

How clean is New Zealand?

Measuring and reporting on the health of our environment

April 2010



Parliamentary Commissioner
for the **Environment**
Te Kaitiaki Taiao a Te Whare Pāremata

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Photography

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Commissioner's overview

Not everything that can be counted counts, and not everything that counts can be counted.

Source: Albert Einstein (1879–1955), sign hanging in Einstein's office at Princeton

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Measuring and assessing the state of our environment is no easy task. Unlike counting money or people using well-developed economic and social statistics, the sky is the limit for natural and physical world statistics. There is no end of parameters that could be measured. Moreover, our perspective on what should be measured changes as our understanding of the environment grows. The challenge for any country to achieve quality reporting on the state of its environment should not be underestimated.

In this report I focus on what we need to take account of to improve state of the environment reporting in New Zealand. Phosphorus in rivers and lakes is used as a case study to help illustrate the main points.

Two State of the Environment reports have been produced in New Zealand – one in 1997 and one in 2007. Both were prepared in some haste with the authors forced to rely on whatever data was available. The 2007 report contained a great deal of information, yet drew significant criticism. For instance, the freshwater chapter contains two graphs of phosphorus concentration in rivers, yet it is impossible to tell from either graph whether this important environmental problem is getting better or worse. Such inadequacies are not solely the fault of those who wrote the report, but illustrate a fundamental failure of our system (or lack thereof) of environmental statistics.

The 2007 report was also criticised because the last chapter, which drew conclusions from the data, was withdrawn from final print. The result was a call for reporting on the state of our environment to be done independently, specifically by the Parliamentary Commissioner for the Environment.

The possibility of an addition to my functions in part has motivated the writing of this report. It seemed both timely and appropriate to review state of the environment reporting and the foundation of environmental statistics on which it must rely.

Fundamentally, environmental statistics serve three purposes.

First, we need them to diagnose the health of different parts of our environment. For instance, if the concentration of phosphorus in a particular river is rising fast and/or nearing some kind of threshold then we know that all is not well.

Second, we need environmental statistics to identify the cause of a problem. Is a rising concentration of phosphorus in a particular river being caused by discharge from a town sewage or freezing works? Or is it being caused by sediment from eroding riverbanks and overzealously cleared gullies? Or is it being caused, as is sometimes claimed, by Canada geese? If there is more than one source of phosphorus, then what are the relative contributions of each? Hand-waving and finger-pointing will not do the job.

Third, we need environmental statistics to tell us the success of our remedies. One such measure might be the percentage of town discharge consents that comply with prescribed limits on phosphorus discharges. Over time, the concentration of

phosphorus in the river will reveal the real success of the policies and management tools used to improve the health of the river.

Sir Peter Gluckman, Chief Science Advisor to the Prime Minister, has spoken publicly about his concern that in New Zealand we too often develop policy without a proper evaluation of the evidence. Good environmental policy needs a good evidence base of environmental statistics.

A State of the Environment report for the whole country – careful selection of key environmental statistics, aggregated up to the national level, and informatively presented – is one product of environmental statistics.

Environmental statistics need to be chosen, measured, and made available in ways that will support all three of these purposes.

Obtaining value for money is essential since there is no limit to the number of parameters that could be measured, and where and how often they could be measured.

The need for trust and transparency in state of the environment reporting is critical if it is to be taken seriously. Ensuring environmental statistics and sources are freely accessible on the internet is an ideal way of achieving this.

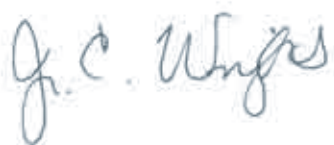
The case for an Environment Reporting Act is clear. New Zealand is the only country in the OECD without an ongoing statutory commitment to regularly reporting on the state of its environment. Yet we brand ourselves as 'clean and green'.

All other OECD countries are bound by a European Union Directive and/or have their own environmental reporting legislation. Typically, the reporting role is a responsibility of the country's Environmental Protection Agency (EPA), and is thus done with some degree of independence.

An embryonic EPA was created in October 2009 within the Ministry for the Environment. While initial indications suggested that it was likely to become an Autonomous Crown Entity, the current climate of state sector amalgamation suggests that a new stand-alone independent agency may not eventuate, at least in the short term.

There is more than one option for achieving independent state of the environment reporting in New Zealand. Having the EPA remain within the Ministry for the Environment does not preclude it from playing a major role. Many of the functions associated with state of the environment reporting can be performed independently within government departments and ministries.

In a review of the 2007 State of the Environment Report, a past Minister for the Environment, Simon Upton wrote "...when it comes to fearless acknowledgement of results the report seems anaemic to me". It is the fearless acknowledgement of the results of reporting, which seems to me to be the challenge to which we should aspire, regardless of which agencies are involved.



Dr Jan Wright
Parliamentary Commissioner for the Environment



Introduction

Is New Zealand really as clean as our popular image suggests? How can it be established and by what criteria? It is only through a system of gathering relevant information that the question can be answered. Yet establishing just what should be measured, and where and how, is not easy. Around the world many countries continue to grapple with the concept of measuring the health of their environment. Yet the information is vital to allow informed decision making, for central and local government, for non-government organisations, and for individuals.

Measuring and reporting on the state of our environment is an important part of promoting shared stewardship. It provides a way to measure the health of water, land and air, and our native species and ecosystems. Without robust information, good decisions that affect not only the environment, but also the economy and wider society, cannot be made.

1.1 Purpose

This is a report to the House of Representatives pursuant to sections 16(1)(a-c) of the Environment Act 1986. This report investigates the way state of the environment reporting is carried out in New Zealand, and recommends changes that will improve its quality and usefulness.

New Zealand lacks reliable and independent state of the environment reporting. Only two national state of the environment reports have ever been produced: in 1997 and 2007, by the Ministry for the Environment.

This report highlights the critical role good environmental statistics play in enabling quality and useful environmental reporting. Further, the report identifies three key properties that are critical to improving state of the environment reporting in New Zealand:

Independence: Effective and trustworthy reporting must be upfront and honest. To that end the responsible organisation(s) must have a degree of independence from government.

Accountability: Clear accountability requires statutory compulsion. The history of national state of the environment reporting in New Zealand has been one of 'stop-start' progress. The responsible organisation(s) must be required under law to report on the state of the environment at a national level.

Technical capacity: Trust in environment reporting relies on an expectation that the organisation(s) concerned actually has/have the capacity to carry out the required work. The capacity to work raw environmental statistics into forms that are suitable for a state of the environment report is critical.

1.2 Structure

Chapter 2 outlines a short history of New Zealand's state of the environment reporting. It also briefly covers how the reporting is currently done in New Zealand.

Chapter 3 explains why reporting on the state of the environment should be embedded within an ongoing environmental statistics programme, and not be treated as a separate exercise.

Chapter 4 discusses three fundamental features of state of the environment measuring and reporting that are required in order that the information be useful and trusted.

Chapter 5 illustrates the points raised in Chapter 4 using the example of a key indicator of water quality, namely phosphorus in freshwater.

Chapter 6 considers the key properties an organisation must have to be able to undertake reliable and regular state of the environment reporting.

Chapter 7 contains conclusions and recommendations. These recommendations relate to the key points raised throughout the report.

1.3 Background

The writing of this report was motivated by criticisms of the Ministry for the Environment's 2007 State of the Environment Report. The report had a number of key fundamental problems.

The purpose was not clear

It was not clear from the 2007 State of the Environment Report what its purpose actually was. The report's preface indicated it was trying to fulfil many functions. These included reporting on the state of the environment, setting environmental benchmarks, supporting decision making, and highlighting changes to government policies and monitoring efforts.¹ All these functions require outputs or products with different structures and focuses.

Some information was not useful

The way some of the information in the 2007 report was analysed and presented created real concerns. An example is shown in Box 1, where a graph showing concentrations of phosphorus in rivers does not tell us whether that particular problem is getting better or worse.

Some information was not trusted

As source of mistrust was the way some of the information in the 2007 report was obtained. For example, the inclusion of examples of local and central government programmes aimed at addressing environmental problems was viewed by some as being at odds with objective reporting of data.

The report was not independent

The removal and then subsequent release of the draft conclusions chapter by the Ministry for the Environment created real concerns about the independence of the report. Former Minister for the Environment Simon Upton was one of several voices who noted the need for independence. He commented:

"Perhaps the next one – hopefully in five years – should be overseen by the Parliamentary Commissioner for the Environment." ²

There were significant gaps in information

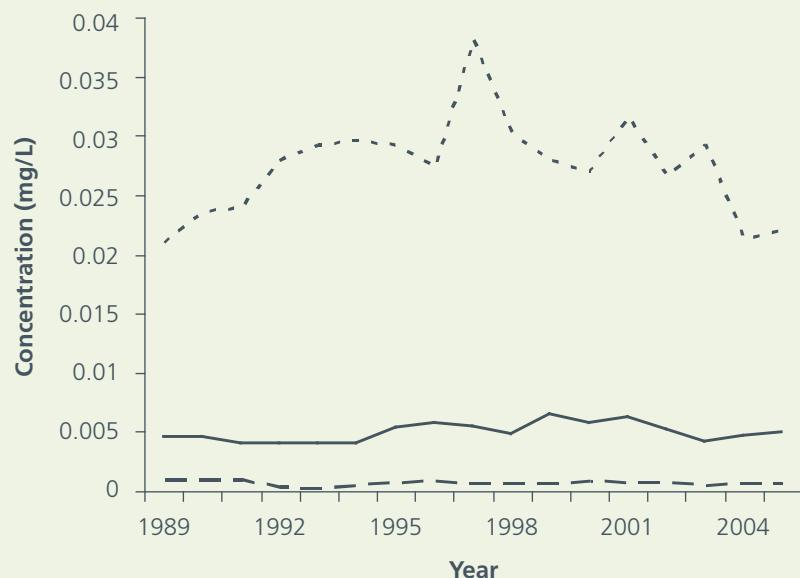
A plethora of organisations collect environmental data across the country. However, in many cases the collection, analysis, and presentation methods are not the same, and the data cannot be easily pulled together into a useful national dataset. This was the case for the 2007 report, where the Ministry for the Environment often had to make do with whatever limited – and less useful – data it could gather.

Box 1: Reporting of phosphorus in rivers in the Environment New Zealand 2007

The 2007 State of the Environment report attempted to illustrate the concentrations of phosphorus in a sample of rivers across the country. The average level of dissolved reactive phosphorus at each site was calculated from measurements taken over the year, and the sites were ranked from lowest to highest. This exercise was done yearly.

The data was then analysed and graphed (see below) to give an idea of the levels of phosphorus in the 'average' river, as well as in the most and least polluted rivers. However, because all of the samples sites were re-ranked each year, the lines do not represent phosphorus concentrations in the same river. As a result it was not possible to:

- identify which rivers were the 'best' or 'worst'
- tell whether conditions were improving or not
- determine what might be causing the results



1.4 What this report does not cover

This report is not a detailed and exhaustive scientific evaluation of current analyses or datasets related to national state of the environment reporting.

It is not a study of current environmental policy, or of whether environmental measurements have been used appropriately to design or evaluate environmental policies or laws.

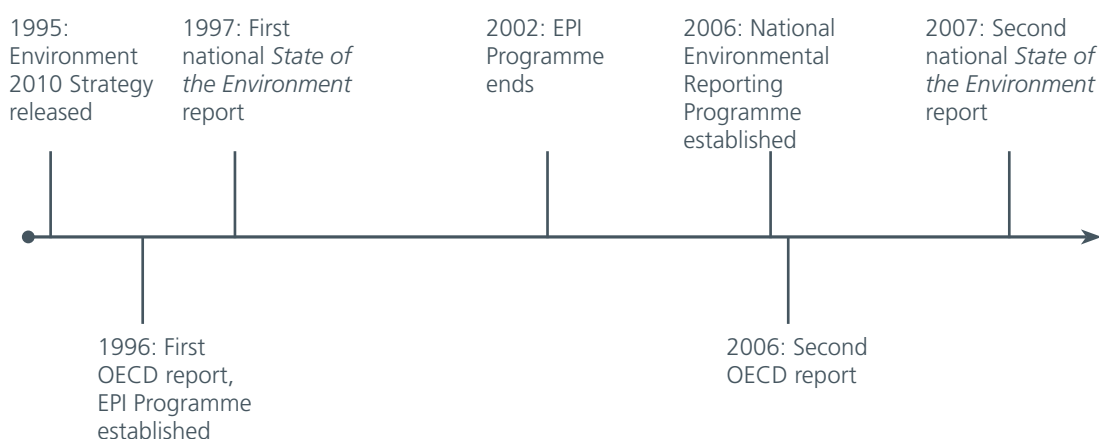


A short history of environment reporting in New Zealand

State of the environment reporting in New Zealand has been a stop-start affair (Figure 1). As early as 1981 the OECD called for organised and mandated national environment reporting in New Zealand.³ That advice has never been implemented. The two state of the environment reports since (in 1997 and 2007) suffered because of the lack of good data and good centralised processes.

The Ministry for the Environment (MfE) has been the main agency responsible for the overall management and use of national environmental data. In general, the Ministry does not **collect** primary environmental data – rather it **collates** data and indicators collected by other agencies.⁴ The agencies include local government (district and regional councils, unitary authorities), Crown Research Institutes,⁵ and central government (including the Ministry of Economic Development,⁶ Statistics New Zealand,⁷ and the Department of Conservation).⁸ There has never been any specific compulsion on any of those organisations to supply standardised data to, or be responsible for, a national State of the Environment programme.

Figure 1: Timeline of major events relating to New Zealand's national State of the Environment reporting.



2.1 State of the Environment Report 1997

It was not until 1995 that government acknowledged a need for a central and standardised system to measure the quality of the environment. It was realised that information on trends on the quality of the environment was important to provide feedback for policy design.⁹

At the same time, the OECD's first Environmental Performance Review of New Zealand in 1996 noted the continuing lack of good national environmental data. The review also recommended the development of national environmental indicators and the production of a national state of the environment report.¹⁰ The 1996 OECD review and the government's recognition of the importance of environmental monitoring led to the first State of the Environment report in 1997.

This first state of the environment report provided a good overview of New Zealand's natural environment and the pressures it faced. The report was limited, however, by a lack of good environmental data. The authors of the 1997 report found that the data drawn on was in many cases out of date, had limited national coverage, was only collected over a very short time,¹² and was not standardised.¹³ Often the required data simply did not exist.

An attempt was made through the late 1990s into the early 2000s to rectify the problems with existing environmental data by establishing a national indicator programme through the Ministry for the Environment. This initial programme, the Environmental Performance Indicators (EPI) Programme, ran from 1996 – 2002 and made good progress towards building a strong foundation of data collection and reporting. However, since the end of the EPI programme in 2002 there has been limited progress in the development of good environmental datasets.

Box 2: The Environmental Performance Indicators Programme

The Environmental Performance Indicators (EPI) Programme had three goals, namely to:

- systematically measure the performance of the government's environmental policies and legislation
- better prioritise policy and improve decision making
- systematically report on the state of New Zealand's environment.¹⁴

The indicator¹⁵ development undertaken by the EPI team used the pressure-state-response framework for designing and selecting individual indicators.¹⁶ The team had a final core indicator set approved by the Minister for the Environment by the early 2000s. These indicators were a mix of those that were already developed and ready to implement and those that required further development.¹⁷

The Ministry for the Environment established the National Environmental Reporting Programme in 2006,¹⁸ and from this a new core set of national environmental indicators was confirmed. These formed the basis of the State of the Environment Report 2007, which again fell short in many of the same ways as the first report.

2.2 State of the Environment Report 2007

New Zealand's second report on the state of the environment was published by the Ministry for the Environment in 2007.¹⁹ A full list of MfE's current indicators versus the earlier Environmental Performance Indicators set is presented on our website (www.pce.parliament.nz).

The 2007 State of the Environment Report was released just after the OECD conducted its second environmental performance review of New Zealand.²⁰ The OECD noted 'National-level aggregates of data and indicators on the state of the environment and environmental pressures' were scarce,²¹ and said renewed efforts were needed to standardise local data collection methods. This was to help 'data aggregation and periodic reporting of key environmental indicators at national level.'²²

Reaction to the State of the Environment Report 2007 was mixed, and the Ministry for the Environment commissioned an independent end user survey. This consisted of an online survey and two focus discussion groups.²³ While overall the survey provided favourable results, one of the discussion groups was critical of the report.

Some of the criticisms emerging from the groups were:²⁴

- There should be a review of who actually does the report in future, to ensure the independence/validity of the information presented.
- The list of environmental indicators needs to be revisited, to decide the most important indicators on which to focus for the future.
- There needs to be more attention paid to ensuring that the base data needs to be robust, transparent, comparable, and accessible.
- The facts should be separated from the policy.
- Future reports need to contain more regional-level indicators.

NZ IS THE ONLY
OECD COUNTRY NOT
COMMITTED TO REGULAR
ENVIRONMENTAL
REPORTING

Those recommendations confirmed the underlying problems with existing environmental data and indicators. Frequent changes to the programme for determining indicators and collating data meant good long-term data was not available. The coverage and quality of the data available for the 2007 report was variable and indicators had to be selected based on availability of data, not on the merit of the indicator. This severely limited the usefulness of the report. (See Box 3 below for an example.)

Box 3: The difficulty of drawing conclusions

The effects of drawing conclusions based on limited data can be seen in the chapter on fresh water in the State of the Environment Report 2007. One of the key indicators (consisting of six separate variables) was drawn from the National River Water Quality Network run by NIWA. The network uses only 77 sites on 35 rivers. In comparison, there are hundreds of monitoring sites on rivers around the country run by local and regional councils. By using such limited data only very broad national-level conclusions can be drawn.

From the way the 77 sites were analysed and presented in the state of the environment report, it was not possible to tell if the quality of freshwater was improving or getting worse. Indeed it was not possible to say if concentrations had gone up or down at a particular site. There were no formal trend analyses presented in the report (although they were conducted and contained in a background report²⁵), and the graphs didn't show changes in individual rivers.

2.3 Current environment reporting practices

Since the publication of the 2007 report, the Ministry for the Environment has continued to hold responsibility for the National Environmental Reporting Programme. It has identified some of the problems with national state of the environment data: problems with national coverage of datasets, lack of standardisation of monitoring techniques, and the storage and accessing of information.²⁶

The Advisory Committee on Official Statistics has also identified these three issues with the national environmental statistics system run by the Ministry. In addition, the Committee noted that there is no clear mandate for running the national programme, and there is a real need for prioritisation of activities.²⁷

There have been a number of activities underway as part of the National Environmental Reporting Programme since the 2007 State of the Environment Report:

- Frequent updates of the core environmental indicators,²⁸ including some regional disaggregation of data²⁹
- Scoping the development of additional indicators³⁰
- Work to improve the consistency of monitoring and reporting by different agencies³¹
- Developing web-based data availability and reporting³²
- Developing measures of success for the activities of the National Environmental Reporting Programme.³³

The Ministry for the Environment also notes that work is underway to align with the principles and protocols of the Official Statistics System,³⁴ including contributing to Statistics New Zealand's stocktake of environmental datasets, the *Environmental Domain Plan*.³⁵

The current National Environmental Reporting Programme largely picks up on the earlier work of the EPI programme, and is a welcome development.

Regional councils (including unitary authorities) have also been actively considering their role in national-level state of the environment reporting, particularly with respect to how the data they have collected should be used and presented at the national level.

But there are key problems with national state of the environment monitoring and reporting that 'tinkering around the edges' will not fix.

Fundamental problems with the way data is chosen, measured, and made available should be corrected. Also clear statutory guidance on the purpose of national environmental reporting and the roles and responsibilities of different government agencies is needed.

Currently, there are no mechanisms in place to ensure recent improvements to the programme will continue.



Why do we need environmental statistics?

Reporting on the state of the environment is one reason why we need environmental statistics. There are however other reasons for establishing environmental databases. It makes sense to consider these reasons together in order to extract the most value from the data. Because of the importance of data to environment reporting it should be embedded within an ongoing environmental statistics programme, and not treated as a separate exercise.

There is an infinite number of details we can measure about the environment. The challenge is knowing which to measure (see Box 4 for examples).

Fundamentally, there are three main uses of environmental statistics for policy development and they are described in this chapter.

Box 4: Different types of statistics suit different purposes

Environmental statistics can be one of two general types. 'Simple' measurements generally provide information on a single piece of the environment. Examples include concentrations of a nutrient in water, counts of individuals of a particular bird species, and concentrations of sulfur dioxide in the air in different urban areas.

In comparison, composite measurements draw on a number of different information sources to produce an overall summary measure. Examples include the trophic level index (TLI),³⁶ carbon dioxide equivalents (CO₂e),³⁷ and the percentage of harvest fish stocks that are at or above their target level.

The type of measurements needed depends to some extent on the use. Do we want to know about the general health of the environment, what is causing a particular environmental concern, or whether our management is working? Composite measurements are most suitable for measuring overall environmental health (although simple measurements of bioindicators³⁸ can also give a very good picture). But if we are interested in what is causing health to change, then generally simple indicators are needed.

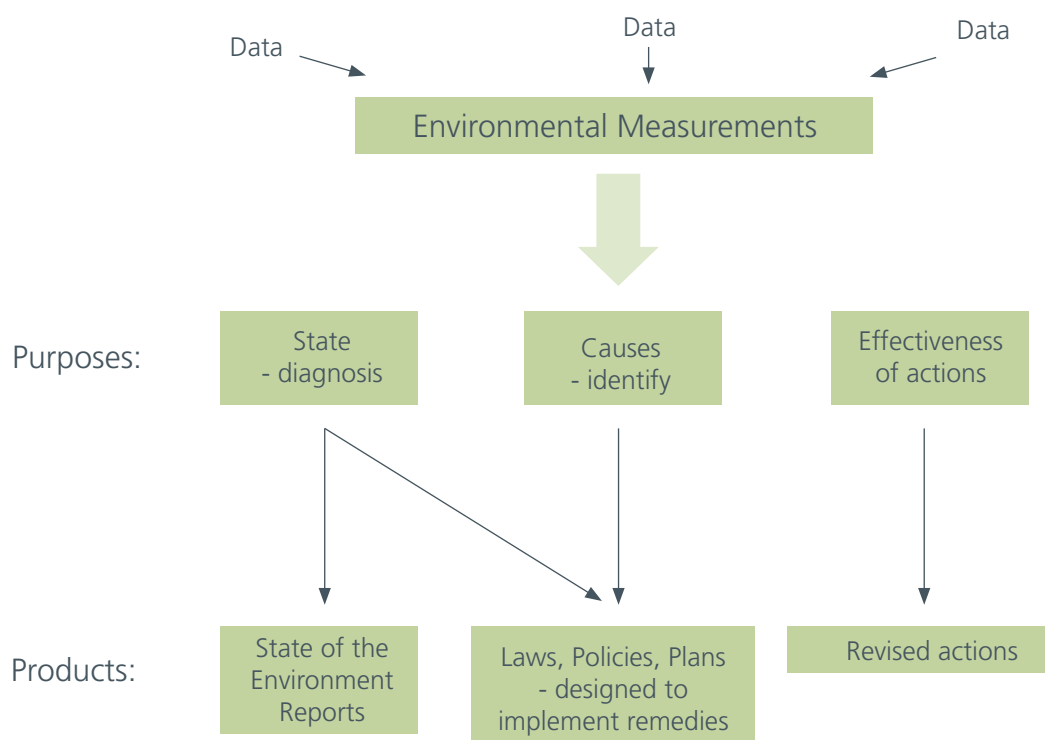
In reality, we need both sorts of statistics. For example, the trophic level index measures several characteristics of lakes, like nutrient levels and visual clarity. This gives an indication as to whether the health of a lake is declining. To determine the cause of any decline, however, supplementary information is required. This includes the lake's physical characteristics, the surrounding land-use, levels of nutrients, and the presence of introduced plants or fish.

Environmental policy should be based on evidence. There are three ways in which environmental statistics should be used to support policy development:

- understanding the state or health of the environment
- identifying causes of environmental change
- determining if our efforts to manage the environment are working.

These three uses are interrelated, as shown in Figure 2.

Figure 2: The framework for environmental data



3.1 Three uses of environmental statistics for good policy

What is the state of the environment?

To manage the environment we first need good information on its current state (or health).³⁹ The example used in the case study in this report is the level of phosphorus in lakes and rivers.

Just as important, however, we need to know if the state is changing. What are the trends in relevant data? We then need to ask whether the current state or trend is such that action needs to be taken.

In order to be of practical use, statistics gathered on the current state and trends in the environment must be fed into the development of policy and management actions.

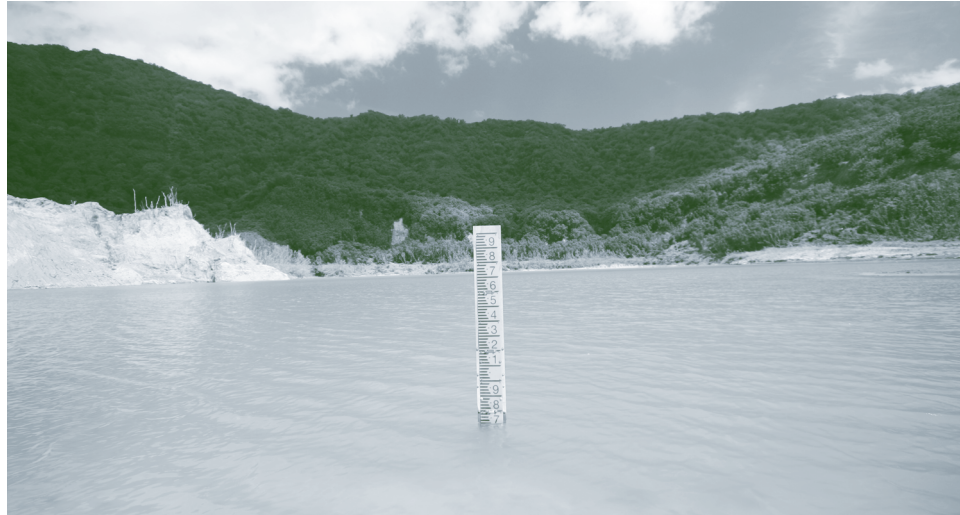
What is causing change in the environment?

If the environment is in an undesirable state, or changing in an undesirable way, we need to know what the causes are.⁴⁰ Is it due to natural variation or human activities?

If the change is natural it may mean we need to prepare to adapt to the situation. If we are causing the problem we need to think about what remedies could be applied. In the case of a problem being caused by both natural and artificial processes, we need to know their relative importance so we know which to focus on.

There are several sources of phosphorus in rivers and lakes: erosion that is partly natural and partly caused by changes in land cover, point sources such as sewage, and non-point sources from agriculture.

Statistics that establish causation can be used to develop good policies and plans. These policies will be much more effective if built on solid evidence of causation, rather than simpler correlations, hunches, or anecdotes.



Source: Department of Conservation

Is our management of the environment working?

Once the health of the environment has been assessed and policies have been implemented to manage it better, we need to know if the actions taken are working. This means periodically monitoring and reassessing the state of the environment and statistical trends.

If actions to reduce the increase in phosphorus concentration in a river are having no effect over the expected timeframe, it is time to review those actions.



Useful and trusted environmental reporting

The focus in the previous chapter was on the three uses for environmental statistics in supporting policy development, with reporting on the state of the environment as just the first of these uses. In this chapter, the focus returns to reporting on the state of the nation's environment.

Three questions about state of the environment reporting are addressed in this chapter.

- What environmental parameters should be measured?
- How should they be measured? Specifically, where, how often, and by what methods?
- How should the information be made available to the public?

4.1 What should be measured?

There is an infinite number of things we can measure about the environment. Given limited resources, how then should decisions be made about what to measure? A clear logical process of prioritisation is required.

We are not starting with a blank page. A great deal of information about environmental problems already exists but too little resource might be dedicated to detailed measurement of an environmental problem that is critical. The reverse may also be true; it is easy to fall into the trap of measuring what **can** be measured easily rather than what **should** be measured.

One set of criteria that could be used to rank environmental problems is the following:

1. Is the problem cumulative? Do successive impacts keep stacking up or is there some natural mechanism that tends to restore the system?
2. Is the problem reversible? This is closely related to cumulative, but allows for the possibility of human restoration of the system through technology and management practices.
3. Is the size of the problem significant? Is it widespread and pervasive, or is it confined?
4. Is the size of the problem accelerating? Does it need to be dealt with urgently?

5. Is the problem approaching some kind of physical limit? Is there a tipping point – a level of the problem that tips the system into another state?

These criteria could be used to provide a high level view of the emphasis to place on different kinds of environmental damage.

The selection of parameters that capture the nature of the problems is a scientific exercise. For instance, is phosphorus in freshwater best measured in total phosphorus or dissolved reactive phosphorus or both?

4.2 How should measurements be done?

Once we have decided what environmental problems to focus on and which parameters to measure, we need to think about how we collect this information. There are three things of importance that need to be considered:

1. **Where to measure:** Choosing locations for taking measurements should be done strategically. For instance, there is no point in regularly measuring water quality in a high country lake in an undeveloped catchment. Only occasional measurements may be required to give a baseline. In some cases, the choice of measurement sites provides an opportunity for establishing causality. For example, sampling water quality in a river above and below a point source of pollution.
2. **How frequently to measure:** To grasp trends in the health of the environment we need repeated sampling to develop time-series. The frequency of sampling will depend on the natural properties of the system and the severity of any impacts. For example, it might make sense to sample phosphorus monthly in a river, but only sample changes in soil quality every ten years.
3. **What methods to use:** It is crucial that the collection and analysis methods for environmental statistics are standardised. This includes what, when, and how samples are collected, how they are analysed, and how they are reported. This is particularly true for reporting on the state of the environment at a national level, given that information often comes from a number of sources.

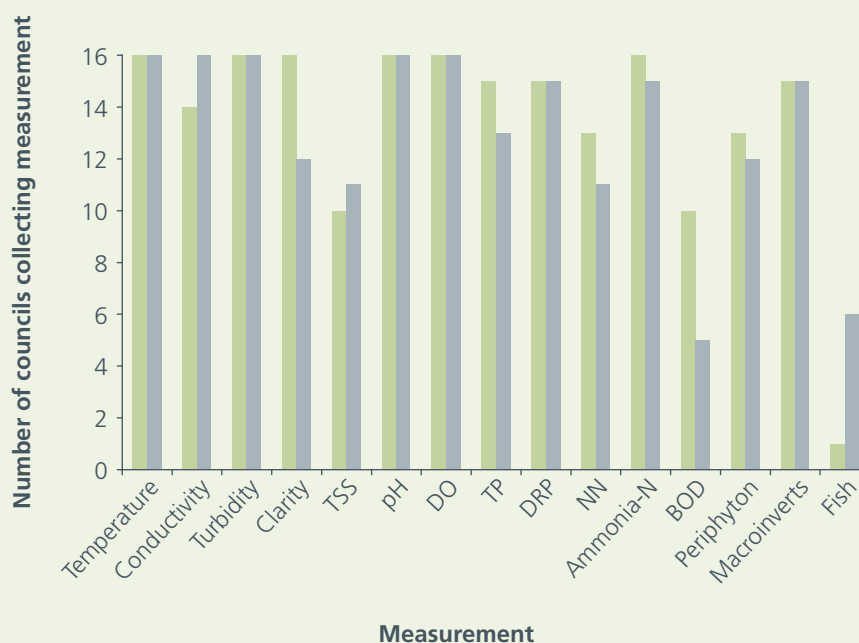
The lack of standardisation of methods among data collectors is a major barrier to effective and efficient national environmental reporting and management. (See Box 5.)



Source: Department of Conservation

Box 5: The problem of inconsistency; variation in regional council monitoring of water quality

The 16 regional councils and unitary authorities differ in what they measure to assess water quality. The figure below shows the number of councils that collect certain environmental data in 2001 (white bars) and 2009 (grey bars). There is little consistency between the councils. In 2009 for example, all councils record water temperature while only five measure biochemical oxygen demand (BOD).



Note: The data in the graph above comes from two surveys of regional councils conducted by the Ministry for the Environment; one in 2001⁴¹ and one in 2009 (unpublished data). TSS = total suspended solids, DO = dissolved oxygen, TP = total phosphorus, DRP = dissolved reactive phosphorus, NN = nitrate nitrogen, BOD = biochemical oxygen demand.

There is also very little consistency in the methods used by councils to analyse their data. In the 2009 survey, two different laboratory techniques were used by the councils to measure BOD, while six different techniques and nine different laboratories were used to determine DRP concentrations.

As a result, very little regional council data is used at the national level. The Ministry for the Environment and Hawkes Bay Regional Council are looking at ways to standardise council sampling programmes to improve the quality and usefulness of the data they collect. These efforts are to be commended, despite being long overdue.

4.3 How should data be made accessible?

Criticism of the 2007 State of the Environment Report was at least partly based on distrust of the data, leading to the call for independent reporting. Another cause of distrust was the way in which data was amalgamated and averaged. Trust in environmental statistics and state of the environment reports can be enhanced by making data generally available and readily accessible to all.

The way to do this is via web-based databases, as Statistics New Zealand does with economic and social statistics.

Data should be presented in standard formats, and users given direct access to non-aggregated forms of the data (for example via downloadable spreadsheets). Technical notes and background information should be provided to enable users to both understand the information and assess its quality.

There are good international examples of how public access to primary environmental data could be made available. A good example is the European Environment Agency's Water Information System for Europe (WISE). It is a web-based resource where users can access a range of water quality data from monitoring stations around the European Union.⁴² Local, regional, and national scale data can all be accessed through interactive maps and pre-defined graphs, or via database files of primary data. The website also contains background information on water quality issues and management, and links to national government departments responsible for managing and regulating water quality in the EU.

This approach could be used to develop a high-value, web-based national environmental data resource for New Zealand. The Ministry for the Environment has begun to make environmental data available on its website, although to a much more limited extent than the EU example described above. Also, underlying problems with the usefulness and overall accessibility of the data itself remain.



A case study: phosphorus in freshwater

In this chapter, the theory of Chapter 4 is illustrated with a real example: measuring and reporting on a key indicator of water quality, namely, phosphorus in freshwater.⁴³

In Chapter 4, three questions were addressed:

- What should be measured?
- How should measurements be done?
- How should data be made accessible?

Each of these questions is addressed in turn, relating to phosphorus in fresh water, in the three sections in this chapter.

5.1 Why should we measure phosphorus in freshwater?

Increased levels of phosphorus can lead to many changes in the state and functioning of lakes and rivers (Box 6). But water quality is affected by many things, so why is it important to focus on phosphorus?

Few would dispute that phosphorus in freshwater is a serious environmental problem. Application of the five criteria in section 4.1 supports this.

1. *Is the problem cumulative? Do successive impacts keep stacking up or is there some natural mechanism that tends to restore the system?*

Phosphorus trapped in a lake binds to soil and sediment and cycles between the lake bottom and the open water, resulting in poor water quality and helping drive annual cycles of algal blooms. Phosphorus in the sediment of a river can be transported down the river. In some circumstances, if the river is prone to frequent flooding, sediment can be flushed out to sea, but the concentration of phosphorus will be determined by flood frequency and the rate at which more phosphorus finds its way into the river.

2. *Is the problem reversible? This is closely related to cumulative, but allows for the possibility of human restoration of the system through technology and management practices.*

It is very difficult to remove phosphorus from lakes. Options include removal of sediment, capping the sediment with phosphorus-binding compounds, and harvesting water weeds that contain phosphorus. All are costly and only partially effective.

3. *Is the size of the problem significant? Is it widespread and pervasive, or is it confined?*

Phosphorus can enter lakes and rivers from a range of sources, including natural weathering of phosphate rock, erosion, urban wastewater, animal effluent, and fertilisers. There are real risks of phosphorus inputs in any developed catchment.

4. *Is the size of the problem accelerating? Does it need to be dealt with urgently?*

The likelihood of phosphorus entering freshwater is generally increasing across the country from continuing erosion, intensification of agricultural production (more phosphate fertiliser and higher animal stocking rates producing more effluent), and population increases (sewage and wastewater).

5. *Is the problem approaching some kind of physical limit? Is there a tipping point – a level of the problem that tips the system into another state?*

Increased levels of phosphorus can contribute to major and sometimes irreversible shifts in the state and functioning of lakes – from clear waters dominated by aquatic plants to murky waters dominated by algae. It is estimated that at least 37 lakes have already undergone this change, and nearly 60 others could be at risk.⁴⁴ The existence of tipping points in rivers is less clear, but many rivers are in poor condition.

Measurements of phosphorus in rivers and lakes indisputably belong in any national state of the environment report. Phosphorus is a key nutrient for aquatic plants. High concentrations of phosphorus, along with other nutrients – particularly nitrogen – in freshwater bodies are undesirable as this can lead to large unwanted growths of water weeds and photosynthetic algae (periphyton).

Box 6: Effects of increased levels of phosphorus (and nitrogen) in freshwater

Excessive growth of water weeds and algae can have adverse effects on the environment. These can include, among other things:

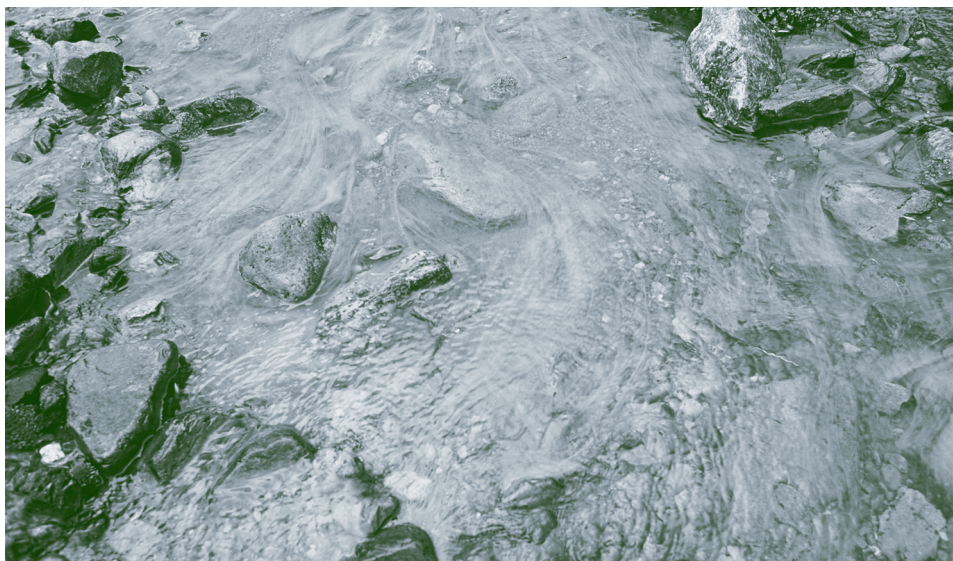
- Some algal species produce toxins (toxic blooms) that can affect animals and people.
- Weeds and periphyton can smother the stream or lake bed, reducing habitat for insects and fish.
- Excessive growth can alter nutrient cycles in water bodies, altering food webs.
- Excessive growth of waterweeds or periphyton can affect recreational activities (such as fishing, boating and swimming) by creating a physical hazard or a visual eyesore.

5.2 How should phosphorus in freshwater be measured?

Recall that in section 4.2 three aspects of how measurements should be done were discussed:

1. Where to measure?
2. How frequently to measure?
3. What methods to use?

This section contains responses to each of these questions for measuring phosphorus in freshwater.



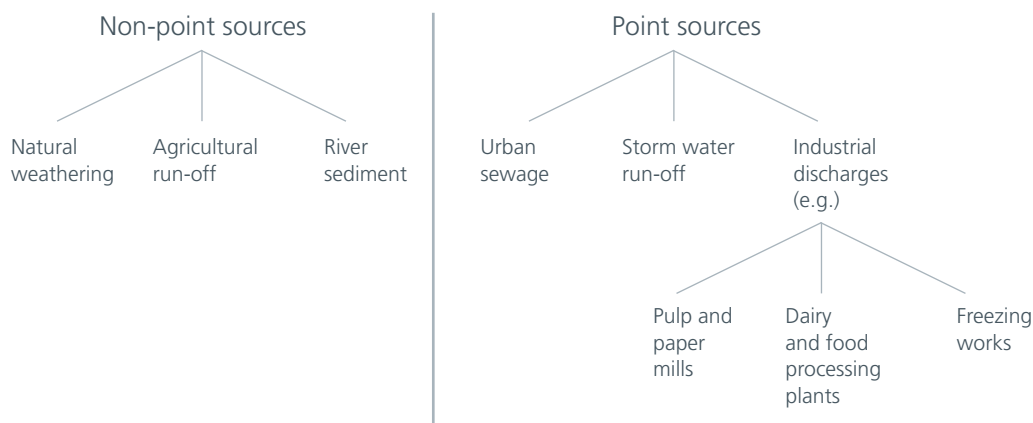
Source: Department of Conservation

Where to measure?

If we want to manage phosphorus in freshwater systems, we need to know where it comes from. Sampling phosphorus in freshwater for reporting on the state of our lakes and rivers should be done in such a way that enables us to identify the causes of the problem. This is the key message from Chapter 3. Reporting on the state of the environment should be embedded within an ongoing environmental statistics programme, and not treated as a separate exercise, in order to get the most value from a sampling programme.

There are three main sources of phosphorus: natural rock weathering and diffuse and point sources (Figure 3).⁴⁵

Figure 3: Sources of phosphorus into rivers and lakes



The relative contributions of different sources of phosphorus can vary. It is worrying that there is very little data available to actually determine the relative sizes of sources of phosphorus for the majority of rivers and lakes in New Zealand.

For phosphorus in rivers, the only significant studies available come from Horizons Regional Council. In the Manawatu-Wanganui region, 33% to 85% of the total phosphorus input into rivers over the year comes from diffuse sources – almost entirely from agricultural runoff.^{46,47,48}

The Environment Bay of Plenty has identified the sources of phosphorus in its 12 special lakes. For example, 43% of the phosphorus entering Lake Rotorua is estimated to come from pasture, 33% from geothermal springs, and 10% from urban areas.⁴⁹

Sampling networks need to account for all the major sources. For rivers this includes sampling above and below a point source – and the point source discharge itself – to determine its contribution to the river. It also means sampling phosphorus concentrations at key sites on the river to account for phosphorus inputs from diffuse sources.

For lakes, information can be readily collected for point source discharges. For diffuse discharges, estimated loadings can be calculated using nutrient export coefficients⁵⁰ and information on land cover and land use within the catchment.

Regional councils are collecting a large amount of information on the environment as part of their responsibilities under the Resource Management Act. All but one of the regional councils and unitary authorities monitor concentrations of dissolved reactive phosphorus in rivers.⁵¹ This information is collected at over 800 sites throughout the country.⁵² The 2007 State of the Environment report, however, only used data from the 77 sites in the National River Water Quality Network.

How frequently to measure?

We want to know if there is a problem with phosphorus in lakes and rivers all the time, or just at particular times of the year. Therefore sampling needs to be conducted throughout the year.⁵³ As we also want to know if the state of the lake or river is getting better or worse, we need to repeat the sampling over successive years. In general, at least five to six years of monthly samples are required to pick up significant trends – and longer if fewer samples are taken each year.

What methods to use?

Once we know where and when we should measure phosphorus, we need to know how we should measure it. Phosphorus in lakes and river systems cycles between a particulate form, attached to the sediments on the river bottom, and in dissolved forms in the river water.⁵⁴ It is one of these dissolved forms – commonly known as *dissolved reactive phosphorus* – that is readily available to plants and algae for growth. Therefore, this form of phosphorus is of particular interest.

The way dissolved reactive phosphorus is measured is important. Standardised sampling methods are required so that measurements from different times and locations are comparable. This standardisation includes ensuring the following:

- Sampling conducted for different purposes uses the same techniques. For instance, monitoring of water quality for state of the environment reporting should not be done differently from monitoring of point discharges for resource consents.
- Different authorities use the same sampling techniques.
- Statistics are calculated the same way and presented in the same units. For example, concentrations of phosphorus from individual samples should be converted to loadings to allow comparison across different rivers and over time.

Nationally there is little standardisation in the way dissolved reactive phosphorus is collected, analysed, and reported on by data providers (see Box 5). This clearly does not provide a sound basis for national state of the environment reporting.



Source: Department of Conservation

5.3 How should data on phosphorus in freshwater be made accessible?

Information on sources and amounts of phosphorus in rivers and lakes must be made generally accessible to the public if it is to be trusted.

The data should be accessible in an un-summarised, un-aggregated form. For instance, the flow-adjusted concentration of dissolved reactive phosphorus⁵⁵ at each site on each sampling occasion should be provided. Important background information should also be available, such as the number of samples that were taken, and the sample collection and analytical techniques that were used.

This can be done through web-based databases where the primary information can be requested and displayed as a spreadsheet. A web-based approach also allows information to be easily displayed in a number of ways, particular if the database is linked to a Geographical Information System (GIS) so that results can be presented on maps.

Advantages of this approach include the following:

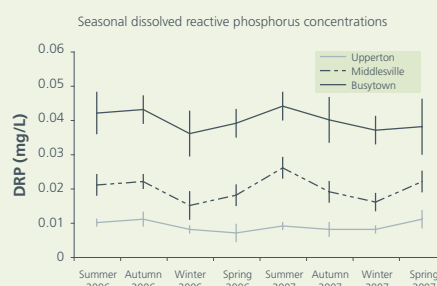
- Information can be scaled up or down, from the individual site, to the river or lake catchment, to the whole country.
- Information can be presented in a number of ways, such as the concentration of phosphorus at the time of sampling or the total annual load of phosphorus over the year.
- Comparisons can be added – concentrations of phosphorus can be compared to regulated guidelines or reference values.

The key features of this approach are that the information can be presented in a range of visual ways – a picture can be worth a thousand words. The underlying data can be downloaded and analysed by anyone. Box 7 contains an illustration of how phosphorus concentrations in rivers in a catchment could be presented.

Box 7: Making information accessible – phosphorus concentrations in freshwater

Site	Year	Average DRP	Standard error	Exceeds guideline?
Upperton	2006	0.009	0.001	No
Middlesville	2006	0.019	0.001	Yes
Busytown	2006	0.039	0.001	Yes

Environmental measurements database



Users of the Ministry for the Environment's environmental reporting website can now access spreadsheets that contain the data used to produce figures on the website. It is though not possible to access the majority of the underlying environmental statistics themselves.

There are some promising developments, however, and moves towards this style of information management and reporting. All 16 regional councils have at least some automatically collected river and rainfall data available on their websites. In particular, Horizons Regional Council has recently launched its WaterQualityMatters website⁵⁶ that uses a map- and graph-based approach to present information on levels of dissolved reactive phosphorus (and nitrogen, bacteria and carbon-based contaminants) in the region's rivers. Users cannot access the underlying data.⁵⁷ Horizons Regional Council is also leading a project to develop a national database that presents water quality data from all 16 regional councils and unitary authorities on one website.⁵⁸

The issues with standardisation of sampling and analysis techniques already identified will still need to be addressed. Nevertheless, these actions are very encouraging and could lead to the development of the representative and useful national-level sampling network that is so urgently required.



Where to for state of the environment reporting?

Critics of the 2007 State of the Environment report suggested independent reporting was required to restore public trust. In this chapter, the need for independence is examined, along with two other requisites for reporting on the state of our environment – accountability and technical capacity.

6.1 Trust - independence, accountability, and capability

Creating and maintaining public trust in environmental reporting requires three characteristics in the responsible organisation(s) - independence, accountability, and technical capability.

Independence: The call for independence following the publication of the 2007 State of the Environment Report was in large part due to the exclusion of the last chapter in the draft – the chapter that contained some conclusions. Effective and trustworthy reporting must be upfront and free from perceived bias.

Accountability: Clear accountability requires statutory compulsion. The history of national state of the environment reporting in New Zealand has been one of stop-start progress. Neither the Ministry for the Environment nor any other agency is required under law to report on the state of the environment at a national level.

Technical capacity: Trust in environmental reporting relies on an expectation that the organisation concerned actually has the capacity to carry out the required work. Working raw environmental statistics into forms that are suitable for a state of the environment report is not a straightforward task.

Reporting on the state of the environment at a national level is particularly challenging for a small country such as New Zealand with high regional environmental variation. Amalgamation and averaging of data from different regions and localities must be done with great care. Something considered an environmental problem in most of the country may be fine in some places.

For example, brown water is generally a sign of fresh water degradation but in some places water is naturally brown because of tannins from surrounding beech forest. Even ensuring that the measurements of a particular pollutant in different regions have been reported in consistent units can require painstaking effort and a commitment to technical quality.

6.2 How does New Zealand compare with other countries?

Compared with other OECD countries New Zealand's current state of the environment reporting is overall less independent, has no statutory compulsion, and lacks the required technical capacity.

Independence

In other OECD countries national state of the environment reporting is more often than not undertaken by institutions that have some degree of independence and are somewhat at arms length from political control.

Table 1 lists 30 OECD countries which have national programmes for measuring and reporting on the state of the environment. In 20 of those countries the programme is run by an institution that has some legislated degree of independence. The degree of independence varies with the most independent being in Denmark where Aarhus University produces the report. In the other ten (including New Zealand), the programme is run by a ministry or government department.

Accountability

New Zealand is very different from other countries. Table 2 shows that almost all OECD countries reporting on the state of the environment at the national level are required to do so. This requirement is by legislation, and/or by a directive from the European Union,⁵⁹ and/or by being a signatory to the Aarhus Convention.⁶⁰ The exception is New Zealand – the country that brands itself as 'clean and green'. An Environment Reporting Act, as proposed by the current Minister for the Environment, would bring New Zealand into line with other OECD countries.

Technical capacity

Most of the institutions that produce national state of the environment reports are large organisations responsible for such operational matters as implementing and enforcing environmental standards. New Zealand would need similar capacity in whichever institution was to undertake the reporting.

Three countries that are a useful point of comparison for New Zealand are Australia, Ireland and Sweden.

6.3 Case studies: Australia, Ireland, and Sweden

Australia

In Australia, the federal government produces a national state of the environment report every five years. The report, produced by the Federal Department of the Environment, Water, Heritage and the Arts, aims to:

*“capture and present, in as accurate and useful a format as practicable, key information on the state of the ‘environment’ in terms of: its current condition; the pressures on it and the drivers of those pressures; and management initiatives in place to address environmental concerns, and the impacts of those initiatives.”*⁶¹

The report uses an *issues-based* approach and reports on general themes, such as Human Settlements, Coasts and Oceans, Inland Waters, Land, and Natural and Cultural Heritage. Data is collated from various sources.⁶²

Independence: An executive panel in the Department of the Environment, Water, Heritage and the Arts determines the overarching process for the production of the report. The development of the report itself is overseen by an independent State of the Environment Committee.

Accountability: The Australian Federal Government is required to produce a national state of the environment report under S 516B of the Federal Environment Protection and Biodiversity Conservation Act 1999. Specifically, the Act requires

1. The Minister [for the Environment, Heritage and the Arts] must cause a report on the environment in the Australian jurisdiction to be prepared in accordance with the regulations (if any) every 5 years. The first report must be prepared by 31 December 2001.
2. The report must deal with the matters prescribed by the regulations.
3. The Minister must cause a copy of the report to be laid before each House of the Parliament within 15 sitting days of that House after the day on which he or she receives the report.

Capacity: Technical work on the state of the environment report is carried out by a project team within the Department of Environment, Water, Heritage and the Arts. The team includes staff from the Department's Environment and Sustainability Reporting Section. The team assists the Departmental Executive and Independent Committee and is responsible for management of the overall process including: developing indicators; identifying, collating and analysing data for the report; and management of the drafting of the report and an independent reviewing process.⁶⁴

Ireland

Ireland produces a national state of the environment report every four years, and produces interim updates at regular intervals in between. The report collates information from a range of sources, and uses indicators to report on state and trends across a series of environmental themes: Climate Change and Air Quality; Water; Waste and Resource Use; Terrestrial Environment and Biodiversity; and Protecting and Managing the Environment.⁶⁵

Independence: The Irish Environmental Protection Agency is an independent public body, formed in 1992 under the Environmental Protection Agency Act. It has an executive board consisting of a Director General and four Directors, and an Advisory Committee of 12 members.⁶⁶

Accountability: The Environmental Protection Agency Act 1992 defines the functions of the EPA, including the requirement to:

*"the monitoring of the quality of the environment, including the establishment and maintenance of data bases of information related to the environment and making arrangements for the dissemination of such information and for public access thereto"*⁶⁷

Capacity: The Irish EPA has a staff of 290 who work in ten locations throughout the country.⁶⁸ As part of the EPA's state of the environment monitoring and reporting activities, the agency is responsible for developing monitoring and data collection techniques, collating environmental data, producing the national state of the environment report and regular interim updates, and hosting environmental data and ensuring it is accessible to the public.⁶⁹

Sweden

Sweden's Parliament has approved 16 high-level environmental objectives that set broad aspirational goals for the country such as Flourishing Lakes and Streams. These objectives are underlain by 72 targets that set specific goals and timelines that must be achieved to reach the overall goals. A range of government authorities have been given responsibility for monitoring progress towards the targets and objectives.⁷⁰ The lead organisation – responsible for ten of the 16 objectives – is the Swedish Environmental Protection Agency (EPA).

Independence: The Swedish EPA is an independent authority created by the Swedish Parliament in 1967. It has a Director General and Advisory Council, and has an annual work programme set out each year by the government.⁷¹

Accountability: The EPA is required to monitor progress against ten of the 16 environmental objectives under Swedish Legislation.⁷² Under these pieces of legislation, the EPA and the other responsible organisations are required to develop indicators that can be used to monitor progress, and to provide information for annual update reports to Parliament.

Swedish legislation also creates an Environmental Objectives Council under the EPA to coordinate the overall process. The members of the council are appointed by the government and include representatives of the organisations that have responsibility for the different objectives, as well as members from outside of central government. The primary role of the Environmental Objectives Council is to coordinate the work of the technical organisations and to prepare reports to Parliament on behalf of the government.⁷³

Capacity: The Swedish EPA is a technically based organisation with a staff of 550 and an annual budget of 37 Million Euro. Its staff includes scientists, engineers, lawyers, economists and social scientists. Ten Advisory Councils, whose function is to advise the Agency of specific matters, are attached to the Agency. The EPA has a wide range of functions and expertise that include, inter alia, regulating environmental activities, setting standards and guidelines, monitoring and reporting on the state of the environment, and researching environmental processes and stressors.

6.4 What is involved in state of the environment reporting

Many different organisations play different roles in building databases of environmental statistics that among other uses provide the foundation for reporting on the state of New Zealand's environment.

The particular tasks involved in preparing a state of the environment report include:

- deciding which data to collect
- standardising methodologies
- collating and storing data from many providers
- converting raw data into indicators that say something meaningful
- analysing data and indicators
- preparing regular reports.

The complexity and magnitude of this work should not be underestimated.

6.5 Who should undertake national environment reporting?

In order to be trusted, state of the environment reporting requires independence, accountability, and technical capacity. There are existing public organisations in New Zealand that collectively could meet those requirements. Three of the most prominent organisations are the Environmental Protection Authority (EPA), the Parliamentary Commissioner for the Environment, and Statistics New Zealand.

Independence

The extent of independence in organisations undertaking state of the environment reporting in other countries varies. In New Zealand, the Environmental Protection Authority, the Parliamentary Commissioner for the Environment, and Statistics New Zealand each has varying degrees of independence.

The *Environmental Protection Authority* was created in October 2009. At the time of its creation, it was expected that the EPA would be fully separated from the Ministry for the Environment and become an Autonomous Crown Entity.

It remains to be seen exactly how the EPA will develop but whether or not it becomes an Autonomous Crown Entity, the EPA could be given some independent functions. It has been clearly established in New Zealand that some functions may be performed independently within a government agency. The planned amalgamation of Archives New Zealand with the Department of Internal Affairs is an example; advice to Cabinet indicates the Chief Archivist will still be independent.⁷⁴

The *Parliamentary Commissioner for the Environment* is an independent Officer of Parliament, and is responsible to Parliament through the Speaker of the House of Representatives. The purpose of the role is to provide independent advice to Members of Parliament.

Within *Statistics New Zealand* the Chief Statistician independently decides on the procedures and methods used to collect statistics. The Minister for Statistics, however, can still direct whether or not certain statistics should be collected.

Accountability

Accountability should be established through statute. This legislation would assign functions to appropriate organisations, and state which functions must be independently performed.

Technical capacity

The Environmental Protection Authority may well be the most appropriate institution to undertake much of the technical work required for state of the environment reporting. The EPA is expected to have the required operational and scientific capability,⁷⁵ in contrast with the policy capability of the Ministry for the Environment.

The Parliamentary Commissioner for the Environment has a small focused staff without the technical capacity to carry out the work that would be required for robust state of the environment reporting. The Ministry for the Environment employed 28 staff and the services of over 200 other people to produce the 2007 State of the Environment Report.⁷⁶ The Commissioner could still play a role such as commenting on and monitoring the quality of the reporting.

Statistics New Zealand is already doing some work on environmental statistics and is very experienced in storing data and making it publicly accessible on the internet.

Table 1: State of the environment reporting in OECD countries – independence?

Countries where the national state of the environment report is produced by an institution with some degree of independence (generally an EPA)	Countries where the national state of the environment report is produced by a Ministry or Department of the Environment
Australia	France
Austria	Hungary
Belgium	Japan
Canada	Luxembourg
Czech Republic	Mexico
Denmark	New Zealand
Finland	Norway
Germany	Republic of Korea
Greece	Spain
Iceland	Turkey
Ireland	
Italy	
Netherlands	
Poland	
Portugal	
Slovakia	
Sweden	
Switzerland	
United Kingdom	
United States of America	

Table 2: State of the environment reporting in OECD countries – accountability?

Country	Legislation	European Community Directive	Aarhus Convention signatory
Australia	Yes	No	No
Austria	Yes	Yes	Yes
Belgium	No	Yes	Yes
Canada	Yes	No	No
Czech Republic	Yes	Yes	Yes
Denmark	Yes	Yes	Yes
Finland	Yes	Yes	Yes
France	Yes	Yes	Yes
Germany	Yes	Yes	Yes
Greece	Yes	Yes	Yes
Hungary	Yes	Yes	Yes
Iceland	Yes	Yes	Yes
Ireland	Yes	Yes	Yes
Italy	Yes	Yes	Yes
Japan	Yes	No	No
Luxembourg	Yes	Yes	Yes
Mexico	Yes	No	No
Netherlands	Yes	Yes	Yes
New Zealand	No	No	No
Norway	Yes	Yes	Yes
Poland	Yes	Yes	Yes
Portugal	Yes	Yes	Yes
Republic of Korea	Yes	No	No
Slovakia	Yes	Yes	Yes
Spain	Yes	Yes	Yes
Sweden	Yes	Yes	Yes
Switzerland	Yes	Yes	Yes
Turkey	Yes	Yes	No
United Kingdom	Yes	Yes	Yes
United States of America	Yes	No	No



Conclusions and recommendations

7.1 A National Environmental Reporting Act

Reporting on the state of the environment has been prone to frequent redirection, accusations of political interference, and hasty collation of available data. Since the publication of the 2007 report, the Ministry for the Environment has worked hard on improving the quality of environmental monitoring – developing some new indicators, standardising some existing indicators, and issuing some updates.

Trustworthy environmental reporting will require independence, technical capacity, and accountability.

New Zealand needs a National Environmental Reporting Act. It is extraordinary that the country in the OECD that brands itself as ‘clean and green’ is the only one that has not made an ongoing commitment to assessing the state of its environment.

A National Environmental Reporting Act should make clear which organisations are responsible for the different tasks involved in state of the environment reporting at the national level. Reporting need not be constrained to large publications every five or ten years. The flexibility provided by the internet allows for updating as data becomes available. Indeed, making environmental statistics freely available on web pages is one form of reporting on the state of the environment.

A National Environmental Reporting Act may also require local government and other information providers to provide standardised data.

I recommend that:

- 1. The Minister for the Environment drafts legislation that mandates regular reporting on the state of the environment by assigning roles and responsibilities to specific public entities.**

7.2 Making the foundation solid

There is a pressing need to rationalise, streamline, and standardise environmental statistics at both the regional and national levels. This is critical to provide a solid basis for environmental reporting. It will also allow for the causes of environmental change to be identified, addressed, and the effectiveness of interventions assessed.

The choice of indicators to measure (and report) is not straightforward. A significant amount of work was done on this in the late 1990s and some work on developing some new indicators is underway. The test of usefulness is whether the data has value, because it has the potential to influence decision making.

Because ‘the sky is the limit’ when it comes to measuring our environment, a review of current data collection programmes may well lead to greater value for money. It is easy to fall into the trap of measuring what can be easily measured rather than what should be measured.

Standardisation of measurement variables, sampling methods, and analysis techniques must be robust. All primary data must be publicly accessible via the internet.

I recommend that:

- 2. The Minister for the Environment ensures that indicators for assessing the state of the environment are reviewed, the underlying environmental statistics are significantly improved, and primary data is made publicly available on the internet.**

7.3 Who should be responsible for what?

Many different organisations will continue to play roles in the collection and analysis of environmental statistics. The preparation of a trusted state of the environment report, however, requires independent reporting and technical capacity, as well as the accountability that would be provided by an Environmental Reporting Act.

The Ministry for the Environment does not meet the test of independence and is policy rather than technically focused.

The Environmental Protection Authority, whether or not it becomes an Autonomous Crown Entity, could have a measure of independence, and is likely to have the technical capacity for standardisation, collation, and reporting. The Parliamentary Commissioner for the Environment is independent but lacks the technical capacity. Statistics New Zealand has an important role to play in ensuring the quality of environmental statistics, and may be well suited to making environmental statistics accessible to the public on the internet.

The exact nature of who does what with regards to state of the environment reporting is a decision for the Minister for the Environment and Parliament after careful evaluation of the exact capacity and resources needed to complete the task.

I recommend that:

- 3. The Minister for the Environment assign the responsibility for state of the environment reporting to an agency or agencies that can provide the required independence and technical capacity.**

Endnotes

1. Ministry for the Environment (MfE), 2007. Environment New Zealand, 2007. Wellington: MfE.
2. Simon Upton (2008). Upton at Large. *The Dominion Post*, 12 February 2008.
3. Organisation for Economic Cooperation and Development (OECD). 1981. *Environmental Policies in New Zealand*. Paris: OECD.
4. This is different from the local government level, where regional councils and unitary authorities have clear responsibilities for state of the environment monitoring and reporting spelt out in s35 the Resource Management Act 1991.
5. For example, information on surface water quality and stratospheric ozone levels collected by the National Institute of Water and Atmospheric Research (NIWA) is used by MfE for national state of the environment reporting.
6. The Ministry of Economic Development supplies MfE with information on energy supply and consumption, and emissions of greenhouse gasses. See Ministry for the Environment (MfE). 2009. *A technical guide to New Zealand's Environmental Indicators*. Report ME 925. Wellington: MfE. <http://www.mfe.govt.nz/publications/ser/technical-guide-new-zealand-environmental-indicators/html/index.html> [Accessed 21 July 2009].
7. Data on household consumption and expenditure. See Ministry for the Environment (MfE). 2009. *A technical guide to New Zealand's Environmental Indicators*. Report ME 925. Wellington: MfE. <http://www.mfe.govt.nz/publications/ser/technical-guide-new-zealand-environmental-indicators/html/index.html> [Accessed 21 July 2009].
8. Data on land cover, land use, protection of marine areas, and distributions of selected native plants and animals. See Ministry for the Environment (MfE). 2009. *A technical guide to New Zealand's Environmental Indicators*. Report ME 925. Wellington: MfE. <http://www.mfe.govt.nz/publications/ser/technical-guide-new-zealand-environmental-indicators/html/index.html> [Accessed 21 July 2009].
9. Section 9: Risks, Priority Setting, Planning and Review Process. In Ministry for the Environment (MfE). 1995. *Environment 2010 Strategy: A Statement on the Government's Strategy on the Environment*. Wellington: MfE.
10. Organisation for Economic Cooperation and Development (OECD). 1996. *Environmental Performance Reviews: New Zealand*. Paris: OECD.
11. Ministry for the Environment (MfE). 1997. *The State of New Zealand's Environment*. Report Number ME 612. Wellington: MfE.
12. One of the key things we are interested in with monitoring the environment is whether things are getting better or worse over time. This requires a time-series of information – repeated samples of the same thing at many times.
13. Ministry for the Environment (MfE). 1997. *The State of New Zealand's Environment*. Wellington: MfE.
14. Johnston, K. and Reid, R. 2005. *Reporting and Review Group functions: Lessons learned from the Environmental Performance Indicators (EPI) programme*. Ministry for the Environment. Internal report.
15. It is not possible to measure every part of the environment that we might be interested in. Instead, we try and choose indicators – simple measures that tell us what is happening in the wider environment. For example, the EPI programme proposed using concentrations of dissolved phosphorus in rivers as a measure of nutrient enrichment.
16. From the start of the EPI Programme the Ministry proposed using the pressure-state-response (PSR) approach (see Ministry for the Environment 1996. *National Environmental Indicators: Building a framework for the core set*. Ministry for the Environment Discussion Document), and the PSR was subsequently adopted for indicator development and reporting. (For example, see Ministry for the Environment (MfE). 2000. Environmental Performance Indicators: Confirmed indicators for waste, hazardous waste and contaminated sites. Wellington: MfE.)
17. *Environmental Performance Indicators Programme Newsletter*, May 2000. Ministry for the Environment, Wellington.
18. In 2006, Cabinet noted MfE's development of an environmental reporting framework; directed MfE to confirm a core set of national environmental indicators, and directed MfE to prepare a national-scale SoE report (Ministry for the Environment (MfE). 2008. *An assessment of how the research, science and technology sector can contribute to strengthened national-scale state of the environment reporting*. Wellington: MfE. Internal Report.)
19. Ministry for the Environment (MfE). 2007. Environment New Zealand 2007. Wellington: MfE.
20. Organisation for Economic Cooperation and Development (OECD). 2007. *Environmental Performance Reviews: New Zealand*. Paris: OECD.
21. Organisation for Economic Cooperation and Development (OECD). 2007. *Environmental Performance Reviews: New Zealand*. Paris: OECD.
22. Organisation for Economic Cooperation and Development (OECD). 2007. *Environmental Performance Reviews: New Zealand*. Paris: OECD.
23. The online survey was completed by 254 people and the two focus discussion groups attended by a total of twelve people. (Peter Glen Research. 2008. *Market Research Study: A review of the Environment New Zealand 2007 report*. Report prepared for the Ministry for the Environment. Wellington: MfE.)

24. Peter Glen Research. 2008. *Market Research Study: A review of the Environment New Zealand 2007 report*. Report prepared for the Ministry for the Environment. Wellington: MfE. http://www.mfe.govt.nz/publications/ser/review-envirozn07_report/html/index.html [Accessed 9 April 2009].
25. Ministry for the Environment (MfE). 2006. *State and trend in the National River Water Quality Network (1989-2005)*. Wellington: MfE.
26. Ministry for the Environment (MfE). 2008. *An assessment of how the research, science and technology sector can contribute to strengthened national-scale state of the environment reporting*. Wellington: MfE. Internal Report.
27. Advisory Committee on Official Statistics. (2010). Advisory Committee on Official Statistics (ACOS) annual report: 2009. Wellington: Statistics New Zealand. See <http://www.statisphere.govt.nz/about-official-statistics/acos/acos-2009.aspx> [Accessed 3 March 2010].
28. Since December 2008, regular 'report cards' have been produced by the Statistics and Geospatial Team and published on MfE's website <http://www.mfe.govt.nz/environmental-reporting/report-cards/>
29. For example, air quality and recreational water quality. See <http://www.mfe.govt.nz/environmental-reporting/about/tools-guidelines/indicators/core-indicators.html> [Accessed 2 February 2010].
30. For example, see Ministry for the Environment (MfE). 2009. *Draft Report – Using biological indicators to determine water quality and ecosystem health for national environmental reporting: A scoping study to inform Ministry for the Environment work in 2009*. Wellington: MfE.
31. For example, in mid 2009, the Ministry for the Environment surveyed regional council state of the environment river water quality sampling programmes. The aim of the survey was to determine the degree of consistency of sampling techniques and protocols used by the councils. Preliminary results were presented at the 3rd Environmental Reporting Forum in October 2009. <http://www.mfe.govt.nz/environmental-reporting/about/partnerships/forum-2009-10-20/> (Further results expected in 2010.)
32. MfE has started to add links to underlying data for its environmental indicators in the Environmental Reporting section of the Ministry's website. The aim is to have all the data used in environmental reporting accessible on the website (Pers. comm., Ms Justine Daw). The Ministry has also made the Land Cover Database (LCDB – see <http://www.mfe.govt.nz/issues/land/land-cover-dbase/>) and Land Environments New Zealand classification (LENZ – see <http://www.mfe.govt.nz/publications/ser/lenz-apr03.html>) freely available online.
33. MfE, as part of its National Environmental Reporting Programme, lists measures of success that will help the Ministry determine if its environmental reporting is 'useful, fact-based and timely' <http://www.mfe.govt.nz/environmental-reporting/about/>
34. For example, an errors policy has been developed for the development of MfE's reporting products (Pers. comm., Ms Kathryn Botherway, Senior Analyst, Statistics and Geospatial, Ministry for the Environment).
35. See Statistics New Zealand (2009). *Stocktake for the Environment Domain Plan: 2010*. Wellington: Statistics New Zealand <http://www.stats.govt.nz/Publications/NationalAccounts/environment-domain-plan-stocktake-paper.aspx> [Accessed 25 March 2010].
36. The Trophic Level Index (TLI) was developed as an indicator of lake water quality. It combines four parameters: total nitrogen concentration, total phosphorus concentration, water clarity and chlorophyll a levels. (Burns, N., Bryers, G. and Bowman, E. 2000. *Protocol for Monitoring Trophic Levels of New Zealand Lakes and Reservoirs*. Report prepared for the Ministry for the Environment (MfE), Wellington. <http://www.mfe.govt.nz/publications/water/protocol-monitoring-trophic-levels-mar-2000/index.html> [Accessed 16 December 2009].
37. The three main greenhouse gases are CO₂, CH₄, and N₂O, all with different abilities to warm the atmosphere. To account for this under the Kyoto Protocol, tonnes of non-CO₂ gases are converted into tonnes of CO₂ that would give the equivalent warming. These are known as carbon dioxide equivalents (CO₂e).
38. Biological organisms such as algae, plants, insects, fish or birds spend all their time in their environment. Consequently they are good assimilators or integrators of environmental conditions, and good indicators of the functioning or health of that system. Bioindicators can provide information on state as well as trends in that functioning over time. There is widespread use of bioindicators in scientific studies and SOE reporting internationally and a growing recognition in New Zealand.
39. 'Ecosystem health' is a widely used but often poorly defined term. In general it can be considered as referring to a situation where the main physicochemical characteristics of a system – such as temperature, water availability, pH, and nutrient levels – are kept within limits compatible with the long-term development and functioning of that system. Note that a 'healthy' ecosystem does not need to be 'pristine' with no introduced species or human impacts; rather the concept is concerned with the overall status and functioning of the system.
40. Many things can be correlated with each other without one being the cause of the other. For example, one could say as ice-cream sales increase, rates of drowning also increase. However, ice cream doesn't cause drowning. The cause of both is more likely to be that over summer, when temperatures are higher, more people are likely to buy ice cream. At the same time more people are also likely to go swimming, increasing the chance of drowning. Carefully designed and controlled experiments are often required to separate correlation from causality.
41. Ministry for the Environment (MfE). 2001. *Survey of Regional Council River Water Quality Monitoring Programmes*. Wellington: MfE.
42. See <http://www.eea.europa.eu/themes/water>
43. There are four general types of freshwater bodies: streams and rivers lakes, wetlands and groundwater. Elevated levels of phosphorus and other nutrients can cause similar problems with excessive plant growth and

changes in functioning in streams and rivers, lakes, and wetlands. Although the chapter focuses on streams and rivers and lakes, most of the problems discussed refer to wetlands as well. For groundwater, increases in nutrient concentrations do not cause the same problems with plant growth or ecological functioning. Excessively high levels of nutrients, however, can lead to human or animal health problems if the water is used for drinking. Additionally, groundwater that is high in nutrients can increase the risk over fertilisation of land if the water is used for irrigation.

44. Schallenberg, M., and Sorrell, B. 2009. *Regime shifts between clear and turbid water in New Zealand lakes: environmental correlates and implications for management and restoration*. New Zealand Journal of Marine and Freshwater Research, 43: 701-712.
45. Adapted from Ledein, E., Aussiel, O. and Roygard, J 2007. *Identifying point and non-point source contributions to nutrient loadings in water ways in three catchments in the Manawatu-Wanganui Region: Technical report to support policy development*. Horizons Regional Council. Palmerston North.
46. Ledein, E., Aussiel, O. and Roygard, J 2007. *Identifying point and non-point source contributions to nutrient loadings in water ways in three catchments in the Manawatu-Wanganui Region: Technical report to support policy development*. Horizons Regional Council. Palmerston North.
47. McArthur K. and Clark M. 2007. *Nitrogen and Phosphorus Loads to Rivers in the Manawatu-Wanganui Region: An Analysis of Low Flow State: Technical Report to Support Policy Development*. Horizons Regional Council, Palmerston North.
48. Roygard, J. and McArthur, K. 2008. *A framework for managing non-point source and point source nutrient contributions to water quality. Technical Report to Support Policy Development*. Horizons Regional Council, Palmerston North.
49. Environment Bay of Plenty 2007. Proposed Lakes Rotorua and Rotoiti action plan: A programme for the long-term restoration of lake Rotorua and Rotoiti's water quality. Environmental Publication 2007/11, Environment Bay of Plenty, Whakatane.
50. Nutrient loss coefficients estimate the average rate of loss of nutrient from a particular land cover or landuse, and are used when it is not practical to physically measure actual rates of nutrient loss. Nutrient loss coefficients are based on measured rates of loss and are usually expressed as kg/ha/year. By multiplying the nutrient loss coefficient of a particular landuse by the area of that landuse, annual loadings into the lake or river from the landuse can be estimated.
51. Ministry for the Environment (MfE). 2001. *Survey of Regional Council River Water Quality Monitoring Programmes*. Report Number TR 70. Wellington: MfE.
52. National Institute of Water and Atmospheric Research (NIWA). 2008. *An Assessment of Regional Council Water Quality Data (1996–2002) in Support of National State of Environment Reporting (ENZ07)*. Report for the Ministry for the Environment, Wellington.
53. Summer low flows versus annual loadings.
54. Phosphorus can be present in lakes and rivers in one of three forms: particulate phosphorus that is bound up to sediment particles; dissolved reactive phosphorus (DRP); and dissolved organic phosphorus (DOP). 60-90% of the phosphorus in a lake or river is present in the particulate form. Dissolved reactive phosphorus is readily available for uptake by plants and algae, while dissolved organic phosphorus needs to be modified by enzyme activity into DRP before plants and algae can use it for growth. (See Parfitt, R. et al 2007. *Best practice phosphorus loss from agricultural land*. Report prepared for Horizons Regional Council. Landcare Research Contract Report No. LC0708/012.)
55. Most water quality measurements are affected by changes in the flow rate – and thus the volume of water – of the river. For example, concentrations of dissolved metals may decrease with higher flow rates, lowering the relative conductivity. Conversely, turbidity may increase at high flow rates due to increased erosion of soil from riverbanks and mobilisation of sediment from the stream bed.
56. <http://www.horizons.govt.nz/default.aspx?pageid=376>
57. As of January 2010.
58. Pers. comm., Jon Roygard, Manager Science, Horizons Regional Council.
59. The European Community is a signatory to the Aarhus Convention. As a result, the European parliament has developed Directive 2003/4/EC on public access to environmental information to meet the Community's obligations under the Convention.
60. The United Nations Economic Commission for Europe (UNECE) Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (The Aarhus Convention) establishes three core rights of the public with regard to the environment: the right to access to environmental information; the right to participation in environmental decision-making; and access to justice. The Parties to the Convention (40 countries are currently signatories to the Convention) are required to make the necessary provisions so that their public authorities (at national, regional or local level) can meet these public rights. The Convention was adopted on 25 June 1998, and came into force on 30 October 2001. See <http://www.unece.org/env/pp/> [Accessed 25 February 2010].
61. See <http://www.environment.gov.au/soe/about.html#legislative> [Accessed 22 July 2009].
62. Beeton RJS (Bob) et al (2006 Australian State of the Environment Committee) 2006. *Australia State of the Environment 2006*. Independent report to the Australian Government Minister for the Environment and Heritage, Department of the Environment and Heritage, Canberra. See <http://www.environment.gov.au/soe/2006/publications/report/index.html> [Accessed 22 July 2009].

63. See <http://www.comlaw.gov.au/comlaw/Legislation/ActCompilation1.nsf/0/7EC1BA887FF2D99FCA2576790019FA1E?OpenDocument> [Accessed 24 July 2009].
64. See <http://www.environment.gov.au/soe/about.html#independent> [Accessed 22 July 2009].
65. Environmental Protection Agency (EPA). 2008. *Ireland's Environment 2008*. EPA: Wexford. See <http://www.epa.ie/downloads/pubs/other/indicators/irlenv/#d.en.25214> [Accessed 22 July 2009].
66. Part 2, Ss 19-28, Environmental Protection agency Act 1992 (<http://www.acts.ie/en.act.1992.0007.1.html>)
67. See <http://www.acts.ie/en.act.1992.0007.1.html> [Accessed 22 July 2009].
68. See http://epanet.ew.eea.europa.eu/european_epas/countries/ie
69. Environmental Protection Agency (EPA). 2008. *Ireland's Environment 2008*. EPA: Wexford. See <http://www.epa.ie/downloads/pubs/other/indicators/irlenv/#d.en.25214> [Accessed 22 July 2009].
70. See <http://miljomal.se/Undre-meny/Vem-gor-vad/Miljomalsansvariga-myndigheter/> [Accessed 1 March 2010].
71. See <http://www.naturvardsverket.se/sv/Nedre-meny/Om-oss/Organisation/> [Accessed 2 March 2010].
72. Government Bill 2000/01:130 *The Swedish Environmental Objectives – Interim Targets and Action Strategies* and Government Bill 2004/05:150 *Environmental Quality Objectives – A Shared Responsibility*. See <http://miljomal.se/Undre-meny/Publikationer-och-bilder/Rapporter/Regeringen/Propositioner-och-regeringsskrivelser/> [Accessed 21 July 2009].
73. Government Bill 2000/01:130 *The Swedish Environmental Objectives – Interim Targets and Action Strategies* and Government Bill 2004/05:150 *Environmental Quality Objectives – A Shared Responsibility*. See <http://miljomal.se/Undre-meny/Publikationer-och-bilder/Rapporter/Regeringen/Propositioner-och-regeringsskrivelser/> [Accessed 21 July 2009].
74. Minister of State Services, Cabinet paper released 25 March 2010, *Next Steps in Improving State Services Performance*.
75. Bluegreen Vision for New Zealand. "... technically-focused Environmental Protection Authority (EPA) ... to fill the implementation gap at the national level..." <http://www.national.org.nz/bluegreens/A%20Bluegreen%20Vision%20for%20New%20Zealand.pdf>
76. Ministry for the Environment (MfE). 2007. *Environment New Zealand 2007*. Wellington: MfE.