be seen as a measure of how efficient we are as a society in terms of our use of natural resources.

4.4.1 Indicator and variable description

This indicator shows the quantity and composition of solid waste being disposed into landfills in New Zealand. The indicator can be displayed as a total quantity for the entire country of all types of solid waste combined, or by waste types, so that the composition is revealed.

The indicator also enables the compilation of supplementary information to show any decoupling of solid waste going to landfill from Gross Domestic Product or per capita waste disposal.

Table 5: Variables of the solid waste indicator

Indicator	Variables
Solid waste disposal	The quantity (by weight) of solid waste disposed of to landfill The composition of solid waste disposed of to landfill.

4.4.2 Indicator calculation and measurement

Sampling and analytical protocols: Solid waste analysis surveys should be designed and carried out in accordance with the Solid Waste Analysis Protocol (MfE 2002), and the composition determined during such surveys classified according to the classifications given in Figure 13 over page.

Sampling frequency: Annually.

Data needed to compile the indicator: Waste disposal quantity information from landfill censuses. Results from surveys of the composition of solid waste. Gross Domestic Product and population figures for decoupling information.

Data sources: For more information on data sources refer to the Ministry for the Environment's document *Data stock-take for the core set of national environmental indicators and associated variables*.

Spatial coverage and length of record: Information on trends in solid waste going to landfill is based on solid waste surveys carried out in 1983, 1991, 1994, 1995, 1997, 2002, 2003, 2004, and 2006. Some of these surveys were censuses of waste quantity disposed of to landfill, and some were composition assessments at a selection of landfills. The sample coverage of these censuses has progressively grown, notably since 2002, when the weighing of incoming waste became standard practice at major landfills. At smaller facilities without a weighbridge, waste volumes are estimated and then converted to weight on the basis of an average density of the waste.

Figure 13: Waste classification

Primary classification:	Secondary classification:	Examples:
1 Paper*	* Paper (excluding newsprint and magazines)	*e.g. photocopy paper*
	* Paper (newsprint)	*e.g. newspapers*
	* Paper (magazines and printed materials)	*e.g. advertising brochures*
	* Paper board (corrugated cardboard)	
	* Paper board (including cereal and shoe boxes)	
	* Paper board (liquid cartons and multi material)	*e.g. waxed cartons, foil lined cartons*
2 Plastics*	PET – Code 1	*e.g. soft drink bottles*
	HDPE – Code 2	*e.g. milk bottles, retail bags*
	PVC – Code 3	*e.g. cups, shower curtains, binders*
	LDPE – Code 4	*e.g. retail carry bags*
	PP – Code 5	
	PS – Code 6	*e.g. foam meat trays, foam cups*
	Multi-material – Code 7	
3 Putrescibles*	* Putrescibles (excluding garden)	*e.g. food scraps, dead animals*
	* Putrescibles (garden)	*e.g. grass clippings, weeds, trees*
4 Ferrous metals*	* Ferrous (excluding steel cans)	*e.g. car body, roofing iron, appliance body*
	* Ferrous (steel cans)	*e.g. baked bean can, soup can*
5 Non-ferrous metals*	* Non-ferrous (excluding aluminium cans)	*e.g. copper pipe, aluminium windows*
	* Non-ferrous (aluminium cans)	*e.g. soft drink can*
6 Glass*	* Glass (brown bottles)	
	* Glass (clear bottles)	
	* Glass (green bottles)	
	* Glass (jars)	*e.g. jam jar, gherkin jar*
	* Glass (excluding bottles and jars)	*e.g. window glass*
7 Textiles*	* Non-leather	*e.g. carpet, curtains*
	* Leather	
8 Nappies and sanitary*	None	*e.g. disposable nappies, sanitary napkins*
9 Rubble, concrete, etc	Rubble and rocks	*including bricks*
	Concrete	
	Plasterboard	*e.g. gib board*
	Fibre cement products	*e.g. hard planks, shakes*
	Fibreglass	
	Soil/clay	*e.g. topsoil, sand*
	Other	
10 Timber	Lengths and pieces	*e.g. framing timber, boards, sawn timber*
	Pallets and crates	
	Fabricated	*e.g. joinery, beds, cabinets*
	Sheets	*e.g. plywood, particle board, MDF*
	Sawdust/shavings	
	Debris/other	
11 Rubber	Tyres	
	Rubber products	*e.g. rubber pipes, mats*
12 Potentially hazardous	Household hazardous waste	*e.g. cleaning agents, aerosols, wax products, glues, cosmetics, medicines, batteries, lighters, paint and ink, agrichemicals*
	Special and treated waste	
	Medical waste	*e.g. prescription medicines, animal remedies*
	Untreated hazardous waste	
	Debris/other	*e.g. contaminated soil*

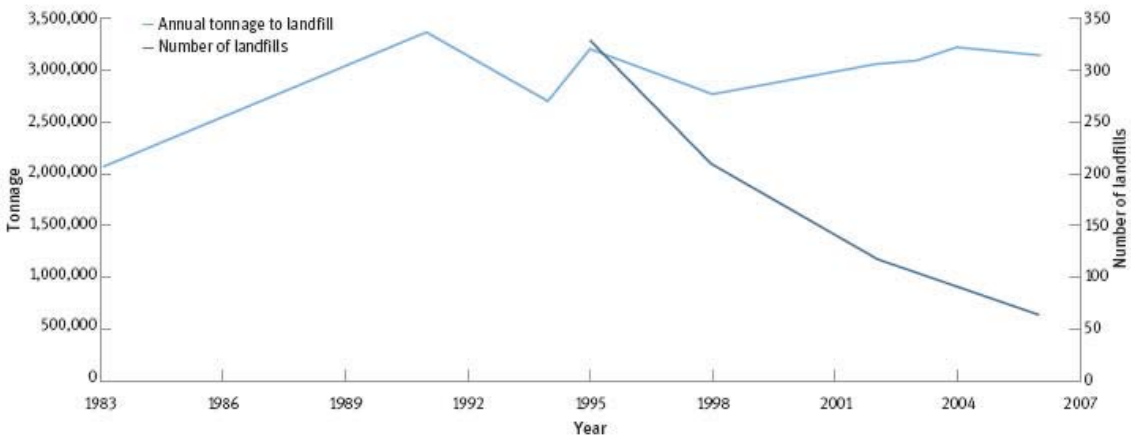
Source: Solid Waste Analysis Protocol.

Measurement methods: National landfill census. Solid Waste Analysis Protocol. When a landfill has no weighbridge, quantity is estimated by counting incoming trucks multiplied by typical volume for different vehicle or load types; or site survey of the change in the volume of the landfill. This volume is then converted to a weight using an average density of the waste.

Method for variable calculation: Where measured data does not include all of a region's landfills, overall quantities of waste going to landfill are calculated on a proportional population basis (ie, measured quantities are multiplied by the population of entire region and divided by the population living in measured waste catchments).

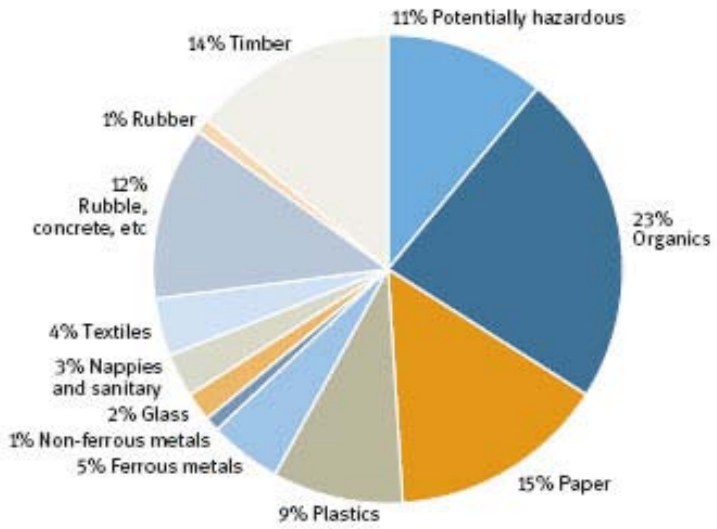
4.4.3 Sample reporting formats

Figure 14: Estimates of waste disposed of to landfill, 1983–2006, and number of landfills operating, 1995–2006



Source: Ministry for the Environment, 2007a.

Figure 15: Estimates of the composition of waste disposed of to landfills, 2004



Source: Ministry for the Environment, 2007a.

4.4.4 Compatibility with other indicator programmes

National indicator sets	International indicator sets	
None	The United Nations Commission on Sustainable Development core sets includes indicators on the generation of municipal, industrial and hazardous waste and on recycling and reuse, but no explicit indicator on solid waste disposed to landfill.	
	OECD Core Environmental Indicators	European Environment Agency Core Set of Indicators

Note: Small differences may exist in the way these variables are represented in other indicator sets.

Source: Web sites of Statistics New Zealand, UN Division of Sustainable Development, OECD, European Environment Agency.

4.4.5 References

Ministry for the Environment (MfE). 2002a. *New Zealand Waste Strategy*. MfE, Wellington.

Ministry for the Environment. 2002b. *Solid Waste Analysis Protocol*. ME number 430. MfE, Wellington. ISBN 0-478-24058-9. http://www.mfe.govt.nz/publications/waste/solid-waste-analysis-mar02/chapters-mar02.pdf

Ministry for the Environment. 2003. *The 2002 Landfill Review and Audit Report*. ME number: 46, MfE, Wellington. ISBN: 0-478-24083-X. http://www.mfe.govt.nz/publications/waste/landfill-review-and-audit-mar03.pdf

Ministry for the Environment. 2007a. *Environment New Zealand*. MfE, Wellington. ISBN 978-0-478-30192-2.

Ministry for the Environment. 2007b. *Targets in the New Zealand Waste Strategy, 2006 review of progress*. MfE, Wellington. ISBN 0-478-30133-2.

4.5 Air

In most parts of New Zealand, the outside air we breathe is of high quality. In some locations, the concentration of pollutants generated by domestic heating, traffic or industry can be a health concern.

Air pollution is the result of complex interactions between local topography, weather and contaminant concentrations from various sources. In New Zealand, the worst air pollution usually occurs during cold and frosty conditions in winter when pollutants, notably from wood burners and open fires, are emitted into a calm atmosphere.

4.5.1 Indicator and variable description

This indicator tracks air quality in managed airsheds for pollutants covered by the health-based national ambient air quality standards introduced in 2004 under the Resource Management Act 1991 (RMA).

This indicator reports the number of exceedences, peak levels and annual averages for each of the following pollutants in ambient (outdoor) air: PM_{10}, nitrogen dioxide, carbon monoxide, sulphur dioxide and ground-level ozone (see Table 6).

The air quality standards set acceptable levels for certain pollutants in outdoor air, and are considered to be met as long as the frequency of exceedence of the threshold concentration is not greater than the number allowed (see Table 6). For each of the contaminants listed in Table 6, the National Environmental Standards (NES) set a threshold value, expressed as the ambient air concentration (averaged over a nominated time interval) and an allowable frequency of exceedences per year.

Table 6: Ambient air quality standards for contaminants

Contaminant	Time average	Threshold value	No. of allowable exceedences per 12-month period
PM_{10} particulates	24-hour	50 µg/m^3	One 24-hr period
Nitrogen dioxide NO_2	1-hour	200 µg/m^3	9 hours
Carbon monoxide CO	8-hour running mean	10 mg/m^3	One 8-hour period
Sulphur dioxide SO_2	1-hour 1-hour	350 µg/m^3 570 µg/m^3	9 hours 0
Ground-level ozone O_3	1-hour	150 µg/m^3	0

Source: Ministry for the Environment, 2002.

4.5.2 Indicator calculation and measurement

Sampling and analytical protocols: Monitoring should be carried out in accordance with the "Good-practice guide for air quality monitoring and data management" (MfE, 2000).

Sampling frequency: Annual.

Data needed to compile the indicator: This indicator requires measuring the concentration of five pollutants (PM_{10}; NO_2; CO; SO_2; ground-level O_3) in ambient air, as prescribed in the NES.

Data sources: Regional councils monitor air quality in their region, as required under the NES. Not all pollutants are monitored at all sites. For more information on data sources refer to the Ministry for the Environment's document *Data stock-take for the core set of national environmental indicators and associated variables*.

Measurement methods: In order to effectively implement the NES, measuring practices must be consistent across all air quality monitoring stations. Hence, Schedule 2 of the NES prescribes standardised measuring methods for each variable (Table 7).

Table 7: Standard measurement methods

Pollutant	Method
PM_{10} particulates	Continuous high volume sampling in accordance with United States Code of Federal Regulations, Title 40 – Protection of Environment, Part 50, Appendix J – "Reference method for the determination of particulate matter as PM_{10} in the atmosphere". This reference method incorporates a number of other equivalent methods which are provided in full in Appendix 3 of MfE (2005) Continuous high volume sampling in accordance with AS 3580.9.6 "Methods for sampling and analysis of ambient air – Determination of suspended particulate matter PM_{10} high volume sampler with size selective inlet – Gravimetric method" Continuous high volume sampling in accordance with AS 3580.9.11 (2008) "Methods for sampling and analysis of ambient air – Determination of suspended particulate matter PM_{10} high volume sampler with size selective inlet – PM_{10} Beta Attenuation Monitors"
Nitrogen dioxide	Continuous ozone chemiluminescence in accordance with AS 3580.5.1 "Methods for sampling and analysis of ambient air – Determination of oxides of nitrogen – Chemiluminescence method"
Carbon monoxide	Continuous infrared absorption in accordance with AS 3580.7.1 "Methods for sampling and analysis of ambient air – Determination of carbon monoxide – Direct reading instrumental method"
Sulphur dioxide	Continuous fluorescence in accordance with AS 3580.4.1 "Methods for sampling and analysis of ambient air – Determination of sulphur dioxide – Direct reading instrumental method"
Ozone	Continuous ultraviolet absorption in accordance with AS 3580.6.1 "Methods for sampling and analysis of ambient air – Determination of ozone – Direct reading instrumental method"

Source: MfE, 2005.

Siting of monitoring stations: Regulation 15 of the NES stipulates that regional councils must monitor air quality in airsheds where the NES is likely to be breached. Selecting the correct location for monitoring stations is another aspect of consistent monitoring because the siting of monitoring instruments can affect the value of measurements. In general, siting decisions depend on the nature of the site and the purpose of the monitoring. Australian standard AS3580.1.1–2007 for *Ambient Air – Guide for the Siting of Sampling Units* and US Environmental Protection Agency Code of Federal Regulations (40 CFR Pt 58 Ch 1 App D pp 158–172) provide further guidance on site selection.

Method for variable calculation: The methodology for variable calculation follows from Schedule 1 of the NES (Table 8).

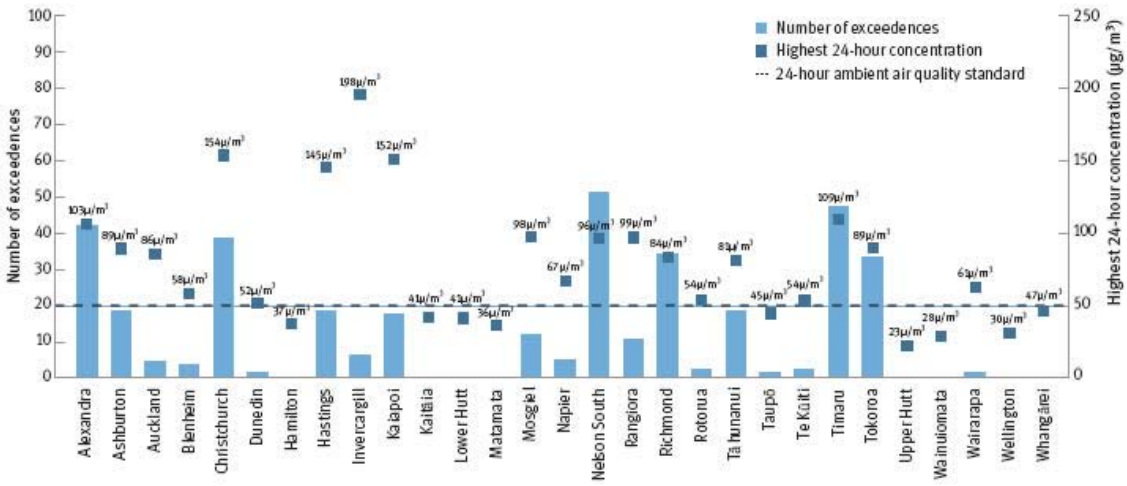
Table 8: Variable calculation methods

Contaminant	Calculation
PM_{10} particulates	The variable value must be calculated as the 24-hour mean, which means, in relation to small particles at a particular location for a particular 24-hour period: • the mean level at which the contaminant is recorded in the air, by continuous sampling of the air at that location, throughout that 24-hour period • the mean of the 1-hour means for that contaminant at that location for the preceding 24 hours
Nitrogen dioxide NO_2	The variable value must be calculated as the 1-hour mean, which means, in relation to nitrogen dioxide at a particular location for a particular hour, the mean of not more than 10-minute means, collected not less than once every 10 seconds, for NO_2 at that location during that hour.
Carbon monoxide CO	The variable value must be calculated as the running 8-hour mean, which means, in relation to carbon monoxide at a particular location for a particular hour, the mean of the 1-hour means for CO at that location for that hour and the preceding 7 hours.
Sulphur dioxide SO_2	The variable value must be calculated as the 1-hour mean, which means, in relation to sulphur dioxide at a particular location for a particular hour, the mean of not more than 10-minute means, collected not less than once every 10 seconds, for SO_2 at that location during that hour.
Ground-level ozone O_3	The variable value must be calculated as the 1-hour mean, which means, in relation to ozone at a particular location for a particular hour, the mean of not more than 10-minute means, collected not less than once every 10 seconds, for O_3 at that location during that hour.

Only time series with a data capture of at least 75 per cent per calendar year are used (ie, with more than 274 valid daily values per calendar year).

4.5.3 Sample reporting formats

Figure 16: Highest 24-hour concentrations and extent of exceedences of PM_{10} particulates in monitored airsheds, 2005



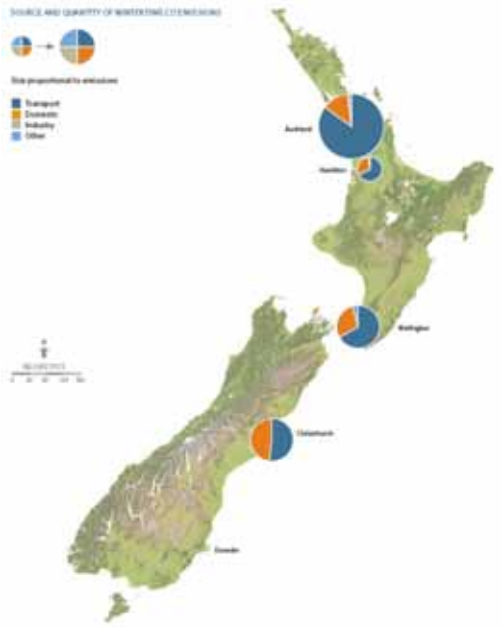
Notes:

(1) µg/m^3 = micrograms per cubic metre

(2) No data was available for Reefton for 2005

(3) The data for Richmond was extrapolated to account for one-day-in-three monitoring.

Figure 17: Carbon monoxide (CO) levels and emissions in main centres of population



Notes:

(1) The size of the pie graphs is proportional to the amount of emissions in each location represented.

(2) Auckland emissions represent daily emissions throughout the year rather than daily emissions during winter.

(3) A different scale is used on the Christchurch (St Albans) graph.

(4) No data is available for Dunedin.

(5) mg/m^3 = milligrams per cubic metre.

Source: Data compiled from Air and Environmental Services Ltd, 2001; Auckland Regional Council, 2006a; Auckland Regional Council, 2006b; Environment Canterbury, 2004; Environment Canterbury, 2006; Environment Waikato, 2006a; Environment Waikato, 2006b; Greater Wellington Regional Council, 2005.

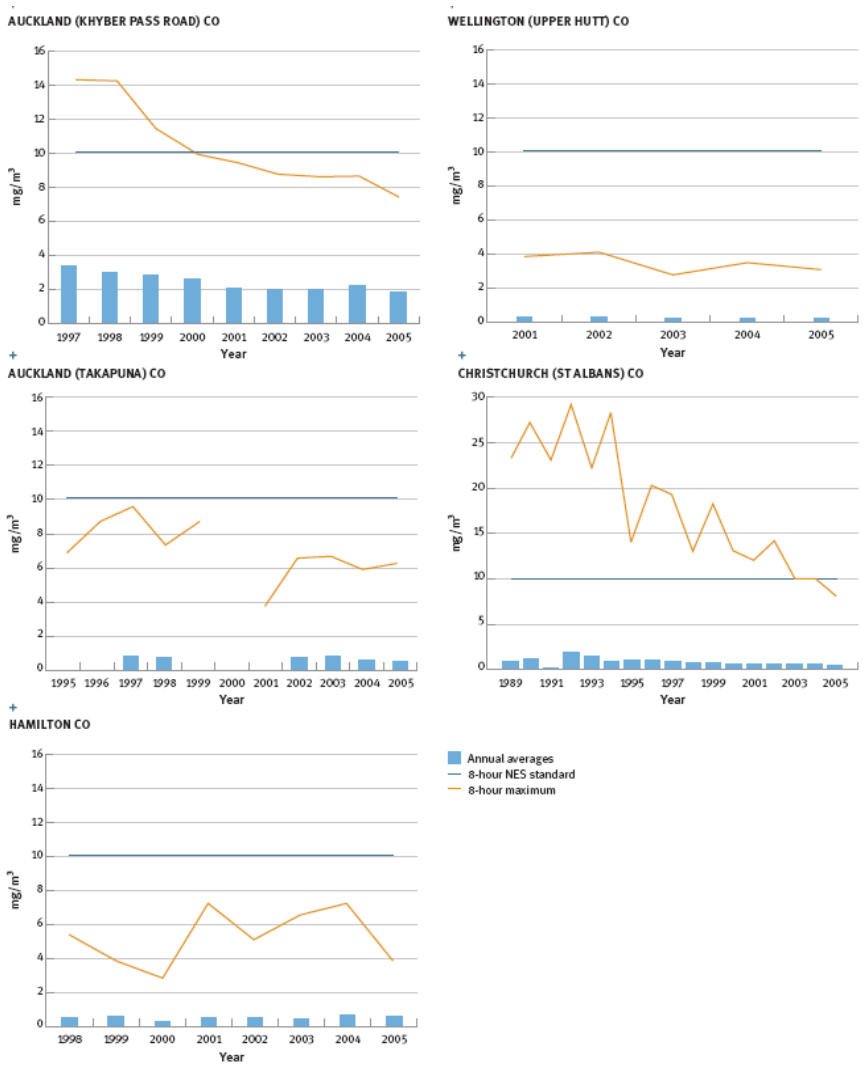
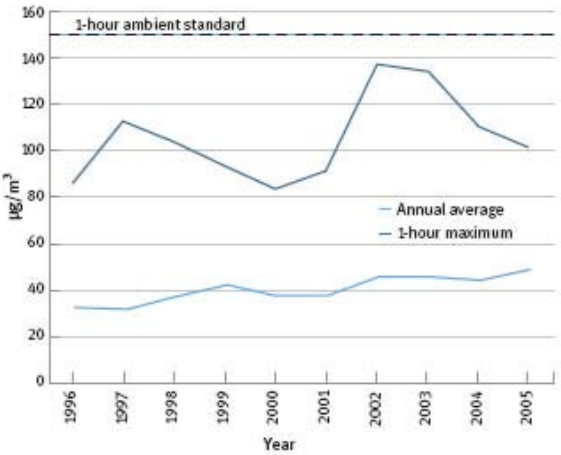


Figure 18: Ozone levels at Musick Point, Auckland, 1996–2005



Note: µg/m3 = micrograms per cubic metre.

Source: Auckland Regional Council, 2006a.

4.5.4 Compatibility with other indicator programmes

National indicator sets	International indicator sets	
Statistics NZ linked indicators	United Nations Commission on Sustainable Development core set	United Nations Commission on Sustainable Development Indicators of Sustainable Development
	OECD Key Environmental Indicators	European Environment Agency. Core Set Indicators (No. CSI 004)

Note: Small differences may exist in the way these variables are represented in other indicator sets.

Source: Web sites of Statistics New Zealand, UN Division of Sustainable Development, OECD, European Environment Agency.

4.5.5 References

Fisher GW, Graham BW, Bell MJ. 1995. Design of a National Ambient Air Quality Monitoring Network for New Zealand. A NIWA/ESR study prepared for the New Zealand Ministry for the Environment. Environmental Performance Indicators, Technical Paper No. 2 Air. MfE, Wellington.

Ministry for the Environment (MfE). 1998. Environmental Performance indicators. Confirmed indicators for air, fresh water and land. MfE, Wellington, ISBN 0-478-09042-0.

Ministry for the Environment. 2000. Good Practice Guide for Air Quality Monitoring and Data Management, Air quality technical report 10, ME number 369, ISBN 0-478-24005-2. http://www.mfe.govt.nz/publications/air/air-quality-good-practice-guide-dec00.pdf

Ministry for the Environment. 2002. Ambient Air Quality Guidelines 2002 Update, Air Quality Report No. 32, ME number 438. MfE, Wellington. ISBN 0-478-24064-3. http://www.mfe.govt.nz/publications/air/ambient-air-quality-may02/ambient-guide-may02.pdf

Ministry for the Environment. 2003a. Health effects of CO, NO_2, SO_2, ozone, benzene and benzo(a)pyrene in New Zealand, Air Quality Technical Report No. 43, MfE, Wellington, November 2003.

Ministry for the Environment. 2003b. Health Effects of PM_{10} in New Zealand, Air Quality Technical Report No. 39, Ministry for the Environment (MfE), Wellington.

Ministry for the Environment. 2005. Updated User Guide to Resource Management (National Environmental Standards Relating to Certain Air Pollutants, Dioxins and Other Toxics) Regulations 2004 (including Amendments 2005), MfE, Wellington.

Ministry for the Environment. 2007 . *Environment New Zealand*. MfE, Wellington. ISBN 978-0-478-30192-2.

New Zealand Government, Resource Management (National Environmental Standards Relating to Certain Air Pollutants, Dioxins, and Other Toxics) Regulations 2004 (SR 2004/309 and amendments SR 2004/433 and SR 2005/214).

World Health Organization (WHO). 2006. Air Quality Guidelines. Global Update 2005. Particulate matter, ozone, nitrogen dioxide and sulfur dioxide, WHO, Geneva. ISBN 92 890 2192 6. http://www.euro.who.int/Document/E90038.pdf

4.6 Atmosphere – greenhouse gases

In recent decades, climate change has emerged as an issue of global concern. In response, the international community has targeted action to quantify and reduce greenhouse gas emissions (GHG) from human activity.

4.6.1 Indicator and variable description

This indicator provides information on total GHG emission by sector and by type of gas. Growing forests absorb carbon and act as "sinks" of carbon dioxide, thereby offsetting emissions. This indicator also provides information on the removal of greenhouse gas emissions from the atmosphere as a result of absorption by forestry.

Table 9: Variables of the Greenhouse Gas indicator

Indicator	Variables
Emissions and removals of greenhouse gases	Carbon dioxide (CO_2) Methane (CH_4) Nitrous oxide (N_2O) Hydrofluorocarbons (HFCs) Perfluorocarbons (PFCs) Sulphur hexafluoride (SF_6) Greenhouse gas emissions removed from the atmosphere as a result of absorption by forestry

4.6.2 Indicator calculation and measurement

Sampling and analytical protocols: The calculation of individual country's GHG emissions follows internationally agreed methodologies. The guiding documents in inventory preparation are the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (IPCC, 1996), the *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (IPCC, 2000), *Good Practice Guidance for Land Use, Land-Use Change and* Forestry (IPCC, 2003) and the UNFCCC guidelines on reporting and review (FCCC/SBSTA/2004/8). The concepts contained in *Good Practice Guidance* are being implemented in stages, according to sector priorities and national circumstances.

Sampling frequency: Annual.

Data needed to compile the indicator: Emissions data for each of the greenhouse gases listed in Table 9, and removals data, from all main emission sources.

Data sources: Ministry for the Environment, 2007. *New Zealand's Greenhouse Gas Inventory 1990–2005, The National Inventory Report and Common Reporting Format*. Ministry for the Environment, Wellington. For more information on data sources refer to the Ministry for the Environment's document *Data stock-take for the core set of national environmental indicators and associated variables*.

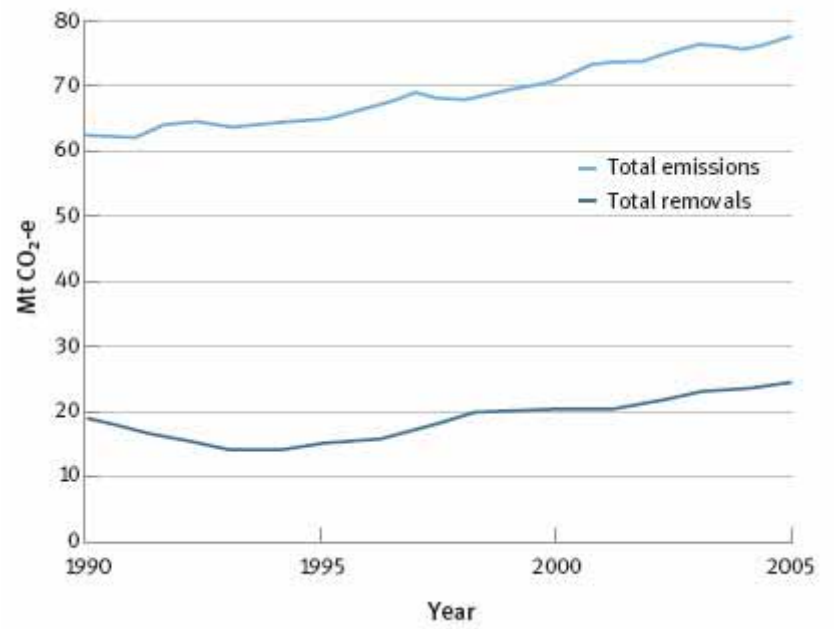
Spatial coverage and length of record: Emission estimates cover all anthropogenic emissions and removals of greenhouse gases in New Zealand since 1990.

Measurement methods: Emission figures are calculated/estimated in accordance with standardised UNFCCC methods.

Method for indicator calculation: See Ministry for the Environment, 2007. *New Zealand's Greenhouse Gas Inventory 1990–2005, The National Inventory Report and Common Reporting Format*. Ministry for the Environment, Wellington.

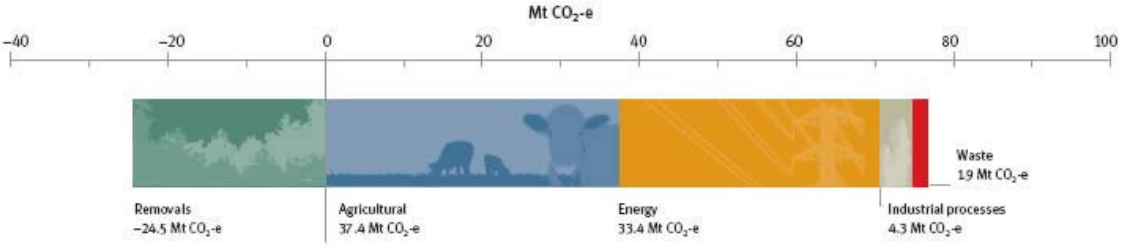
4.6.3 Sample reporting formats

Figure 19: New Zealand's total greenhouse gas emissions and removals, 1990–2005



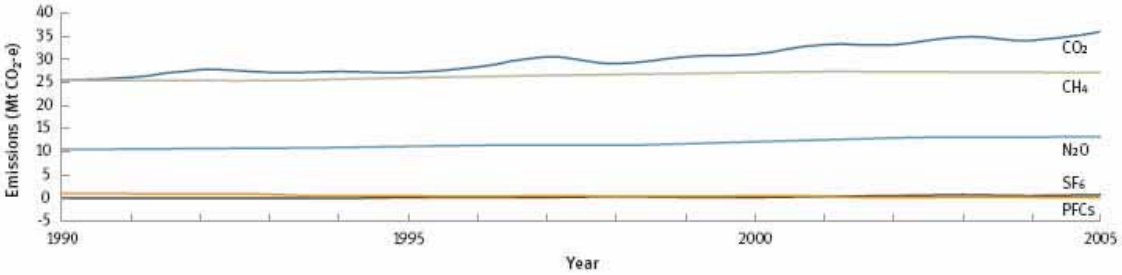
Source: New Zealand's Greenhouse Gas Inventory 1990–2005.

Figure 20: New Zealand's GHG emissions by sector, 2005 (Gg CO2-e)



Source: New Zealand's Greenhouse Gas Inventory 1990–2005.

Figure 21: New Zealand GHG emissions by gas, 1990–2005



Source: Ministry for the Environment

4.6.4 Compatibility with other indicator programmes

National indicator sets	International indicator sets	
Statistics NZ linked indicators	United Nations Commission on Sustainable Development core set	United Nations Commission on Sustainable Development sustainable development indicators
	OECD Core Environmental Indicators	European Environment Agency Core Set of Indicators (CSI 010)

Note: Small differences may exist in the way these variables are represented in other indicator sets.

Source: Web sites of Statistics New Zealand, UN Division of Sustainable Development, OECD, European Environment Agency.

4.6.5 References

Ministry for the Environment (MfE). 1998. *Proposals for stratospheric ozone and climate change indicators*. Environmental Performance Indicators. MfE, Wellington. ISBN -0-478-09021-8.

Ministry for the Environment. 2007a. *Environment New Zealand*. MfE, Wellington. ISBN 978-0-478-30192-2.

Ministry for the Environment. 2007b. *New Zealand's Greenhouse Gas Inventory 1990–2005, The National Inventory Report and Common Reporting Format*. MfE, Wellington.

4.7 Atmosphere – stratospheric ozone

The ozone layer protects the earth from damaging ultraviolet radiation. Increases in ultraviolet radiation at the earth's surface can damage human health resulting in skin cancer, eye cataracts, and suppression of the immune system. In addition, marine and terrestrial ecosystems can be affected through reduced photosynthesis and production of phytoplankton.

The "thickness" of the ozone layer has decreased markedly over the last 20 years as a result of human emissions of ozone-depleting substances. International cooperation under the Montreal Protocol of the Vienna Convention has brought about a large decrease in global production and consumption of ozone-depleting substances.

4.7.1 Indicator and variable description

This indicator shows average yearly ozone levels over New Zealand, expressed in Dobson Units (DU), which measure the total amount of ozone in the air column between ground level and the top of the atmosphere at an altitude of about 30 km.

4.7.2 Indicator calculation and measurement

Sampling frequency: Weekly.

Data needed to compile the indicator: The total amount of ozone in the air column between ground level and the top of the atmosphere (30 km) is measured by the National Institute of Water & Atmospheric Research (NIWA) at Lauder in Central Otago.

Data sources: For more information on data sources refer to the Ministry for the Environment's document *Data stock-take for the core set of national environmental indicators and associated variables*.

Spatial coverage and length of record: Ground-based measurements of total column ozone are available at Invercargill from 1/01/70 to 30/09/87. Similar measurements are available at Lauder from 30/01/87 to the present.

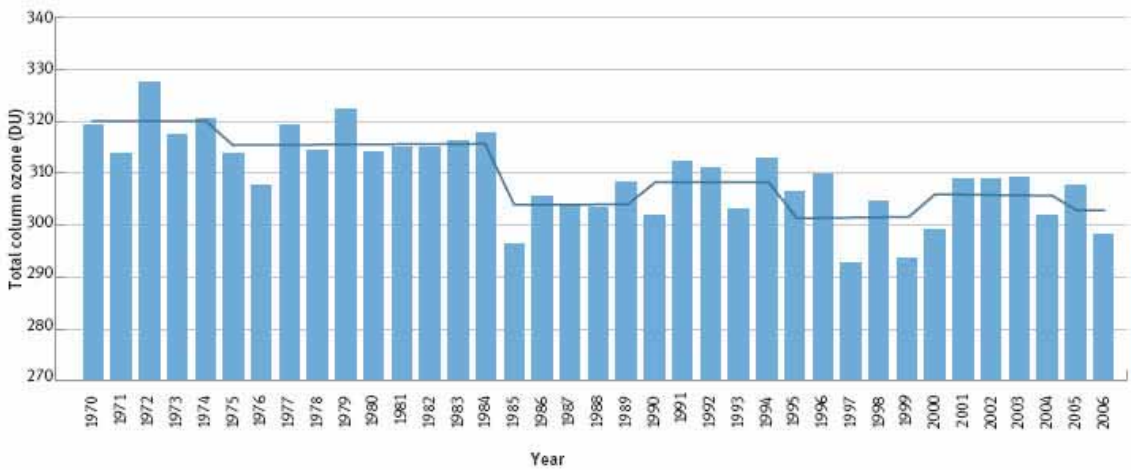
Measurement methods: All ground-based measurements at both sites were taken from a Dobson instrument. To merge these two time series measured at two different locations, satellite-based measurements were used to calculate daily differences in total column ozone between Lauder and Invercargill over the period 1/11/78 to 31/12/05. A climatology of these differences was then used to adjust the Invercargill measurements to account for their geographical separation from Lauder.

Siting of monitoring stations: One station at Lauder (Central Otago) from 1987.

Method for indicator calculation: The indicator shows annual averages of weekly measurements in Dobson Units at Lauder without further transformations or conversions of the measured data.

4.7.3 Sample reporting formats

Figure 22: Average yearly ozone levels over New Zealand, 1970–2006



(1) Five-year averages have been plotted to give an indication of trend in ozone concentration.

(2) DU = Dobson units.

Source: National Institute of Water & Atmospheric Research.

4.7.4 Compatibility with other indicator programmes

National indicator sets	International indicator sets
None	None of the international indicator sets operated by the OECD, UNCSD and EEA include an indicator about the state of the ozone layer, but the latter two comprise indicators about the production and consumption of ozone depleting substances.

Note: Small differences may exist in the way these variables are represented in other indicator sets.

Source: Web sites of Statistics New Zealand, UN Division of Sustainable Development, OECD, European Environment Agency.

4.7.5 References

McKenzie R, Bodeker G. 2007. Unpublished note to the Ministry for the Environment by the National Institute of Water and Atmospheric (NIWA) Research, Lauder.

Ministry for the Environment. 2007. *Environment New Zealand*. MfE, Wellington. ISBN 978-0-478-30192-2.

4.8 Land – land cover

New Zealand's total land area of 26 million hectares supports many varied landscapes and diverse landforms; from dry plains to steep hill country, snow capped mountains, coastal dunes and everything in between. Reporting and analysing changes and trends in land cover can help identify changes in New Zealand's land resources, and assist decision-making for sustainable land management.

4.8.1 Indicator and variable description

This indicator shows changes in land cover over time. The term land cover describes the type of feature present on the surface of the earth, eg, pastures, lakes, forests, and urban areas.

4.8.2 Indicator calculation and measurement

Sampling frequency: The Land Cover Database (LCDB) was last updated in 2002. An update of the database is presently in its early stages of development. Five-yearly reporting is recommended if updated geospatial mapping imagery and analysis is available.

Data needed to compile the indicator: Digital data derived from LCDB imagery for land cover. The 42-class Land Cover Database 2 classification provides the basis of a simplified classification of 9 major land cover groups used in this indicator (Table 10).

Table 10: LCDB* land cover classes and aggregated land cover classification used for national environmental reporting

Land Cover Database (LCDB) classes	Aggregated land cover classes used for environmental reporting
Afforestation (imaged post LCDB1**) Afforestation (not imaged) Forest harvested Other exotic forest Pine forest – closed canopy Pine forest – open canopy	Exotic forest
Deciduous hardwoods Gorse and broom Major shelterbelts Mixed exotic shrubland	Exotic shrubland
Indigenous forest Mangrove	Native forest
Alpine grass-/ herb field Broadleaved indigenous hardwoods Depleted tussock grassland Fernland Flaxland Grey scrub Herbaceous freshwater vegetation Herbaceous saline vegetation Manuka and or kanuka Matagouri Sub-alpine shrubland Tall tussock grassland	Native vegetative
Alpine gravel and rock Coastal sand and gravel Estuarine open water Lake and pond Landslide Permanent snow and ice River River and lakeshore gravel and rock	Other native land cover
Orchard and other perennial crops Short rotation cropland Vineyard	Primarily horticulture
High producing exotic grassland Low producing grassland	Primarily pasture: • high-producing exotic grassland • low-producing grassland
Built-up area Dump Surface mine Transport infrastructure Urban parkland/open space	Artificial surfaces

* LCDB = Land Cover Data Base; **LCDB1 = land cover as in 1996/97.

Data sources: For more information on data sources refer to the Ministry for the Environment's document *Data stock-take for the core set of national environmental indicators and associated variables*.

Spatial coverage and length of record: There are currently two LCDB series that show changes in land cover over a five-year period: LCDB1 (1996/97 imagery) and LCDB2 (2001/02 imagery).

Measurement methods: Satellite photography (land cover). The LCDB is a digital map of New Zealand's land cover. Satellite images were taken on cloud-free days in the summer of 1996/97 (LCDB1) and in summer 2001/02 (LCDB2). These images were used to classify and map different land cover classes nationally (see Table 11). This way it is possible to show land cover at five-yearly intervals.

Method for indicator calculation: Once the satellite photography has been processed and digitised, calculating the indicator is a matter of simple arithmetic of distributing land areas according to the relevant classification and adding up surface areas.

4.8.3 Sample reporting formats

This core indicator is based on digitised satellite imagery, allowing it to be displayed both in the form of maps and as tables presenting the amounts of land taken up by the various land cover classes.

Table 11: Changes in land cover between 1997 (LCDB1) and 2002 (LCDB2)

Land-cover class		1997 area (hectares)	Percentage of total land area (%)	2002 area (hectares)	Percentage of total land area (%)	Change in area (hectares)
Exotic forest		1,822,300	6.79	1,961,800	7.31	139,500
Exotic shrubland		370,900	1.38	363,300	1.35	–7,600
Native forest (including mangroves)		6,485,400	24.18	6,483,100	24.17	–2,300
Native vegetation		5,263,400	19.62	5,248,500	19.57	–14,900
Other native land cover		1,588,400	5.92	1,589,100	5.92	700
Primarily horticulture		413,000	1.54	417,400	1.56	4,500
Primarily pasture	High-producing exotic grassland	8,985,200	33.50	8,885,800	33.13	–99,400
	Low-producing grassland	1,678,100	6.26	1,652,300	6.16	–25,800
Artificial surfaces		215,000	0.80	220,500	0.82	5,500
Total		26,821,600	100	26,821,600	100	

Source: Ministry for the Environment, 2007.

4.8.4 Compatibility with other indicator programmes

National indicator sets	International indicator sets	
Statistics NZ linked indicators	OECD Core Environmental Indicators	European Environment Agency Core Set of Indicators (CSI 014 – Land take)

Note: Small differences may exist in the way these variables are represented in other indicator sets.

Source: Web sites of Statistics New Zealand, UN Division of Sustainable Development, OECD, European Environment Agency.

4.8.5 References

Ministry for the Environment (MfE). 1997. *Proposals for air, freshwater, & land*. Signposts for Sustainability. MfE, Wellington. ISBN 0-478-09016-1.

Ministry for the Environment. 1998. *Confirmed indicators for air, freshwater and land*. Signposts for sustainability. MfE, Wellington. ISBN 0-478-09042-0.

Ministry for the Environment. 2007. *Environment New Zealand*. MfE, Wellington. ISBN 978-0-478-30192-2.

4.9 Land – land use

Accurate and up-to-date information about land use is important for a country whose economy is largely based on tourism and primary production, both of which rely heavily on the quality of the natural environment.

4.9.1 Indicator and variable description

This indicator shows changes in land use over time. The term land use describes the human activity or economic function associated with a parcel or tract of land. Change in land use can be a driving force behind land cover change.

4.9.2 Indicator calculation and measurement

Sampling and analytical protocol: This core indicator is based on digitised satellite imagery, allowing it to be displayed both in the form of maps and as tables presenting the amounts of land taken up by the various land cover and land-use classes.

Sampling frequency: Five-yearly. The Land Cover Database (LCDB) was last updated in 2002. An update of the database is presently in its early stages of development, and the new Land Use and Carbon Analysis system (LUCAS) will provide up-to-date land-use information. Five-yearly reporting is recommended if updated geospatial mapping imagery and analysis is available. The annual Agricultural Production Survey can provide land-use information in the interim.

Data needed to compile the indicator: Land use is classified according to 18 land use and four land cover classes that describe the functional activities associated with an area of land (Table 12); the match between the land cover and land-use classifications is also shown.

Land use can be inferred from land cover at a summary level, eg, pasture land cover and agricultural land use. Digital data derived from LCDB imagery for land cover can be used to make this inference, along with other classification tools such as Land Environments of New Zealand (LENZ), and the Agricultural Production Survey.

Table 12: Land-use classes for national environmental reporting

Land cover class used for environmental reporting	Land-use class used for environmental reporting
Primarily pastoral	Dairy Intensive sheep and beef Hill country sheep and beef High country sheep and beef Deer Other animals Ungrazed
Urban areas / artificial surfaces	Urban
Exotic forests (all classes)	Planted forestry
Primarily horticultural	Arable cropping Vegetables Berry fruit Pip fruit Grapes Summer fruit Tropical fruit Kiwi fruit Flowers
Non-vegetative and vegetative indigenous land cover	Tussock* Native forests Rivers, lakes, snow and ice Scrub

* The distinction being made in this table between land cover and land use poses problems for the various "land uses" listed next to the indigenous land cover class, which are, in fact, more detailed land cover descriptions. However, they could be considered as being linked to economic activities such as tourism, gathering and hunting (deer, wild pigs, honey), or ecosystem services.

Data sources: For more information on data sources refer to the Ministry for the Environment's document *Data stock-take for the core set of national environmental indicators and associated variables*.

Spatial coverage and length of record: There are currently two LCDB series that show changes in land cover over a five-year period: LCDB1 (1996/97 imagery) and LCDB2 (2001/02 imagery).

Measurement methods: Satellite photography (land cover). The LCDB is a digital map of New Zealand's land cover. Satellite images were taken on cloud-free days in the summer of 1996/97 (LCDB1) and in summer 2001/02 (LCDB2). These images were used to classify and map different land cover classes nationally (see Table 11). This way it is possible to show land cover and infer land use at five-yearly intervals.

The Agricultural Production Survey surveys approximately 30,000 farms by a mailed out questionnaire from Statistics New Zealand. This aims to gather information on agricultural land use, and every second year this includes horticultural land uses. Every five years a census is sent to around 70,000 farms to get full coverage of agricultural land use in New Zealand.

Method for indicator calculation: Once the satellite photography has been processed and digitised, calculating the indicator is a matter of simple arithmetic of distributing land areas according to the relevant classification and adding up surface areas.

4.9.3 Sample reporting formats

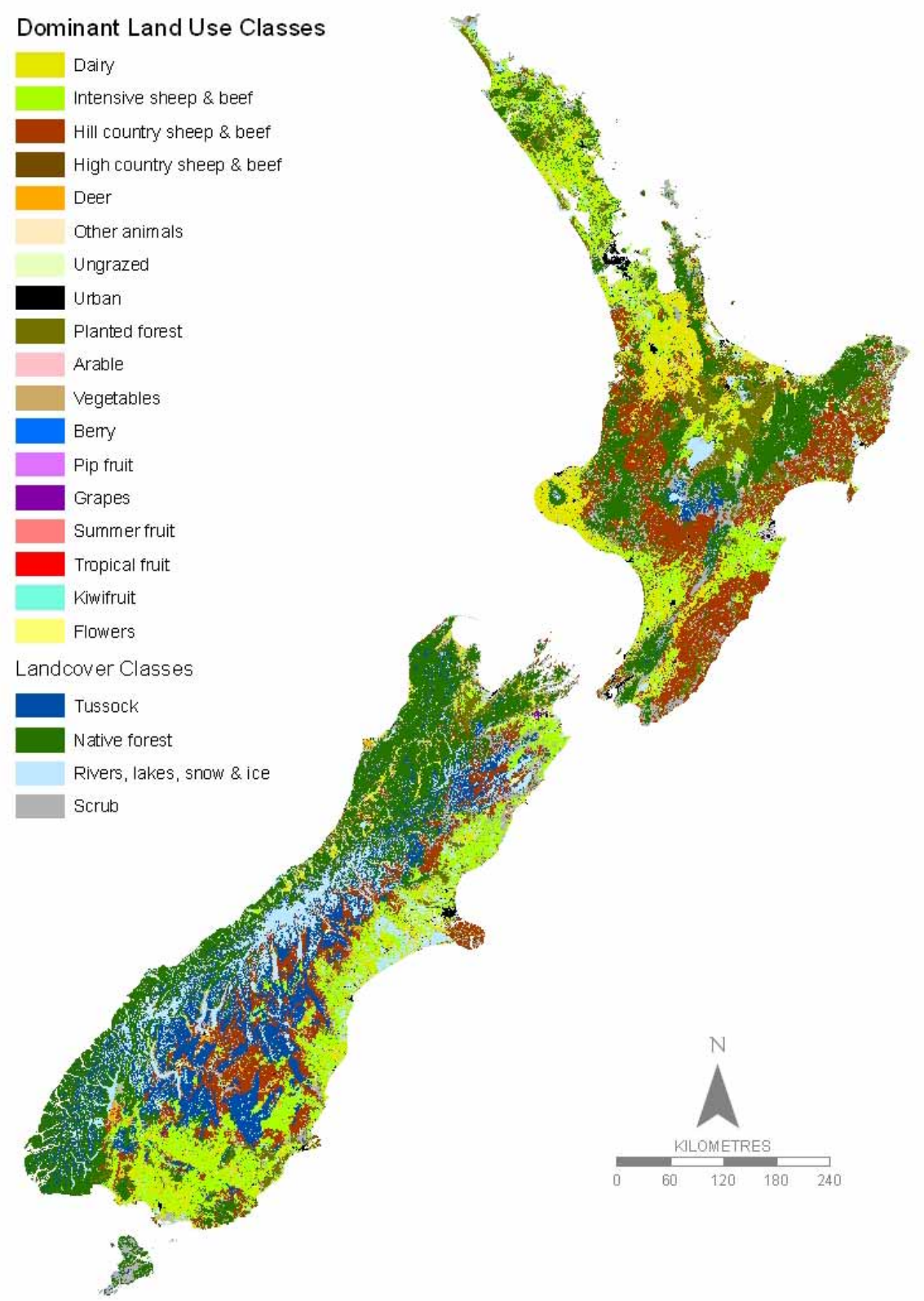
This core indicator is based on digitised satellite imagery, allowing it to be displayed both in the form of maps and as tables presenting the amounts of land taken up by the various land cover and land-use classes.

Table 13: Dominant land use and selected land cover in New Zealand, 2004

Land-use classes	Hectares	Percentage of total land area (%)
Dairy	1,879,600	7.00
Intensive sheep and beef	3,841,100	14.32
Hill-country sheep and beef	4,023,200	15.00
High-country sheep and beef	48,900	0.18
Deer	249,700	0.93
Other animals	64,900	0.24
Ungrazed	659,800	2.46
Urban	203,600	0.76
Planted forest	1,957,000	7.30
Arable crops	1,200	0.0044
Vegetables	2,200	0.0083
Berryfruit	1,200	0.0045
Pipfruit	10,200	0.038
Grapes	18,800	0.070
Summer fruit	1,800	0.0069
Tropical fruit	1,600	0.006
Kiwifruit	6,400	0.024
Flowers	57	0.0002
Land-cover classes		
Tussock	2,645,200	9.86
Native forest	6,567,200	24.48
Rivers, lakes, snow, and ice	2,094,200	7.81
Scrub	2,543,600	9.48
Total	26,821,500	100

Source: Ministry for the Environment, 2007.

Figure 23: Land use in New Zealand, 2004



Source: Ministry for the Environment, 2007.

4.9.4 Compatibility with other indicator programmes

National indicator sets	International indicator sets	
Statistics NZ linked indicators	United Nations Commission on Sustainable Development core set (Arable and permanent cropland area) OECD Core Environmental Indicators	United Nations Commission on Sustainable Development sustainable development indicators (Land-use change; Arable and permanent cropland area) European Environment Agency Core Set of Indicators (CSI 014 – Land take)

Note: Small differences may exist in the way these variables are represented in other indicator sets.

Source: Web sites of Statistics New Zealand, UN Division of Sustainable Development, OECD, European Environment Agency.

4.9.5 References

Ministry for the Environment (MfE). 1997. *Proposals for air, freshwater, and land*. Signposts for Sustainability. MfE, Wellington. ISBN 0-478-09016-1.

Ministry for the Environment. 1998. *Confirmed indicators for air, freshwater and land*. Signposts for sustainability. MfE, Wellington. ISBN 0-478-09042-0.

Ministry for the Environment. 2007. *Environment New Zealand*. MfE, Wellington. ISBN 978-0-478-30192-2.

4.10 Land – soil health

Seventeen per cent of New Zealand's GDP depends on the top 15 centimetres of our soil. Soils underpin food and fibre production in New Zealand and protect our environment by; acting as buffers and filters to reduce nutrient loss; limit the need for irrigation, breaking down pollutants, regulating gas emissions and acting as a fundamental part of the water cycle.

4.10.1 Indicator and variable description

Soil health is defined as the biological, chemical and physical condition of different soil types under specific land uses (Table 14). Soil health can be characterised in terms of:

- soil biological activity, which is important for plant growth, organic matter and nutrient cycling, pest and disease control (eg, root rot) and soil structure
- soil nutrient management, which affects plant growth and soil biological activity
- soil physical condition, which influences plant growth, gaseous exchange, and water storage and movement through soil (MfE, 1997).

Table 14: Key soil health attributes

Measures	Soil health information
Biological properties	
Potentially mineralisable nitrogen	Readily mineralised nitrogen reserves
Chemical properties	
Total carbon content	Organic matter status
Total nitrogen content	Organic nitrogen reserves
pH	Acidity or alkalinity
Olsen phosphate	Plant-available phosphate
Physical properties	
Macroporosity	Soil compaction, root environment, aeration

Source: Ministry for the Environment, 2007a.

The soil health indicator is calculated for seven separate land-use types as follows:

- arable cropping
- tussock grassland
- mixed cropping
- exotic forestry
- drystock pasture
- native forest
- dairy pasture.

4.10.2 Indicator calculation and measurement

Sampling and analytical protocols: Sampling and interpretation protocols for soil health indicators can be found in the documentation for the "500 Soils Project" (Sparling and Schipper, 2004). Furthermore, the National Land Monitoring Forum is developing guidelines for soil quality sampling for use by regional councils.

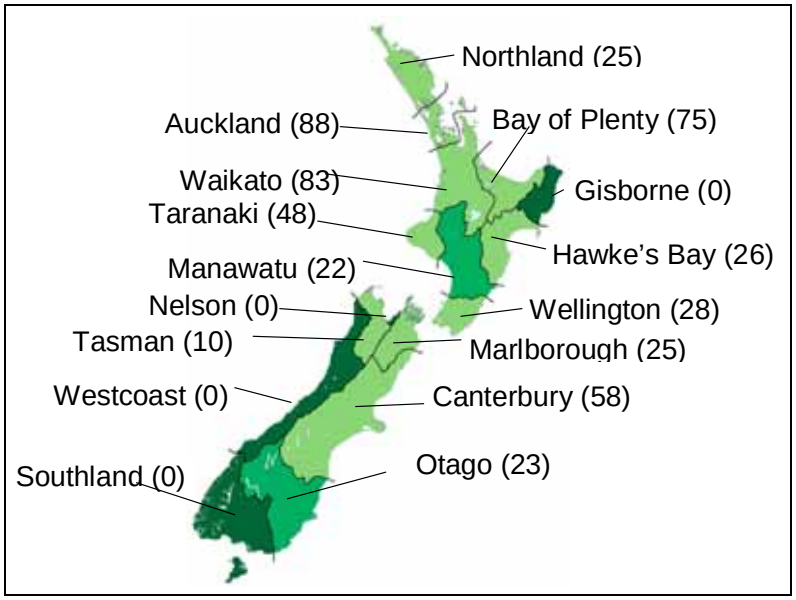
Sampling frequency: Prior to the "500 Soils Project", there was periodic soil health monitoring undertaken by regional councils, but little nationally consistent and frequent soil health monitoring.

Data needed to compile the indicator: See Table 14.

Data sources: For more information on data sources refer to the Ministry for the Environment's document *Data stock-take for the core set of national environmental indicators and associated variables*.

Spatial coverage and length of record: Figure 24: identifies the number of monitoring sites from each of the participating regions of the '500 Soils Project'. This project was undertaken between 1999 and 2001, however, only four regions have continued with regular, ongoing monitoring.

Figure 24: Number of monitoring sites in regions participating in the '500 soils project'



Measurement methods: The '500 Soils Project' between 1995 and 2001 measured soil health attributes at the 511 sites of the soil health monitoring project.

Method for indicator calculation: Statistical processing of laboratory test results in accordance with the documentation for the '500 Soils Project'.

4.10.3 Sample reporting formats

Table 15: Soil properties under the 500 Soils Project, arranged by land-use categories

Soil property	Arable cropping (N=44)	Mixed cropping (N=17)	Drystock pasture (N=142)	Dairy pasture (N=127)	Tussock grasslands (N=20)	Exotic forestry (N=67)	Native forests (N=58)
Mineralisable nitrogen (µg/m^3)	56	70	128	160	88	63	100
Total carbon (mg/cm^3)	40.7	37.6	50.8	66.9	38.3	46.4	56.5
Total nitrogen (mg/cm^3)	2.32	3.13	4.29	5.92	2.62	2.99	3.48
pH in water	6.17	6.17	5.75	5.74	5.61	5.36	5.36
Olsen phosphate (µg/m^3)	49	44	19	44	16	10	11
Macroporosity (%v/v)	14.7	9.3	13.3	10.1	15.6	25.6	9.3

Source: Ministry for the Environment, 2007a.

4.10.4 Compatibility with other indicator programmes

National indicator sets	International indicator sets
None	None

Source: Web sites of Statistics New Zealand, UN Division of Sustainable Development, OECD, European Environment Agency.

4.10.5 References

Ministry for the Environment (MfE). 1997. *Proposals for air, freshwater, and land*. Signposts for Sustainability. MfE, Wellington. ISBN 0-478-09016-1.

Ministry for the Environment. 1998. *Confirmed indicators for air, freshwater and land*. Signposts for sustainability. MfE, Wellington. ISBN 0-478-09042-0.

Ministry for the Environment. 2007a. *Environment New Zealand*. MfE, Wellington. ISBN 978-0-478-30192-2.

Ministry for the Environment. 2007b. *Land: Soil quality assessed from the 500 Soils Project*. Unpublished technical paper by G. Sparling. MfE, Wellington, New Zealand.

Sparling G, Schipper L. 2004. Soil quality monitoring in New Zealand: trends and issues arising from a broad scale survey. *Agriculture, Ecosystems and Environment* 104 (2004) 545–552. Science Direct. Com.

4.11 Land – erosion risk

Soil intactness (the ability of soils to stay in place) is important for three main reasons.

- soil loss (through actions of water or wind erosion) can accelerate sedimentation and nutrient runoff, and degrade water quality in adjacent or downstream water bodies
- downstream erosion debris can cause rivers to become filled in with silt and gravel, increasing the risk of flooding in heavy rainfall
- the gradual loss of topsoil affects the general health of the soil and reduces the fertility and productive capacity of the soil resource – the restoration of which may take hundreds of years.

4.11.1 Indicator and variable description

This indicator identifies the area of hill country at risk of erosion (tunnel gully, gully and earth flow forms of soil erosion, *excluding* wind and other forms of erosion).

4.11.2 Indicator calculation and measurement

Sampling frequency: Five-yearly. The Land Cover Database (LCDB) was last updated in 2002. An update of the database is presently in its early stages of development.

Data needed to compile the indicator: Digital data derived from LCDB imagery for land cover. Land-use Capability (LUC) classes VI, VII and VIII.[2]

Data source: The NZ Land Resource Inventory (NZLRI) and Land Cover Database. For more information on data sources refer to the Ministry for the Environment's document *Data stock-take for the core set of national environmental indicators and associated variables*.

Spatial coverage and length of record: There are currently two LCDB series that show changes in land cover over a five-year period: LCDB1 (1996/97 imagery) and LCDB2 (2001/02 imagery).

Measurement methods: Satellite photography (land cover). The LCDB is a digital map of New Zealand's land cover. Satellite images were taken on cloud-free days in the summer of 1996/97 (LCDB1) and in summer 2001/02 (LCDB2).

Land cover is considered in combination with the LUC classes and elevation to derive measures of erosion risk, as listed below:

- developed land in exotic pasture without woody vegetation on land in LUC classes VI, VII and VIII
- developed land in exotic pasture without woody vegetation (above 1,000 m[3])
- urban areas in LUC classes VI, VII and VIII.

Method for indicator calculation: Once the satellite photography has been processed and digitised, calculating the indicator is a matter of calculating land areas according to the relevant classification.

---

[2] LUC classes VI, VII and VIII denote land subject to severe, very severe and extreme erosion risk, respectively.

[3] This criterion is applied to *all* land above 1,000 m, not just land in LUC classes VI, VII and VIII.

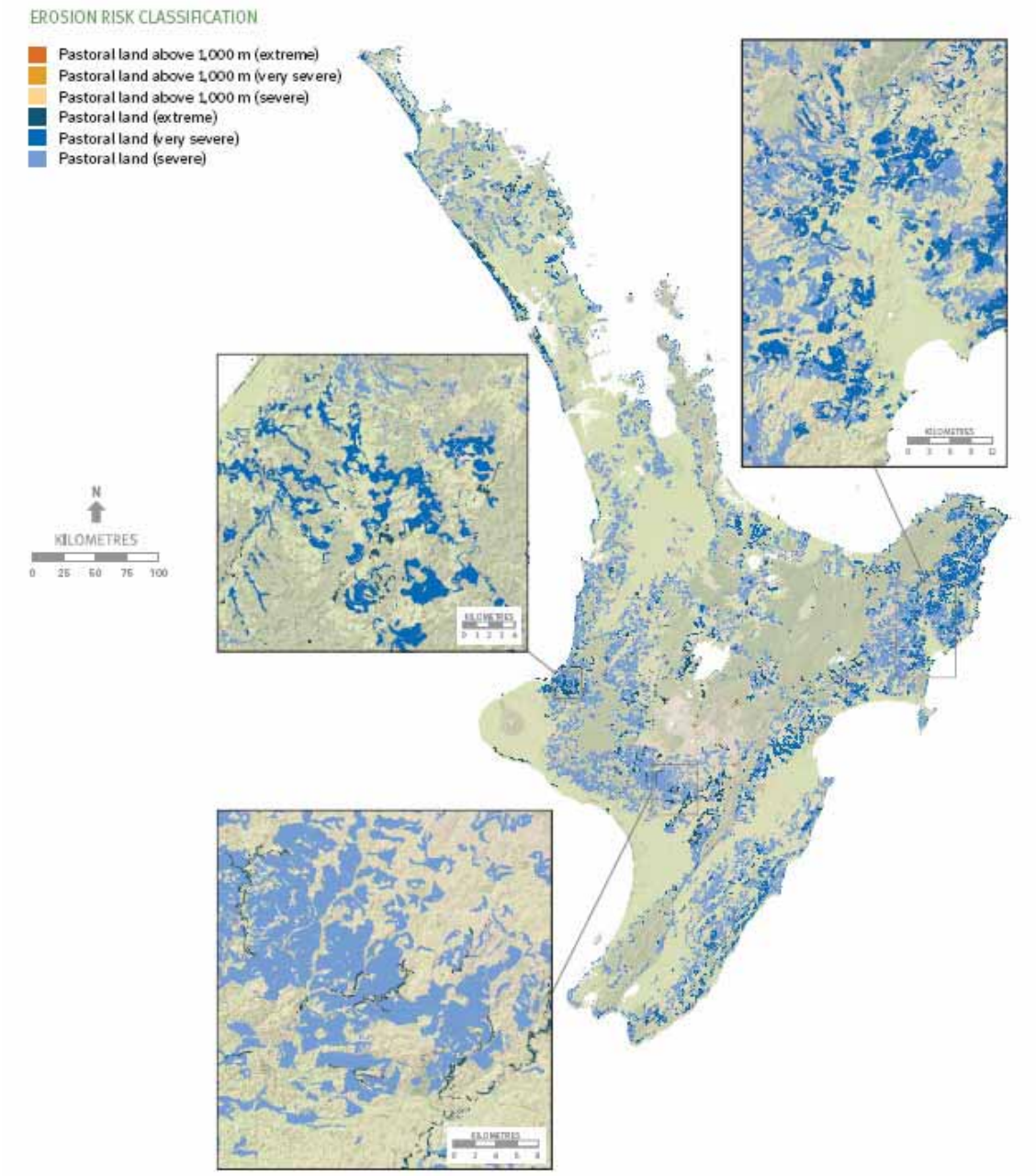
4.11.3 Sample reporting formats

Table 16: Pasture on hill-country erosion-prone land by region between 1997 and 2002

Region	Erosion-prone area (hectares) in pasture (LCDB 1)	Erosion-prone area (hectares) in pasture (LCDB 2)	Percentage of total New Zealand land area (LCDB 2) (%)	Percentage of total regional land area (%)	Area (hectares) change from pasture (LCDB 2)	Percentage change (%)
Northland	67,723	65,832	0.25	5.10	–1,691	–2.50
Auckland	13,101	12,988	0.05	2.49	–53	–0.40
Bay of Plenty	27,000	25,855	0.10	2.10	–1,104	–4.09
Waikato	116,049	112,315	0.42	4.58	–3,680	–3.17
Gisborne	167,141	158,382	0.59	19.01	–8,151	–4.88
Hawke's Bay	113,128	110,416	0.41	7.80	–2,537	–2.24
Manawatū	230,585	223,535	0.83	10.08	–6,793	–2.95
Taranaki	40,580	38,444	0.14	5.30	–2,136	–5.26
Wellington	54,281	51,387	0.19	6.33	–2,794	–5.15
Nelson	1,612	1,535	0.01	3.52	–76	–4.74
Tasman	24,249	22,697	0.09	2.39	–1,012	–4.17
Marlborough	75,042	71,946	0.27	6.84	–3,107	–4.14
Canterbury	113,995	113,770	0.42	2.52	–220	–0.19
West Coast	4,623	4,592	0.02	0.20	–16	–0.35
Ōtago	101,531	101,236	0.38	3.17	–294	–0.29
Southland	26,083	25,437	0.09	0.80	–646	–2.48
North Island	829,587	799,154	2.98	na	–30,433	–3.67
South Island	347,134	341,213	1.27	na	–5,921	–1.71
Total	1,176,721	1,140,367	4.25	na	–36,354	–3.09

Source: Ministry for the Environment, 2007a.

Figure 25: Hill-country pasture areas at risk of erosion – North Island (LCDB 2, 2002)



Source: Ministry for the Environment, 2007a.

4.11.4 Compatibility with other indicator programmes

National indicator sets	International indicator sets
None	OECD Core Environmental Indicators

4.11.5 References

Ministry for the Environment (MfE). 1997. *Proposals for air, freshwater, and land*. Signposts for Sustainability. MfE, Wellington. ISBN 0-478-09016-1.

Ministry for the Environment. 1998. *Confirmed indicators for air, freshwater and land*. Signposts for sustainability. MfE, Wellington. ISBN 0-478-09042-0.

Ministry for the Environment. 2007a. *Environment New Zealand*. MfE, Wellington. ISBN 978-0-478-30192-2.

Ministry for the Environment. 2007b. *Land: Soil quality assessed from the 500 Soils Project*. Unpublished technical paper by G Sparling. MfE, Wellington, New Zealand.

Sparling G, Schipper L. 2004. Soil quality monitoring in New Zealand: trends and issues arising from a broad scale survey. *Agriculture, Ecosystems and Environment* 104 (2004) 545–552. Science Direct. Com.

4.12 Freshwater – water quality

Water quality has deteriorated in some rivers, lakes, and groundwater aquifers as a result of pollution from human activities. While sewage and wastewater discharges from point sources are still a significant influence on water quality in some areas, the effects of non-point sources of pollution, such as run-off from agricultural and urban land uses, have been identified as the most serious freshwater management challenge in New Zealand today.

There are four indicators – focussed on non-point sources of pollution – that tell us about the extent of deterioration and the environments in which water quality is most at risk. The four indicators are:

- river water quality
- lake water quality
- groundwater quality
- recreational water quality.

4.12.1 Indicator and variable descriptions

Table 17 shows the variables that make up the indicator for water quality in New Zealand's rivers, lakes, and groundwater aquifers.

Table 17: Indicators and variables for freshwater quality

Indicator	Variable	Indicative of/significance for water quality
River water quality	Nutrients (total and dissolved concentrations of nitrogen and phosphorus)	Indicative of nutrient status, eutrophication related to human activities (urban and agricultural runoff). Potential adverse impacts on freshwater ecosystem
	E. coli	Indicative of animal and/or human waste (faecal matter) sources
	Clarity	Can be indicative of sediment load relating to erosion, or algal biomass in the water column relating to eutrophication. Potential adverse impacts on freshwater ecosystem, important in relation to aesthetic appreciation and other human uses.
	Water temperature	Potential adverse impacts on freshwater ecosystem. Can be indicative of riparian zone management (ie, shade from trees) and abstraction effects.
	Dissolved oxygen	Potential adverse impacts on freshwater ecosystem. Oxygen depletion is commonly caused by breakdown of organic pollutants, or respiration by algal blooms in nutrient-rich waters.
	Macroinvertebrates [MCI and/or %EPT]	Macroinvertebrates (in-stream insects, worms and snails) are good indicators of overall stream health (habitat condition) and water quality. Some taxa (%EPT) are particularly sensitive to pollution.
Lake water quality	Trophic Level Index (TLI): • total nitrogen • total phosphorus • algae (chla) • visual clarity	Indicative of nutrient status, eutrophication related to human activities (urban and agricultural runoff). Potential adverse impacts on freshwater ecosystem.
Groundwater quality	Nitrate nitrogen	Indicative of nutrient sources related to human activities (urban and agricultural runoff). Public health concerns (nitrate can be toxic in high enough concentrations in drinking water).
	E. coli	Indicative of animal and/or human waste (faecal matter) sources. Public health concerns (drinking water).
Recreational water quality	*E. coli*	Indicative of animal and/or human waste (faecal matter) and therefore health risk from bacteria, viruses and protozoa to swimmers.

Indicators of biological quality and fresh water ecosystem health

In addition to the macroinvertebrate measures listed in Table 17, other biological variables that describe fresh water ecosystem health are being examined for national reporting. These include a measure of lake ecological health (LakeSPI), a measure of fish community health (Index of Biotic Integrity), and periphyton (algae) occurrence in rivers and streams. Currently, data for these variables is patchy at a national scale (because of inconsistent monitoring over time and/or between regions). For example, the LakeSPI methodology is applied predominantly in only North Island lakes and there are very few repeat-sample records in the New Zealand Freshwater Fish Database. This limits the ability to derive sufficient trend information to make conclusive statements at a national scale. However, recent (2009) assessments of periphyton in rivers of the National River Water Quality Network and Fish IBI using all available information will help advance work in this area.

4.12.2 Indicator calculation and measurement

There are no binding standards for water quality in New Zealand. Councils use their own regional guidelines to set water quality objectives for both reporting and setting conditions on applications for consent under the Resource Management Act 1991. However, two national water quality guidelines (ANZECC 2000; MfE 2003) provide non-binding guidance on some aspects of water quality, including trigger limit values for four of the variables comprising the water quality indicators (Table 18). Additionally, the New Zealand Periphyton Guideline (Biggs, 2000) is also used to report nitrate and dissolved reactive phosphorus concentrations, in the context of these nutrients promoting nuisance algae growth. It is noted that the Australian and New Zealand Environment Conservation Council (ANZECC) (2000) trigger values are designed primarily as management tools rather than as benchmarks to report against. However, in the absence of dedicated reporting guidelines (based on standards), the ANZECC triggers provide useful standardised reference points.

Table 18: Selected quality guidelines

Variable	Impact rationale	Guideline value
Nitrate nitrogen	Possible adverse ecosystem effects Public health Stock water supply	Upland: 0.16 gm^{-3} Lowland: 0.44 gm^{-3} 11.3 gm^{-3} 400 gm^{-3}
Ammoniacal nitrogen (NH_4^+)	Possible adverse ecosystem effects Chronic toxicity (eg, to fish)	Upland: 0.010 gm^{-3} Lowland: 0.021 gm^{-3} 0.90 gm^{-3}
Dissolved reactive phosphorus	Possible adverse ecosystem effects	Upland: 0.009 gm^{-3} Lowland: 0.010 gm^{-3}
Visual clarity	Ecosystem protection, aesthetics	0.8 m upland rivers 0.6 m lowland rivers
E. coli	Contact recreation freshwater	Acceptable < 260 per 100 mL Alert level 260 – 550 per 100 mL Action level > 550 per 100 mL

Source: Australian and New Zealand Environment Conservation Council 2000; Ministry for the Environment 2003.

Sampling and analytical protocols: The following nationally applicable protocols are available in relation to the variables of the water quality indicator:

- macroinvertebrate sampling in streams should be carried out in accordance with the protocols for sampling macroinvertebrates in wadeable streams (MfE, 2001)
- lake water trophic level sampling should be carried out in accordance with the Protocol for Monitoring Trophic Levels of New Zealand Lakes and Reservoirs (Burns et al, 2000)
- microbiological sampling should be carried out in accordance with the procedures outlined in the Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas (MfE, 2003), Notes H(i) and H(ii)
- groundwater sampling should be carried out in accordance with the National Protocol for State of the Environment Groundwater Sampling in New Zealand (MfE, 2006c).

Sampling frequency: Sampling frequency varies depending on both the nature of the measurement variable and the monitoring agency. Typical sampling frequencies for the water indicator variables are given in Table 19.

Table 19: Typical sampling frequency for water quality indicator

Water body or use		Typical sampling frequency			
		Weekly	Monthly	Bi-monthly	Quarterly
River	Macroinvertebrates				✓
	All other variables		✓		
Lake	All variables		✓	✓	✓
Groundwater	All variables		✓		✓
Recreational	All variables	✓*			

* Weekly recreational water quality sampling generally only occurs in summer months from November to March.

Data needed to compile the indicator: See Table 23.

Data sources: The vast majority of water quality indicator data comes from regional council and Crown Research Institute monitoring programmes. Data sources are summarised in Table 20. For more information on data sources refer to the Ministry for the Environment's document *Data stock-take for the core set of national environmental indicators and associated variables*.

Table 20: Data sources for water quality indicators

Water body or use	Data source		
	Regional councils	NIWA	GNS
River	✓	✓	
Lake	✓	✓	
Groundwater	✓		✓
Recreational	✓**		

* Weekly recreational water quality sampling generally only occurs in summer months from November to March.

** In addition to regional councils, some data also comes from city and district councils.

Spatial coverage and length of record: Table 21 summarises information relating to monitoring sites, spatial coverage and length of data record.

Table 21: Spatial coverage and length of record

Indicator	Number of long term monitoring sites*	Coverage (number of regions)	Length of data record
River water quality	Approximately 800* 77 (on 35 rivers) are part of the National River Water Quality Network. The remainder are operated by regional councils. 22,000+ records in the NZ Fresh Water Fish Database, hosted by NIWA. The large majority of councils and research agencies input sample data to this database.	All regions	Variable. NRWQN has continuous record since 1989. Many council sites established in the 1990s. ENZ07 reported council data for the period 1996–2002. Fish records stretch back to the 1970s.
Lake water quality	Approximately 134 120 monitored by regional councils and a further 14 by universities and NIWA.	8 regions No long-term monitoring in Nelson City, Marlborough, Gisborne and Taranaki.	Variable. In 2006 only 49 lakes had sufficient length of record for formal trend analysis.
Groundwater quality	Approximately 1,100 119 sites are monitored as part of the National Groundwater Monitoring Programme (NGMP). The remainder are regional council sites.	All regions except Nelson City.	Variable The NGMP was established in 1996. ENZ07 reported council and NGMP data for the period 1995 to 2005.
Recreational water quality	Approximately 175**	All regions except Gisborne.	Variable MfE holds data for each year since 2003/04 summer.

* As at 2006 when a series of technical reports were commissioned by MfE. Note that not all sites meet the criteria for all types of water quality analysis.

** These are sites that are monitored at least 10 times each summer. A further 33 sites (as at 2007) are monitored less frequently.

Measurement methods: There are small variations in measurement methods between regions and laboratories. However, the standard methodologies that are employed in most cases are summarised in Table 22.

Table 22: Standard measurement and analytical methods

Variable	Method
Nitrate nitrogen	**Lab.** For nitrate in groundwater, in accordance with the groundwater sampling protocol (MfE 2006a). Absorption spectrophotometry using a specific reagent.
Dissolved reactive phosphorus	**Lab.** Absorption spectrophotometry using a specific reagent.
Ammoniacal nitrogen	**Lab.** Absorption spectrophotometry, Nessler's method, or indophenol blue method.
E. coli	**Lab.** Colilert™ and EPA method 1103.1, 1985 Membrane Filter Method for *E. coli* are the preferred methods. Established standard methods are also available through the International Organization of Standardization (ISO 9308-1), American Public Health Association (APHA), the UK Department of Health (DHSS), and the Guidelines for Drinking-water Quality (WHO).
Dissolved oxygen	**Field.** Measured as percentage of saturation (% DO) by way of titration using the Winkler method or with electrometric method (DO probe and meter).
Visual clarity	**Field.** Measured on site as horizontal black disk visibility.
Temperature	**Field.** Thermometer.
Macroinvertebrate richness	**Field, lab and desktop.** Macroinverterbrates are collected in the field in accordance with methodologies given in MfE (2001). MCI scores are calculated once samples are sorted. The "%EPT" is an index of the richness of the water in three taxa of macroinvertebrates – Ephemeroptera, Plecoptera and Trichoptera – that are particularly sensitive to pollution. Lower EPT richness indicates a stream is under pollution stress.
Trophic status	**Field and desktop.** The protocol for measuring trophic status is set out in detail in Burns et al (2000). Monitoring protocols promote reasonably intensive monitoring, initially in order to obtain a baseline of lake water quality and to understand seasonal changes and lake dynamics. After several years, the monitoring intensity is sometimes reduced to focus on tracking water quality changes over the long term.
Ecological condition of lakes	**Field, lab and desktop.** The protocol for measuring ecological condition in terms of the LakeSPI methodology is set out in Clayton et al (2002).
Conductivity of groundwater	**Lab.** Measurement of sample with conductivity meter and probe.

Method for indicator calculation: Methods for indicator calculation for national reporting will vary depending upon whether the indicator is being calculated to show the state of, or trends in, water quality. For state, generally, raw sample data will be collected from monitoring agencies and analysed to produce annual summary statistics for each monitoring site (ie, mean, median, 5th and 95th percentiles). These summary statistics can be aggregated (eg, using the River Environment Classification) to calculate statistics for pools of sites based on similar land use or other features. Trend assessments for particular periods of time will be calculated from raw data sets (ie, not from summary data sets).

Both state and trend assessments can be tested against guideline values (Table 18 above) where available and appropriate.

Table 23 summarises methods for indicator calculation.

Table 23: Methods of indicator calculation

Indicator	Variable	Method of indicator calculation [also indicates data requirements]	
		For analyses of state	For analyses of trend
River water quality	Nutrients Dissolved oxygen* Water temperature* Visual clarity Macro-invertebrates *E. coli*	Annual means or medians (as well as other percentiles) calculated from monthly (most physical and chemical measurements) and quarterly (macroinvertebrate) data. Calculated for each site and aggregated pools of sites (eg, as defined by land-use categories).	Combination of comparison of state over time and formal trend analyses using raw data (ie, individual sample results). Calculated for each site and aggregated pools of sites (eg, as defined by land-use categories).
Lake water quality	Trophic Level Index	The Trophic Level Index (TLI) requires the calculation (following Burns et al 2000) of annual values of total nitrogen, total phosphorus, algal biomass (as measured by concentrations of chlorophyll a) and water clarity (measured as Secchi disc depth). A TLI score is calculated for each of these parameters and summarised into a single overall TLI score for the lake. The overall score is categorised into seven trophic states indicating progressively more nutrient enrichment, more algal productivity and reduced water clarity, as in Table 24.	Trends calculated periodically (eg, every five years) using the Percent Annual Change (PAC) methodology described by Burns et al (2000).
Groundwater quality	All	Annual means or medians (as well as other percentiles) calculated from monthly data.	Combination of comparison of state over time and formal trend analyses using raw data (ie, individual sample results). Calculated for each site and aggregated pools of sites (eg, as defined by land-use categories).
Recreational water quality	*E. coli*	Every monitored site placed into one of four categories based on number of single samples per year that exceed guidelines for public health. Data aggregated to give proportion of sites in each compliance category. See Table 26.	Based on change in annual state (see sample reporting format below).

* Dissolved oxygen and water temperature can vary significantly over the course of a day. For example, both are typically relatively low during the night compared with during daylight. Therefore caution is needed when aggregating data based on singe, daytime, samples for these variables.

Table 24: Trophic level index categories

State	TLI	Description
Ultra-microtrophic	< 1	Pristine
Microtrophic	1–2	
Oligotrophic	2–3	
Mesotrophic	3–4	Moderately productive
Eutrophic	4–5	
Supertrophic	5–6	
Hypertrophic	> 6	Extremely degraded, algae blooms common

Source: Burns et al, 2000.

4.12.3 Sample reporting formats

The most suitable reporting format to display indicator information will differ from case to case, depending on the context, the required detail, or the desired degree of aggregation (eg, local, regional or national). It may be possible to include, by way of benchmarks, some of the guideline values for various pollutants listed in Table 18. The figures presented in this section are provided as an illustration rather than a prescription.

Examples for state of water quality

Table 25: State of river water quality (one variable, one year)

Land-use category	State of water quality (mg L^{-1})			Percentage of sites exceeding Guideline value
	5th percentile	Median	95th percentile	
Pastoral catchment rivers				
Native catchment rivers				
Urban catchment rivers				
All sites				

Table 26: State of recreational water quality (*E. coli*, multiple years, tested against MfE (2003) guidelines for contact recreation)

Compliance category	What does this mean?	Proportion of sites in each compliance category*			
		2003–04	2004–05	2005–06	2006–07
95–100% samples comply	Between 95% and 100% of samples taken over the bathing season complied with guidelines. Sites in this category have typically good water quality and are generally safe for recreation.	41%	52%	49%	60%
90–95% samples comply	Between 90% and 95% of samples taken over the bathing season complied with guidelines.	22%	16%	22%	13%
75–90% samples comply	Between 75% and 90% of samples taken over the bathing season complied with guidelines.	24%	20%	15%	17%
0–75% samples comply	More than 25% of samples taken over the bathing season did not comply with guidelines. Sites in this category have typically poor water quality and are often not safe for recreation.	14%	12%	14%	10%

* Number of sites in each category as a percentage of the total number of sites throughout the country. Note that percentages do not always add to 100% because of rounding.

Figure 26: State of lake water quality (TLI, one year)

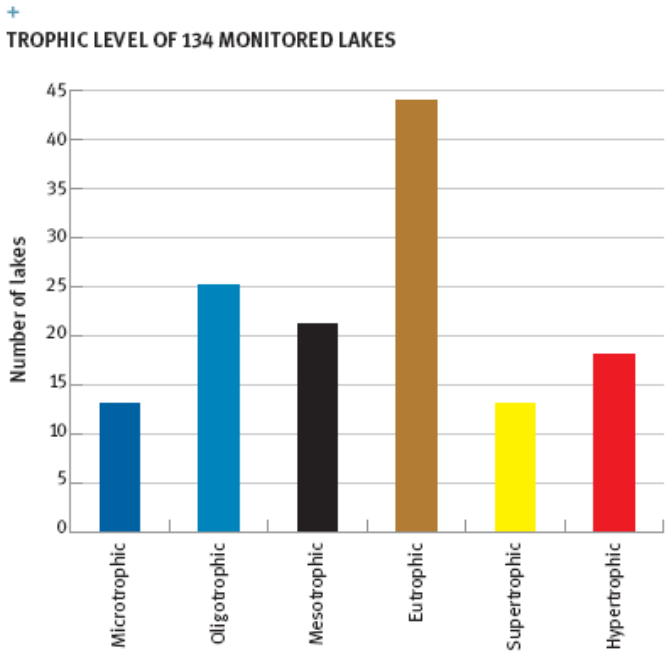
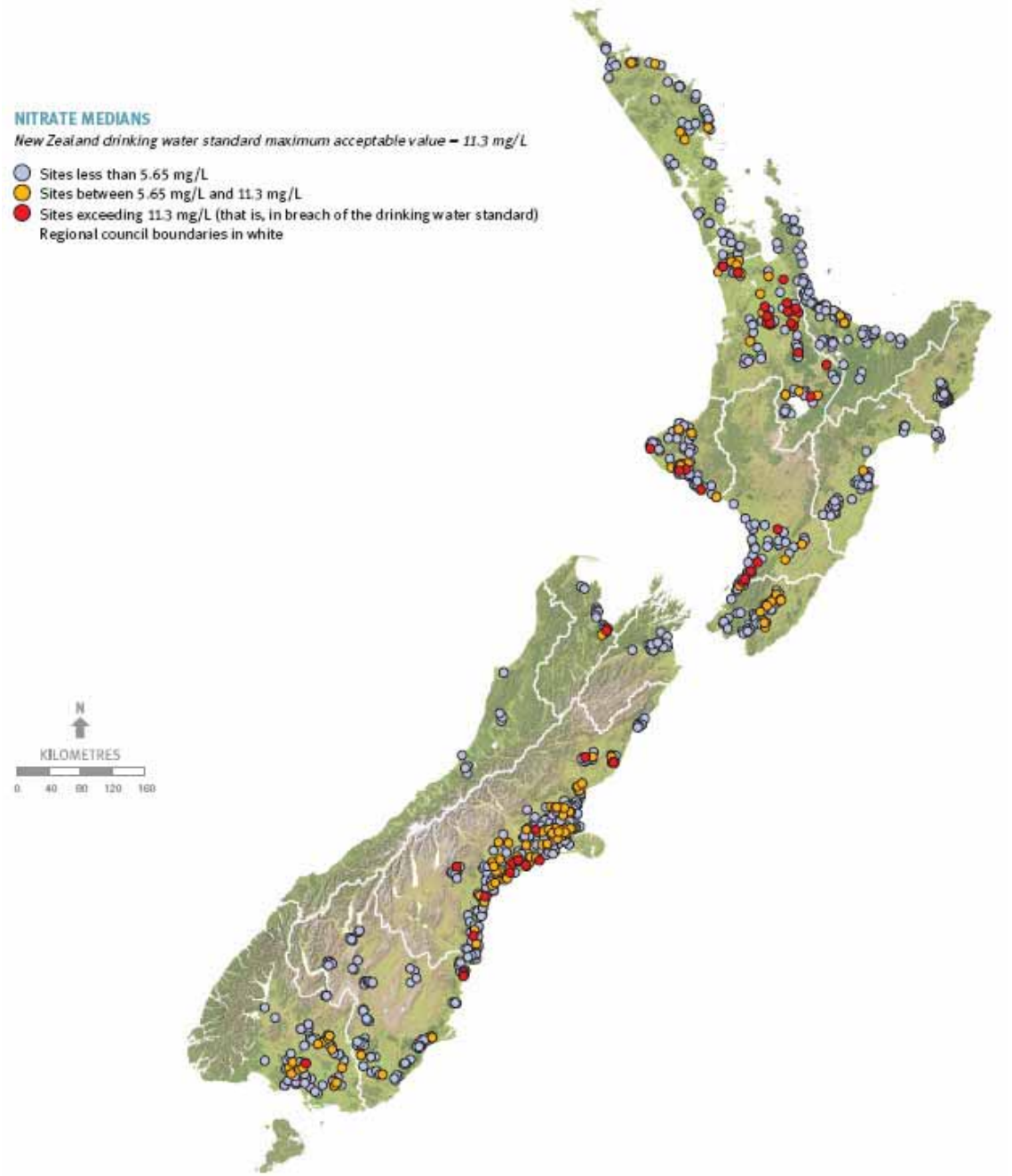


Figure 27: State of groundwater quality (one variable, one time period)



Examples for trends in water quality

Table 27: Trends in river water quality (one variable, one time period, formal trend analyses)

Land-use category	Percentage of sites in each trend category			National average [NRWQN]
	Decreasing trend	Stable	Increasing trend	
Pastoral catchment rivers Native catchment rivers Urban catchment rivers All sites				

Figure 28: Trends in water quality in rivers of the national network (one variable, changes in national average statistics (state) over time)

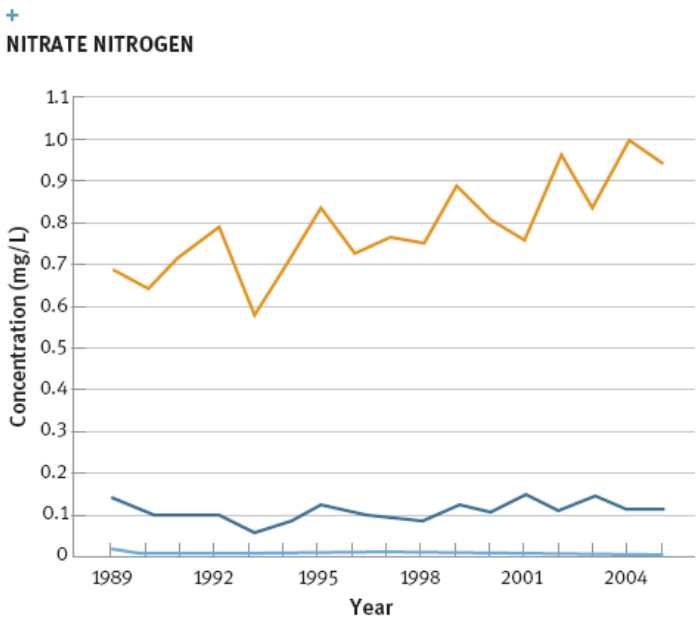


Figure 29: Trends in trophic level of lakes

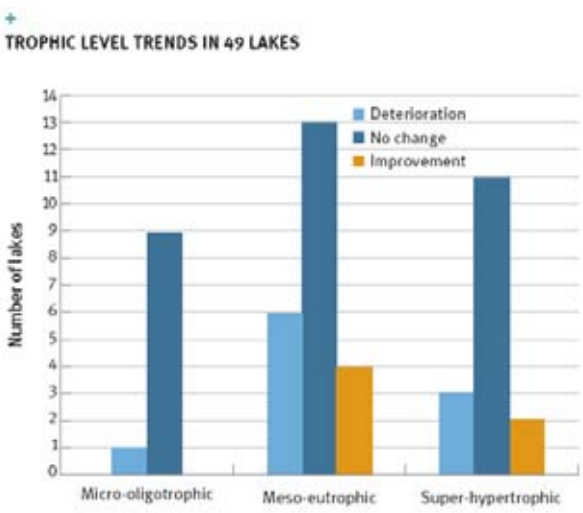


Figure 30: Trends in water quality of rivers in the regional council monitoring network for different land-use categories (one variable, annual medians (state), tested against ANZECC Guideline)

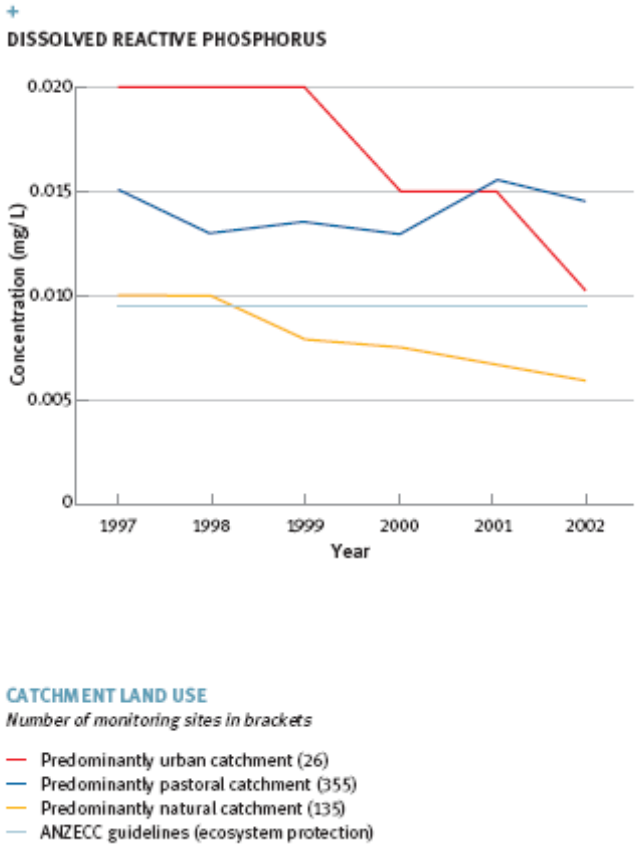
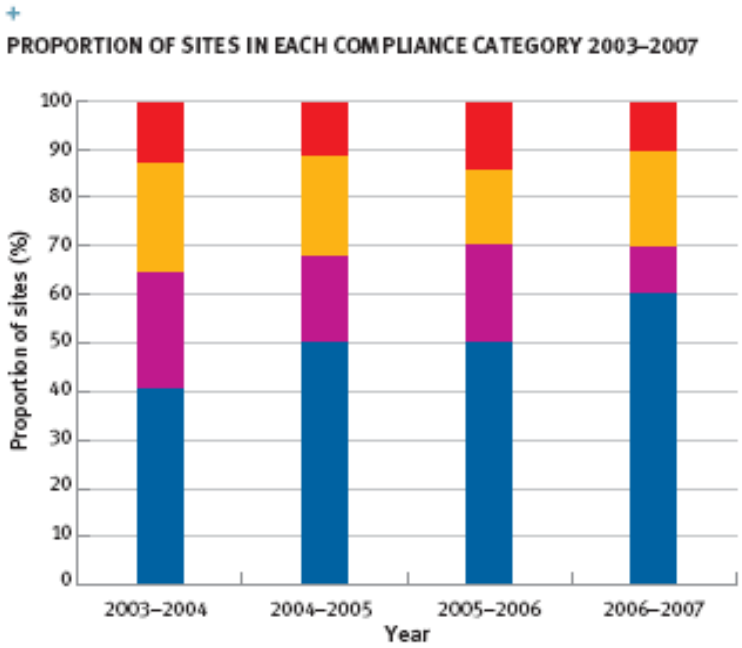


Figure 31: Trends in recreational water quality in rivers, streams and lakes (*E. coli*, single samples, tested against MfE (2003) Guidelines for contact recreation)



Note: Number of sites in each category as a % of the total number of sites throughout the country.

Source: Regional and city and district council data collated by Ministry for the Environment.

4.12.4 Compatibility with other indicator programmes

	StatsNZ linked indicator	UNCSD SD	UNCSD Core set	OECD CEI	EEA CSI
Nutrients					
Oxides of nitrogen/nitrates	✓			✓	✓
Dissolved reactive phosphorus				✓	✓
Ammonia nitrogen				✓	
E. coli	✓	✓	✓		✓
Dissolved oxygen				✓	
Visual clarity					
Temperature					
Macroinvertebrates					
Trophic status					

Note: Small differences may exist in the way these variables are represented in other indicator sets. Statistics NZ linked indicators =set of 43 indicators developed by Statistics New Zealand; UNCSD SD = set of 98 sustainable development indicators proposed by the United Nations Commission on Sustainable Development; UNCSD core set = subset of 50 indicators selected from the UNCSD SD set; OECD CEI = Set of about 50 Core Environmental Indicators proposed by the Organisation for Economic Co-operation and Development; EEA CSI = Core Set of 37 Indicators proposed by the European Environment Agency.

Source: Web sites of Statistics New Zealand, UN Division of Sustainable Development, OECD, European Environment Agency.

4.12.5 References

Australian and New Zealand Environment Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ). 2000. *Australian Guidelines for Water Quality Monitoring and Reporting, Chapters 1–7*. Canberra. ISBN 0 642 19562 5, ISSN 1038 7072.

Biggs B. 2000. *New Zealand Periphyton Guideline: Detecting, Monitoring and Managing Enrichment of Streams*. Prepared for Ministry for the Environment by NIWA.

Clayton J, Edwards T, Froude V. 2002. *LakeSPI: A method for monitoring ecological condition in New Zealand lakes*. Technical Report Version 1. NIWA Client Report HAM2002-011.

Clayton J, Edwards T. 2006a. *LakeSPI A method for monitoring ecological condition in New Zealand lakes*. Technical Report Version 2, NIWA, Hamilton.
http://www.niwascience.co.nz/__data/assets/pdf_file/0010/38656/lakespi_report.pdf

Clayton J, Edwards T. 2006b. *LakeSPI User manual*, Version 2, NIWA, Hamilton.
http://www.niwascience.co.nz/__data/assets/pdf_file/0009/38655/lakespi_manual.pdf

McBride GB, Smith DG. 1990. New Zealand's National Water Quality Monitoring Network – Design and First Year's Operation. AWRA Paper Number 90093, *Water Resources Bulletin* 26(5): 767–775.

Ministry for the Environment (MfE). 1997. *Environmental indicators for the sustainable management of fresh water*. Technical Paper No. 4 Fresh water, Report No 2416/1. MfE, Wellington.

Ministry for the Environment. 1998. *Environmental Performance indicators. Confirmed indicators for air, fresh water and land*. MfE, Wellington, ISBN 0-478-09042-0.

Ministry for the Environment. 2000. *Protocol for Monitoring Trophic Levels of New Zealand Lakes and Reservoirs*. Prepared for Ministry of the Environment by Lakes Consulting, MfE, Wellington.

Ministry for the Environment. 2001. *Protocols for sampling macroinvertebrates in wadeable streams*. New Zealand Macroinvertebrate Working Group Report No. 1. Prepared for the Ministry for the Environment. Sustainable Management Fund Project No. 5103. 57p. MfE, Wellington.

Ministry for the Environment. 2002. *Discussion document for the development of a National Groundwater Data Centre in New Zealand*. Prepared for MfE by the Institute of Geological and Nuclear Sciences. Technical Paper No. 72. MfE, Wellington.

Ministry for the Environment. 2003. *Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas*. MfE, Wellington, ISBN: 0-478-24091-0, ME number: 474.
http://www.mfe.govt.nz/publications/water/microbiological-quality-jun03/microbiological-quality-jun03.pdf

Ministry for the Environment. 2006a. *A National Protocol for State of the Environment Groundwater Sampling in New Zealand*. MfE, Wellington.
http://www.mfe.govt.nz/publications/water/national-protocol-groundwater-dec06/html/

Ministry for the Environment. 2006b. *Assessment of the national pool of river water quality monitoring sites using the River Environment Classification*. Unpublished. Wellington.

Ministry for the Environment. 2006c. *A National Protocol for State of the Environment Groundwater Sampling in New Zealand*. MfE, Wellington. ISBN: 0-478-30112-X ME number: 781

Ministry for the Environment. 2006d. *Snapshot of Lake Water Quality in New Zealand*. Opus International Consultants. ME number: 776. MfE, Wellington. ISBN 0-478-30107-3.

Ministry for the Environment. 2006e. *State and Trends in the National River Water Quality Network (1989–2005)*. Prepared by the National Institute of Water and Atmospheric Research. MfE, Wellington, ME number: 778. MfE, Wellington. ISBN: 0-478-30109-X.

Ministry for the Environment. 2007a. *Groundwater Quality in New Zealand; State and Trends 1995–2006*. Unpublished. Wellington.

Ministry for the Environment. 2007b. *Environment New Zealand*. MfE, Wellington. ISBN 978-0-478-30192-2.

4.13 Freshwater – demand

Water is an essential part of our lives in many different ways and we need to balance the environmental, social and economic aspects of water use to attain the sustainable management of the resource. Although the intensity of water use in New Zealand is very low (less than 5 per cent of available resources) at the national scale and by international standards, this is not the case in some regions, notably Canterbury and Otago. In addition, overall demand is increasing and the effects of climate change may aggravate seasonal water shortages already experienced in some areas.

Water is a finite resource and we need to track the intensity of water use on a national, regional, or catchment scale.

4.13.1 Indicator and variable description

The indicator for freshwater demand is the volumes of water allocated to consumptive human uses. This indicator measures the total volume of river, lake and ground water allocated to various human uses. The indicator shows to what extent freshwater resources are currently allocated by resource consents, and provides guidance as to whether pressures on water resources are intensifying or easing. The indicator can be applied to the country as a whole for all regions, sources and uses combined, or articulated by each of these (Table 28).

Table 28: Description of indicator

Variable	Description
Volumes of water allocated to consumptive users	Can be disaggregated by: • regional council jurisdiction • source (surface water, groundwater, storage, geothermal) • use (irrigation, industrial, public, stock) And for each of the above: • by day or week • by year

Indicator limitations and development: Allocated volumes should be seen as a proxy for volumes of water actually abstracted – allocation figures can be much higher than actual withdrawal figures.[4] The National Environmental Standard for Water Measuring Devices[5] should, over time, enable this indicator to be informed by actual use data.

[4] Actual use typically ranges between 20–80% of allocated volumes.

[5] Draft out for submissions as at August 2008.

Indicator supporting variables: There are two primary supporting variables for this indicator that allow allocated volumes to be expressed as a proportion of renewable water resources; water balance (or *flow to sea*) and mean annual river flow. The division of allocated volumes by renewable resources, variously described as *intensity of water use*, *water exploitation index* or *water stress*, also features in many international indicator sets and therefore allows international comparisons. If intensity of use is less than 10 per cent, water stress is considered low. A ratio in the range of 10 to 20 per cent indicates that water availability is becoming a constraint on development and that significant investments are needed to provide adequate supplies. When the ratio is over 20 per cent, both supply and demand will need to be managed carefully and conflicts among competing uses will need to be resolved (OECD, 2003).

The supporting variables should also be regarded as interim only until better information[6] becomes available about the volumes of water that can be safely abstracted without putting the environment (eg, aquatic ecosystems) at risk. In the long run, therefore, the indicator should evolve to show actual, measured water use in relation to abstraction limits set by regional councils after considering the environmental effects of abstractions, for each major source.

4.13.2 Indicator calculation and measurement

Sampling and analytical protocols: There are no protocols for the storage of allocation consent data.

Sampling frequency: Regional council allocation consent databases are updated on a continuous basis.

Data needed to compile the indicator: The country's 16 regional councils and unitary authorities hold information about allocation consents in their regions (Table 29). The Ministry for the Environment compiled a nationally aggregated dataset in 1999 and 2006.

For more information on data sources refer to the Ministry for the Environment's document *Data stock-take for the core set of national environmental indicators and associated variables*.

[6] Sustainable yields have been calculated for many rivers and aquifers around the country, but there are not yet enough data to inform a national-scale indicator.

Table 29: Structure of resource allocation consents database

Field name	Records	Description
Region ID	ARC	Abbreviated regional authority name
Consent identifier	Council consent number	Unique identifier as per council records
Primary source	Ground Surface water	 Includes all surface-water takes (ie, lakes, dams, rivers and streams)
Source type	Dam Geothermal Lake River Stream Blank	 If primary source is groundwater then blank is used to denote 'cold' groundwater consents. If primary source is surface water then blank is used to denote unspecified consents.
Source identifier		Catchment or aquifer description
Source catchment	Unique identifier	As per NIWA national catchment coverage
Primary use	Drinking Heating Industrial Irrigation Stock Unspecified	
Use type	Arable Community Domestic Energy Forestry Frost protection Heating Horticulture Mining Municipal Nursery Pasture Quarry Recreational Service Stock water Swimming Storage Unspecified Viticulture Waste	

Field name	Records	Description
Instantaneous rate		Listed value or calculation if not listed
Daily rate		Listed value or calculation if not listed
Weekly rate		Listed value or calculation if not listed
Annual rate		Listed value or calculation if not listed
Irrigated area		Listed value or calculation if not listed
Easting		UTM co-ordinate
Northing		UTM co-ordinate

Source: Ministry for the Environment, 2006.

Spatial coverage and length of record – volume of water allocated: Close to 20,000 resource consents for taking water currently exist, of which two-thirds are for groundwater takes. Collectively, the information covers all water use in New Zealand, except for the small takes (eg, for stock water supply on individual farms) authorised as permitted activities under regional plans. On a catchment basis, the nationally aggregated analysis represents coverage of 4,427 parent catchments (greater than 100 hectares) and 287 sub-catchments. Of these, the 535 parent catchments with surface-water allocations account for approximately 95% of total surface-water allocations.

Consents for surface water takes are distributed widely across most regions, reflecting the even distribution of the river and stream network across the landscape. In contrast, groundwater consents tend to be grouped together in areas where groundwater can be accessed easily and cheaply, particularly on flat expanses of land where the water table is relatively shallow and the gravel and sand aquifers yield a relatively high volume of water (eg, Canterbury Plains and Hamilton Basin).

Measurement methods: Measurement of surface and groundwater level, groundwater pressure and stream flow to be carried out in accordance with documented hydrological field party procedures.

Method for indicator calculation: Individual consent allocation volumes are aggregated according to time period, sector of use, and area of interest. Indicator value can be divided by a supporting variable that describes the value of the renewable resource (eg, mean annual river flow or water balance) to place allocated volumes in the context of resource availability; see following equation:

$$\text{Value of indicator} = \frac{\text{total allocation for area and year(s) of interest}}{\text{long-term average renewable resource for area of interest}} * 100\%$$

4.13.3 Sample reporting formats

The most suitable reporting format to display indicator information will differ from case to case, depending on the context, the required detail, or the desired degree of aggregation (eg, local, regional or national). The figures presented in this section are provided as examples of reporting formats.

Resource consents usually allocate water in terms of a maximum daily and/or weekly rate (ie, the maximum rate of take that can be sustained in any given week), a maximum annual volume, or both. Reporting weekly allocation rates is useful for understanding the magnitude of peaks in demand related to seasonal activities like irrigation or to the flow patterns of a river. Reporting annual volumes is useful for understanding how much water is used in relation to the total sustainable yield of a water source, such as a groundwater aquifer.

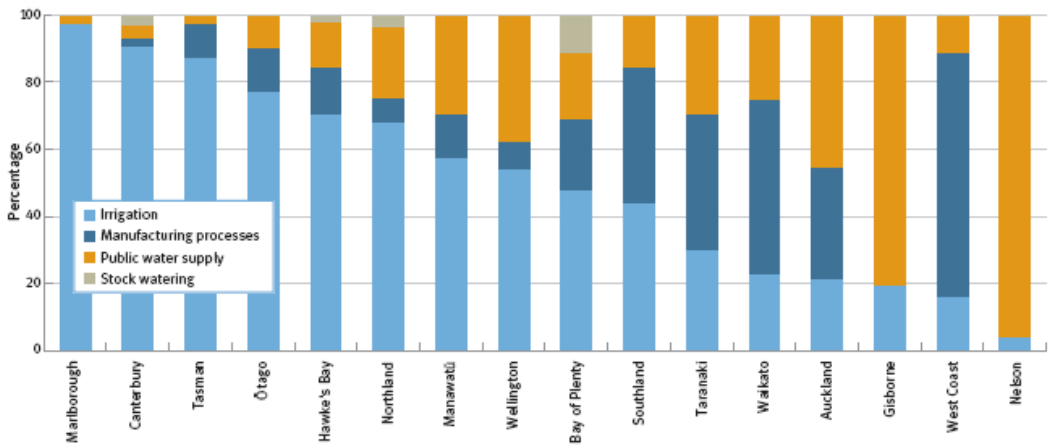
Where water demand is dominated by strongly seasonal activities (eg, irrigation), it is more meaningful to compare water allocation and use with seasonal water availability, for instance mean annual low flow (see sample reporting format).

Reporting state of allocation

Table 30: Annual allocation by region (one use sector, multiple years)

Region	Annual allocated volume [millions of cubic metres]		
	1999	2006	2012
Northland Auckland Waikato			

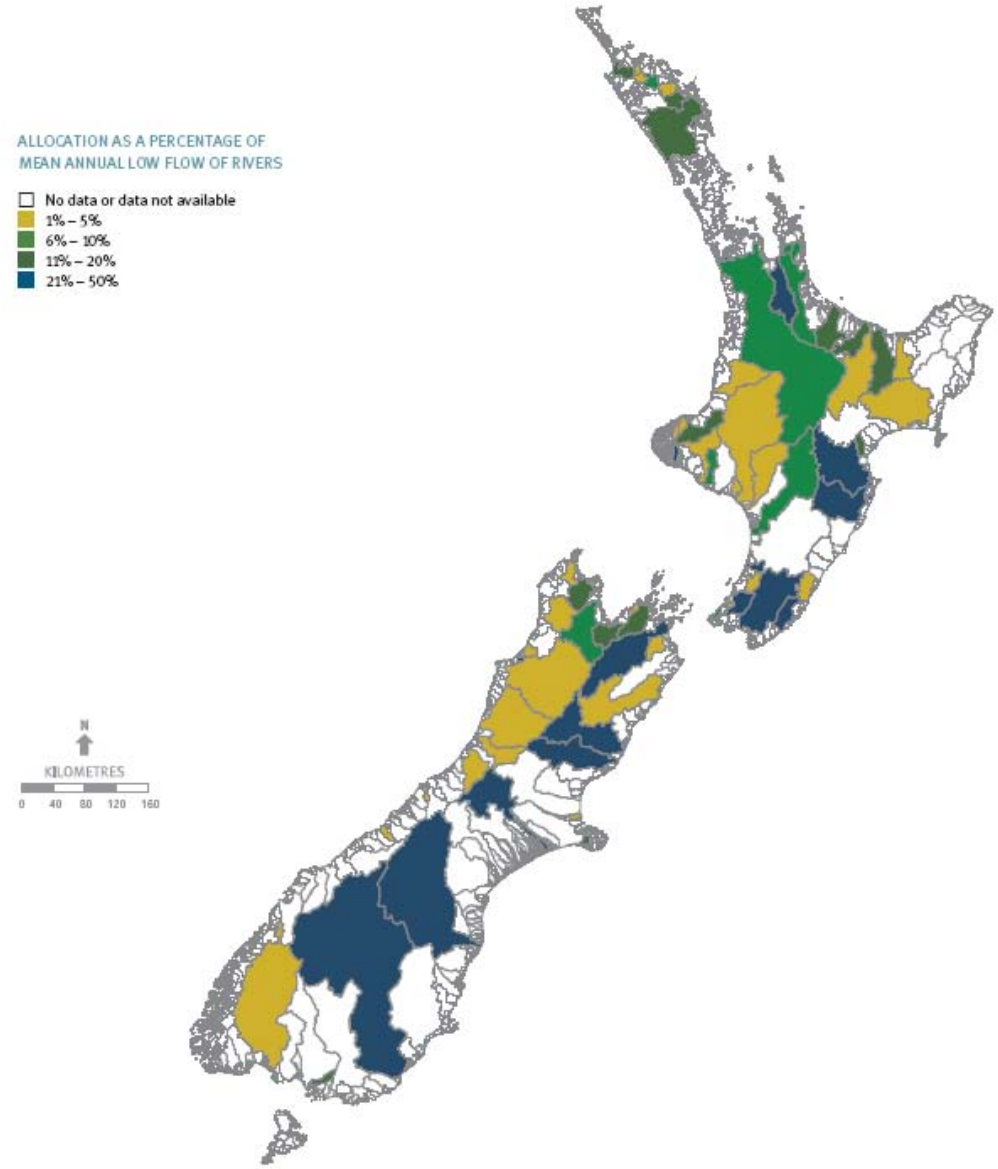
Figure 32: Regional variation in the use of allocated water, 2006



Source: Ministry for the Environment, 2006.

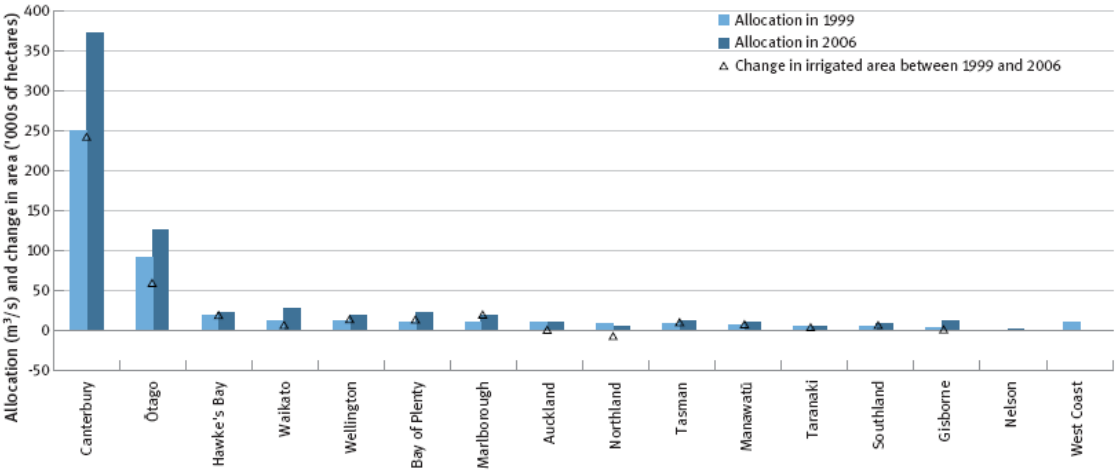
Reporting indicator with supporting variables

Figure 33: Surface water allocation as a proportion of mean annual low flow of rivers, 2006



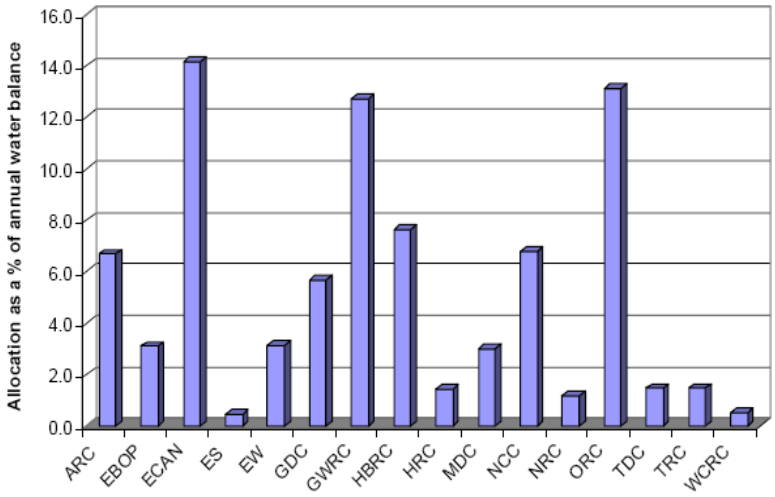
Source: Ministry for the Environment, 2006.

Figure 34: Change in allocation and irrigated area between 1999 and 2006



Source: Ministry for the Environment, 2006.

Figure 35: Regional annual allocation as percent of annual water balance, 2005



Source: Ministry for the Environment, 2006.

4.13.4 Compatibility with other indicator programmes

National indicator sets	International indicator sets	
Statistics NZ linked indicators	United Nations Commission on Sustainable Development core set OECD Key Environmental Indicators	United Nations Commission on Sustainable Development Indicators of Sustainable Development European Environment Agency Core Set Indicators (No. CSI 018)

Note: Small differences may exist in the way these variables are represented in other indicator sets.

Source: Web sites of Statistics New Zealand, UN Division of Sustainable Development, OECD, European Environment Agency.

4.13.5 References

Ministry for the Environment (MfE). 2000. *Information about water allocation in New Zealand. Report No. 4375/1*. Prepared by Lincoln Environmental. MfE, Wellington.

Ministry for the Environment. 2006. *Snapshot of Water Allocation in New Zealand*. MfE Wellington. http://www.mfe.govt.nz/publications/ser/snapshot-water-allocation-nov06/snapshot-water-allocation-nov06.pdf

Organisation for Economic Co-operation and Development (OECD). 2003. *Water. Performance and Challenges in OECD Countries*. OECD, Paris.

Statistics New Zealand. 2004. Water Physical Stock Accounts for the June Years 1995 to 2001, Inaugural Report. Statistics New Zealand, Wellington

4.14 Oceans – fish stocks

In many parts of the world, excessive fishing has depleted fish stocks and aquatic habitats have been damaged. Populations of some non-commercial species caught accidentally during fishing operations have also been depleted, and some protected species are severely threatened. Fisheries managers face common challenges in their attempts to manage fisheries sustainably. These include conflict over allocation between users, too many fishing vessels (overcapacity), increasing demand for fish and fish products, insufficient monitoring, lack of adequate data to assess the status of most stocks, changing environmental conditions, and, in many fisheries, high levels of non-compliance with the law.

4.14.1 Indicator and variable description

This indicator shows the proportion of total commercial catch (by weight) from quantitatively assessed fish stocks in the Quota Management System (QMS) as a proportion of the total commercial landings.

This indicator also presents summary statistics of the status of quantitatively assessed fish stocks in the QMS in terms of a four-category classification: assessed stocks are classified as being: 'near or above target biomass'; 'probably near or above target biomass'; 'possibly near or above target biomass'; or 'below target biomass'. These four categories are used because data is collected and categorised according to them. The number of stocks in each category as a percentage of the total number of assessed stocks can also be assessed.

Table 31: Variables relating to fish stocks under the QMS

Indicator	Can be disaggregated by:
Fish stocks under the Quota Management System	Total commercial catch (by weight) from fish caught both inside and outside of the Quota Management System Status of assessed fish stocks under the QMS

4.14.2 Indicator calculation and measurement

Sampling and analytical protocols: All commercial catch data comes from catch returns that have to be filled in by anyone who holds a permit to harvest fish.

Sampling frequency: The QMS operates on annual cycles, but some species are assessed less frequently.

Data needed to compile the indicator: All commercial catch data is collected by FishServe,[7] a subsidiary of the Seafood Industry Council. Stock assessments and yield estimates from the Fishery Assessment Plenary sessions are available on the Ministry of Fisheries (MFish) web site.

Data sources: For more information on data sources refer to the Ministry for the Environment's document *Data stock-take for the core set of national environmental indicators and associated variables*.

Spatial coverage and length of record: The New Zealand Territorial Sea and Exclusive Economic Zone. Most data was collected in the context of the Environmental Management Strategy (EMS), which dates from 1986.

Measurement methods: The Ministry of Fisheries carries out stock assessments based on various information sources, for instance, data from commercial catch, as follows:

- catch and effort data (for example, how many trawls are done to obtain the full catch allowed by quota)
- catch monitoring (observers aboard vessels)
- length and age data (of fish) to determine population structure
- all other mortality to the stock caused by fishing.

Method for indicator calculation: Once the basic information about the status of fish stock has been garnered, only simple arithmetic is needed to construct Table 32 shown under "sample reporting format".

4.14.3 Sample reporting formats

Table 32: Status of assessed fish stocks under the quota management system relative to target levels, 2006

Stock status	Number of assessed stocks	Percentage of assessed stocks (%)
Near or above target biomass levels	51	52
Probably near or above target biomass levels	23	23
Possibly near or above target biomass levels	10	10
Total fish stocks near or above target biomass levels	84	85
Below target biomass levels	15	15

[7] http://www.fishserve.co.nz/information/onlineservices/

Data source: Adapted from Ministry of Fisheries, 2007b.

As yet, no time series are available for the second component of this indicator, so that for now, reporting will be as part of a narrative text, eg, "*The commercial fishing sector accounts for the most significant proportion of the annual fisheries catch, catching 525,000 tonnes of fish in the 2006 fishing year. This includes fish caught both inside and outside of the New Zealand quota management system, including hoki, squid, jack mackerel, southern blue whiting, barracouta, and orange roughy. These species make up 60 per cent of the total catch by weight*".

4.14.4 Compatibility with other indicator programmes

National indicator sets	International indicator sets
MFish is developing a series of performance indicators, including one similar to this core environmental indicator.[8]	None

4.14.5 References

Ministry for the Environment. 2007. *Environment New Zealand*. MfE, Wellington. ISBN 978-0-478-30192-2.

Ministry of Fisheries (MFish). 2005. *Managing the Environmental Effects of Fishing*. MFish, Wellington.

Statistics New Zealand (StatsNZ). 2002. *Physical Stock Account for Fish Resources in New Zealand, 1994–2000*. StatsNZ, Wellington.

Statistics New Zealand (StatsNZ). 2003. *Physical Flow Account for Fish Resources in New Zealand*. StatsNZ, Wellington.

4.15 Oceans – seabed trawling

Seabed trawling is a major fishing activity that takes place in New Zealand's Exclusive Economic Zone (EEZ) and Territorial Sea (TS). It can have a direct and indirect impact on the marine environment, including habitat disturbance and incidental by-catch.

[8] http://www.fish.govt.nz/en-nz/Publications/Statements+of+Intent/SOI-2005-2008/examples+of+possible+performance+indicators.htm?WBCMODE=PresentationUnpublished

4.15.1 Indicator and variable description

This indicator shows the size of surface area and location of seabed that has been seabed-trawled since 1989. The indicator can also be disaggregated to show the types of fish communities most targeted by trawling by using the Demersal[9] Fish Community Classification (DFCC), a geographical classification system that identifies types of fish communities on the seafloor. This indicator further shows trends over time by both area and the frequency of the seabed-trawling effort.

Table 33: Variables of the seabed trawling indicator

Indicator	Can be disaggregated by:
Seabed trawling in deep waters	The area 'swept' (the area trawled over by a vessel towing gear along or near the seabed) by commercial trawlers which are required to report their position by latitude and longitude The types of fish expected to be found in areas that have been swept
Surface area and location of seabed trawled since 1989	The 16 groups of the Demersal Fish Community Classification

4.15.2 Indicator calculation and measurement

Sampling and analytical protocols: Commercial vessels must document all seabed-trawling activity in terms of time and location. The location of seabed-trawled areas can be disaggregated in terms of the 16 groups of the Demersal Fish Community Classification (DFCC) 2006, a geographical classification based on mapping the distribution and abundance of marine organisms (fish, macro-invertebrates) from a range of habitats in the EEZ (Leathwick et al, 2006b).

Sampling frequency: All trawls must be recorded.

Data needed to compile the indicator: The base data for this indicator is contained in more than 600,000 trawl records collected since 1989 from commercial vessels (records do not cover the significant effort taking place in inshore areas and by smaller vessels, where record keeping requirements do not include precise location by latitude and longitude). The total area trawled, the total area of EEZ and of each of the 16 Demersal Fish Community Classification is needed to report this indicator.

Data sources: For more information on data sources refer to the Ministry for the Environment's document *Data stock-take for the core set of national environmental indicators and associated variables*.

Spatial coverage and length of record: In principle, the entire marine area under New Zealand jurisdiction. Record dates back to 1989.

Measurement methods: Location is recorded by way of Global Positioning Systems (GPS).

[9] Demersal fish are fish that live and feed on the seafloor which is the area targeted by benthic trawling.

Method for indicator calculation: Calculating the indicator is a matter of simple arithmetic of distributing trawled areas according to the relevant classification and adding up surface areas.

4.15.3 Sample reporting formats

Figure 36: Commercial trawling effort (total area swept in square kilometres) by Trawl Catch Effort Processing Returns (TCEPR) vessels, 1990–2005

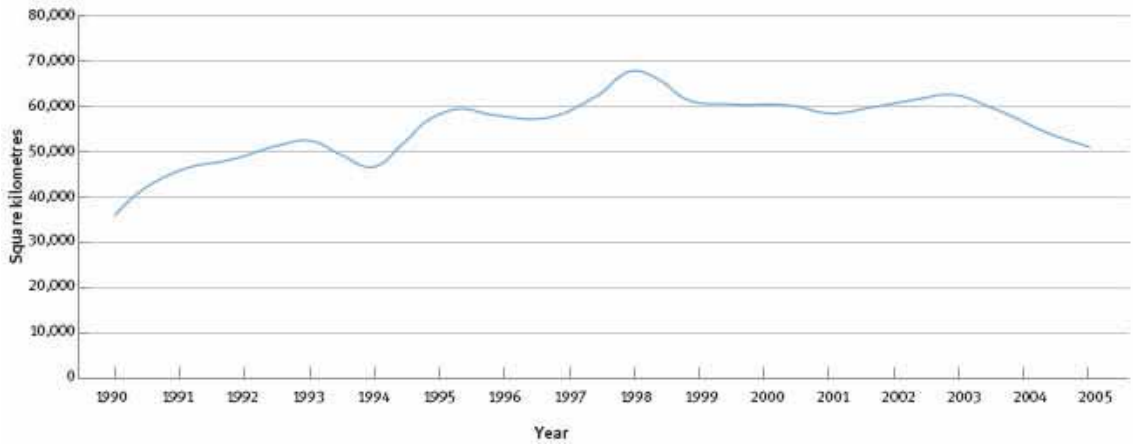


Figure 37: Location of commercial trawling effort (total area swept in square kilometres within 25-square-kilometre cells) by Trawl Catch Effort Processing Returns (TCEPR) vessels, 1990–2005

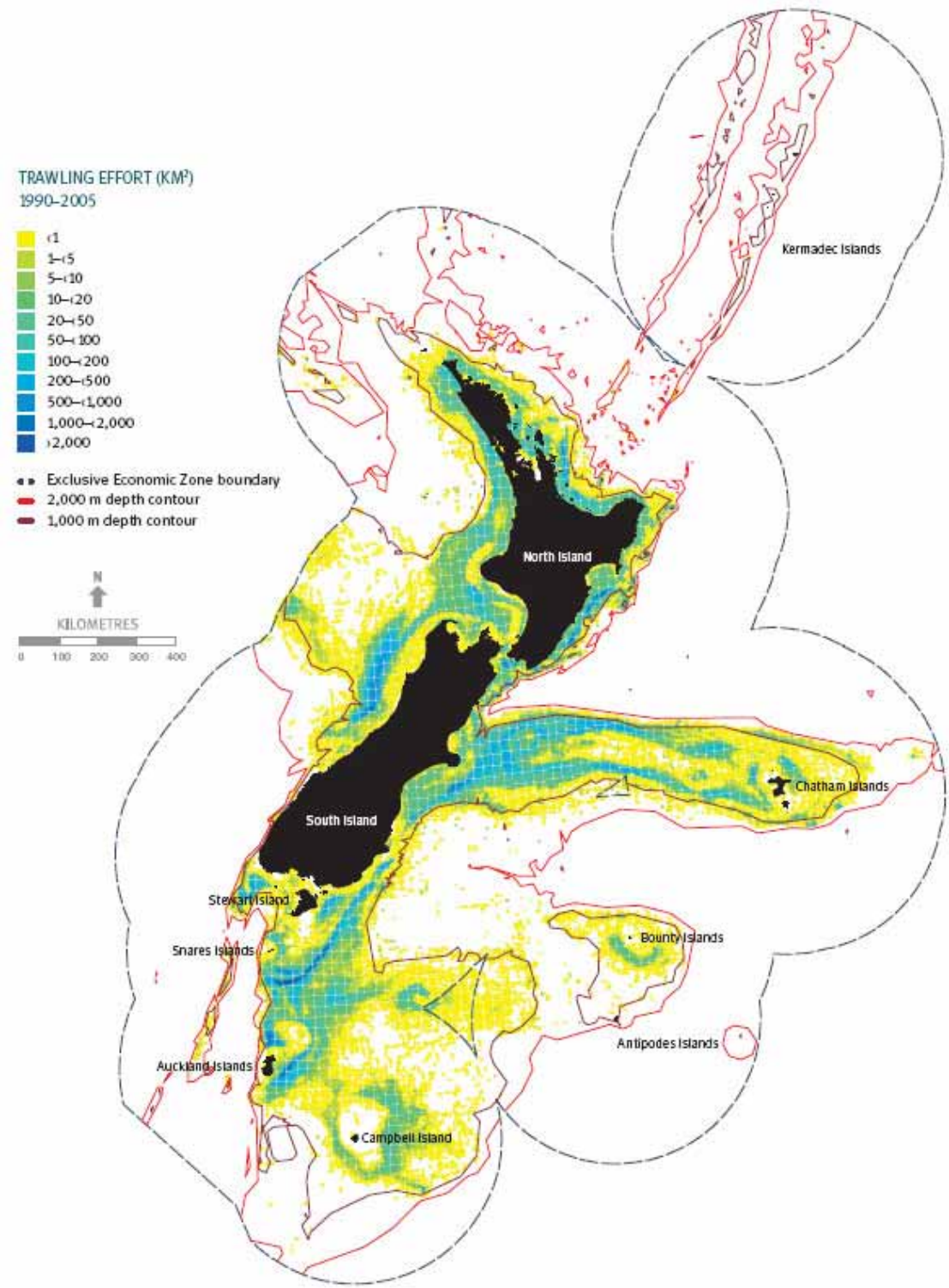


Figure 38: Area trawled (cumulative) by class in the Demersal Fish Community Classification, 1990–2005

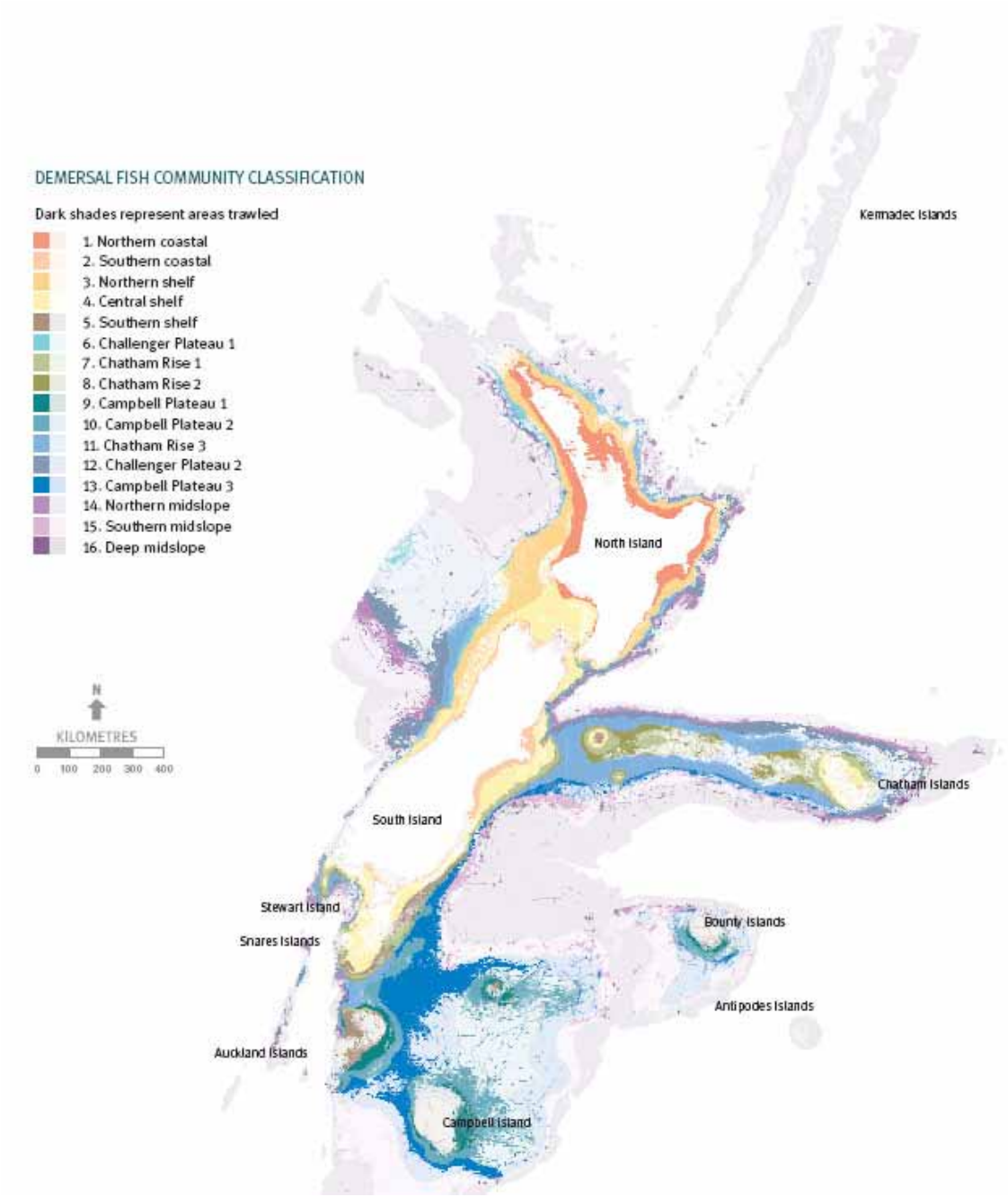


Figure 39: Number of cells trawled at least once as a percentage of the number of cells in each class in the Demersal Fish Community Classification, 1990–2005

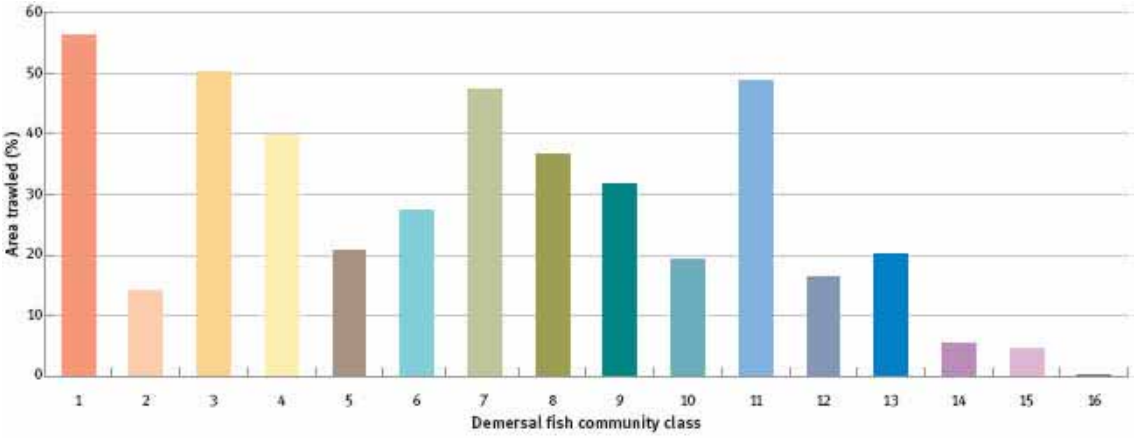


Table 34: Area trawled (cumulative) 1990–2005 by Demersal Fish Community Classification

Classification group	Total area [ha]	Area trawled [ha]	Share of group trawled [%]
1 Northern coastal	4,572,493	2,580,976	56.4
2 Southern coastal	2,772,454	395,069	14.2
3 Northern shelf	7,923,714	4,002,467	50.5
4 Central shelf	8,868,655	3,502,449	39.5
5 Southern shelf	3,848,858	791,022	20.6
6 Challenger Plateau 1	2,352,294	636,526	27.1
7 Chatham Rise 1	3,523,840	1,674,125	47.5
8 Chatham Rise 2	3,553,115	1,305,827	36.8
9 Campbell Plateau 1	3,914,986	1,248,037	31.9
10 Campbell Plateau 2	12,669,212	2,392,082	18.9
11 Chatham Rise 3	13,210,557	6,470,010	49.0
12 Challenger Plateau 2	13,061,215	2,132,941	16.3
13 Campbell Plateau 3	19,183,797	3,847,454	20.1
14 Northern midslope	21,364,072	1,151,262	5.4
15 Southern midslope	15,381,339	648,906	4.2
16 Deep midslope	51,716,451	140,730	0.3
Total	187,917,053	32,919,884	17.5

Note: Area figures are approximate only due to transformation of latitude/longitude data to NZ Topographic Map (NZTM). Percentage figures are more accurate.

Source: Ministry of Fisheries.

4.15.4 Compatibility with other indicator programmes

National indicator sets	International indicator sets
MFish	None

Note: Small differences may exist in the way these variables are represented in other indicator sets.

Source: Ministry of Fisheries website.

4.15.5 References

Leathwick JR, Francis M, Julian K. 2006. *Development of a demersal fish community classification for New Zealand's Exclusive Economic Zone*. NIWA Client Report HAM2006-062, Department of Conservation, Wellington.

Ministry for the Environment. 2007. *Environment New Zealand*. MfE, Wellington. ISBN 978-0-478-30192-2.

4.16 Oceans – recreational water quality

Water quality has deteriorated in some coastal swimming spots as a result of human activities such as discharges from wastewater treatment plants, urban and agricultural run-off.

Although enterococci are common bacteria normally found in the bowel of healthy people, the presence of enterococci in beach water is the indicator most closely correlated with health effects in New Zealand marine waters, confirming a pattern seen in a number of overseas studies. Enterococci themselves do not pose a significant risk to human health. Rather, they indicate the presence of faecal material, which contains disease-causing pathogens.

4.16.1 Indicator and variable description

This indicator shows compliance of water quality at coastal swimming spots with the upper limit for acceptable health risk of guideline values of the number of enterococci per 100 mL of water (MfE 2003) (Table 35). It is the number of enterococci per 100 ml of water that is measured and on which the guideline levels are based.

Table 35: Recreational water quality guidelines for coastal waters

Variable	Impact rationale	Guideline value
Enterococci	Contact recreation coastal waters	Acceptable < 140 per 100 mL Alert level 140 – 280 per 100 mL Action level > 280 per 100 mL

Source: Australian and New Zealand Environment Conservation Council 2000; Ministry for the Environment 2003.

4.16.2 Indicator calculation and measurement

Sampling and analytical protocols: Microbiological sampling should be carried out in accordance with the procedures outlined in the Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas (MfE 2003), Notes H(i) and H(ii).

Sampling frequency: At least 10 times per bathing season (once a week in summer), more frequently after a breach of guideline.

Data sources: Microbiological sampling data from regional councils. For more information on data sources refer to the Ministry for the Environment's document *Data stock-take for the core set of national environmental indicators and associated variables*.

Data needed to compile the indicator: Number of enterococci in 100 ml of water.

Spatial coverage and length of record: Regional and territorial councils currently monitor about 400 coastal sites along the country's shores.

Measurement methods: Membrane Filter (MF) Test Method for Enterococci in Water as described in Document No. EPA-821-C-97-004 (also ISO 7899-2).

Method for indicator calculation: Individual sampling results to be tested against guideline values (Table 35) and evaluated in terms of Table 36.

Table 36: Grading system for recreational water quality

Compliance category	What does this mean?
95–100% of samples comply	Between 95% and 100% of samples taken over the bathing season complied with guidelines. Sites in this category have typically good water quality and are generally safe for recreation.
90–95% of samples comply	Between 90% and 95% of samples taken over the bathing season complied with guidelines.
75–90% of samples comply	Between 70% and 90% of samples taken over the bathing season complied with guidelines.
0–75% of samples comply	More than 25% of samples taken over the bathing season did not comply with guidelines. Sites in this category have typically poor water quality and are often not safe for recreation.

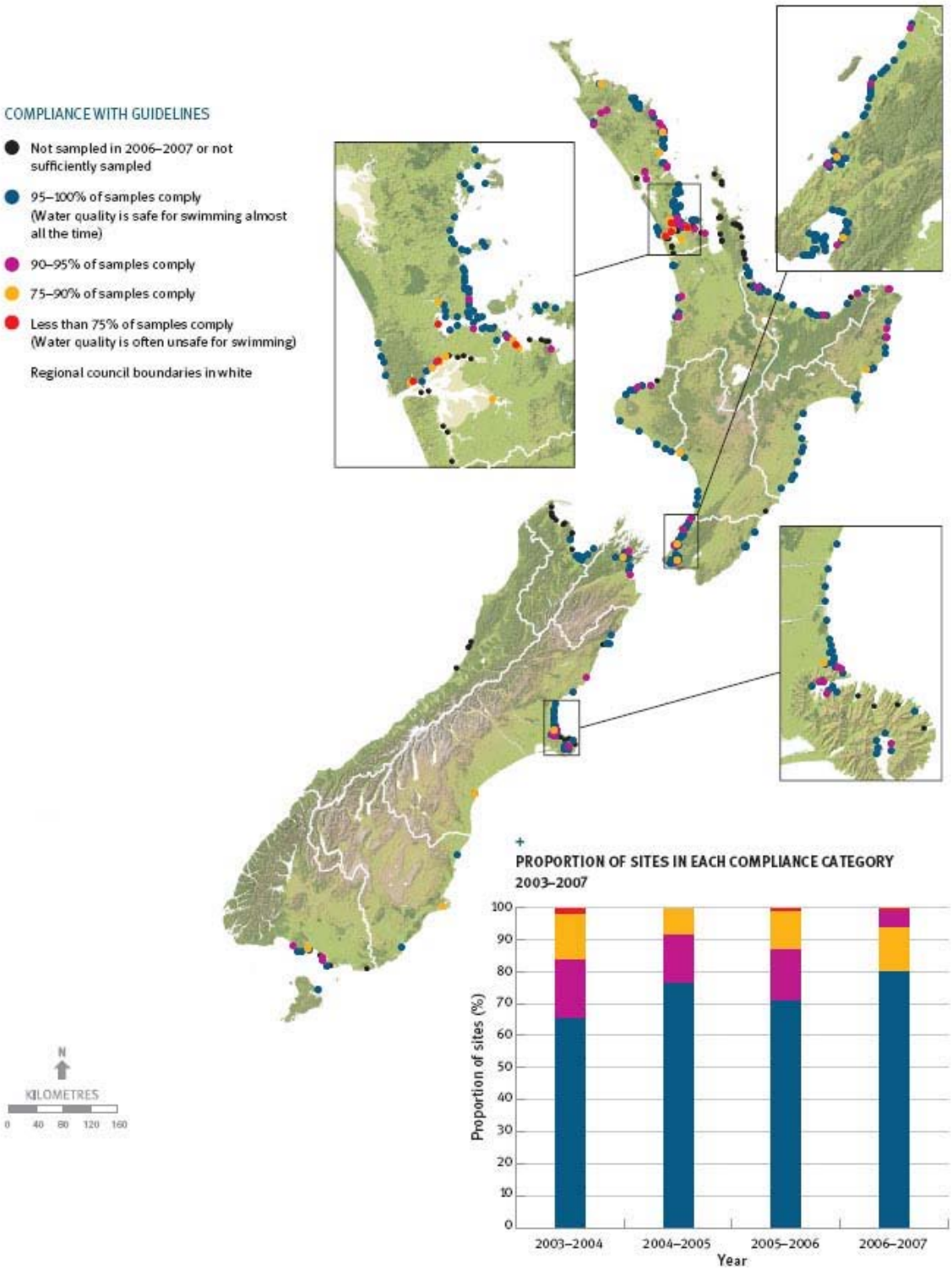
Expressed as a percentage of the total number of sites N sampled at least 10 times per bathing season throughout the country.

Note: Yearly changes in compliance rates can be strongly influenced by weather variations.

Source: Ministry for the Environment, 2003.

4.16.3 Sample reporting formats

Figure 40: Compliance of monitored coastal swimming spots with guidelines for contact recreation, 2003–2007



Source: Regional and city and district council data collated by Ministry for the Environment.

4.16.4 Compatibility with other indicator programmes

National indicator sets	International indicator sets
Statistics NZ linked indicators	EEA Core Set Indicators (No. CSI 022)

4.16.5 References

Ministry for the Environment. 2003. *Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas*. MfE, Wellington, ISBN: 0-478-24091-0, ME number: 474. http://www.mfe.govt.nz/publications/water/microbiological-quality-jun03/microbiological-quality-jun03.pdf

Ministry for the Environment. 2007. *Environment New Zealand*. MfE, Wellington. ISBN 978-0-478-30192-2.

4.17 Oceans – marine protected areas

A range of measures protect our marine ecosystems, habitats, and species. The designation of marine reserves is one of the most important tools[10] available to protect marine biodiversity from over-use.

4.17.1 Indicator and variable description

This indicator shows the extent of legally protected marine reserves as a proportion of biogeographic regions in the Territorial Sea (TS – the "12 nautical mile zone"). The indicator also shows the proportion of the 14 near-shore bioregions represented in New Zealand's network of marine reserves.

Current law (ie, Marine Reserves Act 1971) enables the creation of marine reserves in the TS only, but should this change, it would become possible to do so for marine environments in New Zealand's Exclusive Economic Zone (EEZ – between 12 and 200 nautical miles). This indicator could then cover all marine waters under New Zealand control.

Table 37: Variables of the marine protected areas indicator

Indicator	Can be disaggregated by
Marine areas with legal protection	The percentage of New Zealand's territorial sea in marine reserves The percentage of each class of the Coastal Biogeographic Regions Classification protected by marine reserve

[10] Other tools available in New Zealand are Marine Parks, Marine Mammal Sanctuaries, Seamount Closures, Benthic Protection Zones, Taipure, Maitaitai and Rahui and other fishing restrictions and wildlife management reserves.

4.17.2 Indicator calculation and measurement

Sampling and analytical protocols: Coastal Biogeographic Regions Classification – The Coastal Biogeographic Regions Classification identifies 14 different near-shore biogeographic regions in New Zealand's TS. It also categorises the near- shore physical environment at different spatial scales in estuarine, coastal and marine systems. The first level (ie, biogeographic regions) is overarching and inclusive of all coastal and marine ecological systems; these are distinguished on the basis of biogeography (Department of Conservation and Ministry of Fisheries, 2007).

Sampling frequency: New reserves are included in the indicator as they are gazetted.

Data needed to compile the indicator: Gazetted information on marine reserves. The surface area of legally protected marine areas located in the TS, the total area of TS and of each of the 14 near-shore bioregions is needed to report this indicator.

Data sources: For more information on data sources refer to the Ministry for the Environment's document *Data stock-take for the core set of national environmental indicators and associated variables*.

Spatial coverage and length of record: All coastal waters around New Zealand. First marine reserve was created in 1975.

Measurement methods: Surface area of marine reserves can be derived from description of boundaries, as gazetted, or digitised from maps.

Method for indicator calculation: Surface area of marine reserves can be derived from description of boundaries, as gazetted, or digitised from maps.

4.17.3 Sample reporting formats

Figure 41: Percentage of territorial sea in marine reserves, 1975–2006

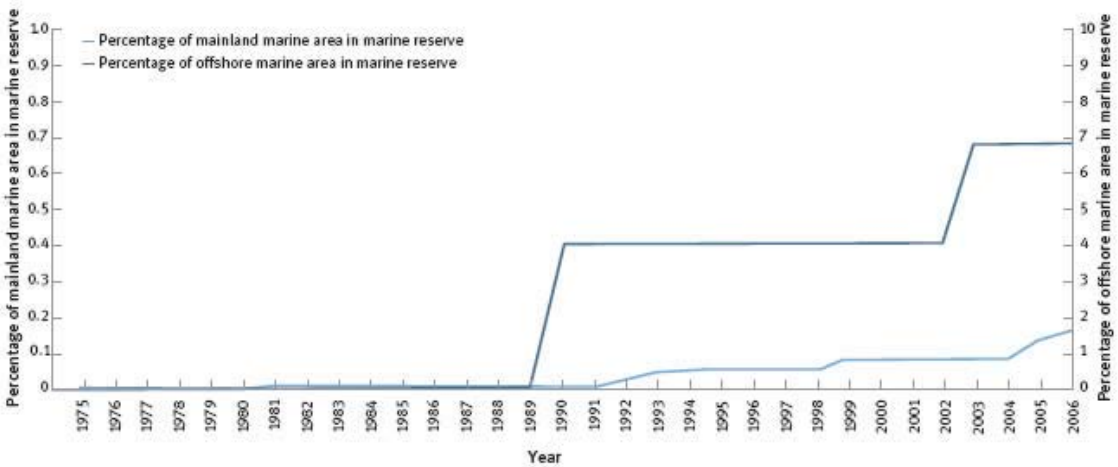


Figure 42: Marine reserves in the territorial sea by Coastal Biogeographic Regions Classification

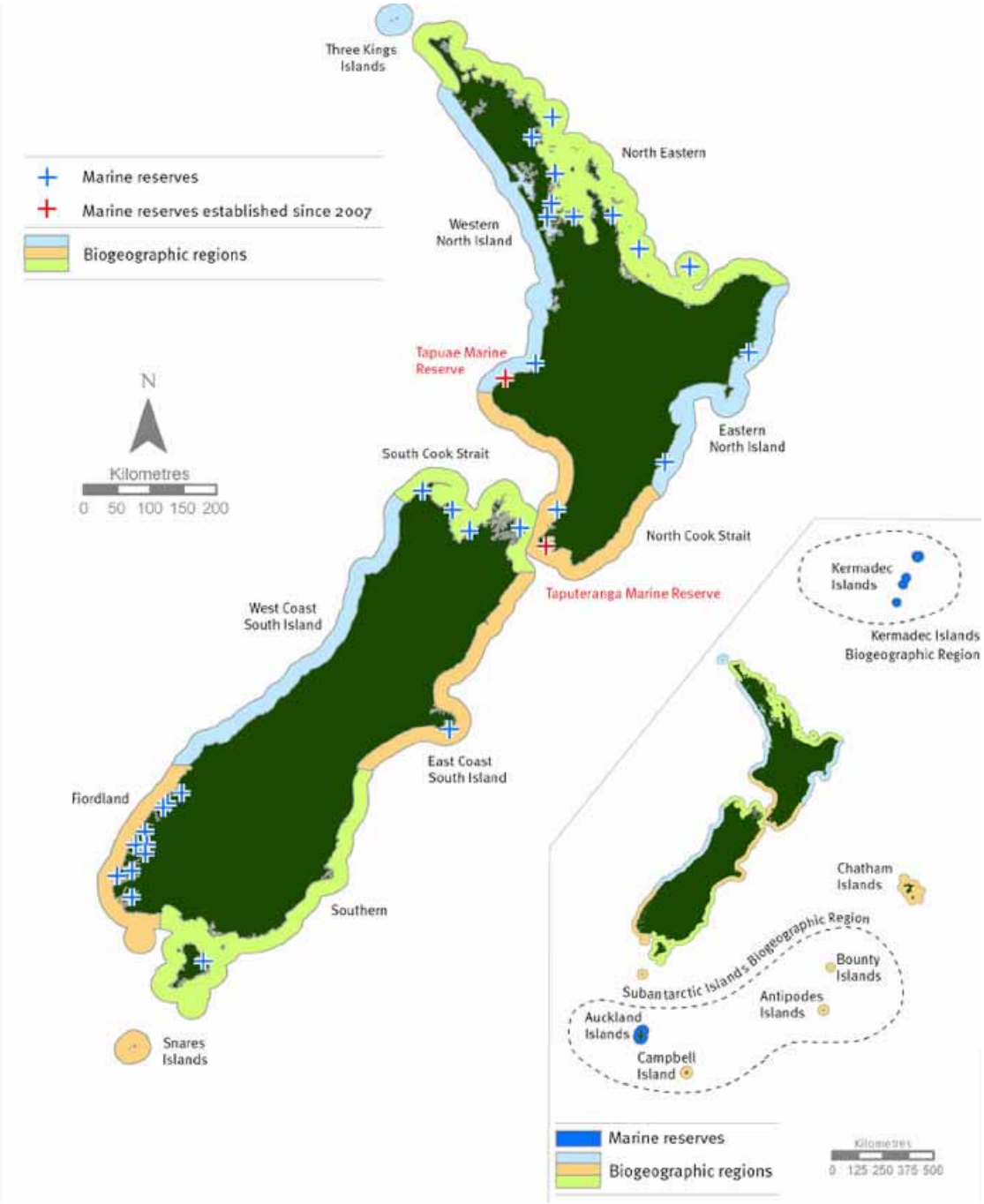
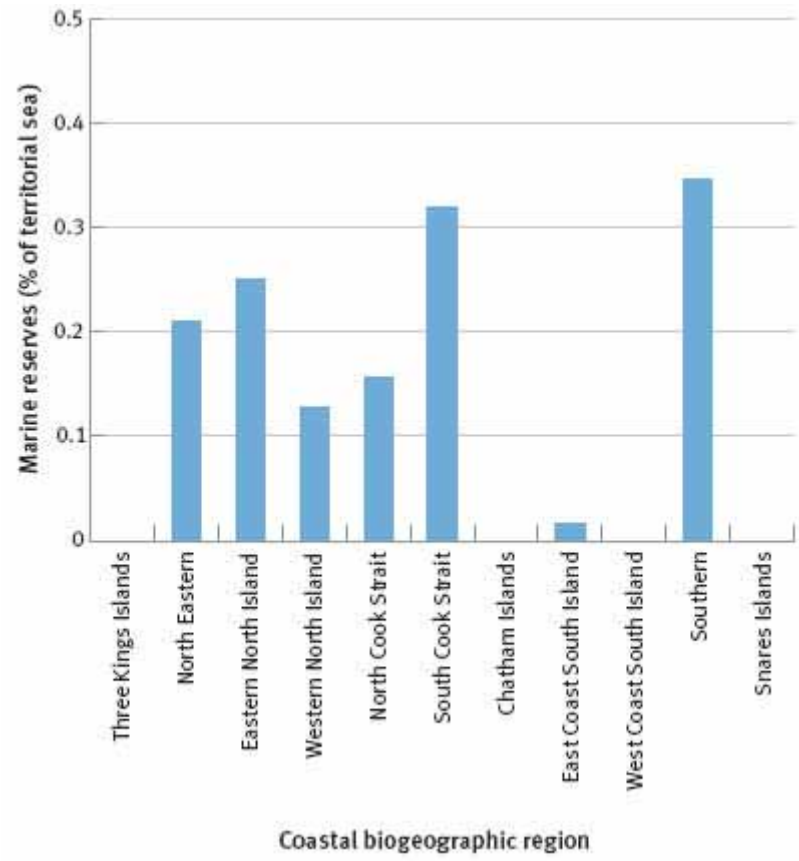


Figure 43: Percentage of mainland Coastal Biogeographic Regions Classification regions in marine reserves, 2007



4.17.4 Compatibility with other indicator programmes

National indicator sets	International indicator sets	
DoC	United Nations Commission on Sustainable Development core set	United Nations Commission on Sustainable Development Sustainable Development set

Note: Small differences may exist in the way these variables are represented in other indicator sets.

Source: Web sites of Statistics New Zealand, UN Division of Sustainable Development, OECD, European Environment Agency.

4.17.5 References

Leathwick JR, Julian K, Francis M. 2006. Exploration of the use of reserve planning software to identify potential Marine Protected Areas in New Zealand's Exclusive Economic Zone. NIWA Client Report HAM2006-064.

Ministry for the Environment (MfE). 2005. The New Zealand Marine Environment Classification. ME number 594. MfE, Wellington. ISBN 0-478-25908-5

Ministry for the Environment. 2007. *Environment New Zealand*. MfE, Wellington. ISBN 978-0-478-30192-2.

4.18 Biodiversity – native land cover

Native land cover provides habitat for many of New Zealand's native species. Protecting native land cover is one way of ensuring that key habitat is retained. Reporting on changes in native vegetation over time provides us with an indication of the changing extent of native ecosystems.

The majority of legally protected land is found in public conservation lands, which cover large tracts of native forest and alpine areas. New Zealand has set aside around 8,400,000 ha of public conservation land, about 32 per cent of its total land area. The Department of Conservation (DoC) is responsible for preserving and protecting these areas, including managing threats from invasive pests and diseases.

Protected areas outside public conservation lands make up about 2.5 per cent of New Zealand's total legally protected area. Although much smaller, privately protected lands derive their value from the fact they are often located in areas with little publicly protected land.

4.18.1 Indicator and variable description

This indicator shows the total area of 22 native land cover (indigenous vegetation and other native land cover) categories and the proportion of each that comes under some type of legal protection. The extent to which each of New Zealand's 20 land environment classes is covered by native vegetation and is under legal protection is also assessed.

Table 38: Variables of the native vegetation indicator

Indicator	Variable	Can be disaggregated by:
Land area with native vegetation, including area under legal protection	Surface area (ha) of total native land cover across native land cover classes from LCDB	22 native land cover categories
	Proportion (%) of the area that is legally protected	Proportion of each category with legal protection
	Extent (ha and %) to which New Zealand's 20 land environment classes have native land cover	20 land environment classes

The term "legal protection" used in this indicator comprises public conservation lands managed by the Department of Conservation (DoC), parks managed by some regional authorities, as well as private land covered by covenants under the Queen Elizabeth II National Trust and Ngā Whenua Rāhui.

The Land Environments New Zealand (LENZ) classification is a national environment-based classification of 20 ecosystem classes together covering the whole of the New Zealand landscape. The ecosystems are classified using climate, landform and soil variables likely to influence the distribution of native species. LENZ does not show us *what* plants or animals actually exist where, but the *types* of environments in which these species should be found. In this way, areas that have similar environmental or ecosystem character can be mapped.

4.18.2 Indicator calculation and measurement

Sampling and analytical protocols: The Land Cover Database (LCDB) is a digital map of New Zealand's land cover. Satellite images were taken in the summer of 1996/97 (LCDB1) and in summer 2001/02 (LCDB2). These images were used to classify and map different land cover classes nationally, including the extent of indigenous vegetation. This way it is possible to show the extent of indigenous vegetation at five-yearly intervals.

Sampling frequency: Once every five years (LCDB). Protected area inventory is updated as new areas are given legal protection.

Data needed to compile the indicator: Digital data derived from LCDB imagery. A geo-referenced list of the protected areas, giving their sizes (area in hectares) and locations, and classifying them by native land cover and LENZ classification.

Data sources: For more information on data sources refer to the Ministry for the Environment's document *Data stock-take for the core set of national environmental indicators and associated variables*.

Spatial coverage and length of record: The whole of New Zealand. LCDB records exist for 1996/97 and 2001/02. The protected area inventory includes all legally protected land discussed above.

Measurement methods: Satellite imagery (land cover).

Method for indicator calculation: Once the satellite imagery has been processed, calculating the indicator is a matter of simple arithmetic of distributing land areas according to the relevant classification and adding up surface areas.

4.18.3 Sample reporting formats

Table 39: Protected native vegetation and other native land cover classes, 1996/97 and 2001/02

Name	Area (ha)		Change	Area legally protected by 2006	
	1996/97	2001/02	[%]	[ha]	[%]
Alpine grass/herbfield	224,400	224,400	0.00	181,100	80.72
Broadleaved native hardwoods	546,200	539,600	-1.22	199,500	36.97
Depleted grassland	250,500	250,500	0.00	33,300	13.29
Fernland	51,800	51,700	-0.15	8,200	15.82
Flaxland	6,500	6,500	0.00	3,600	55.83
Grey scrub	72,500	72,400	-0.06	9,800	13.52
Herbaceous freshwater vegetation	88,800	88,700	-0.13	41,400	46.71
Herbaceous saline vegetation	19,300	19,200	-0.45	6,700	34.8
Native forest	6,459,400	6,457,000	-0.04	5,136,600	79.55
Mangrove	26,000	26,000	0.00	2,600	9.8
Manuka and/or kanuka	1,191,600	1,186,200	-0.45	362,800	30.59
Matagouri	29,500	29,500	-0.02	3,100	10.32
Sub alpine shrubland	385,400	385,400	0.00	314,200	81.53
Tall tussock grassland	2,397,100	2,394,600	-0.10	1,175,500	49.09
Total native vegetation cover	*11,748,900*	*11,731,700*	*-0.15*	*7,478,300*	*63.74*
Alpine gravel and rock	698,000	698,100	0.01	506,400	72.53
Coastal sand and gravel	51,300	51,300	-0.07	18,900	36.8
Estuarine open water	92,500	92,500	0.00	3,600	3.86
Lake and pond	356,800	357,500	0.20	121,500	33.98
Landslide	17,000	17,000	-0.26	11,600	68.16
Permanent snow and ice	111,00	111,000	0.00	109,200	98.43
River	81,900	81,900	0.00	18,100	22.09
River and lakeshore gravel and rock	179,700	179,700	0.00	45,900	25.56
Total other native land cover	*1,588,400*	*1,589,100*	*0.04*	*835,100*	*52.56*
Total native land cover	13,337,300	13,320,800	-0.12	8,313,446	62.41

Source: Landcare Research.

Table 40: Protected native cover by land environment class, 2006

Land environment	Area of land environment class		Area with native land cover		Area with native land cover with legal protection	
	[ha]	[%]	[ha]	[%]	[ha]	[%]
A Northern lowlands	1,849,768	7.05	337,759	18.26	84,754	25.09
B Central dry lowlands	691,023	2.64	70,437	10.19	6,526	9.26
C Western and southern North Island lowlands	636,039	2.43	27,014	4.25	5,783	21.41
D Northern hill country	2,100,703	8.01	927,561	44.15	469,804	50.65
E Central dry foothills	1,323,134	5.05	591,154	44.68	229,675	38.85
F Central hill country and volcanic plateau	5,241,257	19.99	1,901,125	36.27	999,483	52.57
G Northern recent soils	336,969	1.28	56,205	16.68	18,274	32.51
H Central sandy recent soils	135,305	0.52	47,804	35.33	31,187	65.24
I Central poorly drained soils	120,999	0.46	6,159	5.09	2,390	38.80
J Central well-drained recent soils	292,689	1.12	20,779	7.10	3,277	15.77
K Central upland recent soils	160,758	0.61	63,831	39.71	19,936	31.23
L Southern lowlands	801,869	3.06	104,945	13.09	59,356	56.56
M Western South Island recent soils	220,444	0.84	121,532	55.13	98,584	81.12
N Eastern South Island plains	2,044,301	7.80	163,565	8.00	8,780	5.37
O Western South Island foothills hills and Stewart Island	1,412,650	5.39	1,279,893	90.60	1,161,159	90.72
P Central mountains	3,247,880	12.39	3,029,280	93.27	2,313,193	76.36
Q South eastern hill country and mountains	3,276,038	12.49	1,780,287	54.34	622,273	34.95
R Southern Alps	1,929,739	7.36	1,927,944	99.91	1,816,279	94.21
S Ultramafic soils	33,485	0.13	32,513	97.10	31,059	95.53
T Permanent snow and ice	157,144	0.60	157,128	99.99	153,603	97.76
Unspecified	211,114	0.81	116,986	55.41	29,486	25.20
Totals	26,223,310	100.00	12,763,904	48.67	8,164,862	63.97

Source: Ministry for the Environment.

4.18.4 Compatibility with other indicator programmes

National indicator sets	International indicator sets	
Statistics NZ linked indicators	United Nations Commission on Sustainable Development core set OECD Core Environmental Indicators	United Nations Commission on Sustainable Development sustainable development indicators European Environment Agency Core Set of Indicators (CSI 008)

Note 1: Although international indicator sets all have a similar protected areas indicator, the New Zealand core indicator is not directly comparable because it is not expressed in terms of the six categories used by the World Conservation Union (IUCN).

Source: Web sites of Statistics New Zealand, UN Division of Sustainable Development, OECD, European Environment Agency.

4.18.5 References

Department of Conservation (DoC). 2000. *New Zealand Biodiversity Strategy*. DoC, Wellington.

4.19 Biodiversity – indicator species

A number of rare species are deemed to be "species indicators", in the sense that they are sensitive to changes in the quality and extent of their habitat. By observing changes to the range of these species, it is then possible to learn something about the condition and/or functioning of their habitat as a whole.

4.19.1 Indicator and variable description

This core indicator is presented as a series of maps showing the distribution of seven indicator species at three points in time: pre-human settlement, the 1970s and 1980s, and the present. The seven species at hand – a subset of a wider reporting programme for biodiversity managed by the Department of Conservation – were selected for their indicator characteristics, habitat requirements, data availability, and level of threat (Table 41).

Table 41: Indicator species used to illustrate distribution changes of New Zealand's native biodiversity

Name	What is it?	Why is it an indicator?
Lesser short-tailed bat/pekapeka (*Mystacina tuberculata*) Referred to as lesser short-tailed bat in ENZ 07 report	Endemic bat. Bats are our only native terrestrial mammal.	Shows the general health and structure of forested ecosystems in many parts of New Zealand.
Kiwi (*Apteryx* spp) (five species)	Endemic, flightless birds.	A good indicator of the abundance of key mammalian predators in a range of forest types in many parts of the country.
Kākā (*Nestor meridionalis*)	Endemic forest parrot.	A good indicator of possum and stoat abundance in a range of forest types in both North and South Islands.
Kōkako (*Callaeas cinerea*)	Endemic New Zealand wattlebird.	An indicator of rat and possum densities in North Island forests. Due to its sensitivity, it only exists in managed sites.
Mōhua/yellowhead (*Mohoua ochrocephala)* Referred to as mōhua in ENZ 07 report	Endemic insectivorous forest bird.	A very sensitive indicator of stoat and rat densities in South Island beech forest.
Wrybill/ngutu pare (*Anarhynchus frontalis*) Referred to as wrybill in ENZ 07 report	Small, endemic shorebird that is highly specialised for breeding in braided rivers.	These depend on South Island braided rivers for breeding habitat and provide a good indicator of various threats degrading this ecosystem, such as pest predators and direct human impact, including water extraction and four-wheel-drive activities.
Dactylanthus/Woodrose/pua o te reinga (*Dactylanthus taylorii*) Referred to as dactylanthus in ENZ 07 report	Endemic, parasitic flowering plant.	Indicates aspects of forest health in parts of the North Island, including densities of introduced browsers, presence of native pollinators, seed dispersers, and host trees.

4.19.2 Indicator calculation and measurement

Sampling frequency: The distribution of the seven indicator species for the following points of time: pre human settlement, 1970s and 1980s, and current.

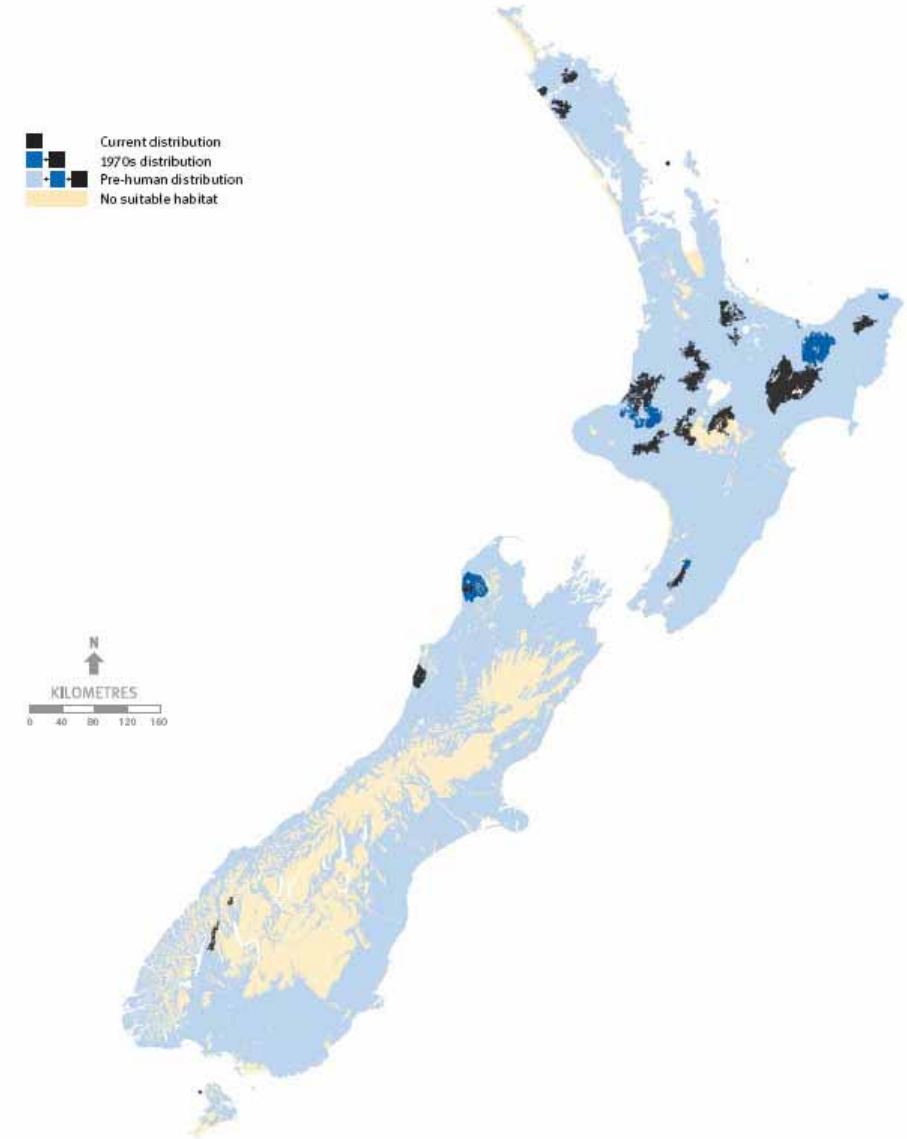
Data sources: For more information on data sources refer to the Ministry for the Environment's document *Data stock-take for the core set of national environmental indicators and associated variables*.

Spatial coverage and length of record: Nationwide coverage or coverage of managed areas. Presence/absence data is available for the 1970s and 1980s and present-day. Availability of further presence absence data varies for each species.

Measurement methods: Methods used in relevant DOC monitoring programmes.

4.19.3 Sample reporting formats

Figure 44: Change in distribution of the Lesser short-tailed bat or Peka Peka



Source: Department of Conservation.

4.19.4 Compatibility with other indicator programmes

National indicator sets	International indicator sets
Proposed DoC national biodiversity indicator set.	No comparable indicator in United Nations Commission on Sustainable Development core set, OECD Core Environmental Indicators and European Environment Agency Core Set of Indicators indicator sets.

Note: Small differences may exist in the way these variables are represented in other indicator sets.

Source: Web sites of UN Division of Sustainable Development, OECD, European Environment Agency.

4.19.5 References

Department of Conservation (DoC). 2000. *New Zealand Biodiversity Strategy*. DoC, Wellington.

Ministry for the Environment. 2007. *Environment New Zealand*. MfE, Wellington. ISBN 978-0-478-30192-2.