Section 3

Key Trends and Influences

This chapter discusses the broader context surrounding the implementation of sustainable development in New Zealand. In order to understand where we should be going, it is important to understand something of our history and the various characteristics of New Zealanders that have influenced and will continue to influence or drive the way we implement sustainable development. It is also important to understand and recognise global issues and trends that will impact on our capacity to implement sustainable development.

3.1 New Zealand and New Zealanders

3.1.1 Who are we?

New Zealand is an isolated remnant of the prehistoric super continent Gondwana. It parted company with Gondwana some 80 million years ago. This produced species of plants, animals and birds found nowhere else in the world (MFE, 1997). The period of human settlement is believed to be less than 1000 years, beginning with the ancestors of the Maori, followed by Europeans and other ethnic groups from the 1800s onwards. Many of New Zealand's pest animals and weeds were introduced by British immigrants wanting to pursue their traditional gardening, fishing and hunting activities.

Te Tiriti o Waitangi (the Treaty of Waitangi 1840) may be considered to be NZ's founding document. The Treaty records the fundamental bargain between the Crown and Maori - the exchange of the right of the Crown to govern (Article I), in return for confirmation of the rangatiratanga of tangata whenua, and the obligation to protect Maori interests (Article II). The Treaty did not convey any special rights to tangata whenua - rather it confirmed and guaranteed their existing rights to land, forests and their natural resources, including rights in respect of intangible taonga. The principles of the Treaty, as established by the Courts and enunciated by the Waitangi Tribunal,

that are relevant to sustainable development include:

- partnership between the Crown and tangata whenua, to act in good faith and to accord each other reasonable co-operation on major issues of common concern
- active protection of the Maori interest in natural resources, species, places and other taonga, which will require more than passive recognition or processes of consultation with tangata whenua
- management of natural resources, species, places and other taonga according to tikanga
- recognition that taonga include both tangible and intangible dimensions and values (PCE, 2001f).

New Zealand's population is already close to four million. Ethnic composition is becoming more varied and diverse. Maori, Pacific Island and particularly Asian ethnic groups are growing more rapidly than the majority European group. More people are indicating they belong to more than one ethnic group. The 2001 Census showed that more New Zealand residents were born overseas: 1 in 5, compared to 1991 when it was 1 in 6. We are experiencing an ageing of the population although the Maori, Pacific and Asian populations are younger than the European population. New Zealanders are highly urbanised, with about 85% of the population living in towns and cities. The North Island will be home to 77% of all New Zealanders by 2021 with about 56% expected to live in the northern North Island by that time. The Auckland region is projected to experience the greatest population growth.

New Zealand's economy has been dominated by 'quarrying' rather than sustainable use, meaning that key environmental resources were depleted, either because they were non-renewable or because they were overexploited (MFE, 1997). We come from a line of immigrants, first hunters and gatherers, then pioneers and exploiters of natural capital. All have contributed to environmental modification including species extinctions, introduction of pest species and removal of forests.

Since the 1960s, New Zealand's economy has been developing from a 'one-legged animal', dependent on pastoral industries, to a 'four-legged beast'. The three new limbs are non-pastoral primary industries such as forestry, fish and horticulture, manufactured exports, and the exports of services, particularly tourism (Belich, 2001). Our agriculture and forestry is based almost exclusively on imported plant and animal species. Today New Zealand is a small trading nation with a GDP per capita which places it amongst the wealthiest nations in the world. This is despite the fact it has slipped from amongst the highest in the world in the 1950s to 21st in the OECD by 2002. Our comparative advantage as a trading nation continues to be strongly influenced by farm-based commodities that make the capital base of our environmental resources critical. Natural capital contributes some 20% of the per capita wealth in New Zealand whereas, in North America and Western Europe, it contributes 5% and 2% respectively (Statistics New Zealand, 2000).

3.1.2 Values and ethics

Values and ethics form an important part of what makes New Zealanders who they are. The underlying values and beliefs of people influence choices that are made and actions taken and, therefore, the rate of progress towards sustainable development. Several participants in this project highlighted the ethical or values base of our actions and suggested the need for more of an ethical component to education to expand understanding and appreciation of values and ethics.

The United Kingdom Royal Commission on Environmental Pollution states in its 21st Report:

> *We understand values to be beliefs, either individual or social, about what is important in life, and thus about the ends or objectives which should govern and shape public policies. Once formed such beliefs may be durable. It is also characteristic that they may both be formed and modified as a result of information and*

reflection. Environmental and social values, in particular, are not necessarily preformed or fixed but, for many people, emerge out of debate, discussion and challenge, as they encounter new facts, insights and judgements contributed by others[1] (PCE, 2001e).

Sustainable development requires people to actively think about and look for better ways of doing things. Langhelle (1999) suggests that 'sustainable' denotes the ethical component of sustainable development. Ethics requires inter-temporal justice along with the integration of all three concepts of economy, society and environment. Peet (2000) proposes an ethical principle for guiding sustainable development indicators as: "All people have their basic needs satisfied, so they can live in dignity, in healthy communities, while ensuring the minimum adverse impact on natural systems, now and in the future".

'Sustainable' also requires us to address the needs of future generations and intergenerational equity. But what are the needs of future generations? While specific future preferences and wants (as opposed to needs) may be hard to determine, it is reasonable to assume that basic goods such as food, clean water and energy will be future needs. Internationally, reasonably foreseeable needs have been recognised as including the right to life, property, culture and health. There is general agreement that responsibilities to the near future are strong but debate exists over obligations to the far future (PCE, 2001f).

Any definition of sustainable development needs to reflect the values of the society or culture concerned. Within New Zealand that includes the values and ethical concerns of tangata whenua. Some values and ethics of Pakeha New Zealanders may be similar to those of tangata whenua, even though there are differing underlying cultural values. Many Maori "view themselves as part of the natural world and ... [believe that] the people, the land, the sea, the forest and all living creations are all members of the same family" (RCGM, 2001 Appendix 2: 265). Western cultural traditions have generally embraced more anthropocentric and modernist values (Huckle, 1996).

Values, beliefs and expectations can at times appear to be in conflict, giving rise to the need for on going debate and discussion to clarify and resolve conflicts. For example, participants in this investigation highlighted New Zealanders' strong sense of private property rights that can, at times, be at odds with their desire for a high quality environment. The argument, "I should be able to do what I like on my property" has been heard often enough in the context of RMA processes and has at times contributed to poor environmental outcomes. Some people suggested that there needs to be recognition of rights other than those of individual property owners, such as the rights of neighbouring property owners to amenity and landscape values, future generations and other species that share our environment.

This diversity of values highlights the need for more widespread discussion, agreement and understanding of the need to move away from unsustainable development patterns. Without changes in values, people will not demand goods and services that are produced in a more sustainable way and it will be business as usual (Lerner, 1998). Many people simply remain unconvinced that sustainability has any relevance for them (PRISM and Knight, 2000). Others are convinced but are unsure how to go about putting it into practice. However, there is evidence that much is being achieved quietly by groups and individuals who do not necessarily label their actions as sustainable development.

Values in decision making

In general, decision making is a matter of choosing between a number of predetermined alternatives, but values are more fundamental to the decision than are the alternatives. Value-focused (or constraint-free) thinking, in the context of sustainable development, involves identifying a desirable end point and working to

make it a reality. In contrast, alternative-focused thinking involves starting with a limited and readily available set of options and adopting the best of the lot. Keeney (1992) expresses the view that one of the main driving forces for decision making should be values. Keeney maintains that focusing early and deeply on values when facing a difficult problem will lead to more desirable consequences in the long term. Peet (2001) also asserts there is always a moral and ethical dimension to policy making.

As an alternative to forecasting futures from existing/known alternatives, the Natural Step framework uses explicit values and scientific criteria to envisage a sustainable future state, then works backwards to identify logical steps to take toward it.

Environmental values in New Zealand

New Zealanders do value their environment and have ethical concerns with regard to their interactions with it. This is evident in the many submissions received in public consultation procedures regarding issues such as the creation of the New Zealand Coastal Policy Statement in the early 1990s, the recent Oceans Policy process and the Royal Commission on Genetic Modification (RCGM). An international study undertaken in 1997 found that New Zealand was among the populations that most strongly favoured environmental protection over economic growth (Environics International, 1997).

A number of consultation processes and studies have been carried out to find out the range of values that New Zealanders place on the environment. The next sections examine some recent attempts to determine these values and the perceptions that people have of the state of the New Zealand environment.

Royal Commission on Genetic Modification

Expressions of the extent to which New Zealanders value their environment can be seen in the range of comments in submissions to the Royal Commission on Genetic Modification during 2000/01 (RCGM, 2001). The Commission had "given much thought to the values New Zealanders hold" and acknowledged the "values held by Maori add special emphasis to the ethical and cultural objections many people have to the new [GM] technology" (Ibid:3). The Commission devoted a complete chapter (Chapter 2) to 'a shared framework of values'. This included comments such as:

> *Values are often hidden or unnamed, and when this happens there is a danger of becoming lost in a debate about strategies and losing sight of what we ultimately want to achieve (p.11).*

The Commission identified seven values pertinent to its report. In summary, these are:

- **The uniqueness of Aotearoa/New Zealand** recognising New Zealand's unique features such as its relatively low population density, and its ecosystems, flora and fauna.
- **The uniqueness of our cultural heritage** recognising the significance of the Treaty of Waitangi and the essential element of Maori heritage in the New Zealand culture of today.
- **Sustainability** recognising the need to sustain our unique but fragile environment for generations yet to come, and that an environment that is cherished and cared for is not just a survival mechanism; it is for many also a source of spiritual and cultural hope.
- **Being part of a global family** recognising that to be geographically isolated is not to be isolationist. New Zealanders are very much world citizens in terms of travel, trade, and partnerships of knowledge and endeavour, sharing in global developments and having the capacity to exercise leadership.
- **The well-being[2] of all** recognising that economic and social goals are not mutually exclusive but symbiotic. A strong economy makes possible the provision of effective educational, health and social systems, and a population that has benefited from those systems contributes in turn to a strong economy.

- **Freedom of choice** recognising that in a democratic nation freedom in diversity requires a flexible and co-operative spirit to ensure that as far as possible everyone's freedoms are maintained.
- **Participation** recognising that a democratic nation requires effective systems of consultation and shared decision making, and that national policies are most likely to succeed when they arise out of processes of participation.

Ministry for the Environment's Rio+10 community programme

During the period May to July 2001, the Ministry for the Environment (MFE) sought public views on the state of the environment and priorities for environmental sustainability.[3] This was done through its 'Rio+10 community programme', which involved the distribution of information packs and a series of public debates. Of the 3,588 responses received by MFE, 65% thought that New Zealand had not made a strong enough commitment to dealing with environmental issues in the past ten years. The top five issues seen as requiring high priority action were:

- having healthy streams, rivers and lakes
- reducing waste
- having clean beaches and coastal water
- having clean air
- managing toxic chemicals.

The majority saw global warming, healthy streams, rivers and lakes, and clean air as issues where progress had been unsatisfactory.

Perceptions of the state of New Zealand's environment

Lincoln University published a report in 2001 (Hughey et al., 2001) as part of a long-term project to determine people's views about the state of New Zealand's environment. The aims of this research were to measure, analyse and monitor changes in New Zealanders' perceptions, attitudes and preferences towards a range of environmental issues, ultimately contributing to improved state of the environment reporting.

Among the main findings of the 2001 report were:

- On average, New Zealanders consider the state of their environment to be adequate to good.
- Many New Zealanders still think the country is clean and green.
- While the environment overall and the urban environment in particular are thought of very highly, the same findings do not occur for a number of other resources. Notably the beach and coastal environment and marine fisheries are considered to have declined in condition in recent years.
- New Zealand's management of the environment is not highly rated, with the lowest ratings going to the management of farm effluent and runoff, the use and disposal hazardous chemicals, air quality, coastal water, beaches, marine fisheries and the change in management of those resources over the previous five years.
- Pests and weeds, dumping of solid wastes, hazardous chemicals, sewage and stormwater are perceived to be significant causes of damage to many parts of the environment.
- The public gave highest significance to more expenditure on pests and weeds, endangered species, air quality and fresh water.

When the study compared the public's perception of the state of the environment with the actual results from scientific monitoring of the environment, it found the following divergence that indicates a need to provide more information to the public about the scientific state of the environment:

- The actual state of soil and fresh water is worse than the 'good to adequate' rating given by respondents.
- The state of marine fisheries is better than the perception held by the public.
- The study also found it surprising how high a rating New Zealanders give to the natural environment in towns and cities.

New Zealanders and the environment

A survey by Massey University Department of Marketing (Massey University, 2001) identified that most New Zealanders are concerned about

environmental problems, and believe the environment is under threat from pollution of waterways, air pollution from cars and industry, waste produced by households and businesses, and by the greenhouse effect.

The survey found that there is a fairly widespread belief that New Zealand's 'clean green' image is a myth and that our small population is the only reason we are cleaner than other countries.

Other findings from the survey include the following:

- What New Zealanders value most about the environment is clean, clear air and clean, unpolluted water in lakes, rivers and the sea.
- Many placed a high value on safe towns and cities, beautiful scenery, national parks, and healthy soil, unpolluted with chemicals. But less value is placed on New Zealand's cultural heritage.
- Most New Zealanders express concerns about the effects of economic growth and progress on the environment.
- While New Zealanders' concerns for the environment are clear, their behaviour and attitudes suggest that the environment is less important to New Zealanders now than in 1993.
- Ultimately, we are all responsible for the environment, and we may have to accept some financial or other sacrifices in order to protect it.

Environmental concerns in the Waikato

The Waikato Regional Council undertakes telephone surveys of approximately 1000 of its constituents every two to three years, to gauge people's understanding, knowledge, actions and attitudes towards the environment. They also aim to raise awareness of environmental issues so people understand how their actions impact on the environment. The 2000 survey found that the environmental issues of most concern to public respondents were water pollution, waste disposal and general pollution. This was only slightly different from the 1998 survey, in which air pollution replaced general pollution in the top three. While not debating these rankings, in reporting the results of the survey the Council highlighted the need for education to inform citizens of other important issues[4].

Summary of the four surveys

The areas of concern common to all four surveys mentioned above include:

- water quality in lakes, rivers and the sea
- air quality
- waste and hazardous materials.

However, there are clearly some differences between public perceptions of, and scientific evidence on, the state of the environment, highlighting a need for improving public awareness of the actual quality of the environment. There is also a significant difference in two of the surveys' responses to the country's clean green image. In one, the image is seen as a reality, while in the other it is seen as a myth. Irrespective of whether or not this can be explained by how the question was phrased in each of the surveys, the difference in responses shows the tenuousness of relying on image alone.

Values change over time, and what is acceptable to this generation may be regarded as totally unacceptable to later generations. While we cannot predict or make decisions based on the unknown values of future generations, we should not make it impossible for them to modify decisions and trade-offs made today.

3.1.3 Legacies of the past

As part of the investigation for this report, a stocktake of New Zealand's environmental management systems was undertaken based on previous PCE investigations (see appendix 2 for the full stocktake discussion). A number of key findings for New Zealand's future sustainability arise from that stocktake.

The Commissioner's (PCE,1999b) wider investigation of the management of New Zealand's marine world outlined "a picture that is full of opportunity, yet deeply disturbing in its limited

effectiveness and capacities to date." The management systems in place do not equate to the sustainable management of the marine environment as a whole. However, a number of Government initiatives such as the Oceans Policy are underway aimed at addressing these issues (see appendix 2 section A2.2.3). Biodiversity is continuing to decline despite a wide range of Government initiatives (see appendix 2 section A2.2.5).

A number of major biosecurity investigations by the Commissioner focused on the environmental management of pests (invasive alien species) that threaten indigenous biodiversity (see appendix 2 section A2.2.7).

The Commissioner's investigation identified strengths and weaknesses of the biosecurity system then outlined a number of opportunities for its improvement. These were to:

- develop numerous 'lines of defence' against unwanted organisms, including off-shore preventative measures
- broaden membership of the Biosecurity Council
- improve coordination and co-operation between agencies
- develop risk management principles
- strengthen monitoring, surveillance research and intelligence systems, particularly in the Auckland region
- establish more partnerships
- develop a 'learning by doing' approach to managing pest and disease incursions to improve operational success rates.

New Zealand is now a highly urbanised society with over 85% of the population living in urban or suburban environments. (The global average for all countries is 50%.) The successful management of its cities can be seen as a challenge to New Zealanders to achieve sustainable urban development, recognising that cities are, in effect, very complex, highly managed ecosystems. The first PCE investigation of the management of the urban environment (PCE, 1998a) found that:

"With a few notable exceptions at the city level, the concept of sustainable urban development is largely being ignored in New Zealand, with a lack of leadership and vision." (See appendix 2 section A2.2.9 and chapter 3 section 3.3.2 for further information).

The Commissioner's energy report (PCE, 2000b) concluded that in response to international agency recommendations and an analysis of Environment 2010 Strategy actions, little progress had been made in a large number of areas concerning energy efficiency and renewable energy. All agencies had paid insufficient attention to renewable energy issues and energy efficiency issues associated with the transport sector. Lack of action, despite the extensive analyses that had been done (14 major reports) suggest that deep ideological debates have impeded and ultimately constrained Government investment and willingness to sign off on policy initiatives (see appendix 2 section A2.3.1). Recent Government initiatives seek to address these issues (see chapter 4).

The management of waste has been the subject of a number of public reports throughout the 1990s including PCE investigations. The 1996 OECD review of New Zealand's environmental management (OECD, 1996) comprehensively criticised New Zealand's "poor performance in waste management with respect to inconsistent policies between local authorities, lack of incentives, piecemeal approach, inadequate legislation, limited information, and lack of treatment and disposal facilities". The State of the Environment report (MFE, 1997) concluded that the scale of the hazardous waste problem was poorly understood, badly underestimated and prone to flawed management.

The Commissioner's assessment of progress in 2001 with the management of hazardous waste showed that reasonable progress had been made. Despite this progress, the broader goals of the Hazardous Waste Management Programme had not been achieved as planned after three years. Evidence of improved systems or outcomes is

unlikely now until 2005 or beyond. Fortunately, the Ministry for the Environment has clearly identified key milestones for the programme and these will be useful for measuring the programme's progress and outcomes (see appendix 2 section A2.3.3). The new New Zealand Waste Strategy that was launched in March 2002 offers an opportunity to put into practice a series of actions that are essential to stop, and then reverse, the inexorable accumulation of waste that degrades ecosystems and despoils landscapes (see appendix 2 section A2.3.4).

Despite the economic benefits, there is a wide range of environmental effects associated with the tourism sector, some of which have the long-term potential to seriously damage both the environment and the industry. A PCE investigation into the environmental effects of tourism (PCE, 1997c) identified serious shortcomings in information for the tourism sector and its associated environmental effects. Overall, the investigation concluded that the government system for the management of tourism is fragmented. There is poor communication and coordination between different agencies, especially between those agencies that promote tourism and those that manage the environmental effects associated with it. Government agencies have very little ability to influence the direction of the tourism industry, and thus its effects on the environment. The Government subsequently initiated the development of a New Zealand Tourism Strategy in 2000 which was adopted and implemented in 2001 (see appendix 2 section A2.3.5 and chapter 4).

The Resource Management Act (RMA) became law in August 1991 establishing a planning framework, the purpose of which "is to promote the sustainable management of natural and physical resources." While the legislation is quite justifiably regarded as innovative and far-reaching, its implementation was poorly supported by central Government until the late 1990s. In 1998, the Commissioner noted that the extensive criticism of the RMA had largely been about process (time and cost issues relating to resource consents) while "the merits of advancing sustainable development and improving environmental management appear to be largely forgotten" (PCE, 1998e). There has been little guidance from central government, for example, in the form of national policy statements or national environmental standards, which could have been expected to address a number of these problems. Only recently has attention been given to the quality of environmental outcomes (see appendix 2 section A2.2.1 and chapter 4).

These legacies of past actions and approaches to environmental management are issues which need to be addressed and resolved as part of New Zealand's approach to sustainable development if we are to become more sustainable in the long run. Overall while there have been successes in environmental management, the underlying causes of unsustainability remain to be resolved. As noted above and discussed in more detail in Chapter 4 a number of Government initiatives are underway which, if properly coordinated and integrated, should contribute to this.

3.2 Driving forces

This section examines some of the underlying driving forces (drivers) of the pressures on the environment, and describes the links between the driver and the environment and how that might affect the implementation of sustainable development. It also discusses some of the ways in which these challenges are being addressed both here and overseas in terms of implementing sustainable development. The lack of any driving force (positive or negative) is also important, implying that something is not happening which needs to happen, and is dealt with in section 3.4 gaps and barriers.

The particular focus of this section is on how these driving forces affect the environmental component of sustainable development while acknowledging that they may also have profound

effects on the social and economic components of sustainable development. These drivers could be either negative in the sense that they exacerbate the conditions which have given rise to the need for sustainable development or positive in the sense that they encourage the implementation of sustainable development. Driving forces include those actions, institutional structures, values, policies, legislation, leadership and groups that influence the application of sustainable development. The New Zealand situation with respect to legislation and policies that promote sustainable development (important drivers of change) is discussed in chapter 4.

The OECD suggests that, internationally, the main drivers affecting the environment and causing change include economic drivers (economic growth and development, trade and investment liberalisation), social drivers (demographic and labour force developments, and consumption patterns), and technological innovation (OECD, 2001a).

3.2.1 The economy

A key to sustainable development is integration of social, economic and environmental concerns. Sustainable development requires acknowledging and understanding all three areas, the linkages between them and finding ways of achieving positive outcomes in all three areas. Economic systems globally do not tend to value and price ecosystem services. We buy and pay taxes on land but not on air or the assimilative capacity of the environment. An analysis of the Government strategy *Growing an Innovative New Zealand* (2002) indicates that the economy will take priority over the other two when key decisions are being made. The strategy sets out the framework Government is following to achieve a number of economic and social goals to create an innovative New Zealand. While noting the need for integration of the "economic, environmental, and social pillars of sustainable development" (New Zealand Government, 2002:12), the key objective of the strategy is "to return New Zealand's per capita income to the top half of the OECD rankings and maintain that standing" and the bulk of the document is devoted to economic concerns (see also chapter 4).

A common view from some people, mainly from the private sector, who were interviewed during this investigation is that New Zealand must improve its economic performance (i.e., increase GDP) before it can address social and environmental sustainability. The ideas which underpin this thinking derive from standard neoclassical economics: the economy is the total system, and nature, to the extent that it is considered at all, is a sector of the economy, (for example, the extractive sector - mines, wells, forests, fisheries, agriculture). If the products or services of the extractive sector should become scarce, the economy will 'grow around' that particular scarcity by substituting the products of other sectors. If the substitution is difficult, new technologies, will be invented to make it easy (Kibert, 1999).

Ecological economics offers a more complete economic framework. Ecological economics suggests that the environment physically contains and sustains the economy by regenerating the low-entropy inputs it requires, and by absorbing the high-entropy wastes that it cannot avoid generating, as well as by supplying other systemic ecological services (Kibert, 1999). The economy is therefore a subsystem of a larger system that is finite, non-growing, and materially closed. Growth can become uneconomic when, at the margin, it increases environmental and social costs more than it increases production benefits. These include:

- the costs of depletion
- pollution
- disruption of ecological life-support services
- sacrifice of leisure time
- disutility of some kinds of labour
- destruction of community in the interests of capital mobility

- takeover of habitat of other species
- the running down of a critical part of the inheritance of future generations (Kibert, 1999:74).

As Hermann Daly argues:

> *unless one has in mind the preanalytic vision of the economy as a subsystem, the whole idea of sustainable development - of an economic subsystem being sustained by a larger ecosystem whose carrying capacity it must respect - makes no sense whatsoever.... It is the preanalytic vision of the economy as a box floating in infinite space that allows people to speak of "sustainable growth" (quantitative expansion) as opposed to "sustainable development" (qualitative improvement). The former term is self-contradictory to those who see the economy as a subsystem of a finite and non-growing ecosystem. The difference could not be more fundamental, more elementary, or more irreconcilable* (Kibert, 1999:82).

Valuing our environment for the export trade

Some work has been done on estimating the value for New Zealand's export trade of our 'clean green' image. The Ministry for the Environment commissioned a report (MFE, 2001c) to provide an estimate of the monetary value for New Zealand's export trade of our 'clean green' image. The aim was to quantify the extent to which particular New Zealand exports benefit from positive perceptions about our environment. The focus was on three sectors: dairy, inbound tourism, and organic produce. The report also assessed the potential consumer reaction to an illustrative example of a decline in New Zealand's environmental quality.

The main findings of the report included:

- New Zealand's clean green image does have a value. Environmental image is a substantial driver of the value New Zealand can derive for goods and services in the international market place.
- This image is worth at least hundreds of millions, possibly billions, of dollars - aggregating value elements from dairy, tourism and organic produce and extrapolating to other sectors such as meat.
- New Zealand is relatively clean and green. This is mainly attributable to our low population density resulting in relatively benign environmental pressures.
- There are environmental problems that are sufficient to raise questions about the sustainability of the value of New Zealand's exports attributable to its environmental image. There is a risk that New Zealand will lose value that is created by the current environmental image if we are not vigilant in dealing with the problems that could threaten the image.

Among its conclusions the report referred to the widespread use of New Zealand's clean green image in the marketing strategies of producers and in the export value of their products. The report pointed out that it is the environmental image that creates the value, not environmental quality *per se*. The risk is that as environmental quality declines it will be harder to maintain the image. It would become difficult to restore a positive image of New Zealand's environment held by overseas consumers if this image was totally shattered. This would have an enormous effect on the New Zealand economy considering that 64% of exports are edible and rely heavily on the clean green image.

3.2.2 Consumption and production

> *"Anyone who believes exponential growth can go on forever in a finite world is either a madman or an economist"* (Kenneth Boulding).

A UN publication in preparation for WSSD comments that:

> *no major changes have occurred since UNCED in the unsustainable patterns of consumption and production which are putting the natural life support system at peril. The value systems reflected in these patterns are among the main driving forces which determine the use of*

> *natural resources. Although the changes required for converting societies to sustainable consumption and production patterns are not easy to implement, the shift is imperative* (UNESC, 2002)

Underlying this issue is a perspective that increasing production and consumption is vital for economic growth which, in turn, is seen as essential for maintaining or improving the quality of life. But, as figures 3.1 and 3.2 show, as the economy grows so too does the consumption of energy and the amount of waste that is disposed of.

Measuring consumption and production

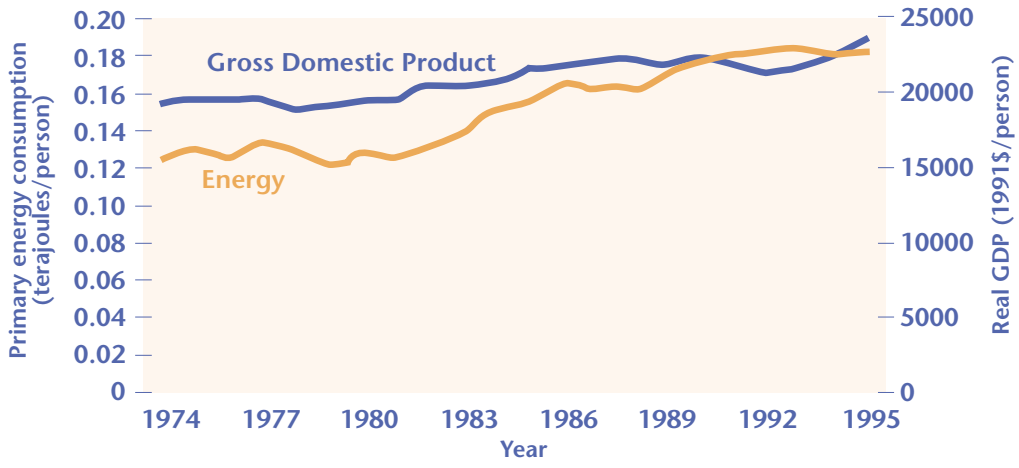
Measuring New Zealand-wide consumption and production trends is difficult because of the lack of a coordinated and reliable collection of relevant statistics (see chapter 4 for current initiatives aimed at addressing this issue). According to the most recent Ministry for the Environment's information on waste (MFE and LGNZ, 2002) every year in New Zealand:

- 3.4 million tonnes of waste ends up in landfills
- 500 billion litres of sewage are fed into 250 wastewater treatment plants, generating up to one million tonnes of sludge
- 13,000 tonnes of medical waste is incinerated
- about 93% of the materials we use are thrown away during production
- about 80% of what we produce is thrown away after one use
- the quantity of waste per person dumped every year in Auckland has increased by almost 75% since 1983.

These statistics are indicative of the behaviour of linear systems in action. Such systems operate on the 'take, make, waste' model. These are in contrast to cyclical systems that are designed from the beginning to minimise waste and maximise the value of resources through their re-use and recycling (see appendix 2 section A2.5 for more discussion).

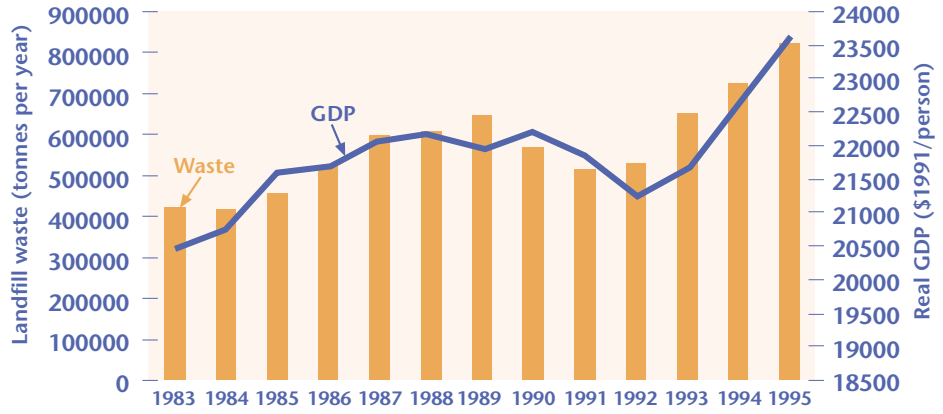
In 1996, New Zealand was around 87% self-sufficient in its primary energy needs. This fell to 72% in 2000. In 1996, the transport sector used 39% of total consumer energy, which increased to 41% in 2000. Between 1996 and 2000 the industrial sector component of total consumer energy decreased from 35% to 32.5% while the residential sector increased from 12% to 13% (Ministry of Economic Development, 2001a). Since 1998, energy intensity has largely remained steady (EECA, 2001)[5].

Figure 3.1: Energy Use and Economic Growth in New Zealand 1974-95



Source: Ministry for the Environment; Statistics New Zealand; Ministry of Commerce

Figure 3.2: Economic Growth and Waste Disposal at Auckland Landfills



Source: Ministry for the Environment

Developing more sustainable approaches

In New Zealand, as elsewhere, the traditional economic system is being challenged and a number of approaches have been developed that provide an operational focus for the general concept of sustainable consumption and production. New approaches include cleaner production, pollution prevention, the Christchurch Redesigning Resources initiative, The Natural Step and Zero Waste. Overseas work is being done on the de-coupling of economic growth from consumption patterns. Some governments have enacted packaging 'take-back' laws that require companies to recycle or reuse packaging discarded by consumers (Worldwatch Institute, 2002).

Redesigning Resources

The Redesigning Resources programme is based in Christchurch and was established to promote an applied understanding of Natural Capitalism (Hawken et al.,1999). Produced by influential business writers Paul Hawken and Amory and L. Hunter Lovins, Natural Capitalism is founded on four principles:

- **radical resource productivity**: redesigning processes to 'do more with less' so fewer resources are consumed
- **biomimicry**: learning from nature and developing more environmentally benign technologies and designs
- **a service and flow economy**: shifting from a product-based economy (where obsolescence is built into products to ensure continued sales) to a service and flow economy (where companies retain ownership of products and lease the services that those products provide)
- **investing in natural capital**: restoring and enhancing ecosystems that sustain life.

A Redesigning Resources conference was held in 2000 with 200 delegates from businesses, research organisations, community groups and representatives from government in attendance. Six 'pilot organisations' also offered themselves to be used as case studies. Christchurch City Council, Macpac, Manaaki Whenua Landcare Research, Orion, The Warehouse and the Shire of the Yarra Ranges (in Australia) have since been joined by Snowy Peak and the Recovered Materials Foundation.

The organisations involved in this project are attempting to redesign the way they use resources. Their progress towards the goals of Natural Capitalism has been monitored through quarterly updates distributed to delegates and other interested parties. They will also report back to a second conference in Christchurch in July 2002, highlighting any successes and impediments they may have faced. The pilot organisations are being supported by a management group responsible for facilitation and advocacy. This group is also establishing a network of global 'mentors' to provide further guidance in this area.

See http://www.redesigningresources.org

Economic instruments have been increasingly used in many countries and sectors to encourage more sustainable consumption and production patterns. Some European nations have begun to shift taxes from income to environmental 'bads' such as pollution and fossil fuel use (Worldwatch Institute, 2002). Some private investors have begun to leverage their wealth for sustainable development through participation in socially responsible investment portfolios. These programmes allow investors to avoid companies with poor social or environmental records (Worldwatch Institute, 2002). Commentators suggest that New Zealand appears to have used economic instruments in a very limited way though there are a growing number of tradeable permit systems, for example, fisheries and land development rights (see appendix 2 section A2.2.3 for a discussion of the fisheries management rights regime in New Zealand).

International Legislative Responses Promoting Reuse and Recycling of Materials

German Ordinance on Packaging Waste, 1993

Requires manufacturers to collect product packaging and arrange for its reuse or recycling, or to join DSD, an organisation that runs a package waste collection system in parallel with municipal waste collection. Consumers can also leave secondary packing behind in retail stores.

Japanese Packaging Recycling Law, 1997

Requires businesses to take back glass, plastic, paper, steel and aluminium cans, bottles, boxes and other packaging. Material that is not readily recyclable must be collected, sorted, transported and recycled at the manufacturers expense.

European End of Life Vehicles Directive, 2000

By 2006, car manufacturers must recover and reuse 85% of the weight of 'end-of-life' vehicles, and by 2015, 95%. Costs are to be borne largely by the manufacturer. In addition, the directive restricts the use of lead, mercury, cadmium, and hexavalent chromium.

Source: Worldwatch Institute, (2002:19).

Environmental taxes

During the round of interviews conducted as part of the background to this report, a number of people raised the subject of environmental taxes as a means of discouraging activities that give rise to adverse effects on the environment. Some referred to it as a method of taxing 'bads'. This means applying taxes to discourage pollution, waste and other activities that have negative impacts on the environment. However, some thought environmental taxes, while potentially useful, were still too crude an approach to be used in isolation.

A large number of environmental taxes and charges have been introduced in OECD countries with the explicit purpose of environmental protection. Examples are taxes on polluting emissions in the atmosphere and water, or on specific polluting products such as sulphur, carbon and pesticides (OECD, 2001c).

Speck and Ekins (2000) point out that the rationale for introducing environmental taxes is based on the existence of environmental externalities, that is, impacts on the environment which are side-effects of processes of production and consumption, and which do not enter into the calculations of those responsible for these processes. The negative effects of such externalities are costs to society. These external costs can be partially or wholly internalised by levying a tax or charge on the effects or on the products or processes that are responsible for them. The tax or charge acts as an incentive to the tax payer to reduce their tax liability by reducing the extent of the environmental damage, and the increased cost on the product encourages both the producer and consumer to switch to alternative products and processes that do not carry the tax liability.

New Zealand's tax revenues raised by 'environmentally related levies', as reported to the OECD[6], are not environmental taxes in the true sense of the term. They are listed as excise taxes on petroleum fuels, motor vehicle licence fees and road user charges. They have not been specifically

introduced for the purpose of environmental protection, although they may influence behaviour towards less consumption of fossil fuels. In contrast, Denmark has a wide range of environmental taxes, including specific taxes on liquid and solid waste, hazardous materials and water use that are intended to minimise impacts of products or processes on the environment. However, as pointed out in another OECD report (2000e), revenue earmarked for environmental purposes may be contrary to the 'polluter pays' principle. Whether or not a given polluter faces an increased burden as a result of a given environmentally related tax depends on whether earmarked expenditures benefit that polluter or not, and if they do, to what extent.

New Zealand's proportion of tax revenue collected from so-called 'environmentally related levies' is about half the average for the OECD. Most of the European Union (EU) member states are well above the OECD average. Energy taxes are the biggest revenue raisers among environmental taxes in the European Union (about 77% of total environmental tax revenue in 1997). Emission taxes and charges are less widespread. The most notable development in the EU is the increasing implementation of ecological tax reforms. Over half of the member countries have implemented such a revenue neutral tax shift (i.e. a shift in what is taxed and at what rate without increasing the overall amount of revenue collected), or will do so in the near future. All countries will use most of the additional generated revenue for reduction in taxes on labour, i.e. personal income tax and social security contributions (Speck and Ekins, 2000).

In their review of New Zealand's tax system, McLeod et al. (2001) addressed 'eco-taxation' and identified three conditions that in their opinion 'favour the use of taxes designed to reduce adverse environmental impacts to their optimal level':

- The impact of the adverse activity or use (however each unit is measured) should be *uniformly distributed*, and the impact of each unit should be the same.
- The adverse activity or use must be *measurable* to be able to apply the tax.
- The *marginal net damage of the activity must also be measurable* to be able to set the level of the tax.

On this basis the review could not identify any instances that would support any new eco-taxes at the national level to address environmental concerns facing New Zealand. However, the review did support the use of carefully designed eco-charges applied at the local level to deal with environmental concerns, most of which the review regarded as localised. The review gave its support to the consideration of a broad-based carbon tax, aligned to international carbon prices. The review also suggested that a carbon tax, combined with government emissions trading, offered the prospect of more efficient outcomes at lower costs of monitoring and compliance.

Taxing pollutant emissions or the use of natural resources is one way to internalise the costs that economic activities impose on the environment. But despite growing evidence of their effectiveness in modifying behaviour, their use has remained limited. Revenues from environment-related taxes in OECD countries still amount to less than 2% of GDP on average.

Reliance on environmentally related taxes has some drawbacks. These include:

- Increased costs due to environmental taxes do not guarantee corresponding changes to producer or consumer behaviour, especially in the short term. However, the OECD (2001e) points out that available evidence indicates that the responsiveness of demand to changes in the price of, for example, energy often is significantly higher in the long run, implying that a consistent long-term implementation of environmentally related taxes could reduce energy consumption and improve the environment.
- When the desired outcome of an environmental tax is achieved (or close to being achieved) there will be less expenditure on mitigation of environmental effects. When

this stage is reached a further reform of the tax system may be needed.

This reinforces the point that environmental taxes should not be considered in isolation. A package of policy instruments needs to be considered, including voluntary approaches, regulations and tradeable permits, to achieve ecologically sustainable outcomes.

While debate on the effectiveness of environmental taxes in New Zealand continues, evidence from the EU suggests that the use of such taxes is widespread and accepted as at least a partial substitute for taxing 'goods' such as labour. Contrary to the view of the 2001 Tax Review that most environmental issues that New Zealand faces are localised, there is a need to revisit the application of environmental taxes on issues that are of national significance, such as:

- the impacts of tourism on biosecurity and threats to biodiversity
- energy consumption (to encourage energy efficiency)
- non-renewable resource consumption (to avoid unsustainable 'quarrying')
- packaging (to minimise waste at source).

3.2.3 The media

Agenda 21 calls for countries to facilitate and encourage public awareness and participation by making information widely available (UNCED, 1992). However, participants in this investigation highlighted the lack of quality information for the public provided by the general media. New Zealand media seem to focus on conflict and sensationalism. This is echoed by overseas studies that have also found many environmental stories lack background and technical or scientific information (Beder, 1997; Smith, 1998; Voisey & Church, 2000). They are also often presented as 'self-contained isolated happenings' (Beder, 1997: 207) with a lack of coverage of associated systematic problems (Darley, 2000). This type of information is unlikely to encourage active citizenship and participation that a participatory democracy requires, as it relegates citizens to spectators and can promote apathy and cynicism (Beder, 1997). There is thus a tension for the media between giving the public what it wants and what it needs to become a well informed, active citizenry.

Certainly the media is a very powerful sector with the ability to not just report the news, but also to make the news (Beder, 1997). The environmental movement relies heavily on the media to convey its message to the general public, with well-planned advocacy campaigns being seen to contribute to the "cumulative public knowledge about environmental issues" (Smith, 1998: 7).

A difficulty for the New Zealand media in reporting on sustainable development is that there is no one organisation responsible for promoting the subject, and no one figurehead for the media to turn to for information or comment. The lack of integration between agencies involved in promoting sustainable development is mirrored in a lack of integration of news stories. While the media may cover stories about all three facets of sustainable development, often the links between them are not made.

Participants in this investigation highlighted the low status of environmental news in contrast to share trading and the economy that have daily slots in television and radio news programmes. Many current affairs programmes are sponsored by business. While this remains the case, sustainable development is likely to remain marginalised and misunderstood.

Advertising in New Zealand is a powerful driving force. The UN claimed in 1998 that our expenditure on advertising as a percentage of GDP was the highest in the developed world, equalling that of Britain and exceeding the United States and Australia.[7] Advertisements aim to persuade us to 'consume more stuff' with the subliminal message that consumption equals happiness and success. While our society is driven by an economic growth culture, consumerism will remain as "the mass participation in the values of

the mass-industrial market (Ewen, 2001: 187)"... "an aggressive device of corporate survival" (Ibid:54). To put it another way, the purpose of advertisements is to help us discover the things we didn't yet realise we needed, but the desires for which can be satisfied by the output of industry (Harrison, 2001). The values of our society and culture mould how our needs are translated into wants and "advertising and the media can stimulate new wants" (Raskin et al, 2002). Advertising appears to have promoted a consumption binge, which has influenced the high level of household debt in New Zealand compared to other developed countries in the OECD. In 2000, New Zealand households were, in aggregate, spending more than their income, while the average OECD saving rate was 8.4%.[8]

What the advertisements do not do is make the links between a consumer's choice of goods and the chain of effects the manufacture and disposal of that product has and will have on the environment and society. Consumers therefore need good quality, independent information to be well informed in their choices. This includes the ability to detect 'greenwashing' in advertising. While purchasing more environmentally friendly products may be preferable, green marketing can also be seen as a way of redirecting willingness to consume less to a willingness to buy green products (Beder, 1997). Green consumerism has been described as "... a palliative for the conscience of the consumer class, allowing us to continue business as usual while feeling like we are doing our part..." (Durining, 1992, cited in Beder, 1997: 180).

Many participants of this study suggested that sustainable development as a concept needs to be made more relevant to people in their own lives. The media could be a very effective partner for other agencies promoting sustainable development, by creating the desire in people to act in sustainable ways. One commentator[9] has suggested that marketing sustainable behaviours and making these behaviours habitual might be a faster way of achieving success than the traditional idea of educating for sustainable behaviours. This is because attitudes tend to follow behaviours. This idea suggests that achieving the desired end product justifies the means.

Turning the Tide - Leicester, England

This is a local initiative which began in Leicester in 1996 and expanded into a regional scheme in 1998. The project aims "to inform people about the environmental issues that directly affect them and encourage them to take simple, practical actions to improve their quality of life and the environment" (Environ website www.environ.org.uk/abouteniron/education/turningthetide.htm retrieved 15/2/02).

The project was developed after identifying four main barriers to the public in changing towards more environmentally friendly behaviour:

1. cost - (which can be a barrier or an incentive)
2. convenience - (more convenience means more people are likely to change their behaviour)
3. information - (appropriate information is necessary)
4. motivation/values - (individual attitudes and values determine to what degree convenience and cost will impact on their potential behaviour change).

Turning the Tide is a partnership of local authorities, regional media and organisations. The partnership runs a series of one-month campaigns which use the media to provide information about a variety of environmental issues (for example energy conservation, transport or recycling). The projects also encourage people to take some personal action regarding the campaign issue using offers and incentives. Past examples have included sales of low cost compost bins and token fares for using public transport.

These offers "have played a significant part in making an impact and encouraging people to take actions and make a difference" (Ibid, retrieved 15/2/02). Use of the brand "Turning the Tide" has been very effective in marketing the campaign and raising awareness about the topics the campaign has covered.

3.2.4 Education for sustainability

Many participants in this investigation, including students, academics and business people, highlighted the need for better education for sustainable development. Chapter 36 of Agenda 21 recognised that education is critical for achieving environmental awareness, values, skills and behaviours consistent with ensuring sustainable development.

The alternative NGO summit at Rio de Janeiro in 1992 produced a 'Treaty on environmental education for sustainable societies and global responsibility' (NGO summit, 1992:1). This treaty recognised that "individual and collective responsibility at local, national and planetary level" was needed to enable the social transformation and ecological preservation required for sustainable development.

Education for sustainability has grown out of the environmental education movement, which emerged from increased international concern about environmental issues in the 1970s. The Belgrade Charter and Tbilisi Declaration were products of intergovernmental conferences in the 1970s, that set out founding goals, objectives and principles for environmental education (UNESCO-UNEP, 1976, 1978). The Belgrade Charter called for a "new global ethic" for living on our planet, "which recognizes and sensitively responds to the complex and ever-changing relationships between humanity and nature and people" (UNESCO-UNEP, 1976:1). The term environmental education is still often used but might be seen to be just one aspect of the broader concept of sustainability education.

In more recent years education for sustainability has promoted the need for education to critically examine the dominant culture that has promoted current practices such as unsustainable economic growth and consumption patterns. Many commentators have highlighted the paradox of education being funded by government (central or local) institutions that are a part of the dominant culture. This implicitly educates citizens to conform to that culture. At the same time, sustainability education's goal is to educate the population to behave in a more sustainable way, a message that is often at odds with messages received from the media and institutions themselves.

Sterling (1996:18) puts it very neatly: "Education is proclaimed at high level as the key to a more sustainable society and yet it daily plays a part in reproducing an unsustainable society". This is not a new idea, as Einstein noted when he said, "No problem can be solved from the same consciousness that created it." (Quoted in Sterling, 2001).

A fundamental premise of education for sustainability is the need to understand the ecological limits operating on our planet and the fact that human beings need to function within them. As natural resource users, we need an appreciation of the importance of maintaining the natural capital of the earth and an understanding of how all our actions impact in some way on the environment.

The need for an ecologically informed citizenry that can participate in democratic governance is therefore a high priority for education for sustainability. Socially critical education, described by Huckle (1993) as emancipatory, is what is needed to help create a new sustainable development paradigm.

Progress in implementing education for sustainability has been slow, however. New Zealand is not alone in this regard, although some countries have achieved more with education than others. An OECD report suggests that those countries with the most advanced environmental education policies are those where the environment is perceived by the citizens as most threatened (OECD, 1995). New Zealand's education system could therefore be a victim of the pervasive perception of our country as 'clean and green'.

New Zealand's environmental education strategy

Agenda 21 urged national governments to "strive to update or prepare strategies aimed at integrating environment and development as a cross-cutting issue into education at all levels within the next three years" (UNCED, 1992: 36.5). New Zealand's environmental education strategy, 'Learning to care for our environment', was published six years after the Rio Earth Summit (MFE, 1998).

The strategy outlines five objectives of environmental education adapted from the 1977 Tbilisi Declaration:

- **Awareness** to help people to understand the impacts of our activities on the environment and our responsibilities
- **Participation** to provide people with the capacity to be actively involved at all levels in helping resolve environmental problems
- **Attitudes and values** to help people acquire values of concern and responsibility for the environment and be motivated to care for the environment
- **Knowledge** to help people gain experience in and a basic understanding of the environment and human interaction within it
- **Skills** to help people acquire the skills to participate effectively in decision making that affects the environment and to play a part in identifying and solving environmental problems.

The Ministry for the Environment is the lead agency for five out of the six priority areas outlined in the strategy. This is because environmental education is seen as a life-long process which extends far beyond formal institutional education. However, while environmental education comes under the cloak of the Ministry for the Environment, other agencies also play a significant part in its implementation, notably the Ministry of Education but also the Department of Conservation, Ministry of Fisheries and local government.

As recently as 1998 a Government strategy was still using the term 'environmental education'. Education for sustainable development needs to have the direct support of a much wider range of Government agencies than just those concerned with natural resources. Traditionally in New Zealand there have not been good links between environment and education agencies and this is echoed overseas (OECD, 1995).

The national environmental education strategy (MFE, 1998) "strongly suggested" that a more coordinated approach was needed to enhance and support the initiatives already being undertaken in the environmental education field and to provide a clear set of priorities for action. One initiative that stemmed from this strategy was the development of a directory of environmental education resources and associated website.[10]

One participant in this investigation said that sustainability education initiatives in New Zealand are still fragmented and lacking strategic direction. One suggestion is to adapt a model from the city of Curitiba in Brazil where a central advisory group, funded from a variety of sources, has the task of coordinating and delivering sustainability education resources.

Implementing education for sustainability

Some proponents of sustainability education believe that teaching children is essential, so that sustainable development is something that becomes as natural to them as reading and writing. Some educators feel that to be effective this teaching must be done before the age of sixteen (OECD, 1995).

The national guidelines for implementing environmental education in the New Zealand school curriculum were published in 1999 (Ministry of Education, 1999). This document provides steps for planning environmental education programmes, within the national curriculum statements. Implementation of environmental education in New Zealand schools is voluntary, with the onus being on boards of

trustees to decide how it will be implemented in individual schools. It is therefore often left up to enthusiastic individuals, a situation that also occurs overseas (OECD, 1995, 2001a).

A recent national initiative is the 'Enviroschools Programme' which has grown out of a project started in Hamilton in 1993, a partnership between Hamilton City Council, the Community Environmental Programme and Hamilton schools. The programme aims to integrate environmental education into school life. Schools develop their own plans based on local and regional issues. These include developing an environmental vision, supporting staff development, creating a strategic plan for the whole school. Students are included in environmental project planning and implementation and document their experiences.

There has been strong interest nationwide in the programme, with approximately 30 schools in the central and upper North Island implementing it. Links are being strengthened between the programme and other agencies providing environmental education programmes, including government Ministries and local bodies. However, there is a need for an advisory group to be established for the project, along with a national environmental education advisory group that would consist of representatives of key agencies and Ministries (Heidi Mardon, EnviroSchools Update April 2002, pers. comm., 8/4/02).

However, formal schooling is only one aspect of education for sustainability. If we left sustainability education only for those children at school, progress towards sustainable development would likely continue to be slow until today's students are in the position to be agents of change. A multi-faceted approach is therefore needed to target all ages and sectors. Informal and formal, lifelong education is crucial for improving public and corporate understanding of sustainability issues (OECD, 2001a).

Local authorities have taken a lead role in implementing sustainability education in New Zealand, driven partly by increased public awareness of environmental issues and requirements under the Resource Management Act 1991. Environment Bay of Plenty, for example, states that environmental education is the "principle non regulatory means by which Environment BOP implements its policies to achieve its environmental objectives".[11]

A survey of the websites of all eleven regional councils showed that nine of those councils have a section on environmental education on their sites. While the majority focus on school education, Environment Waikato also covers industry and business, farmers, landcare and beach groups.[12] One of this study's participants believed that Environment Waikato's strong education programme has had definite impact on community awareness and behaviour change in the region.

Waitakere City also has a broad education focus. Their website has sections for adult education, schools, waste minimisation and cleaner production, and a variety of 'how to' guides for the community covering such topics as water and wastewater, erosion control and streamside planting.[13] Auckland Regional Council has recently initiated a community education programme for households.

The business community is also a key player as both a recipient and provider of education for sustainability. The Massey University (2001) corporate environmental responsiveness survey suggests that while the 'heavy industry' business sectors have an understanding of their impact on the environment, others such as the insurance industry show less awareness that sustainable development applies to them. This study also identified the need for sustainable development education for all staff and management to empower employees and contribute environmental (and sustainability) values into the organisation's culture.

3.3 Trends

As we look toward the future, environmental issues are likely to continue to become increasingly complex. The long-term nature of many environmental problems will become more apparent, as evidence grows of the accumulation of pollutants in ecosystems and of the gradual degradation of renewable resource stocks and qualities. The role of these ecosystems in underpinning economic and social activity will become clearer as will the need to examine the impacts of economic activities on ecosystems. Environmental 'science' will therefore take on a greater importance. On the other hand, the ability of science to deliver credible solutions to these problems is also likely to be called into question more often, and debates about the need for 'precaution' in dealing with environmental matters will probably intensify.

We can also anticipate that decisions concerning environmental policy will increasingly have to be integrated with social and economic policy decisions in a sustainable development context. Two key messages will in particular need to be delivered to economic and social policy makers. The first is the idea that the environment is a vital base upon which all economic and social activity ultimately depends. If this base is jeopardised, then these 'derivative activities' will also be jeopardised. Second, it is no longer possible to completely separate economic and social policies from environmental needs, as if 'someone else' were looking after the environment. In order to achieve full 'policy integration', policy makers in the economic and social spheres will have to accept more environmental responsibilities (and vice versa). (OECD, 2001a:29).

This section discusses both trends in the environment affecting the implementation of sustainable development and trends in the implementation of sustainable development itself. Some of these trends are global and some are more New Zealand specific. These are trends that are going to challenge New Zealand's future environmental sustainability and include globalisation, building sustainable cities, managing the links between human and ecological health, managing freshwater resources and coping with climate change. A general difficulty with assessing trends in New Zealand is the lack of indicators and accumulated data over a meaningful timeframe with which to establish trends. This is particularly so in environmental management and outcomes, affecting the implementation of sustainable development. It is not necessarily that the data does not exist, but that it has not been compiled in a readily accessible form or one which measures, in an integrated way, progress towards sustainability.

3.3.1 Globalisation

Globalisation can be defined as "a process in which economic markets, technologies, and communications gradually come to exhibit more 'global' characteristics and less 'national' or 'local' ones" (OECD, 2001a:47). Liberalisation of international trade regimes, financial market deregulation, intensified competition, as well as rapid technological changes, particularly in information, communication and transportation technologies, are the main drivers of this process (OECD, 2001a). New Zealand is amongst the Top 20 global nations according to the A T Kearney/ Foreign Policy magazine Globalisation Index (A T Kearney Inc and Foreign Policy, 2002).

Contemporary globalisation is typified by the diminishing costs of trading products, investing capital, and employing production inputs, whether sourced in local or international markets. Huge declines in transport and communications costs, convergence towards common global institutional forms, and the knowledge economy with its new organisational forms and infrastructures all help create globalisation (Statistics New Zealand, 2000a). However, as Nobel laureate and former World Bank Chief economist Joseph Stiglitz recently observed, "a borderless world through which goods and services flow is

The Global Responsibility Investment Fund

Tower Managed Funds is promoting a scheme to encourage investment in more socially and environmentally responsible companies. The Global Responsibility Investment Fund has been developed as a response to increasing demands from people who want their investments decisions to reflect their personal values and concerns.

The Fund invests in publicly listed companies around the world that are selected according to environmental, social and financial criteria. In the environmental area, the emphasis is placed on eco-efficiency indicators to determine a company's performance. These indicators are linked to savings in the areas of climate change emissions, ozone depletion, materials usage, toxic releases and energy and water usage. Companies are also assessed according to the quality of their environmental management systems and the nature and impacts of the products they produce.

In the social sphere, an analysis is undertaken to establish a company's performance against a set of human rights criteria. These include a consideration of an organisation's labour relations policies, the procedures and systems they have in place, and monitoring and reporting initiatives.

Based on these analyses, businesses can only be selected for the fund if they rate in the top 30% of companies and if they are expected to perform well financially. Businesses that are selected are also expected to produce strong returns, based on assumptions that:

- Companies that use resources most efficiently tend to have better returns.
- Companies that have undertaken measures to reduce their environmental risks have lower financial risks.
- Companies that perform well against human rights criteria tend to have lower costs and face a lower risk of damage to their reputations.

The international insurance group managing the fund, Storebrand Kapitalförvaltning, believes that companies will be placed under increasing pressures in the future to minimise their adverse social environmental and impacts. As such, those businesses that can demonstrate better performance in these areas are also likely to become more attractive to investors as they produce higher returns.

See http://www.towerfunds.co.nz

also a borderless world through which other things can flow that are less positive" (A T Kearney Inc and Foreign Policy, 2002). The World has seen that recently through the September 11 attack on the World Trade Towers. New Zealand has seen it through the arrival of a variety of plant and insect pests such as mosquitoes potentially carrying the Ross River virus and other diseases. Globalisation involves a dense web of cross-border relationships ranging from the very obvious (the spread of disease) to the very subtle (the spread of ideas).

An outcome of globalisation can be the undercutting of national policies required to address domestic social (for example, equity or unemployment) and environmental issues (Kibert, 1999). Existing international trade exerts influence on national and local community decision making. That influence has the potential to override local sustainable development initiatives. For example, New Zealand may be forced to accept international environmental standards that are lower than domestic environmental standards.

As global issues in trade, resource management and security require governments to take an international perspective, government has more global commonalities, with treaties and alliances, and trends towards national identity being subsumed in larger regional economic identities. Global organisations operate in far wider financial, capital and labour markets with consequences such as looser structures and more product and activity flexibility. While import penetration has risen, consequences of globalisation are not uniformly positive. They can bring to individual regions less local integration, collaboration and employment, as well as less local absorption of change (Statistics New Zealand, 2000a).

3.3.2 Sustainable urban communities

A key challenge for the 21st century will be seeking ways in which we can make our cities and urban areas more sustainable. The majority of New Zealanders live in cities. Cities are major centres of production, consumption, energy and water use and waste production. Sustainable urban

Earthsong Eco-Neighbourhood

The Earthsong Eco-Neighbourhood is an urban housing development being constructed in Waitakere City. It is being managed by a group of current and prospective residents in the estate who have formed a non-profit trust.

The development is being modelled on the principles of permaculture and cohousing. The main aim of permaculture is to create living systems without producing waste. Cohousing is a form of cooperative housing that aims to combine the autonomy of private dwellings with the advantages of community living. Combining these elements, the vision of the project is to create a model of socially and environmentally sustainable urban living.

The development incorporates 'green' architecture principles with buildings oriented towards the sun and designed to maximise energy efficiency. Environmental considerations determine the selection of building materials and components according to their energy content, toxicity, durability and capacity to be recycled. Rainwater is collected for household and garden use and on-site stormwater and wastewater treatment facilities are being developed. Renewable energy technologies such as solar water heaters are also being used.

The physical design of the development aims to encourage a strong sense of community that is balanced with the needs of individuals. For example, a variety of different dwellings are clustered around common paths and courtyards and cars are confined to the edge of the site. A common house provides many shared amenities.

It is envisaged that residents will be able to achieve considerable cost savings while living in the neighbourhood. In part, this can be attributed to the energy and waste efficiency initiatives. In addition, co-ownership of some facilities and tools is being encouraged to reduce consumption costs. Spaces are set aside for growing food. Meanwhile, the project is situated in a central location to support participation in an urban workforce.

A key aspect of the development is the use of consensus-seeking decision making among prospective residents. Early progress was marred by a high turnover of people involved in the project and disputes over the processes required for reaching consensus. Nonetheless, the development of new processes, combined with the commitment of many individuals, ensured that the first tenants were able to move into their homes in January 2002.
See http://www.ecohousing.pl.net/

development involves improving the efficiency of resource use, reducing waste and addressing environmental, economic and social issues in an integrated way (PCE, 1998a).

Despite the highly urbanised nature of our society, as previous PCE reports show, there has been little guidance, research and information assistance for local government from central government on these issues. One significant shortcoming is the absence of an institution with a focus on carrying out research into urban environmental issues (refer appendix 2 section A2.2.9 and A2.5.1). One consequence of central government restructuring has been a loss of national data sets for processing information about people and their environments in urban areas. Consequently, data sets tend to be incomplete, inconsistent and short-run which means that information on the urban environment is fragmented and partial (PCE, 1998a). There is no national agency that can undertake research and provide information on urban sustainability issues to local government.

There is no output class for urban research in the Public Good Science Fund and no urban research funding strategy. However, a FRST review of funding for sustainability currently underway includes 'Sustainable Cities and Settlements' as a component (see section 4.1.6).

Key issues for urban sustainability that need to be addressed are:

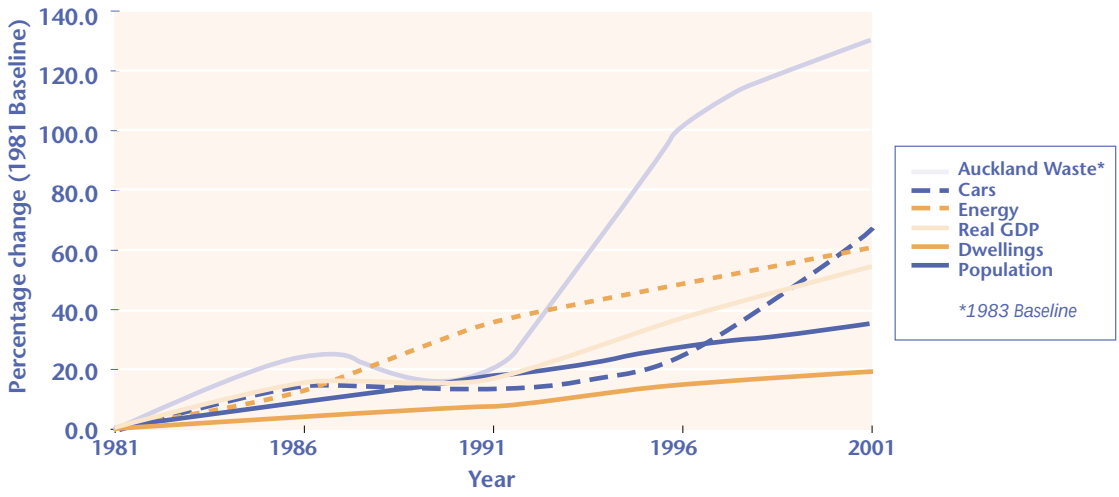
- sustainable urban development based on Agenda 21 principles
- urban growth and development
- transport management
- urban air quality
- climate change
- liveability
- reducing resource inputs
- reducing waste outputs (PCE, 1998a).

New Zealanders have made few gains in terms of resource use efficiencies or reducing their impacts on the urban environment (see table 3.1).

Table 3.1: National Parameters

National Parameters	Percentage Change from 1980 to 1996 (PCE, 1998a)	Percentage Change from 1981 to 2001
GDP	37% increase	54.7% increase[14]
Total consumer energy use	44% increase	60.8% increase[15]
Area of urban land	78% increase	– [16]
Number of dwellings	28% increase	35.2% increase
Number of cars	31% increase	66.9% increase
Solid waste disposal (Auckland Region only)	95% increase	130.5% increase[17]
Population	15.5% increase	18.9% increase

Figure 3.3 Percentage Change in National Parameters 1981 - 2001



Source: Environment Waikato (2002)

The parameters, first noted in 1998, have been updated for the purposes of this investigation and show the trends continue to move towards increasing unsustainability (see also figure 3.3).[18]

Decoupling quality of life from increasing resource consumption and waste production is a significant challenge for New Zealand. Critical to future urban sustainability will be greatly enhancing the role of community and participatory democracy.

3.3.3 Human health and the environment

The links between development, environment and health received a significant amount of attention in Agenda 21. The impacts of environmental risk factors on health are extremely varied and complex in both severity and clinical significance. The impacts on human health from degradation of the environment affect society not only in terms of loss of quality of life, but also in terms of expenditure on health care, loss of productivity and loss of income (OECD, 2001a). Many of the key determinants of health and disease - as well as the solutions - lie outside the direct control of the health sector, in sectors concerned with environment, water and sanitation, agriculture, employment, urban and rural livelihoods, trade,

tourism, energy and housing. Nevertheless, the health sector has an important role as advocate and guide for healthy environments and lifestyles. Addressing the underlying determinants of health is key to ensuring sustained health improvements (UNESC, 2002).

Health Effects of Motor Vehicle Pollution

A recent preliminary study to quantify health effects due to air pollution from motor vehicles in New Zealand (Fisher et al., 2002) provided a 'best estimate' of those effects based on available information. The study found that the most likely estimate of the number of people above 30 years of age who experience pre-mature mortality in New Zealand due to exposure to emissions of PM10 particulates[19] from vehicles is 399 per year. This compares with 970 people above age 30 experiencing pre-mature mortality due to particulate pollution from all sources (including burning for home heating), and with 502 people dying from road accidents (all ages). Most of the increased mortality due to vehicle emissions (253 people, or 64% of the total) occurs in the greater Auckland region.

The results of this study were found to be consistent with other studies, which show that mortality due to vehicle related air pollution is of the order of twice the accident road toll.

The Burden of Asthma in New Zealand

A study carried out for the Asthma and Respiratory Foundation of New Zealand (Holt and Beasley, 2001) identified asthma as a major public health problem in New Zealand, with about 15% to 20% of children and adults having asthma. These prevalence rates are among the highest in the world, particularly in Maori and Pacific Island adults. The economic costs of asthma have been estimated to be around $825 million per year in the late 1990s. Of concern is the incomplete understanding of the underlying causative factors that are responsible for the trend of increasing prevalence in New Zealand and other countries.

In a separate (ten year) study for the California Environmental Protection Agency's Air Resources Board,[20] researchers produced the strongest evidence to date that ozone, commonly referred to as 'smog',[21] can cause asthma in children. Previous evidence has shown that ozone can aggravate existing cases of asthma, but the new study pointed strongly to ozone as a cause in the development of asthma in young people who did not previously have the disease.

In a New Zealand context, good health is recognised as a critical component of well-being. Improved health, both mental and physical, is an important aspect of reducing social exclusion. Poor health can restrict people's ability to take part fully in society, including their ability to work, to engage in and succeed at education, and to enjoy leisure and recreation activities (Ministry of Social Policy, 2001).

Urbanisation can lead to health problems from poor living conditions and inadequate access to basic necessities of life. There is no doubting the health benefits of environmental factors associated with good air quality; safe, secure and quality housing; safe drinking water; access to open space; and safe management of chemicals and hazardous substances (PCE, 1998a). Pollution and environmental degradation are directly connectable with ill health that would otherwise be preventable (Worldwatch Institute, 2002). Climate change is extending the range of mosquitos spreading malaria and other vector-borne diseases. Warmer temperatures increase the incidence of algal blooms affecting bathing water quality and marine life.

Corvalan et al. (1999) refer to two types of environmental health threats:

- *Traditional hazards* related to poverty and insufficient development (e.g. lack of access to safe drinking water and inadequate basic sanitation in the household or the community giving rise to disease).
- *Modern hazards* related to rapid development that lacks health and environmental safeguards and to unsustainable consumption of natural resources, the health effects of which may not manifest themselves until some years later.

Waitakere City eco-hospital

Waitakere City Council is working with Waitemata Health on the development of an 'eco-hospital' in their area. Environmental principles are being incorporated into the design, construction and operation of the new hospital.

The initial designs for the buildings were developed according to the assumption that it is easier and cheaper to plan for environmental factors from the outset, rather than retrofitting later on. Windows are being positioned to catch the light and heat from the sun, while the walls, floors and ceilings are being insulation to reduce energy consumption. Gardens, plants and rocks act as natural filters to direct and control stormwater.

Natural materials are being selected to reduce the presence of toxic fumes and timber has been chosen from sustainable plantation sources. To reduce stormwater problems, the tar sealing of car parks is also being limited. Meanwhile, the Council is working with community groups to replant the grounds with native vegetation to provide a habitat for local species.

After construction is complete, a variety of additional design features will be fitted to reduce water and energy consumption. Rain water will be harvested to be used in toilets and for irrigation and, where there is no health risk, grey water (i.e. that has already been used for purposes such as showering) will be collected and redistributed. Local art works are also being commissioned to make the hospital environment less 'sterile' and gardens and courtyards are being developed to provide patients and visitors with easy access to fresh air and sunshine.

Over time, it is anticipated that the new buildings will achieve significant cost savings on power, water and wastewater. Nonetheless, one of the biggest challenges that the advocates of the hospital have faced is convincing people that these benefits will require a reasonably large investment up-front. Although it has been difficult to work around budgetary constraints, the new hospital is scheduled to open in 2004.

See http://www.waitakere.govt.nz/AbtCit/ec/ecoinit/hospital.asp

3.3.4 Land Use and Systems Changes

Given that our comparative advantage as a trading nation continues to be strongly influenced by farm-based products (see section 3.1.1), trends and changes in land use and production systems are fundamental to the sustainable development of New Zealand.

Current land use in New Zealand is shown in figure 3.4. Agricultural land use is further broken down in table 3.2. The Government reforms of the 1980s and 1990s, coupled with world commodity trading trends, have resulted in some marked changes in pastoral land uses - the most notable being the decline in sheep numbers from 70 million in June 1982 to 45.2 million by June 1999. By contrast, beef cattle numbers have fluctuated modestly in the past twenty years totalling 4.6 million in June 1999. Dairy livestock have increased to an estimated 4.5 million in 2000 (from 3 million in 1982) and the numbers are still rising.

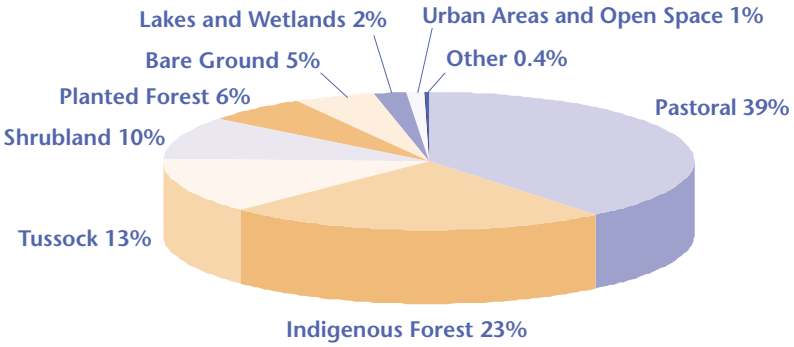
The major trend in agricultural land use is towards intensification and specialisation, with the notable exception of the reversion of marginal hill grazing lands to native vegetation regrowth. The agricultural growth sectors are dairying, deer, horticulture (including viticulture), vegetables, and organic systems. The trend is to higher material input systems (with the exception of organics).

Dairy farming

While more land is being converted to dairying, particularly in Southland and Canterbury, often involving large scale irrigation, there is also a nationwide increase in intensity; i.e. cows per hectare (see table 3.3). The most intractable problem for dairying in New Zealand is the difficulty in managing non-point pollution, a product of stocking rates, soil types and increased fertiliser inputs. The key impacts from live stock intensification on the environment and hence for sustainability are:

- decreased water quality through contamination by nutrient leaching and biological contamination
- loss of wetlands and fisheries
- erosion and sedimentation loadings in streams and rivers.

Figure 3.4 Land Cover as at 1996/97.



Source: Land Cover Database 1. Chart compiled by Policy Information Group, Ministry of Agriculture and Forestry. "Other" includes all land cover classes, which are not shown separately in the chart. A further breakdown of pastoral land cover shows dairy cattle farming comprises 7.6% and horticultural land use comprises 0.2%.

Table 3.2: Area of Farm Land

	1990	2000	2010	% change 2000-2010
Viticulture	5,800	13,300	24,000	+81%
Deer	79,000	170,000	320,000	+88%
Dairying	1,050,800	1,640,400	1,906,000	+16%
Forestry	1,305,000	1,747,100	1,997,100	+14%
Horticulture	82,400	102,800	110,900	+8%
Other pastoral	12,285,200	10,563,800	9,901,000	-6%
Arable	316,000	208,500	186,800	-10%

Source: MAF (2002a)

Table 3.3: Growth in Dairy Industry 1990-2000

	1990	2000	Change
Area (x1000 ha)	980	1290	+31%
Cow numbers (x1000)	2310	3270	+41%
Cows per hectare	2.4	2.7	+13%
Milk solids (x10^6 kg)	550	970	+77%

Source: Livestock Improvement Corporation (1989/90; 1999/2000)

Recent research on E. coli levels and distribution in the Waikato region shows that the pattern of contamination is dominated by non-point discharges. The highest median E. coli concentrations are associated with the most intensive dairy farming in the centre of the region (Collins et al., 2002). Conversely the lowest median E. coli concentrations are found in forested catchments indicating there is some (but minor) contamination by wild animals (Collins et al., 2002).

Two key factors correlate closely with increased E. coli contamination:

- the percentage of poorly drained soils within a catchment
- the density of dairy cows.

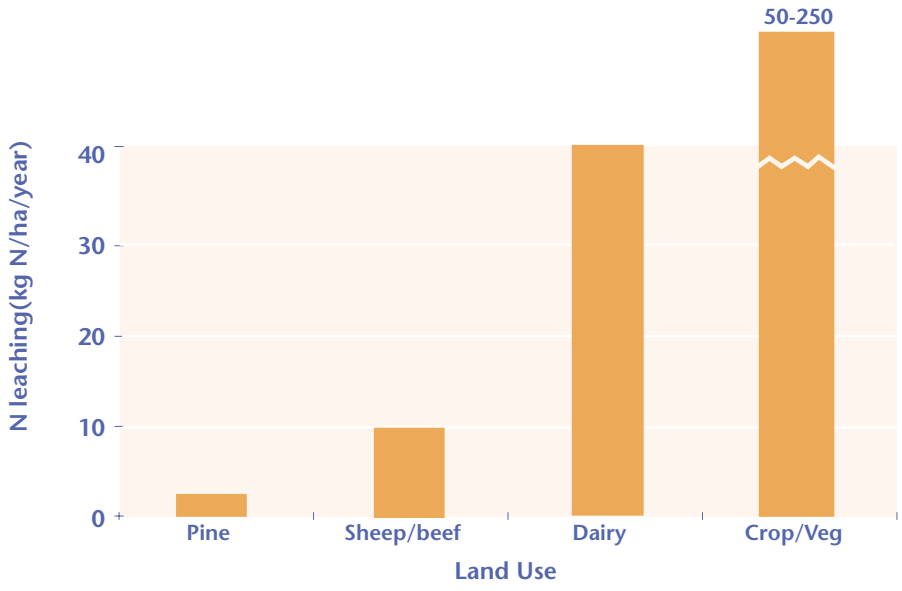
A third factor, the median turbidity at the catchment outlet, is a good surrogate for the E. coli contamination (Collins et al., 2002).

Current contamination levels of surface and groundwater in major dairying areas are resulting in increasingly severe degradation of rivers in these areas. This is of increasing concern to New Zealand communities. It is also recognised as a potential risk to the positioning of New Zealand dairy products in international markets as livestock densities decline in some key markets and the environmental management expectations of consumers rise (Rae and Strutt, 2001). Key mitigation measures are likely to include fencing riparian areas and protection and enhancement of wetlands. Research indicates that wetlands may work to attenuate faecal contamination (Collins et al., 2002).

Nutrient losses

Intensification is leading to increased use of nutrients, particularly nitrogenous fertilisers, with consequential losses from the pasture systems. These losses are highest from intensive cropping but dairy losses are also high. They are much more significant for sustainability overall because of the extensive and increasing area devoted to dairy farming (see figure 3.4).[22] Nitrogen inputs into dairy farms now average about 80kg/ha/year nationally (but often exceed 200kg/ha/yr), up from about 30kg/ha/year in 1990. As a result, it takes about three units of energy input to produce a calorie of milk protein energy output (Wells, 1998). The long-term sustainability of this is questionable given the dependence it places on petroleum products.

Figure 3.5 Loss of Nitrogen from Rural Land Uses



Source: Environment Waikato (2001)

Other land uses and impacts

Other land uses that have increased significantly in recent years are planted production forests and urban areas (see section 3.3.2 for a discussion on urban areas). New Zealand currently has 1.8 million hectares of planted production forests. Those forests are dominated by one species Pinus radiata (90%). Over 60% of them are young forests, 15 years or less. Major forest growing areas are the central North Island, Northland, East

Coast, Hawkes Bay, Nelson and Marlborough, Otago and Southland. The planted forest area is expanding. The average annual area of new planting for 1995 to 1999 was 62,000 hectares. Harvest volumes will increase significantly in the future from 18.0 million m^3 to a forecasted 34.6 million m^3 in 2020 and 52.5 million m^3 in 2040 (MAF, 2002b).

Other impacts from land use, which will influence the long-term ecological sustainability of New Zealand, include erosion, loss of carbon and organic matter, compaction and loss of soil structure, acidification and chemical contamination. Currently 68% of land in New Zealand is considered susceptible to erosion (MFE, 1997).

The most significant impact for arable soils is loss of carbon and acidification. The biggest carbon losses have been recorded in South Auckland market gardens and Waikato croplands (MFE, 1997:8.57). Pastoral systems have less impact on the carbon balance because of return via animal faeces. Acidification of soils is a product of increased N levels and nitrate production. Current levels of lime application are only 50% of that needed to counteract acidification. The result is a reduction in the survival of clovers and thus the sustainability of most New Zealand pastoral systems.

Chemical contamination of lands has increasingly become an issue as the long-term consequences of some agrochemicals (particularly organochlorine pesticides) have become apparent. The extent of some contaminants such as DDT is well known and strategies to mitigate its affects well developed. However, for others, such as those associated with the treatment of sheep for lice, the extent of contamination is not yet known. Initiatives are currently underway to better quantify such sites and establish their environmental risks.

The key trend towards intensification of agricultural land use clearly poses a significant challenge for sustainable development in New Zealand. It is becoming increasingly clear that the range of environmental impacts arising from it are compromising the quality of our environment and threatening our clean, green image overseas.

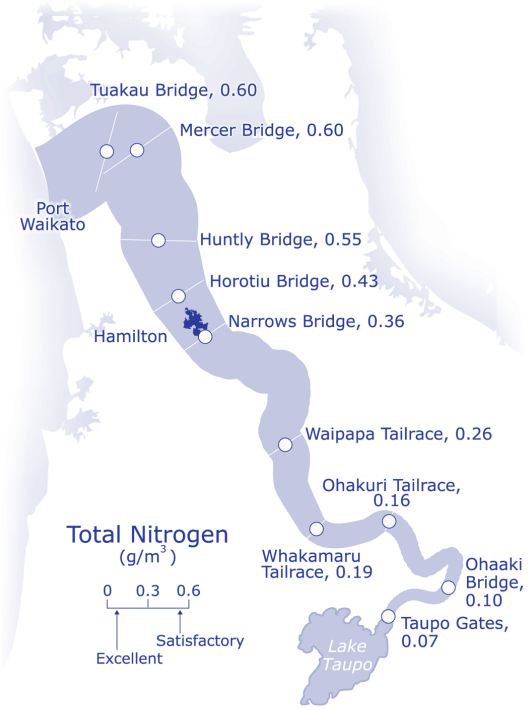
The Waikato River Water Quality Story

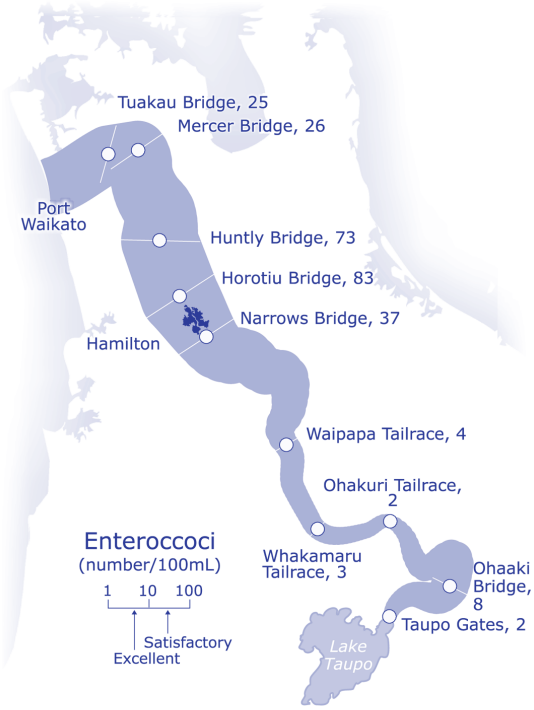
The Waikato River is the Waikato region's longest and most significant river. It stretches 425 km from its source in the Tongariro National Park to Port Waikato on the west coast of the North Island. As with many rivers its size it is a resource with multiple uses, subject to many pressures, and valued in many ways.

The Waikato River is a tupuna (ancestor), a taonga and a life force of Tainui Waka and Ngati Tuwharetoa. The river is deeply embedded in the tribal consciousness through generations of living close to the river. For local tribes it provided for spiritual and material needs - sustenance, a source of cleansing and healing, and a network for trade, travel and communication. The tribes of the Waikato River have long been aware that their tupuna is ill, with a reduction in water quality and food stocks, diseased shellfish and illness among the people. Over the years a disregard for the life giving capacity of the river has meant that its kaha (strength) has diminished.

The clearance of land for agriculture, forestry, industrial development and urbanisation near the river in the mid 19th to mid 20th century means that the pristine quality of water near its source diminishes progressively along the length of the river. In the 1950s, water quality was found to be very poor, with 'indicator' bacteria measured to be 20-170 times higher than a 'desirable limit for swimming'. Inadequate treatment of many sewage and industrial wastewaters discharged into the river was identified as the main cause.

Current monitoring by Environment Waikato shows that water quality has improved substantially since the 1950s. The main improvements have come from better treatment of effluent from urban and industrial processes. Despite these improvements water quality continues to diminish progressively downstream. Major 'point sources' are estimated to contribute up to 10% and 15% of the total load of bacteria





Source: Environment Waikato (2002)

and nitrogen, respectively, in the lower Waikato River (Vant et al., 2000). The remainder is derived from 'non point sources' such as leaching and runoff from agricultural and urban areas.

The following diagrams illustrate the levels of nitrogen and bacteria in the Waikato River. They are based on data collected by Environment Waikato between 1996-2000. The worm-like bands follow the course of the river and their width represents the levels of contaminants. Thus, the wider each worm is, the poorer the water quality.

Ideally, total nitrogen levels in water should be less than 0.5 grams per cubic meter and high levels in water can be a result of both wastewater and agricultural runoff. Environment Waikato considers that rivers and streams with total nitrogen levels above 0.5 grams per cubic meter are nutrient-enriched. This excess of nutrients promotes algal blooms and the growth of nuisance plants that can choke waterways and out-compete native species. Similarly, water quality levels of enterococci bacteria (an indicator of health risk) in the lower river have often been recorded at levels that are not good enough for swimming.

The challenge ahead is to continue to improve water quality in the Waikato River by managing 'non point sources' of contamination. Farming is probably the main non-point source of contaminants to the river. Around 75% of the non-point source nitrogen is estimated to come from pasture - mostly from cow urine which leaches into ground water and eventually flows into the river. The dairy cattle in the Waikato region excrete about 90 times more nitrogen each year than does the human population.

Scientists estimate that the waste generated by the 3,000 dairy herds in the Waikato River catchment is equal to the waste from about five million people or nearly 50 cities the size of Hamilton. Increasing herd sizes are likely to result in higher amounts of nutrients and bacteria entering waterways through runoff and leaching. Environment Waikato has recently undertaken initiatives to manage non point farming sources, such as encouraging fencing and planting in riparian areas and working with industry to improve on-farm nutrient management.

Source: Environment Waikato (1998)

3.3.5 Freshwater Resources

Freshwater resources are essential for human health, economic productivity, and social development. Freshwater is a recyclable but finite resource: with careful use and treatment, it can be managed in a sustainable manner. It is currently abundant on a global scale, but scarce in a number of countries or regions. While the water resources of the Earth are constantly recycled by the hydrological cycle,

> *available freshwater resources for human or environmental use are declining as many water bodies become contaminated with pollutants. As a result, local and regional incidences of water scarcity are likely to increase over the coming decades* (OECD, 2001a:97).
>
> *The only globally competitive advantage New Zealand has is freshwater* (Sir Tipene O'Regan, interview November 2001).

In New Zealand we think of ourselves as being water-rich. On a national scale we are water-rich, with some areas of very high rainfall and extensive groundwater reserves. But often water is not super-abundant in our urban areas; shifts in rainfall patterns indicate greater variability of supply in the future, alongside trends in rising demands per capita. The outlook is for rising stresses on our supply and delivery systems, and pressures on treatment capacity (PCE, 2001a).

A PCE investigation into the management of urban water systems (PCE, 2001a) indicates that there are a number of key challenges common to all towns and cities. They include environmental, social and economic dimensions but many of the underlying causes are interrelated and overlapping. One of the biggest challenges will be reaching consensus between the various stakeholders on the environmental, social and economic goals and values of urban water systems. Without much more extensive community and cultural input, and greater understanding of water management options, improving the sustainability of current systems will be very difficult and painfully slow.

Other major challenges include:

- inadequate water flows from excessive and inefficient water use
- contamination of surface waters and groundwater from uncontrolled or poorly managed stormwater drainage and wastewater disposal
- the increasing expectations of consumers and ratepayers about the provision and quality of water services. However, there is often a negative reaction to large rate increases or increased charges to fund required infrastructure
- a lack of awareness and understanding of the value of urban water systems and the costs of improving water supplies, and wastewater and stormwater management
- poor recreational and bathing water quality, and poor information disclosure
- lack of investment and deferred maintenance, in part through incomplete pricing and inadequate financial contributions from new urban development
- institutional and regulatory barriers to improved management
- potential risk of infrastructure failure and resulting economic, health and environmental impacts (PCE, 2001a:5).

As outlined in section 3.3.4, in rural areas, agriculture imposes the greatest pressure on freshwater through vegetation clearance, land drainage and channelling, draw-off for irrigation and stock watering, and run-off and waste water discharges from farms and agricultural processing facilities. There are also pressures from dams, forestry, mining, introduced pests and weeds and potential impacts from climate change (MFE, 1997).

3.3.6 Air quality

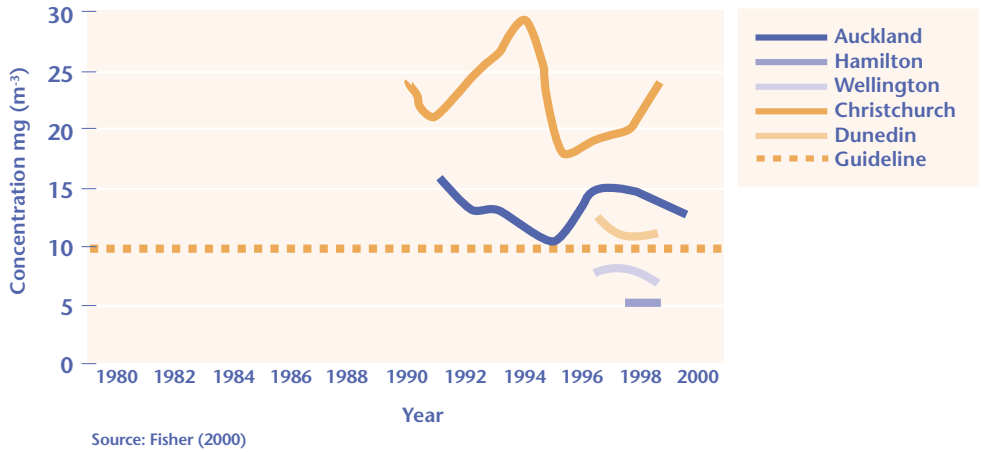
Air is one of the fundamental life sustaining elements. We have no choice but to breathe the air that surrounds us, irrespective of its quality. The state of air quality is, therefore, a key determinant of the health of people and the quality of the environment, and a significant indicator of sustainability.

Air quality in New Zealand is generally very good at many places, for much of the time. It is mainly influenced by geographical location, population density, industry, transport and domestic fuel composition and use, and seasons. Consequently, New Zealand's air quality issues vary in nature, time of year, and scale, but are primarily associated with urban areas.

Trends in air quality over the past 20 years indicates that air quality in New Zealand is getting better in some respects, but worse in others. Fisher (2000) points out that effects due to industrial emissions are decreasing, as the use of 'dirty' fuels (e.g. high sulphur fuel oils and coal) and old practices are phased out. However, some effects are getting worse as the population and vehicle fleet grows, particularly in urban areas.[23] In summary, the following are the key trends in peak contaminant concentrations relative to New Zealand's air quality guidelines (MFE, 2002c).

Getting worse

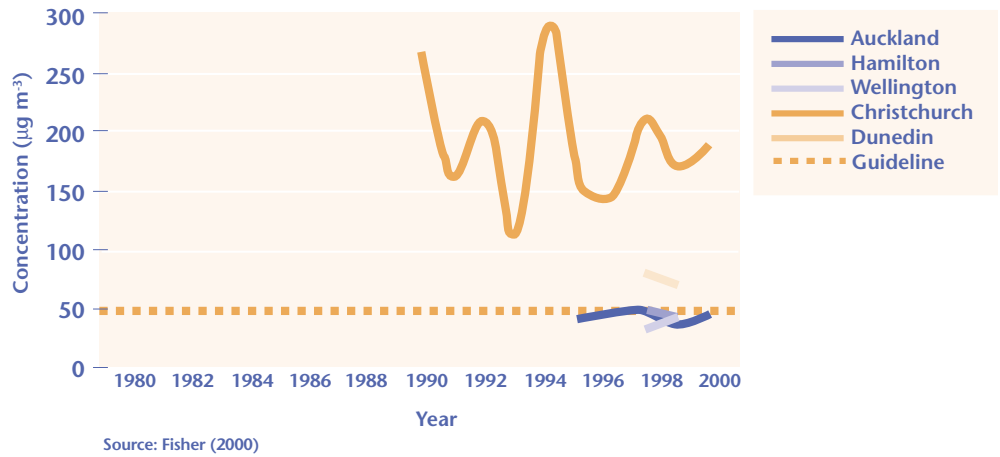
Figure 3.6 Peak Carbon Monoxide (8 Hours)



Source: Fisher (2000)

- Carbon monoxide (CO) concentrations in major cities, especially on or near busy roads, are increasing to levels which exceed guideline values. In Auckland, CO concentrations are higher than those in London and other larger cities. As older vehicles are replaced with newer more efficient ones CO concentrations should begin to decrease, but increasing congestion may affect this decline.

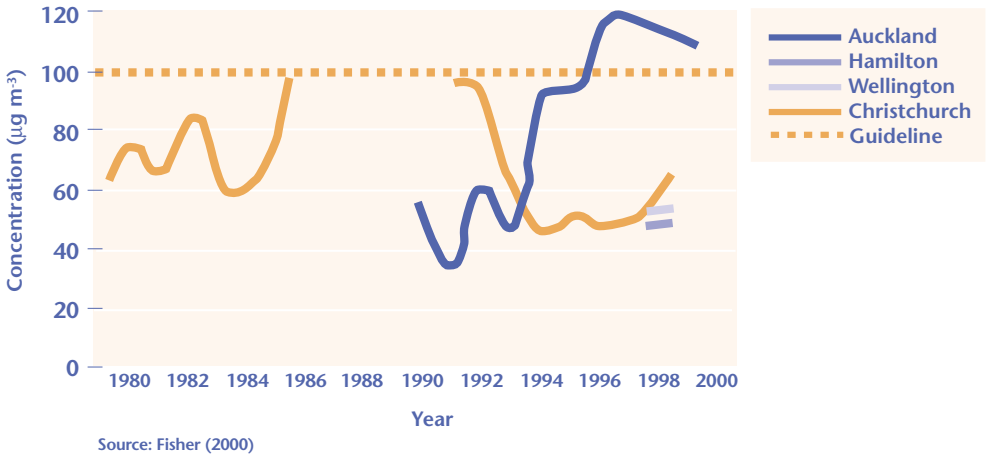
Figure 3.7 Peak PM_{10} (24 Hours)



Source: Fisher (2000)

- Inhalable particles (PM_{10}) [24] are of growing concern because of evidence of health effects at relatively low concentrations. The major sources are motor vehicles and domestic fires. Concentrations pf PM_{10} in some towns, such as Christchurch, have been reducing since the 1970s, but they are still high enough to cause adverse effects on people's health and further improvements are required.[25] Recent monitoring in several smaller towns, such as Nelson, has also found high PM10 concentrations caused mainly by home heating fires used in winter.

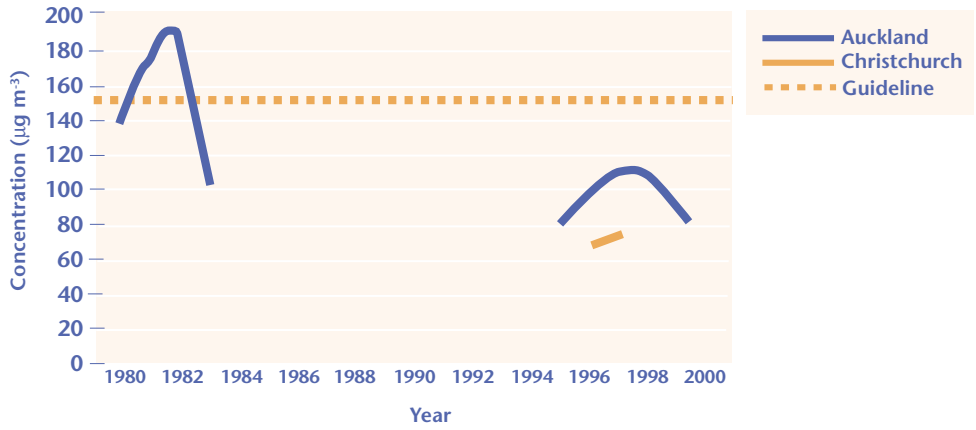
Figure 3.8 Peak Nitrogen Dioxide (24 Hours)



Source: Fisher (2000)

- Nitrogen dioxide concentrations, mainly from vehicle emissions, are increasing in many areas, especially in Auckland where they can exceed guidelines.

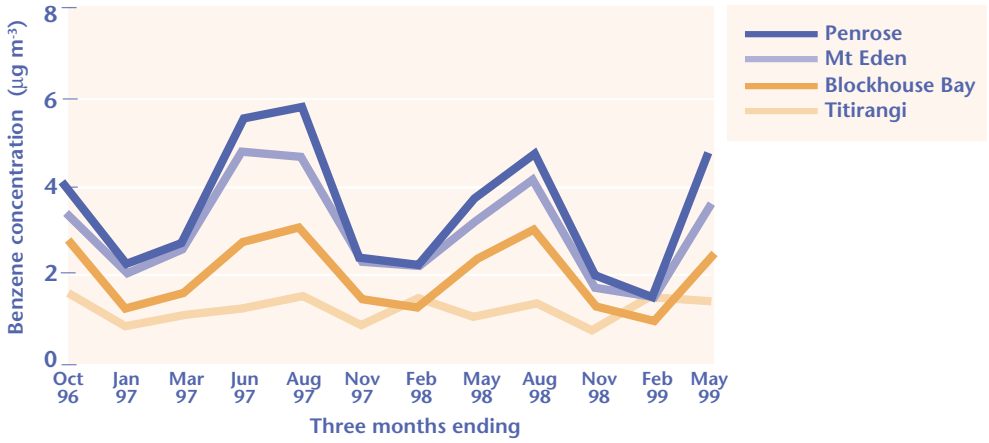
Figure 3.9 Peak Ozone (1 Hour)



Source: Fisher (2000)

- Photochemical 'smog', indicated by ozone concentrations is not as significant as in many other countries, but could get worse in cities like Auckland where precursor conditions (e.g. high hydrocarbon emissions and sunlight) increase.

Figure 3.10 Auckland Outdoor Residential Sites

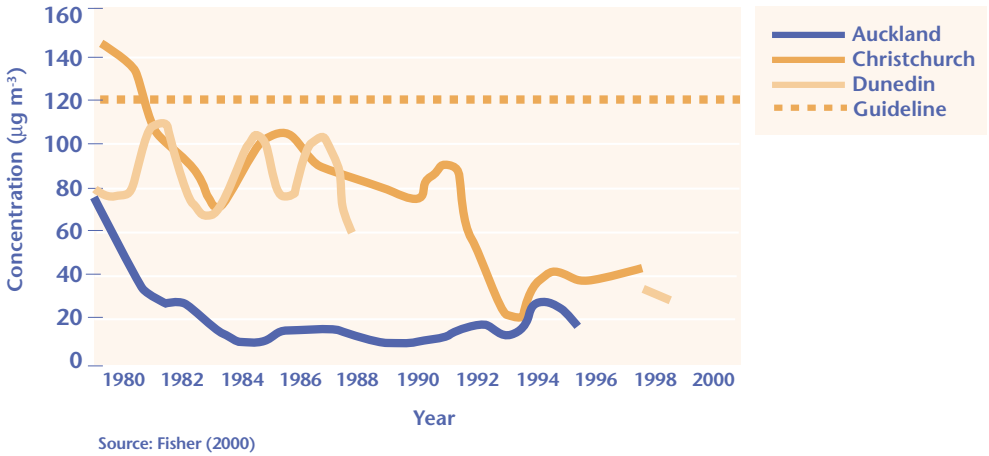


Source: Stevenson and Narsey (1999)

- New Zealand has a high level of benzene in petrol (5% by mass), resulting in higher than acceptable concentrations in air. Benzene concentrations in Auckland air regularly exceed the proposed new guideline of 3.6 microgrammes per cubic metre (annual average). Benzene levels should decline over the next few years as the amount of benzene in petrol is reduced in accordance with new fuel specifications.

Getting better

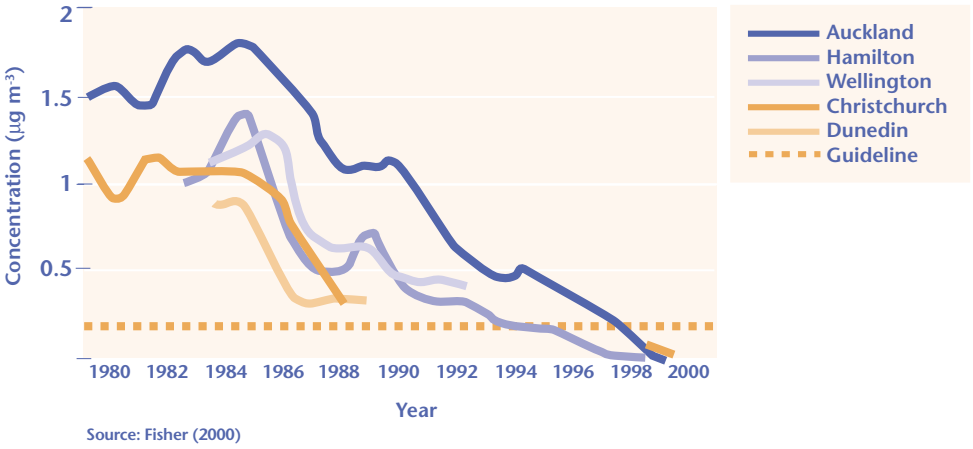
Figure 3.11 Peak Sulphur Dioxide (24 Hours)



Source: Fisher (2000)

- Concentrations of sulphur dioxide have fallen dramatically with the reduction in industrial and domestic coal use, which are the principal sources.

Figure 3.12 Peak Lead (3 Months)



Source: Fisher (2000)

- Lead in air concentrations shows a very significant downward trend due almost entirely to the removal of lead additives in petrol.

3.3.7 Biotechnology

Biotechnology[26] like climate change is of potential concern for New Zealand. It is a technology in the early stages of its development with many uncertainties attached. The potential impacts on the environment and economy and New Zealand's future sustainability are as yet unclear but are likely to be significant.

The results of the survey carried out by Statistics New Zealand indicate that the majority of known modern biotechnology activity in New Zealand is centred on research and development. The survey also found that enterprises that were undertaking biotechnology in the year ending 1999 were mostly aligned with New Zealand-based Crown research institutes and universities.

The current particular focus of debate in terms of biotechnology in New Zealand is genetic engineering or genetic modification. Genetic modification has become an integral part of biological and medical research with medical, commercial and industrial applications. Agricultural and food-related uses of genetic modification are a more recent development attracting wide public debate (RCGM, 2001). The degree of debate and concern led to the establishment of a Royal Commission into Genetic Modification in April 2000. A voluntary moratorium on the commercial planning of genetically modified crops was also established at that time.

The Royal Commission into Genetic Modification released its findings in July 2001. In response to the findings, the Government has proposed:

- the establishment of a bioethics council
- the development of a biotechnology strategy
- requirements for the co-existence and conditional release risks
- amendments to the HSNO Act to increase monitoring regimes and controls on research.

The moratorium on GM field trials was lifted but the commercial release of genetically modified organisms was banned for at least two years.

A continuum of use of biotechnology seems inevitable in New Zealand and globally unless compelling evidence emerges in the near future to indicate that the potential risks outweigh the potential benefits. For New Zealand the important questions are where on that continuum New Zealand will sit, now and in the future. They are also about what policies, legislation and regulatory systems are necessary to support New Zealand's chosen position and any shifts in that position over time (PCE, 2001e).

There are various strategic issues to be considered in the development and application of biotechnologies in New Zealand. These include:

- developing a purposeful strategic framework within which New Zealand can learn more about genetic science and engage constructively with the researchers, decision makers, policy agencies, tangata whenua and interested groups and sectors, to assess the potentials and risks of genetic science for our unique ecological, social, cultural and economic circumstances
- developing a more coordinated approach to policy, determination of research directions and priorities, and meaningful public consultation and participation in decision-making processes
- strengthening trust in science, in environmental management systems, and in the decision making processes
- improving the fundamental gaps in our knowledge of GM technologies. This includes how they function, and what effects they might have on New Zealand's unique biodiversity, on non-target species or the broader environment, on metaphysical and ethical levels, and on the mauri, tapu and whakapapa inherent in physical taonga
- improving gaps in our understanding of the attitudes and acceptability thresholds of New Zealanders, and of consumers in our overseas markets, for such technologies
- making information as accessible as possible to the public in a range of different forms and venues
- the need for ongoing scientific research and research concerning the interface of genetic science with New Zealand society (PCE, 2001e).

In any process of scientific or other research, there are knowns and unknowns. There may be confidence in what is known, and to some extent in our understanding of the priority areas yet to be studied. However, serious concerns arise with those issues, dimensions or impacts of the new technology where researchers cannot even conceptualise the kinds of developments or effects that may arise, let alone offer any reliable assessment or predictions. The comparison is sometimes made between genetic and nuclear technologies - between the claims made in the GE debates of today and the claims made for nuclear energy in the 1950s. New Zealand has not allowed some applications of nuclear technology, for example, power generation and military weaponry. *Will we to need be similarly selective in the application of biotechnology?*

3.3.8 Climate Change

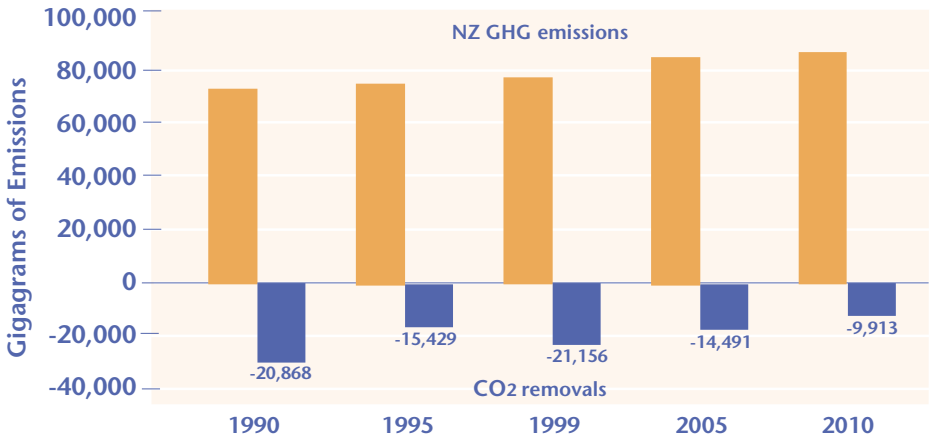
Given that much of our economic wealth is based on environmental and physical resources, climate change is of concern for New Zealand. A broad range of scientific evidence shows that the world has warmed during the 20th century. Evidence is getting stronger that most of the warming over the last 50 years can be attributed to human activities rather than to natural fluctuations, namely the emission of greenhouse gases. The climate has begun to change as a result of global warming and New Zealand is and will be affected. Changes will be gradual and their magnitude will depend on current and future emissions of greenhouse gases. Inertia in the climate system means that once started the changes cannot be stopped.

Overall trends in New Zealand's greenhouse gas emissions indicate that from 1990-1999:

- carbon dioxide (CO_2) increased by 20%
- nitrous oxide (N_20) increased by 5%
- methane (CH_4) decreased by 5%
- hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphurhexafluoride (SF_6) together decreased by 47%, largely due to a sharp decline in PFC emissions (MFE, 2002a).

Figure 3.13 shows the increase in gross greenhouse gas (GHG) emissions from 1990 and forecasts the likely trends to 2010 based on forecasts of energy use and population increase and assuming that policy intervention is minimal. It shows the quantity of CO_2 removals to 2010 (principally achieved through forests).

Figure 3.13 Trends in Greenhouse Gas Emissions in New Zealand



Source: Third National Communication under the Framework Convention on Climate Change (MFE, 2002). Emission forecasts for 2005 and 2010 assume constant emissions of CFC, HFC, and SF_6 based on 1999 levels.

New Zealand began its response to climate change in 1988 with the establishment of the New Zealand Climate Change Programme. This programme has focused on developing a comprehensive strategy which includes:

- an international programme
- a science programme
- development and implementation of policies and measures
- business and economic development
- monitoring, reporting, review and compliance.

Since 1997 domestic effort has been concentrated on enabling New Zealand to meet its target under the Kyoto Protocol. Recent key events include:

- the release of a *Climate Change: Domestic Policy Options Statement* in January 1999 for public submission
- the establishment of a Ministerial group to oversee the programme in May 2000
- the release of the Government's *Preferred Policy Package* in April 2002
- the Government's in principle decision to ratify the Kyoto Protocol during 2002
- introduction into the House of the Climate Change Response Bill on 21 May 2002 outlining a framework to allow New Zealand to meet its commitments under the Kyoto Protocol.

Policy measures to address carbon dioxide emissions include:

- the Energy Efficiency and Conservation Act 2000 and the National Energy Efficiency and Conservation Strategy (EECA, 2001b)
- voluntary agreements with major emitting industries aimed at reducing emissions
- various measures aimed at reducing the growth in emissions from the transport sector.

Other policy measures include ones that will protect and enhance sinks and reservoirs. This will mean designing a system that will enable carbon accumulation in eligible forest sinks to be verified and traded. As yet, there is no policy addressing methane emissions from the agricultural sector though research is being carried out in this area.

Global impacts of climate change, particularly on world markets and developing countries, will have repercussions for New Zealand but at this stage it is unclear what those effects will be. Current modelling is not yet sufficiently good enough to provide that type of information (MFE, 2001a).

The impacts of climate change in New Zealand are more broadly predictable. Temperatures are likely

to increase faster in the North Island than the South Island. Rainfall is projected to increase in the west and decrease in the east. While these general trends are considered relatively robust findings, the magnitude of the projected changes depends on a range of variables and is not yet clearly established. Sea levels are expected to rise under global warming but the scientific uncertainties are large. In the long term, rising sea levels are expected to increase the beach erosion and cause more frequent breaches of coastal protection structures (MFE, 2001a).

Under climate change, the agricultural sector will probably benefit from increased productivity and diversification but will also suffer increased risk of droughts, floods and water limitations in some areas. Climate change alone is considered unlikely to be the dominant cause of native species extinction in New Zealand but may act as a compounding pressure on ecosystems already under pressure. The main threat to urban environments is likely to be increased rainfall, flooding and erosion. Higher temperatures will also bring changes to health risks, reducing risk of some diseases and increasing others. For example, mosquitos that carry diseases such as dengue fever will be able to spread more easily in a warmer climate. Current predictions suggest that Maori are likely to be more affected by climate change because reliance on the environment both as a spiritual and economic resource makes them more vulnerable and less adaptable to climate change (MFE, 2001a).

Overall, there have been major advancements in our understanding of basic climate change science, projected changes in climate under greenhouse gas emission scenarios, and the impacts of such changes on a regional scale. However, impact projections are still limited by uncertainties about regional climate changes and the frequency of extreme events.

3.4 Gaps and barriers

Many of the gaps and barriers that make it difficult to implement sustainable development in New Zealand and overseas have been identified for some time and are well documented. The report, *Here Today, Where Tomorrow?* (PRISM and Knight, 2000) identifies and discusses a number of key gaps and barriers in four areas: institutions, people and attitudes, information and research, and tangata whenua and partnerships. Critical gaps include:

- a lack of leadership
- the need for capacity building
- the lack of fora to debate some of the hard issues
- insufficient recognition of diversity
- inadequate opportunities to share and compare knowledge and experience (PRISM and Knight, 2000:83).

Some of these impediments also came through so consistently and clearly in the interviews carried out for this report that they merit further discussion.

3.4.1 The concept

The term sustainable development can be a difficult, ambiguous concept to understand. Definitions abound (see chapter 2) and can be varied and contradictory. This can act as a disincentive for some people, discouraging them from working out what they can do to implement sustainable development. PRISM and Knight (2000:73) argue:

> *Many of the gaps and barriers arise because sustainability is a 'messy' concept. The 'pure market' model, in contrast, is clean, simple, transparent and therefore intuitively attractive. Sustainability must accommodate difference - but it is diversity and complexity that make it more challenging.*

Commentators suggest that the majority of New Zealanders have a relatively poor understanding of sustainable development but that it is growing.

The focus of most people is more likely to be on economic growth and employment. As some commentators note, New Zealanders often do not have a sense of personal responsibility for environmental issues. At a broad level, there seems to have been little active uptake except by some rural property owners, parts of local government and more recently parts of the business sector. Sustainable development requires an attitudinal change that some suggest will not occur until an external event of some kind forces change. At an international level, the Worldwatch Institute (2002:4) argues:

> *While awareness of the environmental and social issues central to sustainable development undoubtedly was raised in the 1990s, the new consciousness has yet to register improvements on the ground for most global environmental issues.*

This also applies to New Zealand.

3.4.2 Thinking and attitudes[27]

> *[sustainable development] tries to do what people do all the time anyway, i.e., weigh up income against life style against risk against social expectations and obligations against wanting to live somewhere nice etc etc. What sustainable development tries to do is make people (and institutions and governments) think about these things in a distal sense, i.e. over time and space and looking at impacts/effects that are remote or abstracted from their lives. I don't think New Zealanders have thought about sustainable development in that sense.* (Steven Knight, November 2001).

Certain attitudes and ways of thinking entrenched in our culture tend to make it very difficult to implement sustainable development. A culture of consumerism/hedonism encourages us to feel that happiness and success derives from purchasing and consuming more and more goods and services. The pressure to adopt sustainable development is low because we have a small population, a generally good supply of natural resources and a tradition of seeing New Zealand as clean and green (see section 3.1.2). Many New Zealanders feel comfortable with business as usual and there is little incentive to get to grips with sustainable development. However, as one commentator suggested: "If the population of New Zealand were as dense as Europe, New Zealand would be a pigsty".

Another dimension of thinking around sustainable development in New Zealand, particularly ecological sustainability, is influenced by the traditional focus on the conservation of lands with native flora and fauna that are retained in the public estate. This focus contrasts with the approach to lands in private ownership where exotic species predominate and the paradigm is sustainable management.

> *On the one hand we have a strong focus and commitment to the protection (the conservation) of native plants and animals, primarily on Crown-owned conservation lands. On the other hand we have the ongoing evolution of private land uses with trends in three directions: more intensive land uses, peri-urban lifestyle blocks and extensive uses such as forestry based on exotic species* (PCE, 2001h:ii).

Underpinning these approaches is a fundamental difference of views about the appropriate types of relationships that New Zealanders can and should have with indigenous ecosystems and their constituent plant species.

> *"The old adage, 'If you're stumped by a problem, make it bigger' is a neat pitch for systems thinking."* (Worldwatch Institute, 2002:22).

A further 'thinking' barrier to implementing sustainable development is linear or silo thinking, thinking which focuses on part rather than the whole of the big picture and misses the connections between seemingly separate activities. A number of interviewees suggested that Government still tends to operate in silo mode.

Until recently there has been little or no encouragement for cooperative work with everyone focused on achieving his or her 'own' outputs. The culture of Government thinking tends to be short-term, focused on efficient, least cost outcomes, and top-down. This may prevent the achievement of broader outcomes. By way of example, the Commissioner's 1999 investigation into marine management concluded that the institutional structures failed to reflect the complexities of, and the interconnections within, the natural, cultural and economic systems that require management (PCE, 1999b). This reflects the lack of an overarching framework or strategy to guide the many stakeholders towards sustainable management of the marine environment. Instead, the management structures are narrowly compartmentalised and focus on outputs rather than outcomes (see appendix 2 for more information).

A 2001 review of the New Zealand public management system concluded that there needs to be improvements in three areas: integrating service delivery across multiple agencies; addressing fragmentation of the State sector and resulting loss of focus on the big picture; and improving the systems by which state servants are trained and developed (SSC, 2001). The report suggests a culture shift in the State sector is required to one that is more dynamic and innovative, has a greater regional focus, more balance between outcomes, outputs and capability, and a longer-term focus.

Systemic inertia or complacency with the current situation acts as a powerful barrier to progress with implementing sustainable development. The system and people in the system tend to settle back into the default position of business as usual even if there is an effort at implementing sustainable development. This is especially so if the changes required to move towards sustainable development are recognised as being far reaching and daunting. Reaching agreement on how to change decision making [economic] systems creates too many difficulties to be tackled seriously outside academic or 'fringe' circles. Overcoming inertia and complacency requires sustained commitment and political will, not least because the concentration of power and wealth currently supports business as usual.

3.4.3 The reforms of the 1980s and 1990s

A period of reform was initiated in 1984 that aimed at the comprehensive restructuring of the state and economy in the direction variously called 'New Right", 'neo-liberal' or 'free market'. Between 1984 and 1993, these policies massively deregulated the economy, reformed the money system and sold off state assets (Belich, 2001). During this period, the public sector also went through a significant period of institutional, legislative and managerial change.

The dominance of New Right economic thinking in the 1980s and 1990s appears to have precluded consideration of sustainable development as a way of future growth in New Zealand. It was not discussed and debated in the way it was at the highest levels in other countries. The energy and focus required to implement these changes may also have precluded coming to grips with sustainable development as well. These reforms tended to reinforce linear and silo thinking by focusing on effectiveness and efficiency and encouraging separation of policy development from service delivery. There was a deliberate emphasis on setting up a policy and delivery system which separated out economic, social and environmental systems, making long-term integrated planning and analysis difficult.

The reform of the research sector has affected our capacity to obtain environmental information. No particular institution is responsible for it, hence the relative absence of such information as indicated in the country's first State of the Environment report (MFE, 1997).

3.4.4 Leadership

Most people interviewed for this report felt that strong leadership is required to make more progress with the implementation of sustainable development. Leadership is involved with the development of a vision, with communicating that vision and motivating and inspiring people to follow the vision. Leadership is critical to dealing with the changes required by the implementation of sustainable development.

Current trends in successful leadership suggest that leadership for sustainable development needs to be encouraging and supportive rather than directive. It needs to provide inspiration and empowerment, encouraging capacities to innovate and take risks. Leaders need to demonstrate a commitment to the many strands of sustainable development, inspiring others and enabling them to see the potential in new systems and policies to deliver across social, economic and environmental needs. They need to be cheerleaders, catalysts for change, keepers of sustainable development values, leading by example and demonstrating the capacity to strategise (Brosnahan, 1999). Given the nature of sustainable development, leadership needs to be provided at all levels and sectors of the community. It is not something that can and should only be provided from the centre. However, the commitment of CEOs and their equivalents are particularly important.

Macpac and The Natural Step

The Natural Step is a non-profit environmental education organisation that originated in Sweden in 1989. More locally, the Natural Step Environment Foundation, Aotearoa New Zealand, was established as a Charitable Trust in 1997. Among its goals, it aims to work with businesses and organisations to adopt strategies that lead to ecological, social and economic sustainability.

The Natural Step provides a framework for planning based on four key conditions for a sustainable society:

- Fossil fuels, metals and other minerals must not be extracted at a faster pace than their slow redeposit and reintegration into the Earth's crust.
- Products must not be produced at a faster pace than they can be broken down and integrated into the cycles of nature or deposited safely into the Earth's crust.
- Ecosystems cannot be harvested or manipulated in such a way that their productive capacity and diversity are impoverished, for instance by over-harvesting fish or forests so they cannot replenish themselves.
- Basic human needs must be met with the most resource-efficient methods possible.

Macpac Wilderness Equipment is a New Zealand company that has adopted The Natural Step framework. As a designer and manufacturer of high performance outdoor clothing and equipment, Macpac's involvement in the programme was motivated by a growing awareness of the impacts their operations are having on the natural environment. The framework provides them with a useful tool to identify and reduce those impacts.

Macpac staff members have been trained in The Natural Step and have identified priority projects and action plans. Key initial projects include auditing their carbon emissions and conducting an analysis of their pack fabrics. The organisation is trying to consume less oil and minerals by researching how to use materials that are not based on fossil fuels. The factory skip is also sampled regularly to identify ways to reduce waste. In addition, they are changing some suppliers to improve the ease of recycling and a staff member has volunteered to recycle organic materials from the cafeteria.

One of the problems that the company has confronted is that their ability to undertake research and development is somewhat limited by the scale of their operations. This has encouraged them to work more closely with other manufacturers and suppliers to ensure that all of their materials are sourced and produced 'inside the loop'.

Macpac also believes that its commitment to quality and durability is important. Instead of producing inferior, disposable consumer goods, they are actively seeking to minimise their contribution to the waste stream. They are working with The Natural Step to continuously improve the sustainability of their operations.

the Natural Step

See http://www.tns.org.nz/
http://www.macpac.co.nz/

Over the last ten years and until very recently, leadership from central government for sustainable development has been somewhat mixed despite the commitments to international initiatives such as Agenda 21. The basic essentials of sustainable development have been incorporated into environmental legislation and an increasing number of strategies (see chapter 4). However, such strategies are only initial steps towards environmental sustainability let alone sustainable development. (See also PRISM and Knight 2000 for a more detailed discussion of central government approaches to implementing sustainable development.)

Within central government in New Zealand, departmental proponents for sustainable development (Ministry for the Environment and Energy Efficiency and Conservation Authority) appear to be weaker than departmental opponents (Treasury and Ministry of Economic Development). This weakens the leadership potential for sustainable development within central government. Historically, government departments which undertake service delivery functions such as Housing NZ and the Ministry of Education, have not taken up opportunities to demonstrate sustainable development and consequently have not provided leadership. For example, procurement policies for new buildings do not incorporate sustainable architecture/design requirements.

The first Earth Summit in 1992 called for all governments to produce National Strategies for Sustainable Development (NSSD) by 2002.[28] The five-year review of Agenda 21 that took place in 1997 confirmed a target for all countries to develop national strategies for sustainable development (Earth Council, 2001). The current Government approved the development of a New Zealand sustainable development strategy in August 2001 but up until that time little had been done that specifically addressed sustainable development. The relative absence of national leadership demonstrated through a national strategy has been a key impediment through the 1990s.

Local government has been varied in its approach to implementing sustainable development (see also chapter 4). Attitudes seem to fall broadly into three categories:

- those who openly pursue sustainable development or Agenda 21
- those who are involved in programmes and policies that include sustainability but prefer not to label it sustainable development or Agenda 21
- those who consider that their mandate is confined to administering legislation, i.e. the RMA, and who tend not to get involved in social or economic initiatives (PRISM and Knight, 2000).

The spectrum, therefore, runs from councils who have demonstrated considerable leadership through to those who do not consider sustainable development to be part of their mandate at all. The Local Government Bill, currently before the House, will provide more direction by enabling local authorities to play a broad role in promoting the sustainable social, economic, environmental, and cultural well-being of their communities.

The business sector, or at least parts of it, has been actively involved in implementing sustainable development in recent years. In 1999 the New Zealand Business Council for Sustainable Development was established to provide business leadership as a catalyst for change to sustainable development. Several other organisations have also been established including the Business for Social Responsibility (BSR) and the New Zealand Centre for Business Ethics (NZCBE). A number of high profile business leaders are willing to champion sustainable development and are active in encouraging businesses to work on different management approaches (PRISM and Knight, 2000).

A range of businesses are involved in programmes designed to actively implement sustainable development principles, for example, the Natural Step, cleaner production and Zero Waste. There are many examples of partnerships between business

Local Government Leadership for Sustainable Development in the United Kingdom

Researchers have been examining the ways that local government agencies in England are implementing sustainable development principles (Corbet and Roberts, 2001). They have identified a wide variety of practical techniques that these agencies are pursuing to ensure that sustainable development becomes an integral and valuable part of their activities.

The researchers suggested that sustainable development could be mainstreamed in five key areas:

1. Recognising community aspirations
   - placing a strong emphasis on community involvement
   - developing staff facilitation skills to engage diverse groups within the community
   - moving from consultation to dialogue to foster ongoing, two-way communication
   - more closely aligning local authority priorities with community aspirations.
2. Dismantling 'tribal' thinking
   - developing mechanisms to foster interdisciplinary working that cuts across departments
   - developing the interpersonal skills of staff to build stronger partnerships.
3. Providing community leadership
   - providing leadership that balances short-term thinking and explores long-term implications of decisions
   - developing capacity in the community with education that helps people participate in decision making
   - adopting indicators to communicate complex information in an accessible way.
4. Getting one's own house in order
   - setting an example of good practice
   - embedding sustainable development thinking throughout an organisation
   - making sure that actions support priorities.
5. Increasing the capacity to work through influence
   - developing good relationships
   - developing staff facilitation skills
   - breaking down professional boundaries and relinquishing some control to better respond to the desires of the community.

The researchers also identified a variety of barriers that local authorities in England are facing in this area. Among these, they noted the conflicting messages provided by different central government agencies, the lack of integration among central government policies, a shortage of good interpersonal skills among staff, a risk-averse culture and a lack of organisational commitments. Opportunities for overcoming these barriers were also identified. These included prospects for better dialogue between central and local government, encouraging integration of central government initiatives, tolerating and encouraging different ways of thinking, and providing further training and development for staff members.

Based on their analyses, the researchers believe that there is a vital role for local authorities to provide community leadership in this area. In addition, one of their key recommendations was that local government needs guidance and support from central government to mainstream sustainable development initiatives.

and other sectors implementing cleaner production and energy efficiency programmes (see PRISM and Knight, 2000 for more information). Despite this, sustainable development is not the common language of business and the priority given to short term economic and financial matters tends to reinforce the status quo.

The contribution of the NGO sector to the implementation of sustainable development is hard to assess because the sector is diverse and relatively disconnected. It is difficult to find out who is doing what. Information available indicates that there are many small groups all around New Zealand making contributions in their local communities (see PRISM and Knight, 2000 for more information). The Royal Society of New Zealand recently convened a sustainable development 'scoping meeting' aimed at developing a general overview of all sustainable development activities, exchange of information, encouraging collaboration, and initiating new combined initiatives in sustainable development. This process is on-going.

Environmental NGOs have been pivotal leaders in improving the protection and management of New Zealand's native plants and animals, primarily on crown owned conservation lands. Such groups have also been champions for better pest management, biosecurity and marine management. This focus is principally one of 'environmentalism' and it could be argued that environmental NGOs have not yet engaged in the

New Zealand Business Council For Sustainable Development

providing leadership for the business community.

Mission

To provide business leadership as a catalyst for change toward sustainable development, and to promote eco-efficiency, innovation and responsible entrepreneurship.

Aims

Aims and strategic directions, based on their mission include:

Business leadership - to be the leading business advocate on issues connected with sustainable development.

Policy development - to participate in policy development in order to create a framework that allows business to contribute effectively to sustainable development.

Best practice - to demonstrate business progress in environmental and resource management and corporate social responsibility and to share leading-edge practices among their members.

Global outreach - to contribute to a sustainable future for developing nations and nations in transition.

See the NZBCSD website for more information, www.nzbcsd .org.nz

much broader sustainable development agenda. This may be because the imperative to protect endangered species and ecosystems has dominated efforts but it may also indicate a real tension in moving towards a sustainable development paradigm. This may be because of their perception that environmental concerns can be subsumed by economic and social concerns when it comes to implementing sustainable development, particularly under the weak sustainability model.

3.4.5 Participation

Agenda 21 emphasises that a fundamental prerequisite to the achievement of sustainable development is broad public participation by groups and communities in decision making (section III of Agenda 21). Principle 10 of the Rio Declaration on Environment and Development states that "environmental issues are best handled with the participation of all concerned citizens at the relevant level". The picture within New Zealand seems to be rather mixed.

Voter turnout in general elections has declined from 88% in 1984 to 77% in 1999. Voter participation in the 2001 local government election was just over 48%, 5% less than the 1998 elections (Reid, 2001). Declines in voter participation may be associated with decreased levels of trust in political institutions as well as with increasingly disproportional electoral outcomes (Ministry of Social Policy, 2001).

Within local government, communities are offered an increasing number of opportunities to contribute to local decision making through a variety of planning processes under the LGA and the RMA. The average number of submissions made to local authority annual plans has increased from 67 in 1991/92 to 339 in 1999/2000 (Reid, 2001). Such opportunities for making submissions do not in themselves guarantee meaningful participation but at least the potential is there.

A number of changes have been made or are to be made to local government legislation aimed at improving the capacity of communities to participate in the future development of their areas. The Local Electoral Act 2001 requires local authorities to review whether or not to move from the current system for electing councillors to a Single Transferable Vote option. The STV option may have the effect of broadening the range of representation and 'voices heard' in local government. Environment Bay of Plenty's recent initiative to increase iwi representation on the council is also important in terms of broadening the range 'voices heard'. The Local Government Bill includes provision for the development of long-term community plans based on sustainable development principles (see chapter 4 for more information about the Bill).

A PCE investigation into tangata whenua participation in environmental management (PCE, 1998d) concluded that the current legislation provides a strong basis for tangata whenua participation in policy development and management for the natural environment. The

RMA gives recognition to consultation, traditional values and relationships, the principles of the Treaty and the ongoing duties of kaitiakitanga. It found greater and more widespread awareness amongst some councillors, council staff and developers of the practical benefits of more effective involvement of tangata whenua. Iwi and hapu also had greater awareness of the opportunities and processes for their involvement and for the practical expression of kaitiakitanga in sustainable resource management. Despite these useful gains, there were still no national policy frameworks or standards to ensure efficient, consistent and reliable systems for tangata whenua participation in environmental management. Nor was there appropriate accommodation of the values and concerns of tangata whenua as required under the RMA (see appendix 2 section A2.4).

Other ways of expressing and formalising participation in environmental decision making are continually being developed, for example iwi or hapu management plans. Iwi management plans establish tangata whenua goals, practical objectives, priorities and expectations for appropriate management of natural taonga and the wider environment in the rohe. Such plans can provide frameworks and guidance for consultation and practical working relationships between tangata whenua and agencies. Provisions in the RMA require local authorities to have regard to iwi management plans.

There is a multitude of non-governmental groups of all sizes working in New Zealand on projects relevant to sustainable development. (The GreenPages directory, www.greenpages.org.nz, is a source of information on some of these groups.) Many people make a significant contribution to the sustainability of New Zealand through volunteering for these groups.

Zero Waste Community Projects

The mission of the Zero Waste New Zealand Trust is to encourage and motivate all sectors of New Zealand society to work towards a target of zero waste. The trust provides guidance and financial assistance to individuals, businesses, local authorities and non-profit organisations to help them work towards this goal.

Zero Waste principles aim to change people's perceptions of 'waste' and to redesign the ways that resources and materials flow through society. Their objective is to maximise recycling and waste minimisation initiatives and to ensure that new products are designed to be reused, repaired or recycled back into the marketplace and the natural environment.

The trust is also working with over 40 local community organisations to create sustainable employment opportunities. In the Far North, for example, they have provided assistance to the Community Business and Environment Centre (CBEC). This non-profit enterprise was established in 1989 to foster environmentally sustainable businesses and employment prospects in the region. They now run a comprehensive recycling programme under contract to the Far North District Council. As part of their operations, CBEC runs the Kaitaia recycling station. Of the 40,000 cubic metres of refuse entering the station each year, approximately 26,000 cubic metres are recovered through recycling and reuse. CBEC have managed to handle this 'waste' at about two thirds of the cost of more traditional approaches.

At the other end of the country, Innovative Waste Kaikoura is another community group working with the trust. This organisation was formed in June 2000 as a non-profit venture between Kaikoura Wastebusters (started by a group of concerned residents in 1996) and Kaikoura District Council. They are currently diverting over 50 percent of the 'waste' from the local landfill and working towards a goal of zero waste by 2015. They employ five full time staff members who are involved in creating substantially more employment opportunities through a variety of waste reduction initiatives.

The success of these schemes has helped the Zero Waste Trust to advocate the benefits of pursuing a zero waste philosophy. They believe it can be used to improve environmental sustainability, create jobs, reduce waste costs and to foster local economic development.

See http://www.zerowaste.co.nz

Ngai Tahu and the Mountains to the Sea

Ngai Tahu are developing an iwi management plan for the Waitaki Catchment area that could be used as a template for other runanga or tribal councils. The plan is based on the philosophy of ki uta ki tai - from the mountains to the sea and everything in between.

A central idea of the plan is that everything in the catchment of a river - ki uta ki tai - affects the health of the water and the plants and animals that live in and around that waterway. The health of people is dependant on these plants and other animals that provide them with sustenance. The essence of this approach is encapsulated in:

Toi tu te marae nui a Tane
Toi te marae a Takaroa
Toi tu te Iwi

This denotes the belief that the environment needs to be maintained in the best possible state. Thus, if the realms of Tane (God of the forests) and Takaroa (God of the Seas) are sustained and utilised in an appropriate manner, then the iwi or people of an area can also be sustained.

Instead of compartmentalising the environment into different parts, Ngai Tahu are taking an approach that recognises the inter-connectedness of social, economic and environmental issues in a catchment area. This will involve looking at better integration across media such as water, land and the coast. They are also planning to work closely with communities that are situated within the catchment.

As part of this project, Ngai Tahu have already released a Freshwater Policy Statement. It is anticipated that the rest of the plan will be completed by 2005.

Other organisations such as the Queen Elizabeth II National Trust and New Zealand Landcare Trust work in partnership with property owners seeking more sustainable outcomes. The QEII National Trust's principal function is to protect privately owned areas of open space through covenants, without jeopardising the rights of ownership. To date, over 1,450 Open Space Covenants covering in excess of 54,500 hectares have been registered. These covenants protect a variety of open space, including forest and forest remnants, wetlands, lakes, peat lakes, coastline, tussock grasslands, tracts of rural landscape, archaeological sites and geological formations. The Landcare Trust provides an independent voice on landcare, sustainable land management and biodiversity. It seeks to set up and empower land care groups, providing information and developing networks and partnerships. Groups are voluntary, community based and encouraged to set their own agendas. Issues include sustainable farm production, protection and rehabilitation of sensitive environmental areas, pest and weed control, native bush monitoring, river monitoring and rehabilitation, as well as biodiversity enhancement (protection of native flora and fauna).

The Government has also established two independent funds, available to private and Maori landowners, to protect and assist with the management of large areas with significant conservation values. In 1990, Government established the Forest Heritage Fund, called the Nature Heritage Fund since 1998 to reflect a widening of its mandate. In its first eleven years, the Fund has protected through purchase or covenanting, 184,000 hectares of forested and other high value lands. Another similar fund, Nga Whenua Rahui, was established in 1991 to help protect Maori-owned forested lands through a unique covenanting arrangement that is renewed by future generations of owners. To date, over 115,000 hectares have been protected by Nga Whenua Rahui.

A trend which is evident when looking at how sustainable development is being implemented in New Zealand, is that there is a lot of activity at a local level and relatively little at a national level. The diversity and number of the local groups involved in sustainable development activity is a strength for New Zealand. These local initiatives are vitally important for the implementation of sustainable development in New Zealand. However, those initiatives appear to be fragmented and as Casswell (2001:31) argues:

Community initiatives depend upon a supportive policy environment to make a difference in people's lives. Local level action in isolation is unlikely to ameliorate the effects of a policy environment hostile to its goals. Community initiatives inform the need for central policy change if lines of communication between the community voice and policy advisors are open. Central government has a key role to play as a funder of community initiatives and can also encourage support by relevant agencies at the community level.

Without robust national policy action and leadership that connects and encourages, local initiatives will only take us so far.

3.4.6 Cycles

Short-term timeframes and short cycles are characteristic of democratic processes in New Zealand. Decisions are made within the context of a timeframe relating to the parliamentary three-year term of office. Tax payers and ratepayers prefer to see more immediate results. Short-term changes in the political environment can undermine long-term policy commitment. Economic cycles, influenced by world trading conditions, business confidence, fluctuating exchange rates and shareholder expectations, are sensitive and change suddenly. This leads to an emphasis on short-term returns over long-term returns. By contrast, environmental goals need long implementation time frames. Social goals have a variety of time frames from short to long.

Understanding the interactions between different cycles is a key to sustainable development. Experience seems to suggest that the dominance of one type of cycle leads to instabilities and potential collapses in the others. Successful implementation of sustainable development will require a commitment to long-term strategic approaches that endure well beyond a three-year electoral cycle.

3.4.7 Spatial scales

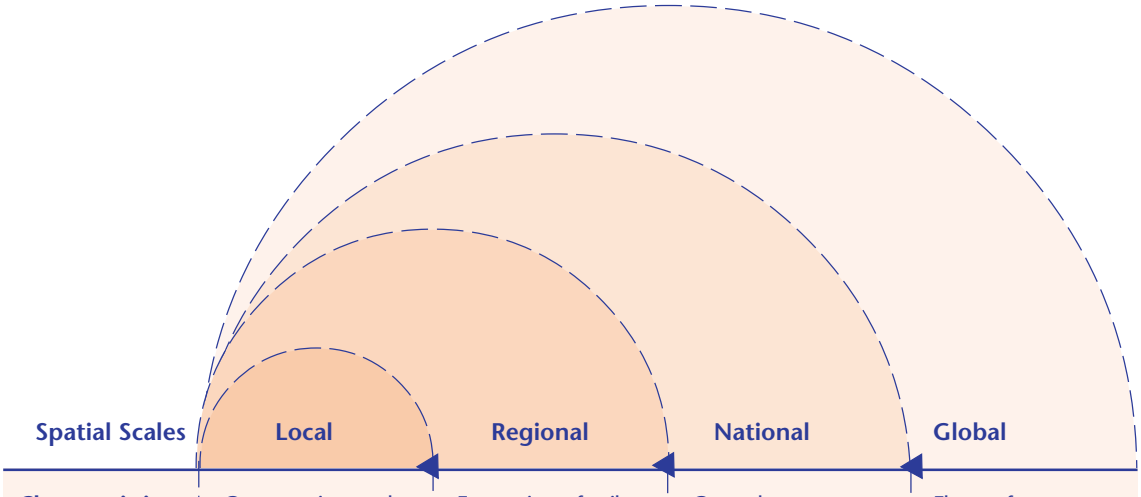
Recognition of the spatial or geographic scale of environmental processes and problems is a key to the implementation of environmental sustainability for a number of reasons. Some problems happen locally and can be resolved locally by the community they occur in. Other environmental problems happen nationally and globally but may also manifest locally. Figure 3.14 illustrates the types of environmental processes, problems and organisations involved and the different types of solutions being used. The higher the scale of the problem the more important it is to also have actions addressing the problem appropriate to the scale. Environmental issues that are national in scale can and must often be addressed locally but that will not be sufficient usually to resolve them. National and regional action is also required. The interaction between the scales is often dynamic. Local levels can influence higher just as much as vice versa.

When decision makers fail to grasp the scale at which environmental issues are happening people can become confused which impedes progress. On the other hand, matching a variety of tools to the right scale offers the potential for resolution of environmental problems. Categorising environmental issues according to geographic scale also helps clarify the responsibilities of different agencies.

3.4.8 Opportunities for discussion and debate

Given the range and varied understandings about sustainable development, a key to progress is discussion and debate about what sustainable development means and how we can go about implementing it. A number of people have commented on the lack of opportunities for debating sustainable development. PRISM and Knight (2000) comment on the lack of fora for debate, the insufficient recognition of the diversity of opinion that exists around sustainable development and the lack of opportunities for people to share and compare knowledge. Tensions

Figure 3.14: Spatial Scales of Environmental Problems



Spatial Scales	Local	Regional	National	Global
Characteristic processes	Construction and demolition of buildings Subdivision and development	Formation of soils Movement of water Climate	Coastal waters Seas	Flows of energy Consumption and production
Characteristic environmental problems	Noise Odour Air pollution City expansion Water supply Waste management	Sustainable land management Over fertilisation Soil erosion Water quality	Biosecurity - pests and weeds Pollution Biodiversity loss	Greenhouse effect Ozone layer depletion
Organisations	City and district councils Regional councils	Regional councils	Central government NZ Business Council for Sustainable Development Zero Waste	United Nations WTO OECD The Natural Step
Actions	RMA District plans Strategic and annual plans Zero waste programmes Landcare groups Watercare groups Earthsong eco-development Macpac and TNS	Auckland Regional Growth Strategy RMA Regional plans ARC Big Clean-up Transport planning Pest management	Biodiversity Strategy RMA NPS on biodiversity Biosecurity Strategy	MEA's, eg, Convention on Biological diversity Kyoto Protocol

Source: adapted from De Jongh and Captain (1999)

and contradictions are not exposed and resolved. The recent initiative by the Royal Society drawing together groups with an interest in sustainable development is providing a valuable opportunity for such discussion and debate.

3.4.9 Resourcing

Barriers to making more progress with sustainable development in New Zealand, particularly with central and local government agencies are likely to be for a number or combination of reasons, including:

- insufficient resources
- lack of understanding of sustainable development
- unwillingness or inability to commit to the broad, long-term implications of sustainable development
- other, more pressing and specific priorities (e.g., statutory obligations).

Generally, the budgets available for initiatives, be they research, community consultation or implementation programmes tend to be small, short term and fragmented. Projects start up but fail in the medium term because the funding is no longer available. Research focuses on small parts of the whole picture because the investment is not there for a more comprehensive approach. We lack data about our natural resources and we also lack systems for dissemination, storage and use of any data that is available (PRISM and Knight, 2000; see also appendix 2 section A2.6.1). Key implementation agencies such as territorial authorities have responsibility for large land areas with a small population and corresponding low rating base (PCE and Auditor General, 1999). Without external sources of funding, few resources are available.

The capacity of people to understand how to implement sustainable development is compromised by under investment in capacity building, education and implementation.

3.5 Key points

- New Zealand has many unique qualities. Ecologically it is a remnant of Gondwana land. Socially we have both the Treaty of Waitangi and a diverse population. Economically we are dependent on the quality and productive capacity of our environment, our natural capital. We value our environment enormously, especially access to clean water and air and beautiful natural environments. A productive and healthy natural environment is a fundamental base to our economy. All of this is often expressed as an image of New Zealand as 'being clean and green'.
- Comparatively, New Zealand is clean and green but there are risks to our future environmental sustainability from the legacies of the past. There are a variety of drivers including the economy, consumption and production patterns. There are also various key trends: globalisation, building sustainable cities, managing the links between human and environmental health, managing freshwater resources, and climate change.
- Maintaining the ecological sustainability of key parts of our environment will be critical to the sustainable development of New Zealand as a whole. Intensification of our urban communities and agricultural land use is challenging the ecological sustainability of key environmental resources, particularly freshwater resources, soils and air quality. Current information indicates that impacts on these environment resources are and will continue to be unsustainable if we continue with business as usual.
- The impacts on New Zealand of other key trends, namely globalisation, climate change and biotechnology, are as yet uncertain. That uncertainty is a key challenge for the sustainable development of New Zealand. The challenge is how to minimise the impact of unpredictable risks but also to be in a position to take advantage of the benefits should it become clear what those benefits are.
- Values and ethical frameworks are a critical element of the implementation of sustainable development. Sustainable development requires us to debate, understand and incorporate new or at least expanded sets of values.
- Thinking and attitudes are also critical element of the implementation of sustainable development. Traditional linear and short-term thinking is acting as an impediment. Attitudes value the status quo. But new ways of holistic, systemic thinking are also showing the way forward. In order to advance sustainable development and to maintain and continue with the quality of life we like, we need to develop a fundamental understanding of ecological limits and the importance of maintaining natural capital. Education for sustainable living will be critical in terms of spreading new ways of thinking and knowledge.

- Education for sustainability is needed:
  - so the whole population understands what sustainable development is and why it is important
  - so everyone understands the ecological limits in place on our planet and particularly in New Zealand, and the importance of functioning within those limits
  - to challenge our dominant consumerist, individualist, democratically apathetic culture
  - to foster a new sustainability ethic, that includes self responsibility regarding individual behaviour
  - to train young people to think and behave in sustainable ways as second nature, i.e. to consider the consequences of their actions
  - to empower individuals and communities to become ecologically aware and thus to play a part in future sustainable development decision making.
- Leadership in all sectors is important as a driver of change. It is critical to dealing with the changes required by the implementation of sustainable development because sustainable development has to involve a move away from the status quo towards a new vision and new ways of doing things. Public acceptance of the need for change is a major challenge for the Government and non-government sectors seeking to promote sustainable development.
- A key impediment to the implementation of sustainable development in New Zealand is insufficient knowledge and capacity to support its implementation. This is knowledge in its broadest sense - research, information, indicators and people with the technical capability to produce that kind of knowledge. There appears to be a lack of accessible information about how to implement sustainable development and a gap in terms of translating information that does exist into material that can be used by the community (including business and government) to facilitate debate and understanding of sustainable development issues. Sustainable development is made tougher because we do not have solid scientific frameworks and knowledge on which to base policy development. The relative lack of established environmental indicators and the absence of indicators for sustainable development is also part of this picture.
- Sustainable development needs to be implemented over a complexity of spatial and temporal scales. Different types of actions work at different spatial and temporal scales from zero waste for a business at the local level through to a national strategy for sustainable development for the whole of New Zealand. This necessitates a wide variety of tools and actions and New Zealand has not used all of what is available. Our commitment to education for sustainable development has been relatively low key and we have not used the range of economic instruments that are being used overseas.

---

1 Royal Commission on Environmental Pollution, October 1998.

2 In the context of this report, the term 'well-being' also includes consideration of environmental needs. This was not explicitly mentioned in the RCGM report.

3 See the findings of the Rio+10 community programme in 2001 in http://www.mfe.govt.nz/new/pages/involved.html.

4 http://www.ew.govt.nz/ourenvironment/indicators/community/communities/p2a/report.htm#Heading2.

5 The energy required to produce a unit of gross domestic product. When the 'energy intensity' measure goes down, it indicates that things are being done, or produced, with less energy input. Hence a reduction of the energy intensity is a positive indicator that energy is being used more efficiently.

6 See the OECD database on environmentally related taxes in http://www1.oecd.org/env/policies/taxes/index.htm.

7 Laird. 2002.

8 Cited in a speech by then Reserve Bank Governor, Don Brash, 25/1/02 http://www.scoop.co.nz/mason/stories/BU0201/S00075.htm.

9 Jason Clarke, key note speaker at the 2002 New Zealand Environmental Education Association conference http://www.nzaee.org.nz/news/files/Jason%20Clarke.doc.

10 See http://www.eednz.org.nz/about.html.

11 See http://envbop.govt.nz/www/EnvironmentalEducation/EnvironmentalEducation.htm.

12 See more at www.ew.govt.nz/educationprogrammes/.

13 See more at www.waitakere.govt.nz/abtcit/ei/index.asp.

14 GDP Statistics: At 1995/1996 prices. Statistics NZ changed the official system for the measurement of GDP in 1988. 1981 and 1986 figures were sourced by creating a linked series between the old and new systems.

15 1981-2000 figure. 2001 data will be published in the Energy Data File July 2002. This will be released at the end of August 2002.

16 Urban land statistics; There is currently no reliable data available from any agencies to calculate the growth in urban land areas since 1980. The figure cited in the 1998 investigation was sourced from MFE's 1997 State of the Environment report. It is very unlikely that the definition of 'urban land areas' used in the calculations gave much regard

to actual land use patterns within territorial urban boundaries. More recently, however, a NZ Land Cover Database (NZLCDB) has been established by MAF and MFE. The database was constructed from satellite images acquired in 1996/97 and provides an accurate indication of urban land areas. Additional images will be taken on an ongoing basis (every 5 years) to enable changes in land use patterns to be established.

17 1983-2001 figure.

18 Car Statistics: The Land Transport Safety Authority collects data on passenger car numbers. Due to changes in their systems, data from 1980-1995 only identified the total number of vehicles licensed. Data from 1996 onwards represents the total volume of vehicles registered on the Motor Vehicle Register (whether licensed or unlicensed). Nonetheless, vehicles are automatically de-licensed if they are not registered for more than one year so this figure should provide a fairly accurate portrayal of the increase in (registered) cars in NZ.

19 Small airborne particles less than 10 microns (or micrometres) in diameter.

20 California Environmental Protection Agency Air Resources Board news release (02-14) of 31 January 2002.

21 Ozone at ground level is a 'secondary' pollutant formed when nitrogen oxides and volatile organic compounds combine in a photochemical process in the presence of sunlight. Motor vehicles are a significant source of the pollutants that combine to form ozone. Incidents of such smog typically occur in Auckland during summer months.

22 Not all nitrogen losses from pastoral or cropping systems result from applied nitrogen. Significant losses of symbiotically fixed nitrogen can also occur.

23 Auckland's burgeoning vehicle fleet is growing at 4% per year, faster than the population (Fisher, et al., 2002).

24 PM10 refers to fine dust particles less than 10 micrometres in diameter, which can be inhaled into the deeper parts of the lungs.

25 For example, Environment Canterbury is imposing restrictions on the use of home heating fires as well as creating incentives to move to cleaner heating appliances.

26 Modern biotechnology is defined as involving genetic manipulation and including the following: Bio-processing - manufacture of fermented products like cheeses, yoghurt, breads, brewing, pharmaceutical and vaccine manufacture and so on, provided that genetic manipulation has occurred; Bio-prospecting - genetic engineering to produce new goods or services whose practical applications may not yet be known; Modern gene/protein technologies (genomics and proteomics), eg producing genetically modified organisms; Other genetic manipulations, eg antibiotic strain improvement and selection; DNA-based services - includes gene technologies used on diagnostics (medical, food hygiene, and forensic and environmental diagnostics); and Bio-informatics - the electronic data management of biological information, such as the archiving of gene sequencing information (SNZ, 2001:8).

27 This section draws extensively on the interviews carried out for this investigation.

28 http://www.earthsummit2002.org/es/nssustainable development /default.htm