

**DEVELOPING BEST PRACTICE IN ENVIRONMENTAL IMPACT  
ASSESSMENT  
USING RISK MANAGEMENT IDEAS, CONCEPTS AND PRINCIPLES**

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## **ABSTRACT**

This thesis argues that the management of environmental impacts has many analogies with the management of risk and practice can be improved by using ideas, concepts and principles found in the management of risk in other spheres of human activity. An overview of the challenges faced by environmental impact practitioners in New Zealand and reinforcement of its importance to the sustainable management of natural and physical resources under New Zealand's Resource Management Act is provided.

Key risk management ideas, concepts and principles drawn from a variety of sources are listed and parallels drawn between these and existing environmental impact assessment practice in New Zealand. From this list a number are selected and opportunities for improving environmental impact assessment practice are explored. A number of opportunities are identified, starting with the need for a common language and methodology amongst practitioners.

Categorisation of impacts to assist transparency of analysis and expression using frequency-consequence curves to aid and promote consistency of decision-making are further areas of opportunity. Risk management has several well-developed techniques for dealing with uncertainty and selection of assessment endpoints. The connection between communication of risk and public perception is an area with significant potential for communication about environmental impacts.

Challenges with effective public participation in environmental decision-making are backgrounded and risk management practised in two high profile areas examined for opportunity for improved practice. Neither appears to offer opportunity for improvement in key decision-making areas.

A relatively new indicator approach towards risk assessment called "healthy systems method" appears to have significant potential for cost-effective analysis of systems of various types and at various levels. This thesis identifies a number of other areas of risk management requiring further research to determine potential for achieving better practice in environmental impact assessment.

## 1 INTRODUCTION

### 1.1 INTRODUCTION OF THE RESOURCE MANAGEMENT ACT 1991.

The Resource Management Act (RMA) was passed in 1991 amidst “high hopes ... that cumbersome and often fragmented planning procedures would give way to a streamlined regulatory system focused on environmental effects“ (Upton, 1998a). When the then Minister of the Environment the Hon. Simon Upton spoke to the third reading of the Bill in Parliament, he described it as providing a framework in which “what people get up to is their affair” (Upton, 1991, cited in Peterson, 1999 p32). It remains their affair until they harm the environment to an extent that warrants intervention. The threshold of intervention is “not predetermined by the language of the Act” (Buhrs and Bartlett, 1993 p130), but established through a process called impact<sup>1</sup> assessment (EIA<sup>2</sup>). The RMA has been described as “the most thorough going, comprehensive effort in the world to achieve integrated environmental policy through impact assessments” (Buhrs and Bartlett, 1993 p148).

Seven years later the same Minister for the Environment lamented “the perception ... that land use restrictions seem to be as extensive as ever” (Upton, 1998a). He is not alone in his criticism. An article appearing in the National Business Review two years earlier stated “... it (the RMA) is expensive, wastes time and can be used in a small-minded way to stop legitimate development” (Knight, 1996 p55). Two years before that a report (Dormer, 1994 p67) prepared for the New Zealand Business Roundtable stated

*The cost of securing approvals is, on the evidence available, higher than was widely anticipated, even allowing for the fact that some in business fail to appreciate that there is now a degree of internalisation of costs previously met by the community.*

These are but a few of the many criticisms directed at the RMA since its inception. Other criticisms, from a range of perspectives (McShane, 1998; McDermott, 1994; Glesson, 1994;

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<sup>1</sup> The term “impact” is synonymous with “effect”. Given the greater international use of the term “impact”, that term will generally be used throughout this thesis.

<sup>2</sup> The Resource Management Act uses the term ‘Assessment of Environmental Effects’ or AEE, which in this thesis is taken to have a meaning identical to the internationally better known term EIA.

Crawford, 1995; Moore and Fairburn, 1999; Slaughter, 2000; Environment Canterbury<sup>3</sup>, unpub.), are set out in Table 1:

**Table 1: Summary of Criticisms Directed at the Resource Management Act**

1. Uncertainty by proponents about what subjects to include in an EIA and to what level of detail;
2. Unreasonable and repeated demands for information by consent authorities;
3. Consent authorities making decisions without adequate information;
4. Consent authorities taking an overly cautious deterministic<sup>4</sup> approach when evaluating effects;
5. Consent authorities inconsistent in their requirements for information and decisions made - over time, between staff and between authorities;
6. Consent authorities failing to notify applications having significant adverse effects;
7. Requirement to obtain written approval from persons proponents do not consider adversely affected, but feel powerless to challenge;
8. Lack of consultation with those who consider themselves adversely affected or interested by a proposal;

What has gone wrong? Are these the unjustified complaints from those who want to gain from the environment at the expense of others, or do they suggest serious shortcomings of the RMA?

The next sentence of the above quote from the report prepared for the Business Roundtable (Dormer, 1994 p68) states: “To a large extent this is due to poor practice on the part of local government”. The next sentence of the article appearing in the National Business Review (Knight, 1996 p55) states: “Such vitriolic criticism is often aimed at the Act. But the acid should remain bottled. Most of the blame lies not with the Act but with those using it”. And the Minister goes on to say “... in some cases, frustration with the Act can be shown to be more a matter of poor implementation than any problem with the law” (Upton, 1998a). Elsewhere he suggests “80% of problems can be blamed on poor practice” (Upton, 1998b). All three deliver a consistent message: blame practice before blaming the RMA.

## **1.2 THESIS ARGUMENT AND METHODOLOGY**

The Collins English Dictionary defines “practice” as “... a usual or customary action”. If the problems with the RMA are due to bad practice, it seems sensible to assume they can be fixed or at least improved through the adoption of better practices. This thesis argues that this is the

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<sup>3</sup> Environment Canterbury has hosted a number of meetings with EIA practitioners and interested parties aimed at improving EIA practice. This reference records a summary of concerns raised at these meetings.

<sup>4</sup> Where risk is expressed as a single point value.



case, and the field of risk management is a valuable source of better practice. It examines some of the responses to criticisms directed at the RMA and EIA generally and argues that risk management has the potential to address at least some of these. It argues that EIA can be viewed as one of many branches of risk management and stands to benefit from an examination of the many other branches.

The thesis examines why, despite the criticism, doing away with the RMA or its main tool EIA is not a feasible option. It discusses the importance of EIA under the RMA at both the strategic<sup>5</sup> and project<sup>6</sup> level. It then outlines some of the uses of EIA including its role in decision-making and how the quality of those decisions is fundamental to addressing the criticisms summarised in Table 1. In particular it highlights the importance of decisions about environmental significance and examines guidance available for making these decisions.

Chapter two provides an overview of key risk management ideas, concepts and principles<sup>7</sup>, drawn from and distilled from many areas of risk management. These will be discussed and parallels drawn with EIA practice, drawing out ideas which could be used to improve EIA. From this process a list of potential opportunities for improving EIA will be created, of which those in Table 3 are discussed in subsequent chapters. A second list in Table 15 is discussed in terms of further opportunities but not discussed in this thesis.

### **1.3 RESPONSES TO CRITICISMS**

In a continuation of his Foreword in McShane's 'Thinkpiece' Upton (1998a) refers to "... practice reviews being conducted by the Ministry for the Environment ... designed to tackle these problems ...". At the same time, government expended considerable effort in proposals to re-draft the legislation and examine institutional arrangements for administering the RMA.

The response of re-drafting legislation and examining institutional arrangements is remarkably similar to that adopted following an international review of the effectiveness of environmental

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<sup>5</sup> Used here to mean policy and plan preparation, but given the RMA definition of 'effect' to include cumulative effect the transition between project level and strategic level EIA is considered seamless.

<sup>6</sup> This term is used to denote a single proposal to use natural and physical resources, irrespective of size.

<sup>7</sup> These terms overlap and are used together to avoid debate about the difference between them. For the purposes of this thesis it is not necessary to separate these terms.

impact assessment (EIA) under the auspices of the International Association for Impact Assessment and a number of governments in 1994. The deliberations summarised in the Final Report (Federal Environmental Assessment and Review Office, 1994) also tended to emphasise the institutional and administrative aspects of EIA practice. Morgan (1998) attributes this to the bureaucratic backgrounds of most of the summit participants. He identifies the need for EIA education as a constant thread running through most of the report and suggests this (lack of education) may have more to do with ineffective implementation of EIA than institutional or administrative aspects.

Before 1991 EIA had been reserved for large-scale projects proposed or authorised by government agencies (Morgan, 1983). After the Resource Management Act took effect in 1991 every application for resource consent required an EIA (s 88 RMA), creating an immediate demand for persons skilled in their preparation. It was predicted that because EIA was so ingrained in the new system, it would become second nature within a short time (Brash, 1991). However reviews (Montz and Dixon, 1993) and surveys (Morgan, 1995) carried out since 1991 suggest the development of skills necessary to meet demand for EIA expertise has not occurred to the degree required. This suggests that one way of achieving better practice is to develop the skills of those involved in the impact assessment process.

But achievement of better EIA practice through skills development assumes that good practices already exist elsewhere. However a review of EIA literature suggests criticisms such as those summarised in Table 1 are also directed at EIA practice carried out in other places and other laws. Questions such as 'how much information to include in an EIA' and 'when is an adverse effect significant' are not easily answered irrespective of the legislative or practice umbrella they are asked under.

If the development of skills based on EIA practice elsewhere does not provide all the answers, are they to be found in other areas? Elms (1998b) asks similar questions of those involved in different areas of risk management. In pursuing an integrated approach towards risk management he emphasises the loss of opportunity that occurs when different areas develop with little 'cross-pollination'. While highlighting the dangers of using techniques developed in one area to address problems in other areas without adequate consideration of differences that might exist, he goes on to say (*ibid.* p1):

*... for different groups to be unaware of the activities and approaches of the others can be a significant loss of opportunity. 'cross-pollination' of ideas can lead to deeper insights, increased capability and a better opportunity to focus on the actual problems being addressed.*

#### **1.4 RISK MANAGEMENT AND ENVIRONMENTAL IMPACT ASSESSMENT.**

An analogy between the processes of risk management and EIA shows they share many similarities. Both involve logical and systematic processes and there is considerable overlap between the two (Morgan, 1998b). Both involve the analysis and evaluation of activities that cause harm to humans and the environment. By some definitions, risk management and EIA are virtually identical processes, defined more by their scope<sup>8</sup> (e.g., Dooley, 1985) than the distinctness of their processes. A number of researchers have examined the application of generic risk management ideas, concepts and principles to EIA (e.g. Burton and Pushchack (1984), Brown (1989), Contini and Servida (1992), Kamrin (1993), Ugoretz (1993) and Carpenter (1995)) while Dooley (1985) examined potential for use of EIA principles in risk management.

This work has no doubt been at least responsible for breaking down boundaries between risk management and EIA, particularly in North America where it is difficult to detect differences in the ideas, concepts and principles used in 'risk' assessment compared with 'impact' assessments. Instead, much of the research examines prospects for 'cross-pollination' between areas of risk management dealing with different subjects, particularly human and ecological health (e.g. Whyte and Burton (1980), Moore and Elliot (1996) and Warren-Hicks (1996)). Others (e.g. Covello and Merkhofer (1993)) have tapped into a much broader range of risk management application to bring about improvements in health and environmental risk assessment.

The blurred distinction between the two processes creates problems when attempting to research existing efforts to bring about better practice in EIA using risk management ideas, concepts and principles. Which ideas belong to risk management and which ones to EIA? This

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<sup>8</sup> The sources of harm, or 'stressors', and the recipient of those sources. For example the scope of EIA under the RMA is defined by the definitions of the words 'effects' (from activities requiring consent) and 'environment' with some important exclusions, such as effects on trade competitors.

together with wide variations in the meanings and uses of terms such as ‘assessment’ ‘identification’, ‘analysis’ or ‘evaluation’ makes it necessary to establish some clear boundaries between the practices of risk management and EIA. Only then can we know which ideas, concepts and principles belong to risk management as distinct from EIA, hence which ones to look at in terms of improving EIA practice.

The Collins Dictionary (McLeod, 1990) defines ‘risk’ as “the possibility of incurring misfortune or loss”. The Australia/New Zealand Standard on Risk Management (AS/NZS 4360:1999) defines ‘risk’ as “the chance of something happening that will have an impact upon objectives. It is measured in terms of consequences and likelihood”. This measure is similar to that used by the Royal Society (1992). Elms (1998b) adds a third component, namely ‘context’, arguing that context may increase or decrease a particular risk depending on ones priorities.

AS/NZS 4360 defines ‘consequences’ as “the outcome of an event or situation expressed qualitatively or quantitatively, being a loss, injury, disadvantage or gain”. ‘Likelihood’ is defined as “... a qualitative description of probability and frequency”. ‘Probability’ is defined as “the likelihood of a specific outcome, measured by the ratio of specific outcomes to the total number of possible outcomes. Probability is expressed as a number between 0 and 1, with 0 indicating an impossible outcome and 1 indicating an outcome is certain”.

Given the need to define terms and the existence of precise definitions in AS/NZ 4360:1999, the definitions contained in that Standard will be used throughout this thesis. However as will be shown in later chapters, the need to consider risk within a given context advocated by Elms (*ibid.*) is absolutely essential for its proper evaluation and may well be what the Standard means when referring to “impact upon objectives” in the definition of risk.

Definitions of EIA within the literature are also highly variable. Given EIA is usually carried out within an imposed framework provided by a lending agency<sup>9</sup> or regulatory body, this thesis will use definitions provided by the RMA for key words such as ‘effect’ and ‘environment’. As indicated earlier, EIA is considered identical in meaning to the term

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<sup>9</sup> The World Bank for example has a list of environmental criteria that must be met and in some recipient countries may be the only applicable standards.

‘Assessment of Environmental Effects’ (AEE) and ‘impacts’ is considered identical to ‘effects’.

The two key words in ‘AEE’ are ‘effect’ and ‘environment’. The RMA defines these as:

*Effect ---In this Act, unless the context otherwise requires, the term ‘effect’ in relation to the use, development, or protection of natural and physical resources, or in relation to the environment, includes---*

- (a) Any positive or adverse effect; and*
- (b) Any temporary or permanent effect; and*
- (c) Any past, present, or future effect; and*
- (d) Any cumulative effect which arises over time or in combination with other effects--- regardless of the scale, intensity, duration, or frequency of the effect, and also includes---*
- (e) Any potential effect of high probability; and*
- (f) Any potential effect of low probability which has a high potential impact*

*‘Environment’ includes---*

- (a) Ecosystems and their constituent parts, including people and communities; and*
- (b) All natural and physical resources; and*
- (c) Amenity values; and*
- (d) The social, economic, aesthetic, and cultural conditions which affect the matters stated in paragraphs (a) to (c) of this definition or which are affected by those matters.*

The above definitions will be used in this thesis, as will the RMA definitions for any other words referred to in the RMA such as ‘minor’ and ‘adversely affected person’.

The Australia/New Zealand Standard defines ‘risk management’ as

*the systematic application of management policies, procedures and practices to the tasks of identifying, analysing, evaluating, treating and monitoring risk*

and ‘risk assessment’ as

*the process used to determine risk management priorities by evaluating and comparing the level of risk against predetermined standards, target risk levels or other criteria.*

The word ‘assessment’ used in the term ‘assessment of environmental effects’ causes much confusion amongst practitioners and participants of resource management. The 1999 version of the Standard replaces ‘assessment’ with ‘evaluation’, a term that for reasons described later has considerable merit when applied to resource management.

From an examination of the above definitions it is not clear what the essential difference is between a ‘risk’ and an ‘effect’. Both have elements of probability, frequency and consequences. An effect does not have a single value – uncertainty, operational error, assumptions made and natural variability all favour a range of estimates for any given effect. Bogardi *et al* (1989) consider that environmental input variables are usually so complex and poorly understood that single value data has no place in environmental decision-making. Morgan (1998 p41) states:

*Strictly speaking, all EIA is about assessing risk: the risk of environmental changes occurring as a result of a proposed activity going ahead, together with the risk of those changes affecting local people in some way.*

He then goes on to say: (p42)

*However, risk assessment is usually taken to mean the study of particular risks to human health and safety linked with ongoing or proposed developments. For instance, risk assessment looks at the potential for, and consequences of, industrial accidents or the possible toxicological effects of industrial processes for employees and local communities. Risk assessment overlaps with EIA when the questions are being asked of proposed activities, but would still retain its distinct identity when looking at those types of risk areas.*

Later (p43) he says:

*Some authors promote an integrated approach that would bring environmental, risk and technology assessments into a single framework. ... While it makes sense to avoid duplication of data collection and analysis where possible, EIA is viewed ... as having a sufficiently distinct focus and set of goals that it can be treated separately from risk assessment, technology assessment, and economic and technical appraisals, especially in the methodological sense.*

Morgan differentiates between risk management and EIA on the basis of sources of risk and assessment endpoints<sup>10</sup>. This is a useful way of delineating between different areas of practice.

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<sup>10</sup> The highest value that can be formally analysed. See Chapter 10 for discussion of assessment endpoints.

AS/NZ 4360:1999 uses a broader definition of risk assessment than Morgan, listing 'environmental issues' as one of a number of applications, ranging from finance to reputation and image issues, to which risk management may be applied (Appendix A).

This thesis will adopt the approach taken by Morgan that EIA can be viewed separately from risk assessment on the basis of its distinct focus and set of goals. In the New Zealand context the focus and goals of EIA are most usefully defined within the imposed framework of the RMA and in particular its purpose and definitions. The distinction on the basis of sources and endpoints allows lines to be drawn around, and connections to be made, between various areas of risk management and EIA practice such as:

- Environmental impact assessment as practised under the RMA, with sources of risk defined by the definition of 'effect' (of activities requiring consent) and assessment endpoints by the definition of 'environment';
- risk management as practised under the Building Act, with sources of risk being 'the construction, alteration, demolition and maintenance of new and existing buildings' and assessment endpoints being 'the health, safety and amenity of people, protect other property from damage, and facilitate the efficient use of energy'; and
- risk management /EIA as practised under the HSNO Act, with sources of risk being hazardous substances and new organisms, and assessment endpoints defined by the word 'environment' which is identical to that described in the RMA.

## 1.5 REASONS WHY RISK MANAGEMENT MAY BE A SOURCE OF BEST PRACTICE FOR EIA

Similarities between the two fields and potential for ‘cross-pollination’ of ideas are not the only reasons why risk management may be a source of best practice for EIA. During the 1970’s a shift in societal concern about environmental issues occurred, from one where the major concern related to gross contamination of air and water – contamination that could be seen and tasted - to concern about human health (Ruckelshaus, 1988). According to Ruckelshaus, the former administrator of the United States Environmental Protection Agency, cancer and its causes became significant influences in our attitude towards environmental contamination (Ruckelshaus, 1988). Rachel Carson’s highly influential *Silent Spring* (Carson, 1962) stimulated many to think about the pervasiveness of manufactured chemicals in the environment and the risks these posed to our health.

Unlike contamination that could be seen, tasted, and generally fixed with existing technology, scientists throughout the world recognised that dramatically different approaches were needed to manage the invisible hazards that might affect public or environmental health (Paustenbach, 1988). The change in approach became one of focusing on risk with a particular focus on quantitative risk analysis. In North America the response was to invest unprecedented sums of money into the identification, evaluation and control of industrial chemicals and wastes (*ibid.*). This investment increased our knowledge of toxicology, industrial hygiene, environmental control, analytical chemistry and the basic sciences related to environmental issues at a rate described as nothing short of remarkable (*ibid.*). Paustenbach continues:

*With this increased awareness came the need to direct our economic and technological resources to solve the environmental and occupational problems. Our first challenge was to prioritise the various hazards. Not unexpectedly, regulators and legislators sought methods to describe these hazards quantitatively. Out of this need to prioritise in an objective manner arose the field of health risk assessment. Risk assessment was soon recognised as a process through which all pertinent scientific data describing a particular problem were brought together so that a comprehensive evaluation could be conducted.*

*A necessary and logical consequence of these assessments was the evaluation of the cost-benefit relation of various clean-up or control options. The presentation of the cost-risk-benefit relation appealed to risk managers since it helped them to evaluate accurately the wisdom of spending various sums of money.*



*By 1984 it was clear that the government had identified risk assessment as a critical and integral part of regulatory decision-making. Soon thereafter, risk assessments were required as part of remedial investigation and feasibility studies for the clean-up of hazardous waste sites, to obtain permits for discharging chemicals into waterways or into the atmosphere, for evaluating the reasonableness of proposed regulations, and were used to help determine causation in toxic tort litigation cases.*

Vast resources have been allocated to the research of risk. This has resulted in a large body of knowledge about risk, available to be tapped if one can find the right opening. By breaking down the barriers that exist, EIA can benefit from this vast knowledge, though by some definitions it arguably already is – it would be difficult to argue that ecological and health risk assessments are not already part of EIA.

Covello and Merkhofer (1993) lament the divisions that exist within the various fields of risk assessment in the preface to their book on risk assessment methodology:

*Much has already been written about risk assessment. Epidemiologists write books on how risk assessment is used to explore the factors that influence the distribution of disease in populations of people. Toxicologists write books on how assessment involves exposing animals to risk agents and concluding from the results what risks people might experience if similarly exposed. Engineers write books on how risk assessment is utilised to estimate the risks of constructing a new facility such as a nuclear power plant. Statisticians write books on how risk assessment may be used to analyse mortality or accident data to determine risks. There are already many books on risk assessment - the trouble is that they all seem to be about different subjects.*

Despite the diverse range of applications, Covello and Merkhofer (1993) are able to bring together all the methods used for assessing risk into a common framework, demonstrating how the various methods relate to one another – a practical example of the ‘cross-pollination’ of ideas promoted by Elms (1998b).

Such ‘cross-pollination’ has also occurred in the joint Australian/New Zealand Standard on risk management (AS/NZS 4360:1999) which covers an even broader list of applications – from construction activity to environmental issues; finance; and even reputation and image issues. The Standard, widely recognised as a watershed document in risk management and in the process of being adopted as a template in other jurisdictions such as the U.K. (Crawford, 2000), provides a common framework by which the risk in each of these activities may be

managed, allowing each application to benefit from insights and understandings gained from other applications. As Covello and Merkhofer (1993) continue in their preface:

*This (creating a common framework through the book) produces four important benefits:*

*First, it provides a comprehensive reference for risk assessment. This one source offers readers concise explanations of the many methods currently available for describing and quantifying diverse types of risk.*

*Second, it consistently evaluates and compares available risk assessment methods and identifies their specific strengths and limitations. Understanding the limitations of risk assessment methods is important. The field is still in its infancy, and the problems with available methods are disappointingly numerous. At the same time, risk assessment is being used. Correctly interpreting risk assessment results requires understanding the limits of the risk assessment methods that are employed.*

*Third, this book provides useful guidance for planning and conducting risk assessments. Organised by the basic steps used in all risk assessments, it shows how methods successfully applied in one area (e.g., assessing the risks of nuclear power plants) might be modified to apply to another area (e.g., assessing the risks of cars lacking air bags).*

*Finally, this book provides a generalised way of thinking about risk and risk assessment. The models introduced serve as conceptual aids, helpful in learning to think about risks and how they can be quantified. The terms, definitions, and concepts provided clarify the common aspects of all risks and risk assessment methods.*

Clickman and Gough (1990, cited in Slaughter, 2000 p17) also mention benefits risk management may bring to decision-making, stating that:

*Risk assessment is a scientifically disciplined way of analysing options, allowing an opportunity for reducing mistakes or maximising opportunities. Risk assessment is used in environmental decision-making situations as a systematic and unbiased aid where uncertainty is specifically acknowledged ... so consistency of decisions can be improved*

Table 2 summarises reasons why risk management may be a source of best practice for EIA.

**Table 2: Reasons why Risk Management may be a Source of Best Practice in Environmental Impact Assessment**

1. Risk management deals with the evaluation of significance, at the heart of many of the criticisms set out in Table 1;
2. Risk management provides methods for dealing with variability and uncertainty;
3. Risk management provides a logical and systematic framework for the management of consequences similar to those considered under EIA;
4. Risk management has a broad range of applications, allowing for 'cross-pollination' of ideas and insights;
5. Risk management is supported with a large body of research and case studies covering areas relevant to EIA.
6. Risk management has a longer history<sup>11</sup>.

## **1.6 BENEFITS OF ENVIRONMENTAL IMPACT ASSESSMENT.**

Given the problems experienced with EIA, it is perhaps presumptuous to look at ways of improving it when one solution, favoured by at least some, is to do away with it. After all EIA is a relatively recent phenomenon and even now some countries do not practice it. Some do not have the infrastructure and some do not have the professional capacity, while others such as Russia had the infrastructure but abolished it. (Goodland, 2000). Why persist with EIA, if it has so many problems? Before looking for ways to improve EIA it is worthwhile examining some of its benefits to ensure any efforts at developing better practice are worthwhile.

This Section examines the benefits of EIA at three levels – the individual project level; the strategic level; and as a mechanism for resolving conflict resulting from competing expectations within civil society<sup>12</sup>.

### **1.6.1 INDIVIDUAL PROJECT LEVEL**

Below are five examples of large engineering projects where EIA failed to predict all the environmental consequences of the projects for which they were prepared. Four relate to the construction of dams (or type of dam, in the case of the Woolston floodgate), which feature prominently in EIAs the world over. A landmark report recently produced by the World

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<sup>11</sup> Covello and Mumpower (1985) trace health risk assessment back to the Asipu who lived in the Tigris-Euphrates Valley about 3200 B.C. The Babylonian King Hammurabi who lived around 1800 BC is commonly cited as the first to have issued a Standard for the construction of buildings, requiring the builder's son be put to death if the building they constructed fell down and killed any occupants. No doubt this Standard promoted the early development of the concept of safety factors in design and construction.

<sup>12</sup> Where those that govern do so with the consent of the governed.

Commission on Dams noted the positive contributions from large dams have in many instances been marred by significant negative social and environmental impacts (WCD, 2000).

Many of the problems of past dam projects identified by the Commission find their origin in the absence of proper impact assessment procedures during the planning phase or inadequate compliance with impact assessment recommendations.

### **Aswan High Dam**

Between 1960 and 1970 the Egyptian government oversaw the construction of the largest earth dam in the world, the Aswan High Dam (Figure1), damming the River Nile so its waters could be retained for irrigation and used to generate electricity (Dubowski, 1997) An EIA was completed for the project and while this predicted many of the environmental consequences resulting from the dam, it failed to predict the extent to which soil productivity would suffer from salination and loss of fresh silt deposits; the rapid reduction of generating capacity resulting from build-up of sediment behind the dam; increased coastal erosion; loss of sardine and shrimp fisheries in the Levantine Basin; and increased incidence of disease resulting from proliferation of snail species (*ibid.*).

Figure 1: Aswan High Dam, Aswan, Egypt.

### **Lower Waitaki Dam**

The New Zealand government oversaw the construction of a dam to generate electricity at Kurow on the Waitaki River (Figure 2) as a 1930's depression era project. The present form of the River has been largely determined by a more vigorous flow regime, characterised by the lower river berms and islands being mantled with lighter gravels, sands and silts than the relic bed. Flow fluctuations and persistent high flows characteristic of power generation were not part of the natural river flow pattern and consequently play havoc from time to time (Hall, pers. comm.) An EIA would have identified these features and provided a basis for establishing a flow regime that protects the protection layers within the bed of the river. The EIA would also provide a benchmark by which to monitor the effects of the dam and its operation.

Figure 2: Lower Waitaki Dam, Kurow, New Zealand.

### **Opuha Dam**

An EIA was prepared for a proposal by a private consortium to dam the Opuha River (Figure 3) in South Canterbury, New Zealand. However the EIA failed to predict the extent to which the inundation of fertile farmland would result in the enrichment of the newly formed Lake

Opuha, causing the Lake water to become starved of oxygen. This in turn resulted in extensive fish kills, loss of potable water for community supply and reduction of amenity value for Lake users (Meredith, 1999).

Figure 3: Opuha Dam, South Canterbury, New Zealand.

### **Woolston Cut**

A dam of consisting of a series of movable floodgates was used to solve an adverse environmental effect resulting from works carried out on the Heathcote River in Christchurch, New Zealand. A loop of this meandering lowland river was effectively isolated by construction of a canal to enhance removal of floodwaters from an area of the city subject to periodic inundation with floodwaters. The river discharges into a tidal estuary and saline water was able to flow further up the river as a result of the canal. This caused damage to vegetation including the death of mature willows with significant amenity value growing along the banks of the river for more than 1.5 km upstream of the canal, as well as promoting bankside erosion by creating conditions favourable for a species of burrowing mudflat crab (*Helice crassa*). Although the EIA for the project had identified some adverse effects associated with increased salinity upstream of the works (Christchurch Drainage Board, 1978), it underestimated the longitudinal extent of environmental damage by a factor of eight (Robb, 1993).

The solution was to construct a low dam within the canal (Figure 4), forcing saline water to continue along its normal course under normal conditions but allowing floodwaters to flow through the canal and over the dam at times of high flow.

Figure 4: Dam in Woolston Cut, Heathcote River, Christchurch, New Zealand.

### **High Temperature Incineration**

Along with dams, the disposal of human waste can also cause significant damage to the environment. High temperature incineration (Figure 5) is a popular alternative to landfilling, particularly for sensitive waste such as medical and quarantine waste. At the time of writing this thesis there are five such incinerators in New Zealand, in Auckland, Wellington, Christchurch and Dunedin. All have been, or are, under review because the original EIA failed to identify the threat to human health posed by the family of chemicals known as

dioxins. Fortunately the RMA (s128) provides opportunity for consent authorities to review conditions of consent in circumstances where adverse impacts require additional mitigation.

Figure 5: High Temperature Incinerator, Christchurch International Airport, Christchurch, New Zealand.

### **1.6.2 STRATEGIC LEVEL ENVIRONMENTAL IMPACT ASSESSMENT**

While perhaps a more recent phenomenon, strategic level EIA is becoming increasingly common as a tool for determining the sustainability of large-scale human activities of both government and non-government supported programmes of all kinds (Thissen, 2000). A strategic level EIA can take many forms. In New Zealand, because the RMA defines effect to include cumulative effects, there is a seamless transition between project level and strategic level EIA .

Strategic level EIA may be used to address the environmental effects resulting from a particular sector such as the sustainability of land use practices, or to implement international commitments, described briefly in the following sections.



### **Unsustainable Land Use**

History is marked with examples of civilisations that have prospered and failed; e.g., the Sumerians of Northern Mesopotamia; Romans in Northern Mediterranean; and Maya communities of South America. While the reasons for failure are often complex (Kennedy, 1988) available evidence suggests the way these three civilisations used and managed their land had a major influence in their eventual demise (Ponting, 1990).

Each of these civilisations developed efficient farming practices that allowed a high proportion of their population to engage in non-agricultural activities. As a consequence each became highly urbanised, placing greater demands for food from areas close to their cities (*ibid.*). Development of marginal land, overcropping and irrigation were used to maximise production of food to satisfy increasing demand. When the land could no longer support this level of demand there were immediate consequences for the dependant communities. Fortunately many of the affected communities were able to migrate to other areas (*ibid.*), avoiding mass starvation.

These civilisations had the luxury of migrating to other areas when their land use practices became unsustainable. With increased globalisation of food production and consumption, and many effects on the environment (ozone, greenhouse gasses) being global in nature, we need EIA to forewarn us of the consequences of our actions so we can take action while there is time.

### **International Responsibilities and Leadership**

New Zealand considers itself a responsible member of the world community, being an inaugural member of the United Nations. It is party to a number of Multilateral Environmental Agreements such as The Rio Declaration on Environment and Development; Agenda 21; The Forest Principles; The Framework Convention on Climate Change; The Convention on Biological Diversity; and The Montreal Protocol on Substances that Deplete the Ozone Layer.

Commitment to such agreements by individual sovereign nations is far from universal, but New Zealand has shown leadership by working towards early ratification and development of

many programmes for implementation of international commitments. It provides regular reports to the United Nations Commission on Sustainable Development, reviewing progress made since the United Nations Conference on Environment and Development in Rio in 1992. Implementation programmes are heavily reliant on strategic level EIA to determine their most appropriate design to deliver expected outcomes. New Zealand has made an environmental stand on the international stage and needs to ensure commitments translate into effective action. To do that, it needs effective EIA.

### **1.6.3 RESOLUTION OF CONFLICT BETWEEN COMPETING INTERESTS**

There are other reasons why New Zealand needs effective EIA. These stem from the expectations of a civil society that values freedom of speech and religion, has a free press, democratic government and independence of the judiciary; having access to its leaders and global information sources, with time to pursue rights and carry out leisure activities.

Each of the above has implications for environmental management. For example having access to global information sources means New Zealanders can carry out their own research and if necessary challenge the accuracy of information used to make decisions. Freedom of religion and a variety of worldviews<sup>13</sup> translate into differing levels of tolerance for the way the environment is used and the level of harm considered tolerable or acceptable. Having time to pursue leisure activities such as fishing and boating means New Zealanders will take greater interest in how others use water resources.

Independence of the judiciary gives New Zealanders the protection afforded by its laws. Two important documents are the Treaty of Waitangi, commonly referred to as New Zealand's founding document, and the Bill of Rights Act 1990. The Bill of Rights Act exists to "affirm, protect, and promote human rights and fundamental freedoms in New Zealand" as well as to "affirm New Zealand's commitment to the international covenant on civil and political rights". In common with the United States of America, Australia and Canada, New Zealand operates

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<sup>13</sup> See Chapter 8.5 for a discussion on worldviews and how these affect reaction to adverse impacts on the environment.

under a common<sup>14</sup> law system and there is right of appeal as well as opportunity to have the Courts review decisions made in the administration of law. New Zealand has an Environment Court, which sits as a District Court and is the final Court of Appeal for decisions on resource consents on matters of technical fact. Appeals may only be made on points of law.

The RMA has given New Zealanders a number of rights, one of which is the right to participate. Interpretation of the RMA by the Courts leaves no room for doubt that management of natural and physical resources is intended to be a public and participatory process. For example in Bayley v Manakau C.C. reference is made to:

*... a policy evident upon reading Part VI RMA, dealing with the grant of resource consents, a general policy must be observed that the process is to be public and participatory. Section 94 spells out exceptions which are carefully described circumstances in which a consent authority may dispense with notification. In the exercise of the dispensing power and in the interpretation of the section, however, the general policy must be observed. A proper application of s94(2)(a) requires the consent authority to consider all aspects of the activity proposed and the effects of that activity on the existing environment. Such an approach is consistent with not limiting rights of objection to any greater an extent than is justified by the words of the Act and to giving effect to the intent of the Act which as Barker J. said in Ports of Auckland v Auckland R.C. [1995] NZRMA 233, 238, favours interested persons having an input into the decision making process”.*

In Murray v Whakatane D.C. the Court decided that:

*... in applying s94 it must be born in mind that the requirements of notice and the wide rights of public participation conferred by the Act are based upon a statutory judgement that decisions about resource management are best made if informed by a participatory process in which matters of legitimate concern under the Act can be ventilated. The scheme of the Act is that the general rule as to non-notification is predicated upon routine applications consistent with the district plan in which the public interest is to be discerned from the plan itself.*

Such ‘policy’ is consistent with both EIA literature and Agenda 21 Principles (Principle10). The right to participate requires a high degree of justification for all decisions made with heavy emphasis on the quality of information used to make decisions, particularly decisions that result in the removal of the public’s ability to participate, through non-notification of

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<sup>14</sup> The body of law based on judicial decisions and custom, as distinct from statute law, practised in many European nations on the continent.

applications for resource consent<sup>15</sup>. Devolution of RMA administration to democratically elected local authorities also has significant implications for transparency and accountability in implementation.

This requires a system of information management that may need to deal with large amounts of complex information, meeting the needs of a range of participants in the EIA process (often referred to as ‘actors’ in EIA literature, e.g. Kornov and Thissen, 2000) with different motivations and perspectives. EIA can provide such a system, hence it plays a central and pivotal role in decision-making under the RMA.

To summarise, EIA is necessary to identify and manage adverse effects of projects on the environment; identify unsustainable practices at a strategic level; monitor New Zealand’s compliance with international commitments; and manage information flows used in decision-making.

## **1.7 LEGISLATIVE FRAMEWORK FOR ENVIRONMENTAL IMPACT ASSESSMENT.**

While some EIAs may be carried out voluntarily, most are carried out within the framework of legislation relevant to the country within which it is carried out, or the framework provided by a lending agency such as the World Bank. In New Zealand most EIA, certainly at the project level, is carried out under the RMA and to a lesser extent the HSNO and Conservation Acts. The RMA forms part of a larger legislative framework designed to give effect to the government’s overall strategy for the environment. This Section contains a quick overview of that strategy before focusing on the administration of the RMA.

The *Environment 2010 Strategy* (the Strategy) set out in Appendix B outlines the principles and issues underlying the Government's approach to environmental policy, and the actions needed to bring about its vision for the environment. Actions are set out in Appendix C. The

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<sup>15</sup> These are required for projects not otherwise allowed by law. Information on resource consents is presented in Section 1.7

Strategy ties in many of New Zealand's key obligations under Multilateral Environmental Agreements.

The Strategy potentially affects every New Zealander, because it relies on individuals and organisations taking responsibility for their effects on the environment. Key legislation giving effect to the Strategy is the Conservation Act, Fisheries Act, Biosecurity Act, Hazardous Substances and New Organisms Act and the RMA. The RMA is the core of the legislation intended to help achieve sustainability. By bringing together laws governing land, air and water resources, the RMA introduces a new, integrated approach to environmental management.

Two central government agencies – the Ministry for the Environment and the Department of Conservation – have key responsibilities in managing the environment, though local government carries most of the responsibility for day-to-day administration. Local government boundaries are largely based on ecological boundaries.

### **1.7.1 RMA ADMINISTRATION.**

Before examining risk management ideas, concepts and principles for opportunity to improve EIA practice it may be helpful to review briefly the use of EIA in the administration of the RMA and what other sources of best practice exist. The RMA's purpose is to promote the sustainable management of natural and physical resources. While it is often hailed as being unique because it is "effects based", it shares this feature with most environmental legislation used around the world, even if the link between prescriptive rules and codes and the environmental effects they are designed to mitigate may have become lost over time. However, it appears to be one of the few pieces of environmental legislation that provides for integration of air, land and water management; the devolution of its administration to regional and territorial authorities; and decision-making through quasi-judicial processes, with provision for appeal to the Environment Court.

The RMA provides two pro-active<sup>16</sup> mechanisms for intervening in the way people may use natural and physical resources: the production of policy statements and plans; and processing of applications for resource consents.

### **1.7.1.1 Policy Statements and Plans**

Environmental Impact Assessment is used to formulate rules (ss32, 68 & 76 RMA) in plans setting out which activities, or effects of activities, will be regulated. Of those regulated, plans can further categorise activities<sup>17</sup> into those that may be carried out subject to compliance with conditions (such activities are referred to as ‘permitted’ by section 68(3)); those requiring resource consent; and activities that are prohibited, for which application for consent cannot be accepted. Deciding which activity falls into which category depends largely on the kinds of adverse impacts produced. At one end of the spectrum are activities having adverse impacts deemed acceptable without limit; at the other end are those producing unacceptable impact, regardless of individual circumstance.

Determining where a particular impact sits on the continuum within this spectrum depends on the significance of that impact. This presents a challenge for decision makers wishing to represent and incorporate the public’s view, because the public seldom holds a single view on the significance of a particular kind of impact. However given the very consultative process followed when preparing a policy statement or plan, the public have significant opportunity for input to ensure their views and information are considered.

If dissatisfied with decisions made, they can be appealed to the Environment Court who will substitute its own decision for that of the initial decision-maker. Such provision for appeal is rare amongst OECD countries and results in considerably greater emphasis on the accuracy and reliability of information used in making decisions, for several reasons. Firstly because the very nature of Court hearings promotes an atmosphere of careful and calm enquiry compared with the sometimes emotive cut and thrust of political debate that can accompany plan formulation. Secondly because evidence presented to the Environment Court can be cross-examined by all parties, unlike that presented to the consent authority (s39(2)(d) RMA). And

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<sup>16</sup> The RMA also provides a range of enforcement tools such as abatement notices and enforcement orders.

<sup>17</sup> Or the effects of activities.

thirdly because Courts are headed by Judges who are answerable only to other Judges and whose sole interest is in the interpretation of law in the light of facts.

Irrespective of whom makes the final decision, the process of preparing a policy statement or plan promotes the full airing of the diversity of views the public may hold about the environment and the significance of impacts on it. At the end of the plan process activities are placed somewhere along the spectrum of no regulation through to prohibition.

### **1.7.1.2 Resource Consents**

The process of applying for and deciding an application for resource consent is similar to the process of preparing a plan, but generally on a much smaller scale. The definition of “effect” to include cumulative and potential effects makes for a seamless transition between the processing of a ‘large’ consent and dealing with that same activity through a planning process. For example dealing with applications for consent to use the coastal waters of Banks Peninsula for marine farming, for which Environment Canterbury received several applications during 2000. Several effects such as those on access and amenity, natural character and effects on the ecosystem including species such as Hector's Dolphin can only be considered cumulatively for all applications including those not yet made.

As for plans, EIAs (s88 RMA) are prepared for a project requiring consent and decisions may be appealed to the Environment Court. However there is one significant difference between planning and consenting processes, a difference with links to many of the criticisms directed at the RMA, particularly the processing of resource consents.

The process of producing a policy statement or plan is always a public one with prescribed processes for involving the public. Similarly, the RMA makes it clear that the process of applying for a resource consent is generally intended to be a public one. However the RMA (s94) allows applications for resource consents to be considered and decided without public notification. The RMA has criteria based on the kinds of impacts a project has on the environment and extent to which persons (including interest groups) are adversely affected to determine whether an application must be publicly notified.

If an application is not notified, there is no ability to make a submission for or against the application or air views at a public hearing. Neither can the decision made be appealed to the Environment Court by anyone other than the applicant. Only the High Court can be asked to review decisions made and where appropriate, refer the matter back to the original decision-maker. The decision to non-notify has important consequences. It is one of four important decisions made by the consent authority – the others being the decision on adequacy of the EIA, the decision to grant or decline and the decision on what conditions to impose on any consent granted.

## **1.8 DECISION-MAKING FOR RESOURCE CONSENTS**

This section deals with decisions made by some of the actors involved in the process of applying for resource consents. Each of the criticisms listed in Table 1 is linked to a decision made hence an overview of decision-making is helpful. This section focuses mainly on formal decision-making, by proponents and consent authorities. Many other actors make decisions and these are discussed in greater detail in Chapter 8.

Proponents of projects initially make the decision on adequacy of an EIA, when they decide:

- what subjects to include in their EIA;
- to what level of detail; and
- which impacts should be avoided, remedied or mitigated, and to what extent.

The consent authority then decides whether the EIA is adequate, defined (s88 RMA) as:

*in such detail as corresponds with the scale and significance of the actual or potential effects that the activity may have on the environment.*

In the process of making this decision several must normally precede it, such as whom to consult when determining adequacy and what information to use when deciding whether more is required. For example, does the consent authority rely on the information supplied or seek advice from Council officers? Does it require a site visit by Council staff? Does it require consultation with neighbours? If the EIA is inadequate further information can be sought and processing of the application is delayed until that information is received.



The second decision is whether the application can be decided without need for public notification. Though the public's views may be sought even if an application is not notified, that input is necessarily limited and selective. The public not consulted misses the opportunity of supplying unsolicited information. Making decisions on whether an EIA is adequate requires careful review of the reliability and completeness of the information supplied. Making that decision without exposing the information used through a public process under an Act with a participatory framework leaves decision-makers exposed to accusation of basing their decisions on incomplete or inaccurate information.

Having decided what information will be used to make the decision to notify or not, the significance of each impact must be evaluated. For each impact a decision must be made to determine whether it is more than minor and whether it may adversely affect persons. As difficult as these decisions are, 95% of all applications for resource consent processed in New Zealand in the two years ended 30 June 1999 were not notified (MfE, 1999).

The third decision is whether the application should be granted or declined and if granted, what conditions will be imposed. If the decision to non-notify the application has been made this decision is normally relatively straightforward. If all adverse effects are minor and any adversely affected person has given their approval, it is highly likely the activity will also be consistent with the sustainable management of natural and physical resources and therefore consistent with the purpose of the RMA.

Each of the above decisions requires the exercise of considerable judgement about the significance of adverse effects. When is an effect significant enough to warrant inclusion in an EIA and how much detail should the EIA contain about it? When is an adverse effect significant enough to cause someone to be adversely affected, and when is it more than minor? Answers to these questions are crucial for the preparation and use of EIAs.

## **1.9 GUIDANCE FOR DECISION-MAKING.**

This Section provides an overview of other sources of better EIA practice. Given the central importance of decision-making about 'significance' as it relates to adverse impacts, it focuses

on guidance for making quality decisions on significance. It starts with an examination of guidance available from within the RMA, then other legislation followed by non-legal sources.

### **1.9.1 LEGISLATIVE GUIDANCE FOR DECISION-MAKING**

The RMA is an administrative law and its administration is subject to a number of principles (Wade and Forsyth, 1994). One is that the exercise of discretion must not be fettered, by for example having policies or guidelines in place that effectively pre-determine the outcome of decisions to be made. There is therefore a potential conflict between desire for certainty and consistency and the fettering of decision-making.

Other principles such as those relating to natural justice also apply to the administration of the RMA. Natural justice requires amongst other matters the absence of bias in decision-making, directing the decision-maker to consider only relevant information when exercising discretion. Such relevant information might include reference to the significance of adverse effects in previous decisions made, or reference to benchmarks of effects known to be widely acceptable.

This section examines the extent to which the law, and its interpretation and application by the Courts, helps develop such benchmarks.

### **Resource Management Act 1991**

The RMA relies on plans to detail what an EIA should contain but in the absence of plans the only criterion against which to judge the adequacy of EIA content is RMA s88 quoted earlier. The RMA does not define 'scale' or 'significance'. Although these are the only benchmarks provided, they have limited use in determining EIA content. At one end of the spectrum an effect may be significant enough to warrant mention in an EIA, but only so that explanation can be given as to why it is of no concern. At the other end an effect may be so significant that it cannot possibly be consistent with the sustainable management of natural and physical

resources. ‘Significance’ is not a fixed benchmark<sup>18</sup> against which an adverse effect can be placed to determine its acceptability.

The RMA also uses the word ‘minor’ to denote an adverse effect on the environment small enough not to require notification of an application; and as a threshold for determining jurisdiction to consider an application for a non-complying activity (RMA s105). It does not define the term ‘minor’.

In 1993 the Environment Court stated (Bethwaite v Christchurch C.C.) that

*the word ‘minor’ is a comparative word meaning lesser or comparatively small in size or importance. The wording of s105(2)(b)(I) does not intend that there should be no adverse effects nor that any effects be minimal. Minor is less than major but could be more than simply minute or slight. Adverse effects could also be made minor by means of conditions.*

In 1995 the Court (Elderslie Park Ltd v Timaru D.C.) referred to minor as:

*lesser or comparatively small in size or importance. Ultimately an assessment of what is minor must involve conclusions as to facts and the degree of effect. There can be no absolute yardstick or measure.*

In 1996 the Court held (Brown v Auckland C.C.) that

*when assessing whether an adverse effect is more than minor there must always be a degree of apparent subjective judgement, although that judgement must be based on an objective assessment of its effects on the environment judged by reasonable members of the community.*

While the above decisions do not give a benchmark – in fact the decision in Elderslie Park Ltd v Timaru D.C. cautions against an “absolute yardstick or measure” – it does provide three important criteria to guide decision-making. Decisions on what is minor must be factually based, objective and reasonable.

A quick overview of a sample of other related legislation follows, to see if legislative guidance on significance is more helpful than that found in the RMA.

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<sup>18</sup> Defined for this thesis as a point on a frequency-consequence curve, for a specific impact type within a specific context. See Chapter 13 for details on frequency-consequence curves.

## **Environmental Protection and Enhancement Procedures 1974**

The Environmental Protection and Enhancement Procedures use the term ‘significance’ to determine the threshold for preparation of an EIA. It provides criteria to guide those making the decision on when a project is “likely to have a significant effect on the human, physical or biological environment” (Procedures, para. 13) but these criteria (*ibid.*) are themselves liberally sprinkled with the word “significance” which is not further defined.

## **Building Act 1991**

The intent of the Building Act is to safeguard the health, safety and amenity of people, protect other property from damage, and facilitate the efficient use of energy. It applies to the construction, alteration, demolition and maintenance of new and existing structures throughout New Zealand.

The Building Act establishes a simple, three-part framework of building controls, namely:

- The Building Act 1991 describes what is covered by building controls and sets down the law for building work in New Zealand.
- The Building Regulations 1992 contain the mandatory New Zealand Building Code and details about the processing of building approvals.
- Approved documents are written by the Building Industry Authority to assist people to comply with the Building Code.

The Building Code, with which all building work must comply, is a performance-based code. It sets out objectives to be achieved, emphasising how a building and its components must perform as opposed to prescription of construction methods setting out how the building must be designed and constructed. The Code is divided into clauses, each clause beginning with an objective such as “safeguarding people from illness caused by infection from contaminated water or food...”. Specific performance criteria for each clause describe the extent that buildings must meet those objectives.

The Building Act uses subjective terms such as “safe and sanitary”, “safeguard people”, “reasonable expectations of any person”, “significant adverse effects on the environment” and “reasonable and adequate provision” which are not further defined by the Act. Nevertheless there appears to be a successful process in place to translate these outcomes into detailed prescriptions covering for example the type, thickness and strength of materials needed to ensure a structure is “safe”.

The Building Act is in many ways a companion document to the RMA, not only in its performance-based approach but also the nature of the outcomes specified. Given the conversion of these outcomes into concrete ‘acceptable solutions’ through the production of the Building Code, a closer look is warranted and will occur in Chapter 8.

### **Hazardous Substances and New Organisms (HSNO) Act 1996**

The purpose of this Act is to

*protect the environment, and the health and safety of people and communities, by preventing or managing the adverse effects of hazardous substances and new organisms. ... All persons exercising functions, powers, and duties under this Act shall, to achieve the purpose of this Act, recognise and provide for the following principles:*

- (a) The safeguarding of the life-supporting capacity of air, water, soil, and ecosystems; and*
- (b) The maintenance and enhancement of the capacity of people and communities to provide for their own economic, social, and cultural wellbeing and for the reasonably foreseeable needs of future generations.*

From both the purpose and principles it is clear the HSNO Act is synchronised with the RMA, taking on board concepts of life-supporting capacity and providing for the reasonably foreseeable needs of future generations. Section 36 of this Act sets out minimum standards for applications to introduce new organisms, as follows:

*Minimum standards---The Authority shall decline the application, if the new organism is likely to---*

- (a) Cause any significant displacement of any native species within its natural habitat;*  
*or*
- (b) Cause any significant deterioration of natural habitats; or*
- (c) Cause any significant adverse effects on human health and safety; or*

*(d) Cause any significant adverse effect to New Zealand's inherent genetic diversity; or Cause disease, be parasitic, or become a vector for human, animal, or plant disease, unless the purpose of that importation or release is to import or release an organism to cause disease, be a parasite, or a vector for disease*

Note again the extensive reference to ‘significant’ without any further definition of that word. Section 9 requires the organisation established to administer this Act, the Environmental Risk Management Authority (ERMA), to:

*establish a methodology (which includes an assessment of monetary and non-monetary costs and benefits) for making decisions under Part V of this Act; and the Authority shall consistently apply that methodology when making such decisions.*

Part V includes section 36.

The methodology has been prepared and approved and refers to a frequency - consequence curve<sup>19</sup> on which the unacceptable boundary is set by s36 and the acceptable boundary will be established through regulation. The main mechanism for establishing boundaries is precedent decisions. Chapter 8 of this thesis contains comments by Upton (1999) on some of the potential dilemmas faced in the application of s36 and in particular the determination of what is ‘significant’.

### **Overseas Legislation**

In the United States the threshold question of whether an EIA is required has generated more litigation than any other aspect of the National Environmental Policy Act (Anderson, 1973, cited in Wade and Forsyth, 1994). In Hanly vs. Kleindienst the US Court of Appeals, Second Circuit, laid down a formulary approach about which one commentator notes “there is less to the Court’s test than meets the eye” (Anderson, 1973, cited in Wade and Forsyth, 1994). In a dissenting judgement Friendly CJ is considered more illuminating (Williams, 1997):

*Although all words may be ‘chameleons, which reflect the colour of their environment’ CIR v National Carbide Corp, 167 F2d 304, 306 (2 Cir 1948) (1 Hand J), ‘significant’ has that quality more than most. It covers a spectrum ranging from ‘not trivial’ through ‘appreciable’ to ‘important’ and even ‘momentous’. If the right meaning is at*

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<sup>19</sup> See Chapter 13.

*the lower end of the spectrum, the construction of the [prison] comes within it, per contra if the meaning is at the higher end...*

*The scheme of the National Environmental Policy Act argues for giving ‘significant’ a reading which places it towards the lower end of the spectrum ... It is not readily conceivable that Congress meant to allow agencies to avoid this central requirement by reading ‘significant’ to mean only ‘important’, ‘momentous’, or the like.*

This decision expresses clearly the inability of legislation to give guidance on decision-making on matters of significance, other than to establish criteria and require objective and reasonable decisions to be made, based on the facts. As Elderslie Park Ltd v Timaru D.C. points out there “can be no absolute yardstick or measure” though this could equally refer to the need to consider context<sup>20</sup> as an integral part of the evaluation process and coming to a reasonable decision.

### **1.9.2 PUBLISHED GUIDANCE ON DECISION-MAKING.**

The Ministry for the Environment has published a good practice guide on notification (MfE, 1997) providing useful information to various parties involved in or affected by the non-notification decision. However, it does not provide any guidance on implementation of the decision in Brown vs Auckland C.C. requiring “objective assessment of its effects ... judged by reasonable members of the community”. Neither does the earlier Working Paper Number 6 (MfE, 1996) produced in the same year as the above decision. Again that publication provides useful guidance on the factors to consider when making the decision including criteria that could be considered, noting also the importance of not fettering discretion.

While the guide does not offer any illumination on the development of objective methods for evaluation of significance, it recommends that delegation for decision-making should rest with experienced and relatively few Council Officers as a way of promoting consistency in decision-making.

The Ministry for the Environment has debated internally and through the amendment process whether what is “minor” can be further defined, but the difficulty of defining ‘minor’ in statute

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<sup>20</sup> Context is discussed in greater detail in Chapter 3.

with any precision has prevented pursuit of such definition (Salter, pers. comm). This is understandable, given that too much detail risks offending the legal requirement for decision-makers to apply their minds to each situation and not have their discretion fettered.

The Parliamentary Commissioner for the Environment has also produced publications on addressing EIA practice under the RMA, most recently following a review of practice by three territorial authorities (Parliamentary Commissioner for the Environment, 1995). Each publication ends with a list of good practices useful for as a yardstick for existing practice and improving where it does not measure up. However, the publications do not provide guidance on the benchmarking of adverse effects.

Over the years a number of practitioners have published articles and presented papers at conferences dealing with the evaluation of significance, particularly as it relates to the non-notification or adversely affected person decisions (McDermott, 1994; Glesson, 1994; Crawford, 1995). The primary focus of these papers is the consequences of poor and inconsistent decision-making although some suggestions are made on where practice might be improved.

## **1.10 CONCLUSION AND CASE STUDIES**

In conclusion, EIA is a key tool for implementation of the RMA at both the strategic and project level. Environmental impact assessment is necessary to identify and manage adverse effects on the environment and identify unsustainable practices at both the strategic and project level. It is needed to develop programmes for monitoring New Zealand's compliance with international commitments and manage information flows between actors involved in decision-making.

To help ground some of the ideas generated by the process of drawing parallels between risk management and EIA, three case studies will be used. A brief description of each activity and the environmental effects they might generate follows:



## **INSTALLATION OF BORES TO TAP GROUNDWATER**

A 'bore' is normally made of steel, placed vertically into the ground to provide a direct conduit between the surface and sub-surface strata, commonly a water-bearing layer. A bore may have holes drilled into its side to allow the entry of water, or more often, a screen of slightly smaller diameter is lowered down the bore which is then lifted to expose the screen. Installation of a bore allows groundwater to be removed, either through its own positive pressure or assisted by pumping. The installation of bores may result in a number of effects on the environment including,:

***Noise during installation*** - depending on method and duration of construction, this sharp, steel-on-steel noise can last intermittently for several weeks and travel hundreds of metres.

***Vibration and consequent damage to structures*** - again depending on method of construction, shock waves can be created as the bore is hammered into the ground.

***Placing restrictions on use of surrounding land*** – activities such as the discharge of sewage, stormwater and offal into the ground may be restricted from taking place at locations where groundwater taken from bores could become contaminated.

***Allowing contamination of groundwater*** – by providing a direct conduit between the surface and groundwater, bypassing nature's protective layer of soil, contaminants may enter directly into groundwater. Contamination can also occur if more than one water-bearing stratum is intercepted by the bore and both are screened, allowing contaminated water in one stratum to flow into an uncontaminated one.

***Reducing groundwater pressure*** – allowing water to flow from one stratum to another can also result in reduction of pressure, which may in turn reduce flows into streams and wetlands or result in the need to pump previously free-flowing groundwater in nearby bores.

## **ABSTRACTION OF GROUNDWATER**

Water is typically abstracted from the ground using pumps placed down a bore. The abstraction of groundwater can result in a number of effects on the environment, including:

*Lowering level of water in surrounding bores* – when groundwater is pumped water is drawn towards the point of intake to the bore, causing a localised depression or ‘drawdown cone’. If other bores are located within this area, water level will be lowered, which may in turn cause a range of effects such as reduced water availability and increased pumping charges from the electricity supply retailer.

*Reducing availability of groundwater for other users* – if additional groundwater is taken from strata already used by other abstractors, availability of water by them will be reduced.

*Reducing level of water in streams and wetlands* – if groundwater is hydraulically connected to streams and wetlands, abstraction of groundwater can result in less water in streams and wetlands. This may in turn affect the ecosystems of the streams and wetlands, or users such as canoeists and other abstractors.

## **DISCHARGE OF COMBUSTION PRODUCTS**

Fossil fuels in various forms are burned in a variety of appliances to create heat for warmth and industry. The products of combustion are normally discharged into the atmosphere. This discharge can result in a number of effects on the environment, including:

*Human health effects resulting from the discharge of small particulates* – small particulates, particularly those smaller than 2.5 microns diameter, enter deep into the lungs where they accumulate and cause irritation, especially affecting those with existing problems such as asthma, emphysema and other health problems.

*Human health effects resulting from the discharge of sulphur dioxide* – sulphur dioxide can induce breathing difficulties, particularly for those already weakened by existing problems or vulnerable groups such as the young and elderly.

*Contribution to greenhouse gasses* – carbon dioxide is one of several greenhouse gasses, which together with water vapour, slow down the re-radiation of energy from earth, stabilising the Earth's temperature at a higher rate than it otherwise would be. Burning fossil fuels at a rate higher than the rate at which they are created risks a change in the fine balance of greenhouse gasses necessary to support life as we know it today.

## 2 KEY RISK MANAGEMENT IDEAS, CONCEPTS AND PRINCIPLES AND PARALLELS WITH ENVIRONMENTAL IMPACT ASSESSMENT

### 2.1 INTRODUCTION

This Chapter discusses key ideas, concepts and principles found in risk management and identifies parallels within EIA. The 1998 publication *Owning the Future: Integrated Risk Management in Practice* edited by David Elms (Elms, 1998) has been used as a source of most of the ideas, concepts and principles identified in this Chapter. Others were taken from AS/NZS 4360 and its Environmental Risk supplement HB 203:2000.

The Standard AS/NZS 4360 applies to a wide range of activities (Appendix A), and hence contains many ideas applicable across a wide range of human activities using risk management. Together with the two Chapters by Elms giving an overview (1998b) and discussion of general issues (Elms, 1998c) the task of identifying key ideas permeating many fields of risk management was a relatively straightforward exercise. While all the papers in *Owning the Future: Integrated Risk Management in Practice* had much to contribute, the ideas, concepts and principles selected for this Chapter were taken from the papers by Elms; Taig; Tweeddale; Keey; Boardman; Gough; Hom and Ellis; and Helm and Stephens

The first part of the title of the book *Owning the Future* ... is perhaps a good lead into risk management. The International Organisation of Impact Assessment (IAIA, 2001) defines impact assessment as “the process of identifying the future consequences of a current or proposed action”. Once such impacts are identified, decisions can be made, and in a sense the future consequences of the action can be owned.

Elms (1998b p2) refers historically to two main approaches by those who sought to manage risk: “One could try to discern the future and sidestep fate, or one could take prudent measures against the possibility of disaster”. From this origin risk management has developed a body of practice with a broad structure which this Chapter will follow. Key ideas, concepts and principles are highlighted in bold italics and parallels are drawn with EIA. From this analysis a number of ideas, listed in Table 3, will be selected for more intensive study in subsequent

chapters. A second list in Table 15 is identified as also offering potential but will not be studied further in this thesis.

*Risk management requires a common understanding and common language.*

Environmental Impact Assessment also has need of a common understanding and language, so practitioners and participants can communicate meaningfully. At present this is not the case, due to the absence of a common understanding of key EIA terms. It extends to endless and fruitless arguments about the scope and place of various branches of EIA – for example whether social impact assessment is included, or economic, health, cultural or cumulative impacts are part of EIA.

The word “assessment” as used in “assessment of environmental effects” means different things to different people. To some it means the determination of how often specified impacts may occur and the magnitude of their consequences; to others the judgement of acceptability or tolerability of adverse effects; and to others it means both. This has practical consequences when attempting to negotiate differences of opinion – it is often possible to arrive at a common understanding of the frequency and magnitude of an effect through the collection of more or better information. However more or better information will not resolve essential differences in values leading to different tolerances of adverse effects.

In a similar vein, when the RMA became law there were many who understood the term “AEE” to be different to the (internationally) better known term “EIA”. This resulted in a communication barrier between New Zealand practitioners and their overseas counterparts, slowing down the transfer of knowledge at a time it would have been very helpful in implementation of the RMA. The extent to which this has slowed the introduction of good EIA practice in New Zealand may never be fully known, but the need for common interpretation of terms and understandings has not disappeared.

*Risk includes context.*

Several definitions of risk found within risk management highlight the importance of context as a third dimension, alongside probability and consequence. A person jumping voluntarily off

a high platform, with a thick rubber band tied around their feet, may pay for the thrill. But if someone forced them into it, they would likely lay criminal charges for assault. Attempting to evaluate the acceptability of bungy jumping without taking account of voluntariness is meaningless. Similarly few people would choose to walk a plank between two tall buildings, but if that was the only means of escape from certain death by fire, few would deny themselves the chance at saving their lives. In both cases the acceptability of the risk is intimately connected to the context within which it is evaluated.

The analogy with EIA is that impact must also include context and attempts at making sense of different reactions to harmful impacts, without taking account of context, are likely to end in frustration. The extent to which someone benefits from the harmful impact, such as an irrigator taking water from a stream, will affect his or her acceptability of the consequences on the stream ecosystem. At another level, a community that sees a direct connection between the production of food they eat and harmful impacts on stream ecosystems, is also likely to be more accepting of such impacts. Communities benefiting from jobs created by a local industry polluting the atmosphere may again be far more accepting of such pollution, particular where alternative employment is scarce. These simple illustrations point to an important principle: that evaluation of impacts cannot occur outside of the need to consider context.

At a national level the acceptability of adverse impacts is intimately connected to such things as standard of living, day to day priorities and level of knowledge. Countries struggling to feed and house their population, or at war, will likely have less concern about matters such as greenhouse gas emissions, use of stratospheric ozone depleting substances or concentration of DDT in Antarctic penguins. This does not mean the populations in such countries will remain unconcerned if their circumstances change, but then so does the context.

*Formal risk management has a joint Australia/New Zealand Standard.*

Given the consensus-seeking method by which standards are produced, the joint Australia/New Zealand Standard AS/NZS 4360:1999 draws practitioners from diverse fields of risk management into a common framework. This enhances professionalism, as outsiders see a commonality and consistency of approaches and methods. It gives clients and practitioners a common ground to work from.

Environmental impact assessment practitioners do not have a standard other than the Fourth Schedule of the RMA (Appendix E) which does not fulfil the role AS/NZS 4360:1999 does. There is considerable diversity amongst practitioners carrying out EIA, some of which originates from different perspectives within the RMA process – what part the practitioner is ‘acting’ within the process. For example whether they are supporting or opposing a project. However within each group of actors there is also considerable diversity and on occasion, this diversity may extend to individual practitioners switching between groups. Adherence to a common standard, a code of practice setting out key terms and processes as a common point of reference, could reduce some of this variability.

*The metaphor of system health is a useful approach since it requires that each system has a purpose that is clearly understood and that, based on the purpose, it is: balanced; complete; coherent; consistent; and clear. The health of a system can be judged by these five criteria.*

Figure 9 shows each of the five criteria in graphic form. The concept of system health can be applied to a number of systems found within EIA as well as the systems within which EIA operates. For example it can be applied to the systems involved in dealing with global environmental issues, where there is lack of balance as sovereign countries vary in their response (and contribution) to impacts such as use of ozone depleting substances, greenhouse gasses and nuclear testing.

The various actors involved can also apply it to the system of RMA administration in New Zealand, with lack of clarity and consistency. Local body politicians elected to represent their communities are asked to ignore personal views and make judicial decisions. The public, with raised expectations of participative decision-making, see most consent applications decided without notification and even when they are notified, decisions may be made against the democratic will of the community that elected the politician. Councils can have the role of applicant, submitter, decision-maker, appellant, consent holder, prosecutor and defendant, all at the same time.

The healthy system criteria can be applied to the production and use of EIAs, as well as the environment itself – an alternative system of assessing and evaluating impacts. And finally

they can also be applied to the systems in place to ensure consents are operated within their environmental limits.

*The communication of risk is an integral part of risk management – both communication between experts from different specialist fields and between managers and decision-makers within an organisation; and communication of risk information between experts and the general public.*

Communication of impacts should therefore also be an integral part of EIA, between the actors described. Not only does communication affect perceptions about impact and hence their significance, it also has a profound effect on building and maintaining credibility and trust, another important risk management principle.

*Risk management should be approached with the right attitude. Having the appropriate mind-set is essential. It is ultimately more important than all the possible techniques that can be learned, and without it, the risk of failure is high. In essence it means to have a systems view and to be wary.*

This concept can be applied at several levels. Preparation of an EIA can be viewed as a system of information exchange. Within that system is a sub-system for collecting and presenting information. And within that is another sub-system that might deal with the origin, treatment and dispersal of a particular contaminant stream. Breaking sources of impact and the affected environment into individual components and dealing with each part separately is essential if the end product is to be transparent and reliable, despite the potential for duplication and fragmentation. Most projects can be seen as systems, taking and converting natural resources, with various impacts coming out of that system.

Wariness of things that might go wrong, or additional contaminants present, or reactions that might occur when certain combinations of chemicals are present, is essential if the outcome predicted by an EIA is to be relied on.

*Risk management differs from accounting; it is not the bottom line of the risk assessment which is important, but the insights gained during the analysis which produced that bottom line.*

The analogy with EIA suggests the process of preparing it, and the consultation that follows it, has as much if not more value than the document itself. The term 'EIA' can mean both a



process and an end product, often referred to as the 'Environmental Impact Statement' or EIS. This points towards EIA being a participative process where the benefit may be in the participation, for philosophical or political motivations, as much as any improvement in the end product.

*When reviewing any risk study, the critical "common sense" test should be applied. If it looks wrong it probably is wrong, or at least needs to be probed carefully. If the details of an assessment are not understood, it should not be relied on. Nothing should be taken on trust. Blind faith in the reputation of experts or of elaborate risk assessment packages is very dangerous.*

This advice is again directly analogous with EIA processes which are sometimes 'hijacked' by technocrats who may disagree with each other, but disenfranchise other actors due to the complexity of their models and the language they use. The above approach within risk management reinforces the ability of all actors to contribute meaningfully and to be wary.

*Whatever the detail in practice, five elements should be in place for good risk management and each needs to be considered carefully: understand the problem; determine the risk; decide strategy; set controls in place; and monitor. These need to be arranged in a loop structure to ensure integrity.*

These five elements would form a logical and systematic process for the collection and presentation of information in EIAs. The process is shown in Figure 6 and has similarities with the process described in AS/NZS 4360:1999 and its supplement HB 203:2000. The five steps of the above process will be used to as a framework for the sections in this chapter and subsequent chapters.

## 2.2 UNDERSTANDING THE PROBLEM.

*Understanding the problem is the essential starting point as there are many basic problem types, each needing different approaches, emphasises and techniques. Risk management problems can be classified in three ways: by context, by objective and by usage.*

Such classifications have several applications in EIA. For example regulators will generally determine the acceptability of an adverse impact by examining the nature, frequency and magnitude of physical impacts from a project, on the environment. While some proponents may share the values that drive such decisions, they may also see commercial (marketing) advantages from an approach widely recognised as environmentally sound. This may be a greater motivator for compliance than protection of the environment. Recognising this should encourage regulators to examine other motivations for meeting environmental standards, placing the ‘problem’ in a different context, namely one that can improve market share.

Similarly when an unauthorised discharge occurs, resource managers will focus primarily on work needed to minimise or avoid environmental damage, while those who caused the discharge may be primarily concerned with avoiding liability. Both parties may work to clean up the discharge, but with different motivations – one does it to protect the environment from greater harm, the other may be primarily concerned with building up good will to avoid legal consequences. Sometimes the desire to avoid legal consequences may result in a decision to avoid assistance, in case such assistance is seen as an admission of liability. Environmental agencies may then need to alter context by for example offering an amnesty against prosecution, or advising that assistance will not be interpreted as implying responsibility.

Classification by objective marks the difference between a system that seeks to maximise reliability of water supply with one that seeks to give early warning of impending drought so stock may be sold or crops harvested early. Both improve incomes and reduce seasonal variability, but in very different ways. By focusing on the objective, options other than taking more water for irrigation may be available.

The third classification, namely usage and the example of management of risk versus management with risk, can be used to acknowledge the distinction between different approaches to adverse impacts within the community. Some are prepared to exchange high

standard of living for high level of environmental degradation; some don't. It can be used to highlight alternatives, but also to point out linkages between one and the other. Use of natural resources must be balanced with acceptance of degradation, and the greater the use, the greater the degradation. When this connection is not seen or understood, there is conflict.

*To understand a risk problem one needs to consider three elements: the aim of the problem, its context and its nature.*

These three elements could be used to dissect an environmental problem so that resources and effort may be focused and used effectively. Society invests considerable resources in the investigation and resolution of environmental issues yet progress is often seen to be painfully slow. The analogy with risk management could be used to draw attention to the need to understand a problem before efforts is put into its resolution.

*Risk management has several aims: understanding of the unexpected; control to within acceptable limits; and optimisation for most satisfactory outcome*

Each of the above aims has a direct parallel within the EIA process. Different actors may use the same EIA with different aims in mind, and will expect the EIA to deliver on all of them. The analogy can be used to distinguish between aims.

For example if acceptable limits have been predetermined, the EIA should focus on demonstrating that the project under consideration will comply with these limits at all times. Similarly where the proponents seek to have their application considered without public notification, and compliance with the threshold 'minor' needs to be demonstrated, the EIA should focus on demonstrating that effects are indeed minor. Where limits have not been predetermined, the EIA may need to demonstrate that the positive impacts outweigh the negative ones so that the outcome may be optimised.

The analogy could also be extended to strategic level decision-making. What is the aim of a research programme carried out before a strategy is decided? If understanding the unexpected

is the aim, effort may be targeted towards analysing earthquake and flood risk. If the aim is to control within acceptable limits, research may be targeted at establishing benchmarks and formulating meaningful monitoring programmes. If the aim is to optimise, research may be targeted at determining the resilience of different systems within the affected environment to determine how much harm they can tolerate to provide benefits, before they suffer irreversibly.

*A good starting point in understanding the aim of a risk problem is to consider the decisions that have to be made. Risk and decision are inseparable; unless there is a decision to be made, there's no point trying to assess or manage risk.*

The analogy here is that there is little point in carrying out an EIA if there is no decision to be made. That also means an EIA should identify, early on, what decisions need to be made and what the criteria are. The EIA should then be focused on providing the information necessary to address these criteria.

Too many EIAs are cumbersome documents with too much irrelevant information. In the context of the RMA, focus on the decision-making criteria suggests an emphasis away from the Fourth Schedule in favour of focusing on the range of matters decision-makers must take into account when making their decisions.

Focus on the decisions to be made also requires explicit recognition of decisions that have already been made. For example if evaluative criteria such as discharge standards have been set, the EIA can focus on meeting these, rather than expending unnecessary effort justifying acceptability. New Zealand's commitments to the international community via Multilateral Agreements may also influence decision-making criteria. Previous decisions may also affect the types of consent required. For example, if some parts of the project are permitted<sup>21</sup> by a plan, the EIA need not address the impacts of these parts.

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<sup>21</sup> As a permitted activity, by a rule, meaning resource consent is not required.

*The nature of the problem can best be understood by placing it along a series of axes, categorising it. The axes could also be called the dimensions of the problem. Together they give the problem type.*

Placing the problem along such axes could give insights and understandings of the problem not immediately obvious. It can give warning signals of inappropriate techniques being used, and help match appropriate analytical technique to a problem.

For example the bore used in the case study has both immediate and delayed consequences, requiring different approaches. Noise emission is immediate and can be treated by consulting with neighbours and determining suitable hours of operation or noise reducing measures. Impact on aquifer integrity resulting from the bore decaying is on the other hand an example of a delayed consequence, requiring a different approach. Only some of those affected can be consulted, given that many of those affected will not yet be born. Some of the present generation may receive considerable benefit from the water abstracted from bores, such as a reliable public water supply at a cheap cost, which will influence their evaluation of harmful impacts.

Similarly with the impacts from the discharge of contaminants from the third case study – sulphur dioxide disperses reasonably quickly whereas particulates can accumulate in the atmosphere, requiring a different technique for analysis.

### **2.3 DETERMINE THE RISK**

*Determining the risk involves a number of steps: identify what can go wrong; decide on the correct risk measure; analyse the risk; and assess (evaluate) the risk.*

The logical and systematic approach inherent in the above is again directly relevant to the approach that should be taken in EIA so that best practice may be achieved. In particular the separation of the analytical and evaluative steps, but equally the importance of appropriate scoping and selection of the right measure by which the consequence may be expressed.

### 2.3.1 IDENTIFY WHAT CAN GO WRONG

*Disasters go through incubation periods with two elements necessary for physical disaster: something to get out of control (energy) and break in information flows.*

The analogy could be applied to the scoping phase of an EIA, but equally to subsequent monitoring. Separating the energy from the information flows could be a useful framework for examining sources of harmful impacts from a project. It could lead to a closer examination of all the potential sources of energy, such as weaknesses in the transport of contaminants, either within a complex or when the contaminant is transported off-site.

*There are four ways in which information problems can lead to disaster: completely unknown prior information; prior information noted but not fully appreciated; prior information not correctly assembled; no place for information in existing categories.*

Following on from the above, examination of information flows using these four categories as an analytical framework could help tease out and expose potential sources of harm. It ties in with other principles related to the need for the right mindset and the commitment that must permeate an organisation carrying out an activity with potential for harm.

*There are many contributors to and precursors of a disaster.*

Again this principle can equally be applied to the monitoring of a project, requiring active monitoring of factors that might give early warnings of an adverse impact. During for example the scoping phase this principle might be applied by examining the financial climate within which the proposed project is operating and potential for taking cost-cutting measures that may result in greater impacts. If the tendering process is carried out at a time of slow economic growth, more care may be required in ensuring the need to remain competitive does not compromise standards.

*For human error to take place, a number of contributing factors or conditions have to line up. Only when they are all in place can a disaster happen. Human factors have a significant role in most disasters. Often, though, it is not merely an error on one person's part, but an error of perception by a whole group. In other words, a cultural problem.*

The analogy with EIA is not to ignore the human factor when analysing sources of impact. Explanations of how structures will be installed, managed and maintained are as crucial to the identification of potential impacts as plans of the actual structure.

*Potential for failure lies in the physical or management systems concerned. If the systems are very complex, there is bound to be unpredictability – unexpected culminations of effects – which will lead to failure.*

The analogy can be applied to both the project causing adverse impacts, and equally to the affected environments. It can be applied to a 'package' wastewater treatment plant relying largely on physical and chemical treatment compared with say an oxidation pond, with more resilience to fluctuations in flow and inflow quality. The former has greater potential for generating impacts than the latter.

At whatever level they are examined, global, local or microscopic, ecosystems are complex systems with complex and often poorly understood interactions between minerals, plants and animals. Predicting how such systems will react to external stimuli is challenging, as they often have inbuilt resilience that limits the extent to which adverse impacts will be expressed. The principle is perhaps more applicable to built systems with less capacity for self-correction.

*Risk may be categorised by source: starting with sources internal and external to an organisation.*

Splitting impacts into these two categories can assist in both the scoping of possible impacts and their subsequent analysis, taking into account the level of control the consent holder has over each impact. Differentiating between internal and external sources can help give greater weight to human error, at all levels – management, worker commitment, internal information flows etc. It can also 'force' recognition of factors that those using natural resources cannot control – such as future level of competition reducing profitability and therefore funds available for treatment of effect.

*Hazard identification must be undertaken by a multi-disciplinary team, using a systematic detailed approach.*

There are two ideas here: the use of a multi-disciplinary team; and the use of a systematic detailed approach. In EIA the multi-disciplinary team could be the participating public, those consulted or invited to contribute. If the public is not used in this role, an alternative source of multi-disciplinary input must be found.

The systematic, detailed approach may also be related to the choice of which public to engage and most effective means of consultation.

*Identification of what can go wrong requires completeness. This requires establishment of a precise understanding of the aim of the risk management exercise beforehand to help focus and limit the efforts required.*

There is a direct analogy here with the scoping phase of an EIA and need to keep informational requirements appropriate to the 'scale and significance' of environmental impacts. This is a significant challenge in EIA, directly related to criticisms of the RMA summarised in Table 1. Aiming for completeness is essential for good decision-making and one of the benefits of a participative process. However completeness can result in the inclusion of many insignificant impacts. This may result in some significant ones being 'hidden' amongst many secondary and peripheral ones; and analysis of such impacts being compromised by dilution of analytical capacity.

*It is not only the high risks which need managerial attention, but also the not-high risks which could have serious consequences if they were realised.*

Some 'not-high' or 'low probability' environmental impacts can cause serious consequences if allowed to accumulate, over time or in combination with other low, similar impacts.

*There is seldom just one risk. Generally there is a hierarchy of risks, with many smaller things that can go wrong leading to one big one. Risk management must operate effectively at all levels.*



There are again several ideas here. The concept of a hierarchy of impacts is interesting. It could apply to differences in their significance, with those of greater significance being placed further up the hierarchy. These are the ones that should receive greatest attention in the EIA, both in the soundness of their analysis and effectiveness of their treatment.

There is also a suggestion here of a sequential relationship between impacts. This could apply to the concept of cumulative effects, where each adds to the other to cause an impact larger than each causes individually. It may also be applied to a fault or event tree type analysis of the steps that might contribute to a large impact. EIA must operate effectively at all levels.

### **2.3.2 DECIDING THE CORRECT RISK MEASURE**

*The correct measure of risk, or more precisely of the consequences, depends on the problem's aim and often needs careful thought.*

This can be applied to the selection of assessment endpoints in EIA. This principle has a lot of content. Firstly it implies there is a correct measure of risk, or at least one that is better than others. Secondly it removes the probability component of risk, leaving it with just two components, consequence within a context. Thirdly it relates the selection of the risk measure back to the aim of the problem. This requires prior knowledge of the aim, and a direct link between that aim and the choice of measure. And finally it anticipates that this is not a simple process, but often requires careful thought.

Risk measure is analogous with assessment endpoint. The principle highlights the importance of selecting the correct one, which may not be easy, but must relate back to the aim of the problem. One application might be the selection of environmental indicators, indicating the state of the national or global environment. Another might be in the selection of parts of the environment particularly valued by a community, affected by a proposed project. If stream health is the problem, that means finding assessment endpoints that reliably reflect the health of that stream. If airshed quality is the problem, that means finding endpoints that reliably measure the quality of the air.

### 2.3.3 ANALYSE THE RISK

*The principle of consistent crudeness can assist in matching the precision of a probability assessment technique to the quality of the information it uses.*

The analysis of impacts using quantitative techniques often relies on a number of steps, each with a range of assumptions and need for data. For example using the case study related to the abstraction of groundwater and its consequent impact on a neighbouring bore, analysis of impacts on water level in the neighbouring bore requires an accurate knowledge of the location of both bores. It requires knowledge of their depths and the depth at which water enters the bores. It requires knowledge of the rate of abstraction, the nature of the strata between the two bores and in particular the existence of any layers impeding vertical movement of groundwater, as well as the ability of the strata to transmit water between one bore and the other. It requires knowledge of fluctuations in groundwater levels, influence from other abstractions drawing from the same water source, influence from nearby streams etc.

This information is inserted into an equation that attempts to simulate drawdown. In doing so it makes a number of assumptions and simplifications, for example it assumes the strata is homogenous rather than heterogeneous. The equation also has the ability to predict drawdown to several decimal places. Given the large number of assumptions and data required as input into the equation, each with its own uncertainty and variability, such precision is probably invalid.

The above principle implies that the aim in such analysis should be to ensure assumptions made and data used are consistent and realistic in their precision. If bore location is critical and the data used has been obtained from an old map of dubious accuracy, there is little point expending vast amounts of effort in obtaining more accurate data on the ability of the aquifer to transmit water if the predicted drawdown will still only have an accuracy of plus or minus 50%. Even if all the data is accurate, there are other sources of variability such as the possibility of bores rusting through, taking water from a higher level; or a different pump installed down the bore, taken water at a higher rate. If the prediction made requires a high

degree of accuracy, emphasis must be placed on all sources of information used to ensure consistent crudeness.

*Integration of the risk management process across different types of risk does not require uniformity of risk management techniques. In fact, because of the range of different types of risk, and the range of disciplines to which risk management is being applied, it is very important that various risk – specific techniques are used.*

Within EIA there are a large number of disciplines – economists carrying out economic impact assessment, anthropologists carrying out cultural impact assessment, health professionals carrying out health impact assessment and ecologists carrying out ecological impact assessment. The different sources of impact they analyse and the parts of the environment affected by those impacts can explain their essential differences. Despite the large amount of commonality between them, the above approach suggests that uniformity of analytical and evaluative techniques is not required and may in fact be undesirable, particularly if it results in the use of inappropriate techniques.

*Be aware of the simple view. Things go wrong because of combinations of events.*

Linked to the principle of being wary, this one places emphasis on the need to avoid superficial analyses and look at combinations of causes that may result in impacts. This applies to the scoping phase as much as the analysis and subsequent review. It emphasises the need for a systems approach, looking for sequences with weak links.

*Risk can be categorised as: estimated, observed, perceived and real.*

Using the analogy of ‘risk’ being the same as ‘impact’, these categories can be applied in a number of ways. Firstly all actors are forced to acknowledge that real impacts of a project will never be known. While monitoring and review may improve the accuracy of a prediction, it is only when the project is at the end of its life-cycle, and comprehensive sets of measurements taken during its life are analysed, that we may begin to have an understanding of what the real impact was.

Secondly it forces actors to question the validity of their prediction of the impact. If the impact is estimated, what technique was used, what assumptions were made and how valid was the data? Does it account for human error? If the impact is observed, where was it observed, under what conditions – normal operating or extreme? How transferable are the results, over what time period were they observed etc. And if impacts are perceived, what is the basis of their perception? How have they been communicated, and how are they understood? The analogy suggests scientific method may resolve differences between the first two types of impact – estimated and observed; whereas differences in perception requires a different approach altogether.

Used sensitively, acknowledging that impacts fall into one of these categories can heighten awareness of inherent weaknesses and promote accountability, transparency and honesty amongst actors.

*Perceived risk is seldom quantified. Whereas estimated and observed risk can usually be expressed in numerical terms, perceived risk is emotionally based and will be seen as grave, severe, negligible etc.*

Applied to impacts categorised as perceived, this approach suggests it is futile attempting to express them in quantitative terms. Perhaps the best that can be hoped for is that their analysis can be verified, or least the subjectivity managed in some way so that results are repeatable.

While all impacts on the environment involve human reaction, psychosomatic impacts do not generally allow analysis to occur as a step distinct from evaluation. Use of the non-numerical terms listed above, along with any evaluative techniques allowing these to be weighted etc will be directly relevant to dealing with some of the more difficult impacts dealt with under EIA, particularly odour, noise and landscape. Fuzzy logic techniques may well have a place here.

*One must be careful when comparing risks, e.g. estimated vs observed in standards.*

This interesting concept is often overlooked but is nevertheless of direct relevance to EIA. It raises a number of interesting questions, such as the need to pay particular attention to the accuracy of an estimated impact and in particular the probability of its exceedance, if it is

being compared with a standard based on observations. It also raises questions about the validity of single value standards often used to represent environmental impacts, when such values are seldom deterministic and the environment represented is itself dynamic.

*The step of analysing the risk is primarily one of estimating probabilities and there are many ways of doing this, from semi-quantitative ranking to precise calculation of probabilities. Matching the appropriate technique to the problem is an important issue.*

This again reinforces the concept of impacts being probabilistic rather than deterministic. Full analysis of an impact requires analysis of both magnitude and probability. The key concept here is one of ensuring the correct match-up between problem and technique. This points towards the need for a sound understanding of the problem, followed by a sound understanding of the range of analytical techniques available. Many impacts do not lend themselves to any sort of quantitative analysis, particularly psychosomatic impacts where the best one can hope for is some form of subjectivity management.

#### **2.3.4 EVALUATE THE RISK**

*In areas of public risk management it is vitally important to take into account the risk perceptions of interested parties, including the public.*

This approach is directly analogous to resource management where there are philosophical and political as well as pragmatic reasons why the public's views should be taken into account. How this is done in two areas of risk management, namely that carried out by the Building Industry Authority and the Environmental Risk Management Authority, will be explored in Chapter 8.

*It is valuable for risks of various kinds to be considered together.*

This approach in EIA is consistent with integrated management and promotes balancing of positive with negative impacts. Some impacts might be cumulative and the evaluation of adverse impacts may be influenced by the extent of the positive ones. It promotes an integrated approach whereby all impacts are considered at the one time.

*When appraising risks, it is important actively to seek the intangible and unquantifiable factors, and structure them into the analysis, giving them equal standing with the quantifiable factors.*

The analogy with EIA is that impacts that cannot be quantified or expressed tangibly should not be ignored. Rather they should be actively sought out and given equal standing with quantifiable impacts.

*A useful preliminary approach for evaluation of significance is to divide risks into four categories determined by whether the probabilities and consequences are high or low.*

This appears to be a very useful approach for initial delineation between impacts, separating them into the four quadrants of Figure 7. This is particularly helpful where standards or other evaluative criteria do not exist. For limited effort it allows impacts that require treatment to be separated from those that can be accepted, focusing attention where the attention is needed. It can be used for all types of impact – those that can be quantified and those that cannot – and where a group makes the decision on which quadrant an impact goes into, can be an effective means of promoting public participation.

Figure 7. Risk categories (After Elms, 1998).

*Risks can be divided into zones of acceptability, unacceptability and tolerability.*

The division of impacts into such zones with express recognition of likelihood and consequence can be used in EIA in a number of ways. It can be used to promote consistency by transferring the content of previous decisions, including those outside of EIA such as the

Building Industry or Environmental Risk Management Authority. One limitation to this approach appears to be a lack of express recognition of context, though that can be included through ensuring decisions with similar contexts are grouped together.

There may be potential for fuzzy logic systems to help define the boundaries between each zone, which could be adapted to distinguish between effects considered '*de minimus*', minor adverse effects, acceptable adverse effects and unacceptable effects.

*No level of risk is really "acceptable" but society considers certain levels of risk are tolerable when there are commensurate benefits.*

This principle highlights the need to consider all impacts together, so positive ones may be seen alongside adverse ones and both can be evaluated at the same time. Techniques for aligning and comparing such impacts in other areas of risk management may be available for use in EIA.

This principle also highlights the need to ensure linkages between adverse impacts and positive benefits are expressly shown. Some linkages are well known because the proponent of a project receives most of them, while others are more obscure. If the community cannot see the link between a dam and electricity supply, or low water levels and food, yet places high values on those resources affected, it cannot be expected to have sympathy for those projects causing adverse impacts.

## **2.4 DECIDE STRATEGY**

*Strategy to deal with risk falls into four groupings: avoiding, controlling (reduction), transferring and accepting.*

These groupings provide a helpful framework for dealing with the impacts categorised using the four quadrants of Figure 7. Even more helpful might be a review of how other areas of risk management deal with each quadrant.

For example property owners deal with the risk of their houses burning down by deciding how much they can afford to pay if it did burn down, and transferring the rest to an insurance company. The insurance company deals with the risk transferred to it by transferring it back to a large number of premium-paying property owners. What analogy might this have in EIA? It could be used to describe the process of discharging small amounts of contaminant over a large area. It could equally apply to the concept of spreading rare and endangered species over a wide area so if any individual area is harmed, the entire population is not wiped out. At a global level it could apply to the concept of preserving pockets of unique ecosystems throughout the world.

*There are basically three strategies for controlling risk once it has been accepted. They depend on the nature of the problem and what has to be achieved. They are: optimising, balancing and satisficing.*

Examination of each of these strategies for their potential for controlling accepted impacts allows for a systematic approach to determine where efforts should be directed. It promotes innovation by examining multiple options for control. While satisficing (meeting a standard) is the most common strategy for discharges of contaminants, optimising may result in greater overall benefit by directing limited expenditure to areas having greatest benefit in terms of reduced impacts, or areas having positive impacts, such as sanctuaries for endangered species, to compensate for harmful impacts. A strategy involving balancing may result in reduced expenditure on automatic control systems and increased expenditure on staff training, for an overall gain in reduction of spill frequency for example.

*Control can be applied to likelihood, consequences or both.*

An important principle again having direct analogy with EIA. In the case studies mentioned in Chapter 1, reducing the magnitude of the noise, or the frequency, or both can reduce the impact from noise during installation of the bore. Similarly, reducing the frequency, or magnitude of the drawdown, or both can reduce impact resulting from drawdown in neighbouring bores.



*Risk is not by itself a bad thing, to be avoided at all costs. It is as much concerned with good things not happening as with bad things happening.*

The analogy here might be that using natural resources allows us to eat and drink, build homes and travel. Such use invariably results in adverse impacts, but there are commensurate benefits.

## **2.5 SET CONTROLS IN PLACE**

*Risk management must be integrated and owned throughout an organisation. The pervasive nature of risk management really means that the ideas have to be a part of the culture of the organisation. It is a way of thinking, or of looking at the world within which one operates.*

The concept has a direct analogy with EIA. Unless the forklift driver unloading drums of chemical raises the alarm when a drum is punctured, or management ensures all staff working on a treatment plant receive proper training, the outcomes predicted by the EIA are unlikely to be achieved. Full implementation of conditions of any consent granted requires full commitment from everyone involved. Conditions rarely address every conceivable eventuality – a successful outcome for the environment depends on a commitment by all involved to strive for the outcomes anticipated by the EIA, even if there is no legal obligation to do so.

*Risk management must consider the information flows involved. This requires appropriate measures of risk and a well-structured information system. These will differ according to the problem but ensuring and maintaining the quality of the responsibility/ information system is paramount.*

This analogy could apply to the system of information flows involved in the production of an EIA, but equally to the operation of the project under consideration and the impacts it might generate. It could also apply to the monitoring in place to ensure compliance with predetermined outcomes. The analogy suggests attention should be paid to information flows and feedback loops, such as the quality and effectiveness of information between actors in the EIA process.

*It is essential that risk management be integrated with line management and not regarded as a separate function or responsibility.*

An interesting principle consistent with earlier ones all pointing in the direction of ensuring management of activities that might cause harm must permeate an entire organisation and become second nature. Without that commitment at all levels within an organisation, harmful impacts originating from the project they run are likely to be greater than one where commitment permeates all levels including management.

*Care should be taken not to place excessive reliance on auditing, as this dilutes the responsibility and commitment of line managers.*

Following on from the principle above is the need to avoid systems whereby management can place the burden of responsibility on audited systems, allowing them to distance themselves from mishaps that might occur. Management of adverse impacts needs to be fully internalised and become part of the organisation's philosophy. It suggests a cautious approach towards over-reliance on quality systems and management plans.

## **2.6 MONITORING**

*Monitoring a risk management system is as essential as setting it up in the first place.*

Another principle with direct analogy to EIA. risk management has some elaborate monitoring systems in place such as air accident investigators who carefully investigate causes of failure so action may be taken to avoid recurrence. Environmental incidents do not normally receive this level of attention, nevertheless the importance of monitoring to ensure implementation of decisions made and provide feedback on predictions made is essential for effective environmental management. The environment is dynamic and organisations too can change over time.

*Disasters seldom occur in isolation, without giving warning beforehand. They tend to follow a pattern of growth prior to the actual event.*

The analogy with EIA suggests incidents resulting in adverse impacts are predictable. This is relevant to both the scoping phase and subsequent monitoring. It provides a framework for developing ideas on the types of monitoring conditions that could be placed on projects requiring consent, requiring for example regular reporting of indicators that might affect the context or climate within which the activity is operating. This allows for modifications to take place so ‘disasters’ may be avoided.

## **2.7 AREAS EXPLORED FURTHER IN THIS THESIS**

From the above analysis it is clear that risk management ideas, concepts and principles have direct application to EIA, adding weight to the view taken in this thesis that EIA is simply one more branch of risk management. This is also the view taken in AS/NZS 4360:1999 through the inclusion of environmental issues in the list of applications (Appendix A).

Table 3 lists areas of risk management practice selected from this Chapter on the basis of their potential to promote better EIA practice. This list will be explored in subsequent chapters to identify opportunities. Chapter 15 lists additional areas with potential for future study.

**Table 3: Areas of Risk management Practice with Potential to Develop Best Practice in EIA, Explored in this Thesis**

1. Definition of terminology
2. Inclusion of context
3. Logical and systematic processes
4. Healthy systems methodology
5. Communication of impacts
6. Focus on decision-making and Inclusion of Public Perceptions
7. Understanding the problem
8. Measurement and assessment endpoints
9. Dealing with uncertainty
10. Categories of impact
11. Zones of significance

### 3 DEFINITION OF TERMINOLOGY

*Risk management requires a common understanding and common language.*

The meanings we attach to words can help or hinder communication. Chapter 1 mentions the debate that took place when the RMA was first passed related to whether an AEE was the same as an EIA. The time taken to decide they are the same was opportunity lost in terms of transferring knowledge and experience from overseas practitioners. This at a time that rapid capacity-building of New Zealand practitioners was fundamental to successful implementation of the RMA, an Act described as “the most thorough going, comprehensive effort in the world to achieve integrated environmental policy through impact assessments” (Buhrs and Bartlett, 1993, p148).

Similar debate took place over whether an ‘effect’ as the RMA defined it was the same as an ‘impact’ used in overseas EIA. Some argued that ‘effects’ could be positive or negative, while ‘impact’ tended to emphasise the negative aspects of a proposal. Others argued that proponents of projects nearly always emphasised the positive aspects of a proposal in their EIA, hence ‘impacts’ were not just about negative effects. EIA as practised in places such as Europe, the UK, Australia and North America uses the term ‘mitigation’ to refer to the process of dealing with adverse effects, but the RMA gives ‘mitigation’ a much narrower meaning, separating it from ‘remedying’ and ‘avoiding’ which overseas is all taken to be part of the process of mitigation. These differences have served to create a barrier slowing down the transfer of good EIA practice, including training programmes, as effectively as any language barrier which it arguably is.

Chapters 1 highlighted the existence of a similar barrier between EIA as practised under the RMA and risk management, a barrier the Environmental Risk Management Authority has effectively pushed through. Such barriers do not exist between risk management and EIA in places such as North America, or at least not to the same extent, with evidence of a seamless transition between the processes of health and ecological ‘risk’ assessments and health and ecological ‘impact’ assessments. The barriers that exist, as they do in New Zealand, are between risk management as practised in different spheres of human activity.

Zach (1998) observes a difference between the North American approach towards risk management and that used in Australia and New Zealand, as described in AS/NZ 4630:1999. In North America risk management is generally used to describe the evaluation and treatment of risks, following a process of 'risk assessment' used to identify the type and size of risks to be managed. In AS/NZS 4360:1999 risk management is defined as: "the systematic application of management policies, procedures and practices to the tasks of identifying, analysing, evaluating, treating and monitoring risk".

The 1999 version of AS/NZS 4360 substitutes the word 'assessment' for 'analysis'. The RMA does not define 'assessment' but it is commonly taken to mean the process of determining the size and significance of an adverse effect. However determining size and evaluating significance are very different processes, using different sets of skills. Sizing an effect is a scientific process while determination of significance is political. The two may be inseparable for some impacts, particularly psychosomatic ones, but otherwise there should be a clear fence between them, for several reasons.

The first reason is that while the analysis of an impact to determine its size may require specific knowledge and expertise, that same expertise is not required for its evaluation. If one subscribes to the axiom that all people are equal then in a democracy every opinion on significance is important. Yet all too often those with analytical expertise cross into the evaluation phase, claiming greater validity for their opinions on the basis of their analytical expertise.

Secondly, public involvement in environmental decision-making is often marked by emotional and bitter disagreements and conflicts. All too often opponents in public debates talk past each other, each focusing on different aspects. Social scientists have examined such conflicts to better understand their sources and suggest improvements for resolution. One set of studies (von Winterfeldt *et al*, 1980; von Winterfeldt and Edwards, 1982; Otway and von Winterfeldt, 1982) quoted by Covello (1983) found that disagreements between participants in conflicts about technological hazards can be broken down into six different types of disagreements (Table 4).

**Table 4: Typology of Sources of Conflict and Debate (After Covello, 1993).**

1. Disagreements about data and statistics;
2. Disagreements about risk estimates and probabilities;
3. Disagreements about assumptions and definitions;
4. Disagreements about risk/cost/benefit trade-offs;
5. Disagreements about the distribution of risks, costs and benefits; and
6. Disagreements about basic values and ideologies.

The first three of Table 4 can only be resolved by access to further information or expertise, using scientific processes. The second three cannot be solved in this manner, despite attempts to do so; they are political in origin and can only be resolved using political processes. The first three involve analysis of impacts; the second three evaluation, a distinction recognised by AS/NZS 4360:1999 for risk management. ERMA has adopted this separation, though it only had access to the 1995 version of the Standard when it prepared its Methodology, hence the evaluative phase is referred to as 'assessment'.

EIA as practised under the RMA would benefit from the same clear definition of terms enjoyed by risk management. Given the need for a common understanding and language (Elms, 1998b) and the consensus-seeking process by which Standards are produced, AS/NZS 4360:1999 fulfils a valuable role. However there is a danger that in trying to cover a broad range of applications such as those set out in Appendix A, details which may be less broadly applicable but nevertheless useful within individual or a smaller group of applications will be lost.

AS/NZS 4360:1999 has brought many areas of risk management practice together under one umbrella with a common framework on which to place similar concepts, as well as a common language so that communication between diverse spheres of activity can be effective. A common language for EIA would equally go a long way towards breaking down barriers with both risk management and international practice in EIA. The ERMA has produced a Methodology which also defines key terms and concepts and a similar document dealing specifically with EIA as practices under the RMA is long overdue.

## 4 INCLUSION OF CONTEXT

*Risk includes context.*

From AS/NZS 4360:1999:

*The context of a risk management process needs to be established to define the basic parameters within which risks must be managed and to provide guidance for decisions within more detailed risk management studies. Establishing the context sets the scope for the rest of the risk management process*

Context has two meanings in the above statements. In the first is express recognition that, particularly during evaluation, risk is meaningless without a context. The acceptability of walking a plank between two high rise buildings is very dependent on the extent to which one's life depends on it. This makes desire for consistency in decision-making very difficult to achieve, and any attempt at analysis to promote consistency must consider context.

The second meaning is broader and brings in the decisions to be made. In work carried out by Tersteeg and Elsen (1999) attention to context during the scoping phase of an EIA is seen as vitally important for a number of reasons. Tersteeg and Elsen claim that making what they refer to as "well-founded choices" early on can streamline the production of the EIA, expressly providing for the "emotional/irrational dimension", in a structured way, at the start of a project. Clear well-founded choices can avoid superfluous information, resulting in a more fluent and open process. Tersteeg and Elsen claim too much energy is spent trying to prevent 'too little' rather than motivating 'enough' information.

The legal, political and societal features within which risk management and EIA are carried out has a significant bearing on the management of risk. There is no point for example in carrying out a risk analysis (or EIA) on a power generating plant in New Zealand using nuclear energy, given that the decision on its acceptability has already been made. Similarly for the case study involving the discharge of combustion products, New Zealand's ratification of The Framework Convention on Climate Change, together with its desire for international respect, cannot be ignored when considering the discharge of carbon dioxide.

New Zealanders access to the judicial system allowing review of decisions and appeal to the Environment Court, backed up by links to international laws and conventions and hundreds of years of case law, will influence the process by which the decision on acceptability of the discharge will occur. The case law on 'reasonableness' will spur decision-makers working within such a framework towards ensuring that the information used is valid and all aspects of the decision can be defended as 'reasonable'.

Level of education, access to information and level of relative wealth, each giving the resources to pursue rights, are all part of the context within which risk management and EIA is carried out in New Zealand. So are freedom of religion and relative freedom from sources of risk present in other societies such as war, famine and natural catastrophe.

Awareness of the decision(s) to be made and the legal, political, social and economic framework within which policies, plans, or individual projects will be considered will assist in the focusing of the EIA. At the strategic level this will include matters such as an awareness of New Zealand's international commitments; global initiatives such as the United Nations Conference on Environment and Development in Rio in 1992 and documents coming from that; growing awareness and understanding of global environmental issues such as build-up of greenhouse gasses and depletion of ozone; the state of New Zealand's environment; system of government; Treaty of Waitangi etc.

At the individual project level this will mean a focus on the types of consents required and the planning framework within which applications will be considered; what decisions can be influenced and which ones have already been made. Also a focus on criteria used to make decisions; whether the project is likely to meet hostile opposition or provides clear benefits for the community within which it is carried out; the knowledge and resources available to affected communities; track record of similar projects previously approved; company compliance record and reputation etc.

At both the strategic and project level, the New Zealand context is unique in its devolution of responsibility which in turn promotes transparency and accountability. High level of integration of environmental law and an Environment Court that will substitute consent authority decisions for its own all go to make New Zealand's context unique.



Awareness of context and need to provide for it in the scoping and evaluation phases is an area of risk management practice that EIA can benefit from.

## 5 LOGICAL AND SYSTEMATIC PROCESSES

*Whatever the detail in practice, five elements should be in place and each needs to be considered carefully: understand the problem; determine the risk; decide strategy; set controls in place; and monitor. These need to be arranged in a loop structure to ensure integrity.*

The above is similar to the risk management process described in AS/NZS 4360:1999 and to that described for EIA by organisations such as the International Association for Impact Assessment (IAIA). Both the Standard (Figure 8) and IAIA Principles (Appendix D) provide a logical and systematic framework for dealing with their respective processes. The Methodology prepared by the ERMA is based on risk management principles and also provides a logical and systematic framework for those involved in applications to use hazardous substances and new organisms.

**Figure 8: Outline of Risk Management Process (After AS/NZS 4360:1999)**

Such frameworks look very different to the Fourth Schedule to the RMA (Appendix E), which sets out matters to be included in, and considered when preparing, an EIA. It is neither logical nor systematic and EIA practised under the RMA would benefit considerably from frameworks similar to AS/NZS 4360:1999 or the Methodology produced by ERMA. Practice

would also benefit from skills development programmes developed around a more formalised process so practitioners can benefit from common understandings and methodologies for each stage of the process.

## 6 HEALTHY SYSTEMS METHODOLOGY

*The metaphor of system health is a useful approach since it requires that each system has a purpose that is clearly understood and that, based on the purpose, it is: balanced; complete; coherent; consistent; and clear. The health of a system can be judged by these five criteria.*

*If disasters can be seen as failures of physical or management systems, and this seems mostly to be the case, then they can almost always be regarded as failures of system health.*

The 'healthy systems criteria' is a new 'indicator' method for risk management proposed by Elms (1998a). Indicator approaches to risk management are a qualitative technique, straddling the boundary between analysis and evaluation and to some extent, risk identification. Their advantage is their ability to take account of intangibles including factors such as human error and sources of risk too difficult to analyse quantitatively. Historically several methods have been in use, including Pugsley's 'safety climate' indicators (Pugsley, 1973) ; Turner's 'incubation' approach (Turner, 1978); Perrow's 'interactive complexity and close coupling' approach (Perrow, 1984); Reason's 'errors and resident pathogens' approach (Reason, 1990); Blockley's balloon model (Blockley, 1992); the International Safety Rating System (ISRS, 1978 ) and to an extent, Quality Assurance and Management Systems. See Elms (1998a) for a helpful commentary on each of these approaches.

The 'healthy system criteria' approach applies five criteria to a system and if all are fulfilled the system is deemed to be healthy. These criteria, listed at the top of this page, are shown in Figure 9. This approach has been successfully used in a number of situations, requiring, like all methods, care and experienced judgement in their application (Elms, 1998a).

Although relatively new to risk management, the healthy systems approach to risk management and appraisal appears to overcome limitations associated with the other indicator approaches. The concept of system health sits well within EIA, as does the emphasis on 'loops' relative to sustainable management; and divisions of systems into 'elements' and 'connections' with ecosystems.

Figure 9: Healthy Systems Criteria (After Elms, 1998a).

Such an approach appears to overcome one of the major limitations of quantitative analysis and evaluation of impacts, namely reliance on expertise, complex techniques and lots of data, all extremely expensive and time consuming. By providing a framework for the analysis and evaluation of systems, it may provide a way of overcoming one of the major criticisms of qualitative assessment, namely that it lacks objectivity, repeatability and freedom from bias.

Elms (1998a) draws on the metaphor of system health to draw on similarities with the human body, pointing out the difference between lay diagnosis based on absence of symptoms of ill health, and sound diagnosis carried out by those with training and expertise. Farmers can tell a lot about the health of their stock by looking at the gloss on the coat, wetness of the nose and shine of the eye. Methods for measuring each of these could probably be developed and these may or may not match the accuracy with which a farmer's keen eye can measure them, but we know for certain they will be a lot more expensive and take much longer.

Use of the five criteria shown in Figure 9 provides a useful framework for diagnosis at several levels within EIA. It could for example be applied to the system of decision-making under the RMA and extent to which actors are clear about their respective roles. It could also be applied

to the concept of sustainable management, with examples of 'ill-health' under each criterion including:

<b>Balance</b>	monoculture, urbanisation;
<b>Completeness</b>	use of pesticides causing elimination of essential part of the food chain;
<b>Cohesion</b>	building roads through forest ecosystems, mining minerals at one location and landfilling at another;
<b>Consistency</b>	point source discharges into air and water;
<b>Clarity</b>	poorly designed waste treatment systems.

The healthy systems approach appears to have considerable potential to give low cost, sensible and defensible answers. By providing a framework for analysis it has the potential to overcome the limitations of purely subjective assessments, and if undertaken by skilled professionals may well provide verifiable, repeatable and defensible data, taking account of not just the measurable but also the intangibles that quantitative analysis has difficulty incorporating. If so, it too can contribute to better EIA practice. The concept of selecting indicators of the health of ecosystems is not new to resource management, and use of the healthy systems criteria has the potential to extend that to other systems found within resource management.

## 7 COMMUNICATION OF IMPACTS

*The communication of risk is an integral part of risk management – both communication between experts from different specialist fields and between managers and decision-makers within an organisation; and communication of risk information between experts and the general public.*

According to Covello (1985):

*One of the most important findings to emerge from the social and behavioral literature on risk is that the public takes a complex array of qualitative and quantitative factors into consideration in evaluating the seriousness of a risk (Slovic, et al, 1980; Vlek and Stallen, 1981; Litai et al, 1983; Renn, 1981). Research suggests that perceptions of risk are influenced not only by mortality and morbidity rates but a host of other factors.*

These factors are summarised in Table 5. Fuller descriptions of each factor are set out in Appendix F

**Table 5: Factors Involved in Public Risk Perception.**

Factor	Conditions associated with increased public concern	Conditions associated with decreased public concern
Catastrophic Potential	Fatalities and injuries grouped in time and space	Fatalities and injured scattered or random in time and space
Familiarity	Unfamiliar	Familiar
Understanding	Mechanisms or process not understood	Mechanisms or process understood
Uncertainty	Risks scientifically unknown or uncertain	Risks known to science
Controllability (Personal)	Uncontrollable	Controllable
Voluntariness of Exposure	Involuntary	Voluntary
Effects on Children	Children specifically at risk	Children not specifically at risk
Effects on future generations	Risk to future generations	No risk to future generations
Victim Identity	Identifiable victims	Statistical victims
Dread	Effects dreaded	Effects not dreaded
Trust in institutions	Lack of trust in responsible institutions	Trust in responsible institutions
Media Attention	Much media attention	Little media attention
Accident History	Major and sometimes minor accident	No major or minor accident
Equity	Inequitable distribution of risks and benefits	Equitable distribution of risks and benefits
Reversibility	Effects irreversible	Effects reversible
Benefits	Unclear benefits	Clear benefits
Personal Involvement	Individual personally at risk	Individual not personally at risk

The communication of risk and the perception of its significance are inextricably linked. Keey (2000) has shown a very poor correlation between observed risk, risk estimated by experts, and risk perceived by the public. In a participative process it is the public's view that matters, hence practitioners must focus on how risk is communicated so that, as far as possible, perceived risk matches that observed or estimated. As Covello (1985) points out, perceptions of risk are influenced not only by mortality and morbidity rates but a host of other factors and in environmental decision-making that is particularly true.

The above comments on risk communication are directly applicable to the communication of adverse impacts. It is strongly linked to the need for a common language, and impact evaluation. Lessons learned are also directly applicable. Anyone dealing with the communication of adverse impacts would be well advised to see some of the excellent publications and training videos available on risk communication, for example those produced by Peter Sandman (2001). Risk Management is again a source of better practice for EIA.



## **8 FOCUS ON DECISION-MAKING AND INCLUSION OF PUBLIC PERCEPTIONS.**

*A good starting point in understanding the aim of a risk problem is to consider the decisions that have to be made. Risk and decision are inseparable; unless there is a decision to be made, there's no point trying to assess or manage risk.*

*In areas of public risk management it is vitally important to take into account the risk perceptions of interested parties, including the public.*

At one level the first principle is very pragmatic, pointing towards the futility of talking about risks (or adverse impacts) where such talk cannot change anything. At another level, where decisions are to be made it points to the need to focus on those decisions and consequently the criteria that will be used when making them. Those criteria should then be used to decide what information to place before decision-makers. While this may seem obvious, it is nevertheless a useful principle to keep in mind when preparing an EIA to ensure it is focused and free of irrelevant information.

A number of actors make a range of decisions during the course of applying for resource consent. The nature and quality of those decisions have a direct bearing on the criticisms listed in Table 1, each one involving a decision made by one or more actors. In exploring this area further it may be useful to begin with an overview of actors involved in decision-making and their expectations, before examining the criteria used to make those decisions and opportunities for better practice.

Only two areas of risk management decision-making will be examined to determine opportunity for better practice – the building industry and by those administering the HASNO. This does not mean other areas of risk management decision-making cannot be a source of good practice. On the contrary many other areas of risk management make decisions that receive regular and sometimes considerable scrutiny, allowing the quality<sup>22</sup> of those decisions to be examined<sup>23</sup>.

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<sup>22</sup> Quality as it relates to the accuracy of the prediction, not necessarily the acceptability of the impact.

<sup>23</sup> Some areas of risk management such as vehicle accidents or LPG tank ruptures allow collection of sufficient data to enable comparison of predicted with observed impacts.

However these two areas are selected because:

- assessment endpoints in both areas are similar to those used in RMA decision-making;
- both areas deal with effects having wide public interest and consequences;
- many projects requiring RMA consent involve the use of structures, and structures are frequently used in the mitigation of adverse impacts;
- decisions on structural safety appear to enjoy wide public support in New Zealand<sup>24</sup>.
- McShane (1998) considers decision-making under the Building Act superior to that made under the RMA; and
- the HSNO Act has the same purpose as the RMA and similar definitions of ‘effect’ and ‘environment’.

## **8.1 ACTORS INVOLVED IN EIA DECISION-MAKING**

In a sense, all actors make decisions. Proponents decide on a project and decide whom they will consult before preparing an EIA. They decide what to put in the EIA, including the range of impacts the project might cause and the level of detail about each impact. Some of these impacts may affect other actors who will decide whether they give their approval to the project. They will also decide their level of involvement in supporting or opposing the project.

The consent authority is another actor, making a series of administrative decisions. These include:

- decisions about how much information is required in an EIA (s92 RMA);
- decisions on whether an application for consent should be decided without public notification; (s94 RMA);
- decisions about appropriate forum for resolution of conflict (s100 RMA); and
- decisions on whether an application for consent should be granted (s105 RMA)
- decisions on whether conditions should be attached to consents granted and if so, what type (s108 RMA).

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<sup>24</sup> Based on anecdotal evidence of lack of protest about the adequacy of standards and allocation of media time and space to environmental versus structural issues. However this may not be the case following for example a large earthquake resulting in widespread structural failure.

These decisions are discussed in greater detail in Section 1.8 They are typical of those made by consent authorities (e.g. Kjellerup, 1999) and are usually preceded by other decisions, such as deciding what information to use, or who to consult, when deciding how much information is required in an EIA.

## 8.2 EXPECTATIONS OF ACTORS INVOLVED IN EIA DECISION-MAKING

The quality of decision-making is important to a range of actors, for example:

1. Individuals and interest groups adversely affected by a project need confidence their written approval will be required before consent can be granted, unless the application is publicly notified;
2. Applicants for resource consent need certainty so they can plan and make decisions. They need what Sadler (1996, p22) refers to as "... efficient, predictable implementation (of EIA processes): applied in a timely manner that fosters certainty, minimises delay and avoids unnecessary burdens". They need assurance their projects will not be delayed or they will not be held to ransom by vocal or influential members of the community not adversely affected by their project<sup>25</sup>.
3. Applicants also need an understanding of impact significance so they know what to include in their EIA and to what level of detail<sup>26</sup>.
4. Politicians need assurance the community they are elected to serve receives the benefit of quality decision-making. Given that most delegate this function to staff<sup>27</sup>, they need the

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<sup>25</sup> In her critical review of the RMA, Frieder (1998) refers to the need for fair and effective processes for both the community and applicants for resource consent, including "decision guidance for determining who is a legitimate interested party" (Frieder, 1998 p21)

<sup>26</sup> Such an understanding can be used to separate effects into three categories:

- effects larger than minor, about which the EIA will need to contain sufficient detail to show the effect is still acceptable in light of the purpose of the RMA and the positive impacts resulting from the project;
- effects that are minor, about which the EIA will need to contain sufficient detail to show the effect is in fact minor and that any mitigation measures proposed are reliable; and
- effects smaller than minor, about which the EIA will need to contain sufficient detail to show why the effect is small. This category can be further split to separate those effects applicants consider negligible but about which there is widespread public concern or scepticism.

confidence that staff decision-making meets the needs of the community. They do not want the embarrassment and financial burden of decisions overturned on judicial review.

5. Decision-makers themselves need assurance the decisions they make will be upheld on judicial review and meets the needs of the community they serve.

### 8.3 CRITERIA USED FOR EIA DECISION-MAKING

The RMA provides criteria for each of the decisions listed in Section 8.1. For example adequacy of EIA content is established using the criterion of “scale and significance of the actual or potential effects that the activity may have on the environment” (s88 RMA). Of the five decisions listed, the one related to non-notification has perhaps the greatest consequences for actors, in that it marks the boundary between formal public participation<sup>28</sup> and less formal involvement. As discussed in the footnotes it also establishes an important threshold for EIA content.

The decision to non-notify an application for resource consent is a significant step for many actors. Chapter one explains that the RMA is intended to be participative<sup>29</sup>. There are several reasons for this, ranging from the pragmatic to the philosophical and political. The philosophical and political arguments for public participation are reflected in the following extracts from Carson’s *Silent Spring*, (Carson, 1962), as relevant today as when she wrote them almost forty years ago:

On page 12 she writes:

*...we have put poisonous and biologically potent chemicals indiscriminately into the hands of persons largely or wholly ignorant of their potentials for harm. We have subjected enormous numbers of people to contact with these poisons, without their consent and often without their knowledge.*

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<sup>27</sup> The author of this thesis is employed by Environment Canterbury as their RMA Regulatory Manager and is delegated to make decisions on non-notification and grant of applicants for consent not notified.

<sup>28</sup> Including the ability to appeal decisions to the Environment Court.

<sup>29</sup> This is consistent with RMA literature and Agenda 21 Principles (11).

And on page 13:

*It is the public that is being asked to assume the risks that the insect controllers calculate. The public must decide whether it wishes to continue on the present road, and it can only do so when in full possession of the facts.*

On page 277 she writes:

*The choice, after all, is ours to make. If, after having endured much, we have at last asserted our 'right to know,' and if, knowing, we have concluded that we are being asked to take senseless and frightening risks, then we should no longer accept the counsel of those who tell us that we must fill our world with poisonous chemicals; we should look about and see what other course is open to us.*

Pragmatic arguments focus on the flows of information associated with a participative process. People living close to the environment affected by a proposal are often best qualified to provide information about that environment, information often not available elsewhere. For example the precise location of a colony of rare bats; the hole where salmon like to rest; and how far the flood of 1952 reached. Such information is crucial to developing a better understanding of the impacts of a proposal. Other information<sup>30</sup> flowing between actors will relate to values<sup>31</sup>. The call for a participative process is often closely linked with the call to incorporate values beyond those held by the technocrats involved in the analysis of impacts.

The fact that 95% of applications for consent under the RMA are not notified (MfE, 1999) would appear to conflict with the need for a participatory process. This does not imply that the public does not participate in applications not notified – in many instances they will be invited to sign written approvals and sometimes proponents or staff employed by consent authorities may carry out extensive consultation, sometimes using media releases and public meetings. However non-notification does not provide opportunity for submissions to be made and concerns to be expressed through a formal hearing process, with right of appeal if dissatisfied with the outcome.

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<sup>30</sup> This distinction in information type is supported by researchers such as Kjellerup (1999) who suggests significance is always composed of at least two elements: the measurable, in the strict scientific sense; and the link between that data and the human world, sometimes called the social dimension of environmental effects (Jyslen, 1997).

<sup>31</sup> See Table 12 for a list of values commonly associated with nature.

From Section 1.9.1 the RMA requires that decisions relative to minor adverse effects must be factually based, objective and reasonable. Beyond that there is no absolute yardstick or measure. EIA literature indicates that decisions should also be consistent, both in process (e.g. Ortolano *et al*, 1987) and decisions made (e.g. Sadler, 1996; CEPA, undated). Morrison-Saunders and Bailey (2000) and Frieder (1998) also emphasise the importance of evaluation being ‘transparent’, requiring (CEPA p15, undated):

*... that all factors relevant to assessment decisions are clearly identified by the decision-maker. For example, the factors taken into account by the assessing authority in determining the appropriate form of assessment should be clearly identified.*

The notion of transparency directly affects the other criteria. It makes decision-makers accountable for the processes and information used in ensuring their decisions are factually based, objective, reasonable and consistent. By clearly setting out how decisions were arrived at, actors can participate even when applications are not notified.

Tribus (1969) offers some valuable insights on decision-making relative to engineering design. He describes two types of decision: those that use all available information; and those that do not. He disagrees with those who would label decisions as ‘wrong’ when, despite using all available information, the outcome is subsequently found to be unsatisfactory. That would require perfect foreknowledge<sup>32</sup> and a simple process of deductive logic. By his definition the only wrong decisions are those made without using all available information, leading to unsatisfactory outcomes.

Public participation increases the likelihood that decision-makers will be fully informed before making their decisions. Provided such information is actually used to make a rational decision, defined as “... one that pursues a logic of consequences” (March, 1994, cited in Kornov and Thissen, 2000, p192) the decision is not wrong, even if the outcome is subsequently found to be unsatisfactory.

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<sup>32</sup> By way of example, an insurance company insuring the life of a person who subsequently dies in a car accident, resulting in considerable losses for the company, did not make the wrong decision when it undertook to insure that person. The decision to insure was based on expectations that the person insured would bring a favourable return to the company and the only way the company could have avoided making the decision would be if it knew that person was about to have an accident, which is clearly impossible.

Two additional criteria can therefore be added to the list already identified: decisions must be made using all available information; and they must be rational.

EIA literature has several more criteria for decision-making (Sadler, 1996) but the ones mentioned are the principal ones. While the focus has been on decision-making relative to the non-notification decision, the criteria are relevant to all decisions made. They require that decisions must be factually based, objective and reasonable, made in a consistent, participatory and transparent manner, using all available information in a rational manner.

Before examining decision-making in the structural industry and by those administering the HSNO Act to determine opportunity for improved practice in EIA decision-making, it is necessary to highlight some of the challenges faced by decision-makers making decisions with wide public interest<sup>33</sup> and consequences.

#### **8.4 USE OF INFORMATION IN DECISION-MAKING.**

Kornov and Thissen question the assumption prevalent in much of the EIA literature that “the provision of better, scientifically valid information or knowledge regarding a decision issue will contribute to a better, more rational decision” (Kornov and Thissen, 2000, p191). They distinguish between rationality of process and rationality of the outcome of the process<sup>34</sup>. According to Kornov and Thissen (2000, p192):

*virtually all empirical research shows that decision-making processes in practice often do not follow (such) a rational procedure, even in cases where significant efforts are made to improve rationality.*

Cognitive and resource limitations, behavioural variations and biases all serve to limit individual rationality (Kornov and Thissen, 2000).

Decision-makers are not the only ones whose rationality is questioned. Maynard-Moody (1984) suggests that the public may obscure beliefs through the use of rational arguments and

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<sup>33</sup> Though decision-making in the structural industry may not attract the media attention of the other two areas, decisions made are nevertheless of wide interest due to their wide application and consequences.

<sup>34</sup> Rationality of the outcome involves decisions about the best approach to achieve given aims

Firth (1998) suggests that the very “non-data” decision-makers claim to exclude from their decision-making – irrationality and emotions - is used by the public to make its decisions. Upton (1999 p23) suggests that the increasingly risk-averse world we live in “is more superficially informed about more things than ever before in human history”. Earlier in the same address (Upton, 1999 p20) he states “It also goes without saying that public consideration of complex issues would be greatly assisted by a more scientifically literate populace – something I have often enough lamented”.

These observations suggest that the link between information and decision-making in at least some areas involving risk are not as strong as Tribus (1969) and March (1994) consider desirable for good decision-making. To make some sense of this it is necessary to step back and briefly examine what drives human reactions to risk. Without some understanding of the forces behind this apparent irrationality we cannot know whether risk management decision-making has any relevance to EIA decision-making and whether it is therefore legitimate to examine the two areas identified for sources of better practice.

## **8.5 HUMAN REACTION TO ADVERSE EFFECTS**

Darwin and Freud strongly influenced explorations into the internal forces that direct, focus and sustain human behaviour (Jarvis, 1999). They believed the forces energising and directing our complex actions are ancient programmes, evolved over aeons of time, passed on genetically from our animal ancestors. They saw us as high-grade animals that, like ants and bees, are driven by inherited biological imperatives called ‘instincts’. This theory had strong support among scientists until a few decades ago when research (Berelson *et al*, 1964) suggested that each of us is constantly shaped and reshaped by our daily experiences. This research suggests that our capacity to learn, think, imagine, conceptualise, reason, wonder and plan releases us from the constraints of instincts, and our personal psychological programmes are written and rewritten through all our experiences<sup>35</sup>.

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<sup>35</sup> This is consistent with the observations of the geneticist David Suzuki (1989) who suggested that a look at second and third generation immigrants in Canada gave powerful evidence that genes are not the primary determinants of behaviour.



It is beyond the scope of this thesis to explore in any depth the research carried out into the decision-making processes of the human mind. Yet a basic understanding of such processes is fundamental to understanding, and hopefully predicting, human reaction to adverse impacts. The industrial psychologist Wolf Jarvis has studied human behaviour over many decades (Jarvis, 1999) and while his work focuses on relationships between colleagues in the work place, he suggests that the results of his research can be applied universally wherever the causes of human motivation are examined.

Jarvis (1999) claims that numerous studies show that the principal themes in human mind and action cannot be accounted for by studying turtles, termites, tarantulas and other ‘lower creatures’ and then applying data from those enquiries to people. Instead he suggests that, despite the intellectual superiority of humans over all other creatures, thanks to very complex structures and processes located in the human cerebral cortex<sup>36</sup>, our reasoning does not drive us. Instead our reactions in any situation are mostly determined by the extent to which our own perceptions arouse three powerful psychological processes co-ordinated in areas of the mid-brain and brain stem: our values, emotions and motivations. He suggests that the combined influence of this trio focuses, directs and determines most of our sensory and intellectual activities and unless we accurately identify the powerful controls exerted by these energies, we cannot understand or predict any human behaviour other than the reactions of natural and unconditional reflexes.

His views are shared by scholars such as Kluckhohn (1954) and Krech *et al* (1974) who present models whereby individuals are motivated to defend a possession or a conviction against outside threats and the energy they expend doing so is in direct proportion to its value to them. They will not defend every value they subscribe to – only those that are perceived as critical to life or lifestyle and are seen as threatened<sup>37</sup>. Both models place highest values or

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<sup>36</sup> The outside covering of the brain giving us significant potential for introspecting, remembering, understanding, thinking, conceptualising, reasoning, planning, sensing, speaking, reading, writing, analysing, synthesising, deciding and many other skills (Jarvis, 1999).

<sup>37</sup> There is a strong link here to context. Firth (1998) suggests a link between values or deeply held convictions and availability or scarcity of the commodity in question. She quotes the example facing most water providers when trying to make policy decisions about water conservation. Given the broad applicability of her example and potential relevance in explaining differing values attached to resources within the New Zealand context, her example is worth repeating in full (Firth, 1998. p326).

“Intellectually, most water customers realise that water is absolutely essential to life. They may even know that consumers can live longer without food than without water. Because water is so vital to life, governments have

most deeply held convictions where the perception of being crucial to life or lifestyle and the perception of loss come together.

Jarvis (1999) continues that there is nothing new in any of his observations – they have been known to observant people for thousands of years. Research over the last few decades has given insights into how the brain directs values, emotions and motivations to respond to information available to it and how people can command their brains to avoid evidence and maintain absurd conclusions (*ibid.*). Careful examination of each of the processes shown on the right hand side of Figure 10 is not just helpful, but essential if we are to make any sense of people's reactions to the significance of environmental harm – or any other threat of harm to them (*ibid.*).

#### Figure 10: Homo sapiens vs. Homo Pathiens.

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long made it their business to provide a continuous supply of safe drinking water. In many places, water providers have been so successful at providing water that, although it is absolutely necessary to sustain life, it is taken for granted because it is always there.

Generally in the United States, water is rarely perceived as scarce, therefore it need not be defended regularly. Without the sense of scarcity, when community values about water management are sought, typical values responses include keeping water in streams, protecting habitat, providing or maintaining recreation, improving aesthetics, water rights ownership, quality and safety; but simply having water to drink on demand is seldom mentioned. Values about water appear to have moved up on Maslow's (1943) hierarchy".

### 8.5.1 VALUES

Checkland (1989) and Kornov and Thissen (2000) suggest that a person's worldview has an important influence on their evaluation of significance and subsequent attitudes directing their reaction to environmental harm. O'Riordan (1981) places values on a continuum from ecocentrism to technocentrism with values representing these positions occupying opposite ends of the continua. The value continua dividing technocentric and ecocentric positions are set out in Table 6.

Table 6: Value Continua Dividing Technocentric and Ecocentric Positions.

Technocentric	Ecocentric
Economy	Ecology
Resourcism	Preservationism
Perfect nature	Protect nature
Dominance over nature	A part of nature
Individual	Group
Self	Community
Private property rights	Public good
Anthropocentric	Ecocentric
Human centered	Earth centered, naturalistic
Human rights	Animal rights
Human benefit	Ecosystem benefit
Centralised	Decentralised
Active management	Passive management
Hands on	Hands off
Exotics encouraged	Only natives
Species specific	Holistic
Free will	Mutual Coercion
Utilitarian	Aesthetic
Local	Global
Imagination limited	Resource Limited
Competition	Co-operation
Change	Stability

When actors share similar spots on the value continua, a value cluster results and they may share a similar "worldview". Kluckhohn and Strodtbeck (1961) refer to three well-known worldviews relative to nature: Mastery-over-Nature; Harmony-with-Nature; and Subjugation-

to-Nature. In the “Mastery-over-Nature” orientation<sup>38</sup> the forces of nature of all kinds are to be overcome and put to the work of humans. Rivers are spanned by bridges; roads built through and around mountains; and lakes filled in or created to suit. The pervading view is that it is part of our duty to overcome obstacles hence there is considerable emphasis on technology. In the “Harmony-with-Nature” orientation<sup>39</sup> there is no real separation of man and nature – one is simply an extension of the other, and a conception of wholeness derives from their unity. The “Subjugation-to-Nature” orientation<sup>40</sup> expresses itself as a form of fatalism whereby the forces of nature are permitted to cause damage with little if any protective measures taken.

While an individual’s values can be determined at a particular point in time, Firth (1998) considers the identification, interpretation, measurement, quantification, and validation of values information for a community of individuals to be highly problematic. For a start she contends it is only possible to engage small portions of a community from time to time and it is a fallacy and waste of time and effort to expect more broadly based involvement than the ‘small public’ generated by a particular project.

There is considerable benefit to the individual from belonging to a group. An individual making a value based decision carries risk of ridicule, social ostracisation and increasingly today, the risk of financial penalty (Firth, 1998). However within a group that risk is shared by many and there is an element of belonging and acceptance. Individual responsibility for decision-making is collectively avoided and the presence of others discussing a problem gives the problem greater significance (Haan *et al*,1985). As the participants exchange information about the problem, their intensity increases, increasing involvement and commitment proportionately. The decision to oppose a project is an amalgamation of strongly held convictions, diminished personal risk, diminished personal responsibility and potential for retribution, increased perceived significance of the problem, an increased sense of self-importance borne of association with an important problem, and an intense sense of commitment to the conviction and to the group (Firth, 1998).

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<sup>38</sup> Ponting (1992) suggests the Judeo-Christian traditions and teachings prevalent in Anglo-Saxon traditions have resulted in a “Mastery-over-Nature” orientation.

<sup>39</sup> Gray and Tankersley (2000) suggest Harmony-with-Nature is the dominant orientation amongst Maori.

<sup>40</sup> Evidence of Subjugation-to-Nature orientation is seen in some forms of Astrology.

Firth (1998 p327) goes on to say:

*Values form the framework out of which the individual or group is motivated to act, by which it perceives reality, and through which it communicates. The value system directs choices and provides the criteria against which the group or the individual judges, evaluates and determines what is good and what is not. Public values are not rational because they represent deeply held convictions, and as such are grounded in feelings and emotions.*

*The individuals making up the groups are all emotionally invested in the same values. The emotional investment is the stuff that binds the group together, gives it energy, voice and direction.*

### **8.5.2 EMOTIONS**

Jarvis (1999) suggests that by storing and processing all the messages we receive from the world around us, and reflecting on their consequences for us, we gradually accumulate very large “data banks” – patterns of pleasant and unpleasant feelings. We rapidly refer to this information when determining the nature and strength of our reactions to all of our experiences. His conclusion about the influence of emotion as a powerful energy in directing and determining most of our sensory and intellectual activities (together with values and motivations) is supported by environmental practitioners such as Verheem (pers. comm) who has the unique perspective of an EIA practitioner by day and entertainer by night. From his experience in both spheres he too places considerable emphasis on peoples’ emotions as a motivating force on environmental issues.

### **8.5.3 MOTIVATIONS**

Motivations are generated when values and emotions are activated (Jarvis, 1999). Energy in our bodies is released, directed and sustained to help us achieve desirable conditions and avoid those we perceive as threats. Jarvis (1999) considers that Abraham Maslow’s “Hierarchy of Motivational Needs” made enormous contributions to our knowledge of what motivates people. Maslow believed our ‘higher’ needs would only be activated if the ‘lower’ needs were reasonably well satisfied (Maslow, 1954). He summarised his original view about human motivation in his famous diagram shown below:

**Figure 11: Maslow's Hierarchy of Needs.**

During his final years Maslow recognised that this model presented several inaccurate conclusions about the causes and meanings of behaviour (Hoffman, 1988). Jarvis (1999) proposes an alternative model he calls the "Energies Dimension" which, while it owes much to Maslow, also represents some significant challenges to Maslow's views. In particular he challenges the view that self-actualisation is the highest need of mature people, suggesting instead that self-transcendence, meaning, fulfilment and hope are the most dominant imperatives for those who seek to discover and express their fullest human capacities. The five stages of his Energies Dimension are set out in the table below:

**Figure 12: Five Stages of the Energies Dimension.**

Self-transcendence is associated with search for higher meaning and commitment to causes outside ourselves. It energises people into voluntarily giving up ‘lower’ needs in order to maintain loyalty to values, to the people we love and to the causes we cherish. It energises some to spend weeks at sea chasing whalers; for others to chain themselves up a native tree; and for others to lobby against nuclear power or genetically modified organisms. This is the energy decision-makers cannot share<sup>41</sup>, yet must deal with when making decisions involving public risk, irrespective of whether such decisions are about structures that might collapse and kill, hazardous substances that might escape or the discharge of carbon particles into the air people breathe.

## **8.6 FRAMEWORKS FOR RISK MANAGEMENT DECISION-MAKING**

How does risk management include public perception in decision-making? Before turning to the specifics of the two areas selected it may be helpful to examine general frameworks for risk management decision-making. Pyle and Gough (1991) propose a framework for decision-making that is consistent with other models prevalent in risk management literature.

### **8.6.1 THE DECISION-ANALYTIC (WEIGHTED) ASSESSMENT**

This technique lies between the purely quantitative and qualitative approaches. It can incorporate a wide range of assessments, not just quantitative. It makes explicit acknowledgement and use of value judgements and uses the process of ranking to determine the importance of different risks. ‘Significant’ outcomes or probabilities can be given increased ‘weighting’ by changing their position in the list of rankings. Magnitudes and probabilities do not need to be determined quantitatively: they can be assessed as ‘large’ or ‘small’. Risk assessment information is provided as a list of risks ranked according to their severity.

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<sup>41</sup> Problems arise when decision-makers, in an attempt to avoid accusations of being uncaring, reclaim some of this energy by adopting some of the values of the groups they encounter, or substitute their own values into their decision-making. Decision-makers must remain aloof – judicial – from the energies involved.

### 8.6.2 RISK PERCEPTION

This approach is based on assessing the criteria important to those exposed to the risk. It recognises that different groups have different appreciations of risk.

1. The **revealed preference** method is based on the assumption that by trial and error society has arrived at a nearly optimal balance between the risks and benefits associated with an activity.
2. The **expressed preference** approach takes the view that it is meaningless to compare risks in different activities, as technical experts have tended to do in the past. A level of risk that is acceptable needs to be determined for each and every situation involving risk, because society perceives different risks in different ways. This approach assumes that there is no one single level of acceptable risk that can be applied in all situations.
3. The **implied preference** method determines society's preferences by considering all aspects of the institutions that have been set up to deal with risk issues in the past.
4. The **natural standards** approach takes the view that nature provides the best indication about environmental risk. It assumes that whatever the environment has tolerated in the past is tolerable in the future, and provided that human activities do not alter natural systems too much, the environment is not subject to excessive risk.

### 8.6.3 THE PRECAUTIONARY APPROACH

The precautionary approach gives the benefit of the doubt to the environment.

### 8.6.4 THE POLICY-ANALYTIC APPROACH

This approach can be used to synthesise all risk assessments into one framework. It can be used to subjectively (but defensibly) determine the type of assessment that will carry most



weight. It emphasises process rather than outcome. It focuses on the social and political process of decision making and can be used to determine the effects of various influences on the risk assessments, such as institutional constraints, communication interactions, power interplays, and the distribution of power among the participating groups. On the basis of information provided by policy analysis, the risk assessment process can be changed to meet specific criteria, such as the need to increase the input from specific participants, or the need to hasten a decision.

## **8.7 DECISION-MAKING BY TWO RISK MANAGEMENT AUTHORITIES.**

### **8.7.1 DECISION-MAKING UNDER THE BUILDING ACT.**

The Building Act is administered by the Building Industry Authority consisting of up to eight members appointed by the Minister, having regard to (s11, Building Act):

*the need to ensure that the Authority possesses a mix of knowledge and experience in matters coming before the Authority, including knowledge and experience in ---*

- (a) Building construction, architecture, engineering, and other building sciences:*
- (b) Economic, commercial, and business affairs:*
- (c) Consumer affairs and the provision of facilities for people with disabilities:*
- (d) Local government and resource management*

The BIA is the decision-making authority under the Building Act. It uses risk management concepts and principles to translate outcomes defined by the Building Act into engineered solutions. There are points of overlap with the RMA, particularly when structures are used to hold or treat contaminants, or dam water to form lakes. The Building Act and RMA tend to work sequentially although some points of 'hand-over' are poorly defined.

According to McShane, the construction industry operating under the Building Act does a far better job of dealing sensibly with the evaluation of risk (than those working under the RMA).

He states: (McShane, 1998, p9):

*This was the attraction of moving from a regime based on the planning of land use to one based on the management of environmental effects. The same arguments were used to encourage a move away from regulatory building codes, which specified acceptable solutions to codes based on performance standards and hence encouraged new building methods and techniques. However, just as building codes continue to lay out*

*simple and proven 'means of compliance' (such as the standard stud frame) to be used by those who want simplicity and low compliance costs, the RMA similarly encourages 'permitted uses' as a means of providing low cost simple 'means of compliance'.*

*Unfortunately, while the new Building Act has been a great success the RMA is widely held to have failed to deliver on its promise.*

How does the Building Act achieve what McShane believes the RMA is not? Both laws protect people from similar assessment endpoints such as injury or illness, yet it appears the Building Act has a more efficient process in place for translating objectives such as “ensuring that buildings perform in a way that safeguards people from injury and illness” into understandable and widely accepted standards at both the strategic and project level.

The BIA employs a small staff and as part of its functions, recommends regulations to the Building Act in the form of a Building Code. The Building Code converts Building Act outcomes such as “safeguarding people from illness or loss of amenity” into standards such as “The Sound Transmission Class of walls, floors and ceilings, shall be no less than 55” and “Natural light shall provide an illuminance of no less than 30 lux at floor level for 75% of the standard year”. The Building Code is law, approved by the executive without scrutiny by the legislature. Before the BIA recommends changes to the Code it is required to consult widely with those affected, though failure to do so does not invalidate the Code. The only public scrutiny of decision-making is through appointees of the BIA, those consulted and the executive.

Decisions are also made at the project level through BIA ‘determinations’. These are made in response to requests for interpretations of standards in the Code, not all of which are as prescriptive as those above. For example the standard to “safeguard people from injury caused by structural failure” is “Buildings, building elements and sitework shall have a low probability of rupturing, becoming unstable, losing equilibrium, or collapsing during construction or alteration and throughout their lives”.

Applications for determinations are not publicly notified although persons will normally be invited to attend hearings. Like the Environment Court the Authority’s determinations are final and may only be appealed on points of law. Determinations made by the BIA are made

available as ‘case law’ though the Authority is not bound by its previous decisions. Decisions may be taken for judicial review, though as with EIA it is the process rather than merit of the decision that the High Court reviews. Unlike decisions made under the HSNO Act there is no provision for call-in by the relevant Minister.

The Building Act gives only very general directions as to how the public interest is to be objectively determined, requiring consultation only with those whom the Authority considers likely to be affected. Though the Authority is not a representative body, it is expected to have a balanced view due to the attributes of its members and be able to take account of the specialist views of interested parties (Cashin, pers. comm.). In practice the Authority tends to cite New Zealand Standards as acceptable solutions which it expects to represent community consensus to the extent that emerges from the Standard process (*ibid.*).

### **8.7.2 DECISION-MAKING UNDER THE HSNO ACT.**

The HSNO Act works parallel to the RMA and while it does not use or define the word risk, the Environmental ‘Risk’ Management Authority (ERMA) administers it. ERMA consists of between six and eight members appointed on the basis of ensuring “that the membership includes a balanced mix of knowledge and experience in matters likely to come before the Authority” (s16, HSNO). ERMA is the decision-making authority under HSNO and is required to prepare a Methodology setting out how it will consider and decide applications for use of hazardous substances and new organisms. The Methodology is permeated with risk management concepts and principles. For example:

- It sets out a clear, logical and systematic process for decision-making;
- The ERMA and its employees are explicitly required to use recognised risk identification, assessment, evaluation and management techniques;
- Risk is used in the Methodology, defined as “the combination of the magnitude of an adverse effect and the probability of its occurrence”;
- It establishes the context for decision-making, including details of approach to risk and applications which will be declined;
- It recognises and sets out processes for dealing with uncertainty;

- It expressly recognises factors such as whether the risk is voluntary or involuntary, when evaluating risk
- It uses likelihood-consequence curves to express thresholds of significance;
- It encourages use of common units of measurement to combine groups of risks, costs and benefits.

Interestingly, the Methodology introduces the word ‘risk’ as having a meaning almost identical to that which the HSNO Act defines ‘effect’ to be; and re-defines ‘effect’ to mean the same as ‘consequence’, removing all reference to probability.

As well holding the office of Minister of the Environment, the Hon. Simon Upton also held the office of Minister of Biosecurity, overseeing introduction of the HSNO Act. The following extract from a speech made by Upton to a group of American scientists suggests that those administering the HSNO Act are not immune from the challenges faced by those administering the RMA. It followed shortly after the virus RCD was illegally imported into New Zealand to aid the battle against rabbits: He said (Upton, 1999, p14):

*No one would, in any circumstances, condone a breach of the Biosecurity Laws. That it should, apparently, have been committed by members of a community who relied on the maintenance of strict biosecurity for their competitive advantage added to the enormity of the offence in the eyes of many people. But it does underline the fact that risk assessment is not a process that can be guaranteed to end in a consensus and that, at times, the passions that are unleashed will be so fierce that no amount of information will settle the matter. It also underlines the reality that the integrity of New Zealand’s biosecurity laws depends on public acceptance of a particular understanding of their role in controlling risks.*

*This in turn draws attention to an important point about the limits of political action. The RCD decision was taken under laws that precluded political intervention. The subsequent illegal importation, however, forced the debate into the political arena. The HSNO Act, while giving the decision-making power to the ERMA, explicitly provides an avenue for the Minister for the Environment to take the final decision after the Authority has heard all the evidence.*

*The grounds on which the Minister may call-in a decision add little to those that already apply to decisions that remain in the hands of the Authority. But the minister is given one potentially potent power. In deciding that he will take the final decision, the Minister is entitled to specify “in the circumstances of the particular case, what is or is not significant” for the purposes of applying section 36 of the Act. Section 36, you will recall, spelt out the risks which, if found to be significant, provide sufficient grounds alone for the Authority to turn down an application. In other words, a politician is*

*given the power to provide a definitive and final definition of an operative provision of the law.*

*Jurisprudence scholars in this audience may well quail at the opportunity for executive excess this might imply. But from the point of view of any politician who might advocate its use, it raises as many problems as it might solve. This provision was framed while the RCD process was being considered and was frequently referred to by those who argued that a duly elected and publicly accountable office-holder should have to exercise the judgment required in hard cases such as those posed by the RCD application. It is an easy argument to advance for everyone other than the person – for the time being me – able to exercise the power. Imagine, in the RCD case I have just outlined to you, deciding that, for the purposes of section 36, adverse effects on human health or safety should not be regarded as significant. Quite apart from requiring the wisdom of Solomon, such a possibility assumes an ability to reflect through the person of a single politician, a level of risk aversion that somehow reflects community held values. The problem is that the circumstances in which such a consensus could be discerned would be the very circumstances in which the pressure to call-in a decision would be at least pressing. Conversely, it is in precisely those cases where the community is irreconcilably divided that the pressure to call-in the decision (and thereby render it politically influenceable and accountable) will be most intense.*

*Given the low regard in which politicians are held in most contemporary democracies, it seems counter-intuitive that we should want politicians to involve themselves in weighing up the esoteric concoctions of science, ethics, values, costs, benefits and probabilities that are at stake. But this is what the New Zealand legislature has opted for. It is, at the very least, a frank admission that at their most profound, these issues of risk management enjoy no immunity from political engagement. Which, in a way, is exactly what the illegal importers of RCD proved.*

So does this area of risk management have any answers? Upton goes on, in the same speech (Upton, 1999 p22):

*I would offer two observations on how scientists can contribute to public confidence about risk assessment on the basis of my experience in New Zealand. In the first place, it would be a mistake to rely purely on process (no matter how exhaustive) as a final guarantee of public acceptability. New Zealand has erected one of the most elaborate and publicly transparent processes for controlling the importation and release of new organisms. The community can be certain that before a decision is taken, all the information that is available in support and in opposition to release will see the light of day and be applied within a statutory framework that places a premium on caution in the face of uncertainty. For many, that will be adequate assurance that matters have been properly considered. But the fact that a public process has been carefully followed should not be used to support the proposition that any final determination amounts to a consensus that will be acceptable to all parties. As the RCD affair in New Zealand showed, strongly held opinions were not dislodged which led, in turn, to the flouting of the law by those who wanted to take the risks inherent in a release. Equally, telling people opposed to running the risk that they had had their day in court would*

*have cut little ice with those who considered that they were being exposed, involuntarily, to risks that they believed to be unacceptable.*

*This leads me to my second observation: an application is likely to win a greater level of acceptance if the existence of public apprehension and specific risk aversions have been factored into the design of a solution from the outset. Public apprehensions of risk should be regarded as a prevailing background condition that moulds research every bit as much as the biophysical limits that constrain the potential solution set. Attempts to engineer brilliant solutions followed by the development of a risk assessment process that is designed to tackle pre-existing fears head on, seems to me a particularly risky strategy. I am not suggesting that research should be constrained by ill-conceived public fears or that scientists should regard the public as uneducable. On the contrary, scientists must be prepared to challenge conventional wisdom fearlessly. But at the same time, if novel techniques are going to be deployed in an increasingly risk averse world ... then the community's particular concerns and aversions, must be factored in from the outset if confidence in solutions with community-wide and irreversible consequences are to be sustained.*

The Methodology prepared by the ERMA refers to processes for ‘capturing’ the approach to risk embodied in decision-making precedents being described within a framework that will enable the implications of the precedents to be analysed and used to promote consistency in future decisions. Gough (pers. comm.) considers that while such analysis is fine in some areas, many of the ERMA related areas are changing at a rate that means past preferences cannot predict current preferences.

### **8.7.3 DISCUSSION**

Both the BIA and ERMA are decision-making bodies appointed by their respective Ministers. They make decisions having large scale effects – either because their decisions (or in the case of the Building Code, their recommendations) have broad applicability – such as the Building Code; or because effects may occur over the whole country, such as the import and release of new organisms. The public interest is taken into account through the appointment of persons representing specific areas of expertise and interest, and submissions. The ERMA notifies applications inviting submissions, whereas the BIA determines whom it will consult. Both hear submissions and make final determinations on matters of technical fact, though under HSNO the public interest can also be represented through the Minister’s call-in powers.

In terms of the risk management framework set out in Section 8.6 both authorities use the ‘expressed preferences’ approach through the hearing of submissions. The BIA appears to rely heavily on the ‘revealed preferences’ resulting from the Standard-setting process while ERMA relies on a range of other approaches (Gough, pers. comm.). Neither authority appears to have analytical tools in place to ensure consistency and balance, apart from centralised decision-making and reasonably long terms of office for authority members (three years).

## **8.8 OPPORTUNITY FOR RISK MANAGEMENT IDEAS, CONCEPTS AND PRINCIPLES TO IMPROVE EIA DECISION-MAKING.**

Can risk management ideas, concepts and principles as practised by the BIA and ERMA be used to improve practice in EIA? This Chapter highlights the very real and difficult challenges faced by EIA decision-makers working within a process designed to promote public participation in environmental decision-making. If the public is encouraged to participate they expect a return for their efforts. Yet the public say different things, sometimes seeking opposite outcomes which invariably causes disappointment and accusations that the public interest was not taken into account.

The RMA response is to require and promote the creation of policy and planning documents through a broad public process. The Courts clearly place weight on such documents when determining the public interest (Murray v Whakatane D.C ), despite McShane’s concern that such documents may not “represent the voice of the community” (McShane, 1998, p32). He likens the view of those who imply that anybody contravening plans is running against a groundswell of public opinion as “dangerously close to a present day endorsement of the notion of ‘the general will’ of the French Revolution” (*ibid.*). Again bearing in mind that his “Thinkpiece” was designed to provoke reaction, there is nevertheless a need to be aware of the weaknesses in strategic level decision-making, particularly given the heavy reliance placed on it by the Courts and the BIA. This is discussed briefly in the context of standard-setting in Section 8.9.

### 8.8.1 DECIDING WHICH PUBLIC TO ENGAGE

Different projects affect different communities in different ways. Using the case studies in Section 1.10, the noise from installation of a bore will affect those living within hearing distance, while future generations may be affected as the bore decomposes and allows flow of water between discrete aquifers, affecting water pressures and flows in streams and wetlands. The drawdown cone resulting from the abstraction of groundwater will affect those abstracting close by, while the cumulative effect may affect everyone else drawing water in the catchment. If the abstraction results in the drying up of a wetland containing an endangered species, then arguably the entire nation and perhaps global community will be affected. Similarly the entire global community may consider itself affected by the discharge of greenhouse gasses from the combustion process. Table 7 describes some of the communities identified in the RMA.

**Table 7: Publics Defined by the Resource Management Act**

Name	RMA Reference	Primary Method(s) of Engagement
Persons interested in or affected by proposals	Fourth schedule 1(h)	Consultation, regional policy statement, plans.
Persons adversely affected by the grant of a resource consent s94(2)(b).	s94(2)(b)	Plans, consultation
Persons directly affected by applications for resource consent	s93(1)(e)	Submissions
First schedule consultees	s60, 64, 65 & 73	Consultation
Maori (tangata whenua)	s6(e), 7(a) & 8	Consultation, iwi management plans
Nation: people and communities using, developing and protecting natural and physical resources	s5(2), s6	National and regional policy statements
Future generations	s5(2)(a)	
Global community	s140(1) & (2) (a), (e) & (g)	Minister's call-in powers.

The EIA literature is light on detail of techniques for defining the temporal and spatial extent of communities to be engaged for specific projects, including future generations, though the RMA requires such communities to be identified. Neither the BIA nor ERMA offer any insights on how the various publics in table 7 might be identified. This is not surprising given



that both authorities make decisions having national rather than local consequences, hence they can avoid the question of having to define the spatial extent of the public affected by their decisions, though the BIA does decide, on a different basis, interest groups from whom they will seek submissions.

### **8.8.2 PROCESS FOR ENGAGEMENT**

The third column of Table 7 identifies methods referred to in the RMA for engagement of each public. For some such as future generations there is no clear methodology while for others such as the global community the primary method of engagement is presumably international fora resulting in Multilateral Agreements and regular reports to update the international community on progress. EIA literature refers to a range of methods for engaging the community in decision-making, ranging from 'low' degree of involvement to 'high'. Figure 13, while not prepared specifically for EIA decision-making, nevertheless provides a helpful overview of relationship between degree of involvement, public influence on decisions and methodology.

**Figure 13: Citizen Involvement in Public Decision-making (After Forgie *et al*, 1999)**

Both the BIA and ERMA represent the affected public, including future generations. The ERMA presumably also represents the international community if the applications under consideration have global effects. Neither body is required to prepare a policy statement or similar document that captures and represents the public will. The public will is reflected in the mix of expertise on each authority. In the case of the Building Act the public interest may also be represented by the Minister and Chief of State<sup>42</sup> and in the case of ERMA the Minister has call-in powers if something is significant enough to warrant it. The Courts cannot be asked to review the technical merit of the decisions made.

The membership of the BIA and ERMA has similarities with that of the Environment Court when Commissioners are used, also appointed on the basis of their mix of expertise. The similarity extends to there being no right of appeal on technical matters and the Court hears submissions as evidence. However the difference between the Environment Court and the other two authorities lies in the fact that the Court can know the public will through the planning documents available to it, whereas the public will can only be known to the BIA and ERMA from within their own membership and the submissions received. From this analysis neither the BIA nor ERMA appear to offer a more defensible process for public participation than the policy and planning processes available under the RMA. On the contrary the BIA is possibly vulnerable to criticism for its heavy reliance on standards determined outside its own decision-making process and public input outside of those invited to participate.

### **8.8.3 DECISION-MAKING**

From Section 8.3 it was identified that EIA decision-making must be factually based, objective and reasonable, made in a consistent, participatory and transparent manner, using all available information in a rational manner. The framework for decision-making used by the BIA and ERMA is similar to that used under the RMA which also relies heavily on the expressed preferences approach through the submissions process. There is nothing inherent in either model that suggests decision-making by the BIA or ERMA is more factually based, objective,

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<sup>42</sup> Both form the executive branch of government, i.e. regulations do not receive scrutiny in the house of representatives.

reasonable transparent or rational, this being very dependent on the qualities of the decision-makers rather than process.

However many consent authorities are senior staff with delegated authority, making decisions on their own or with a colleague. Given the larger number of people and mix of skills available within the membership of both the BIA and ERMA, it is reasonable to assume that there is greater potential for decisions to meet the above criteria. It is also reasonable to assume that given there is only one BIA and ERMA, consisting of members with three-year tenures, decisions are more consistent than those made by almost 80 individual consent authorities throughout the country and within each authority, a number of staff.

The suggestion that consistency of decision-making can be improved through having fewer decision-makers is consistent with the advice offered by the Ministry for the Environment when it recommended that delegation for decision-making should rest with experienced and relatively few Council Officers (MfE, 1996). This does not address consistency of decision-making between councils, although the BIA and ERMA models offer two opportunities for improvement.

The first is decision-making by a larger group of people; the second is the development and use of specialist techniques to analyse decisions and make them available as 'case law'. The first could be used by groups of councils servicing similar ecological areas, or within a single region. The second assumes the development of techniques such as those that will allow ERMA to implement the approach proposed in its Methodology (ERMA, 1998, p13):

- *The Authority's approach to risk will reflect the nature and characteristics of the risk being considered, will build on past decisions and other sources of information, and will be applied consistently across applications.*
- *The Authority's decisions will, over time, form a body of precedents, which will inform its future decisions.*

Later the Methodology states (p21):

*The approach to risk embodied in decision-making precedents will be described within a framework which will enable the implications of the precedents to be analysed and used to promote consistency in future decisions.*

And on page 22:

*This specification of the boundary lines will be strengthened over time through consideration of the body of decisions made by the Authority. These decisions will take account of other relevant information including precedents set under other jurisdictions.*

*As certain precedents prove to be robust (i.e. justified against the information base built up) and consistently applicable to the decision-making of the Authority, they will be recommended as providing guidance to applicants.*

It seems apparent that the BIA needs similar techniques to promote consistency and balance between its decisions. It seems sensible that decisions about acceptable risk of the collapse of a high rise building made by the BIA should be available when making RMA decisions about risk of a collapsed hillside. After all, it is somewhat irrelevant whether we are crushed by a collapsed building or a collapsed hillside, but we are vitally interested in ensuring the risk of both events is very small.

Provided due care is taken and the right mix of expertise is used, analytical techniques that take account of context may produce benchmarks of significance that could be used in EIA decision-making and in particular, in making decisions about the size of a minor adverse effect. Such analysis could be used to compare decisions made about other sources of harm having a similar assessment endpoint, adding credibility and validity to decisions made in separate yet connected spheres of human activity. BIA determinations such as noise transmission in buildings could be used to determine acceptable levels of noise from the installation of bores. Ventilation standards could be used as a benchmark for decisions about acceptable concentrations of contaminants in air; or reliability of water supplies in buildings could be used to benchmark decisions on acceptable loss of reliability resulting from drawdown of water level.

This section highlights the complex and seemingly impossible task of EIA decision-making within a diverse, educated community having ready access to communication systems, information and their political leaders. A community that has time to articulate views and mobilise support, empowered by access to a free media and independent judiciary. Risk management ideas, concepts and principles used within the same community in two different

spheres of activity can provide insights on how EIA decision-makers can overcome some of the challenges provided by such an environment.

This section identifies two possibilities for better practice: co-operation amongst decision-makers; and use of techniques to develop benchmarks. Provided the right set of skills is employed, including the skilled use of assessment endpoints, analysis of past preferences<sup>43</sup> to determine community perceptions holds promise for making factually based, objective and reasonable decisions in a consistent, transparent and rational manner, using all available information.

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<sup>43</sup> In a manner that allows the 'value' component of the preference to be identified and available for future decision-making.

## 8.9 STRATEGIC LEVEL DECISION-MAKING.

Beer and Ziolkowsky (1995) identify two types of problems addressed by environmental risk management: strategic and tactical. The former is pro-active, dealing with 'high level' decisions such as the Building Code; while the latter is carried out in response to specific proposals. This division is analogous to RMA policy and plan preparation (strategic) and processing applications for resource consents (tactical). So far this Chapter has only dealt with the latter, but would not be complete without reference to strategic level decision-making under the RMA. There are two reasons for this. Firstly because strategic decision-making is often seen as the answer to the many challenges faced in project-level decision-making. Secondly because once such decisions have been made, decision-making at the project level is much simpler.

If the estimate of the impact of a proposal is below the standard set out in an RMA plan it can be assumed to be acceptable and no further evaluation is required. This makes the use of standards very attractive. According to Suter (1990), their chief limitations are that they have no meaning outside the legal regulatory context and they only protect values included in the standard setting process. If standards are exceeded, legal consequences are likely to be known before the consequences for the values they are designed to protect, be it public safety or the environment.

The application of standards is an administrative act, appropriate in a range of situations summarised here and attached as Appendix G. (Fischhoff, 1983).

- *When no choice between options is possible;*
- *When no choice between options is required;*
- *When predictability is important;*
- *When regulators hope to shape future options;*
- *When competing technologies fall in the same jurisdiction;*
- *When category members are homogeneous;*
- *When an explicit policy statement is attractive;*
- *When value issues are sensitive;*
- *When political resources are limited;*
- *When process is unimportant;*
- *When awkward applications can be avoided.*

At the strategic level, RMA decisions on significance are mostly made through a public process. The RMA prescribes such a process for the preparation of plans and allows the plan preparation process to set out lists of activities that can be decided without need for public notification. The RMA also provides for lists of mitigation measures in plans, applicable to various activities, and the preparation of national standards.

Such standards are commonly used to deal with impacts such as those originating from the third case study, the discharge of the products of combustion. The Ministry for the Environment has published guidelines for 'acceptable' sulphur dioxide and small particulate concentrations in air. Invariably such standards are based on numerous studies, often carried out overseas, targeted towards the protection of a particularly vulnerable part of the community such as the young, old or sick. Once such standards are set there is usually no further opportunity for input by those affected. Decision-making becomes an administrative act. Impacts from the project are compared to a pre-decided list of acceptable impacts and if all these are met, the project can go ahead. It is assumed that because standards will be met, adverse impacts are acceptable and there is no need, or opportunity, for further debate.

While there are many advantages in setting standards there are disadvantages. If the timeframe for producing them is too long, individuals may lose interest and drop out of the process<sup>44</sup>. Outside the context of a statutory process, standards may be set by groups of people with vested interests in the outcome<sup>45</sup>, seeking to create a high sounding rule to legitimise their actions (Fischhoff, 1983). Vagueness may obscure what the standard is walling in and walling out and it is often difficult to find an audit trail behind an outcome. They can be used to hide values or political motivations (*ibid.*) They may lack the energy and debate associated with debates about individual projects (refer Section 8.5), which can be positive and negative. Standards can take away important rights from the public<sup>46</sup>, despite the public having every opportunity for becoming involved but choosing not to because they are not motivated by an immediate threat.

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<sup>44</sup> Planning timeframes are typically years and if Appealed to the Environment Court, require considerable resources, often excluding individuals from participating.

<sup>45</sup> While not suggesting this the case with the Building Code, a number of assumptions are required to connect Parliament's desired outcomes set out in the Building Act, with the Code.

<sup>46</sup> For example the right to object to a neighbour blocking out sunshine, if they are within recession planes.

A cursory review of many widely used standards, particularly those established for the ingestion, inhalation or absorption of contaminants by humans, demonstrates the extent to which value decisions are obscured. While strategic documents have a place, they are not necessarily better at ensuring that public perceptions are included in tactical decision-making.



## 9 UNDERSTANDING THE PROBLEM

*The nature of the problem can best be understood by placing it along a series of axes, categorising it. The axes could also be called the dimensions of the problem. Together they give the problem type. The axes are:*

<i>Financial</i>	<i>Physical</i>
<i>Internal</i>	<i>External</i>
<i>Frequent</i>	<i>Infrequent</i>
<i>Differentiable</i>	<i>Undifferentiable</i>
<i>Compact</i>	<i>Extended</i>
<i>Absolute .</i>	<i>Relative</i>
<i>Immediate</i>	<i>Delayed</i>
<i>Immediate Effect</i>	<i>Cumulative or chronic effects</i>
<i>Unique</i>	<i>Repeatable</i>
<i>Clear value system</i>	<i>Fuzzy value</i>
<i>Simple</i>	<i>Complex</i>
<i>Single issue/focus</i>	<i>Multiple focus</i>
<i>Own risk</i>	<i>Others risk</i>
<i>Standard driven</i>	<i>Loss driven</i>
<i>External threat</i>	<i>Internal threat</i>

(After Elms, 1998c, pp52-56).

AS/NZS 4360:1999 states:

*Risk analysis involves separating the minor acceptable risks from major risks so that minor risks can be excluded from detailed study. Risk is analysed by combining estimates of consequences and likelihood in the context of existing control measures. To avoid subjective biases the best available information sources and techniques should be used.*

Elms (1998c) stresses the need to understand a problem before selection of a technique by which to analyse it, always ensuring the risk management system employed is problem and not technique driven. To select the right technique requires an appreciation of the hierarchy of risks to be managed and inevitably involves different approaches at different levels (*ibid.*). Tweeddale (1998) observes that integration of the risk management process across different types of risk does not require uniformity of risk management techniques. In fact, because of

the range of different types of risk, and the range of disciplines to which risk management is being applied, it is very important that various risk – specific techniques are used.

Risk management has a long history of analysing and calculating risk, across many spheres of human activity. The mechanical and civil engineering professions alone have spawned a vast array of analytical techniques dealing with everyday sources of risk to the major, such as risk from nuclear accidents. The validity of many of these have been tested and refined through investigations of failures<sup>47</sup>.

### **9.1 SELECTION OF ANALYTICAL TECHNIQUES**

In bringing together all the methods for assessing risk into a common framework, Covello and Merkhofer (1993) split the analysis of risk into four parts: release assessment, exposure assessment, consequence assessment and risk estimation. The first three are sequential steps summarised by the fourth. Each of the first three parts describes four methods of analysis – monitoring, testing, statistical analysis and modelling - highlighting the multiplicity of approaches, yet the consistency between them and the considerable amount of information available to support practitioners of risk analysis.

In comparing human and ecological risk analysis, Warren-Hicks (1996) identifies four criteria for evaluating the validity of methods employed to estimate risk. Risk estimates should:

- be clear and understandable by decision-makers;
- communicate the magnitude and extent of the risk clearly;
- have relatively small errors in bias and precision; and
- provide the risk manager with a high degree of confidence that any management decisions based on the risk assessment data have a high probability of succeeding.

Choice of method employed should consider the extent to which it meets these criteria.

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<sup>47</sup> Note for example the extent to which accidents involving planes are investigated and results fed back to designers and operators.

## 9.2 QUANTITATIVE VS. QUALITATIVE TECHNIQUES

Pyle and Gough (1991) suggest that approaches to risk assessment can be divided into two broad categories: quantitative and qualitative. They note that qualitative techniques are used as part of a more subjective approach in which value judgements are acknowledged as an integral part of the risk assessment<sup>48</sup> process. They also note that although quantitative techniques are often claimed to be ‘objective’, in reality they too are subjective due to the many assumptions inherent in the selections involved.

Vesely (1984) divides quantitative techniques into four clearly defined techniques, set out in Table 8:

**Table 8: Quantitative Techniques for Analysing Risk**

1. Statistical analysis of past events having similar consequences;
2. Extrapolation techniques of past occurrences of less severe events;
3. Event tree analyses; and
4. Fault tree analyses.

Pyle and Gough (1991) provide a helpful summary of the appropriate use as well as the advantages and disadvantages of each of these. Event tree and fault tree analyses are used extensively in determining the risk of engineered structures, but their inability to take into account intangibles such as human error means that predictions made are often unrealistic. Extrapolation techniques are commonly used to predict the size of floods larger than those measured, while statistical analysis of common events such as car accidents will give a more accurate analysis of future risk than an analysis based on all the things that could cause one.

Pyle and Gough identify four main types of qualitative risk assessment approach. These combine analysis and evaluation in a single process and are included in Table 9 for completeness:

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<sup>48</sup> Their use of the term ‘assessment’ straddles the boundaries established by the definitions of risk ‘analysis’ and ‘evaluation’ used in this thesis. While accepting that analysis of risk still involves subjectivity to various degrees, the distinction between the analysis of effects and their subsequent evaluation is nevertheless considered essential. Analysis of risk is a technical process, the validity of which can be established through scientific processes. Evaluation on the other hand is political and value-driven and the views of those with technical expertise have no more validity than any other member of the community, a distinction sometimes forgotten but fundamentally important in a society subscribing to the value of equality of all its members

**Table 9: Types of Qualitative Risk Assessment Approach**

1. The decision-analytic technique, which extends technical assessments into an area of acknowledged (by technical experts) subjectivity;
2. The risk perception approach, which identifies the perceptions of risk that various groups have and is further divided into:
  - Revealed preferences
  - Expressed preferences
  - Implied preferences
  - Natural standards
3. The precautionary approach, which promotes caution; and
4. The policy-analytic approach, which can be used to devise a framework that incorporates all risk assessment techniques.

Again a helpful summary of appropriate use as well as the advantages and disadvantages of each is provided (*ibid.*) AS/NZS 4360/1999 also refers to structured interviews; use of multidisciplinary groups of experts; and individual assessments using questionnaires, as useful techniques for managing subjectivity and avoiding bias when conducting qualitative analyses. It is beyond the scope of this thesis to categorise risk management analytical techniques in an attempt to draw linkages with possible use in EIA. See EPA (1998) for a comprehensive list of impact types and potential analytical techniques for use in EIA.

### 9.3 CASE STUDIES

Emphasis in AS/NZS 4360:1999 on identification of existing management, technical systems and procedures to control risk has a useful role in EIA where the existence of ‘inherent<sup>49</sup>’ mitigation measures is often overlooked. Unless their validity and dependability are examined as part of the analysis process, predictions made may be unreliable or invalid. Conversely, ignoring them involves the practitioner in considerably more effort than is otherwise required.

For example the analysis of the groundwater abstraction on a nearby stream may demonstrate negligible effect, based on the depth of the intake screen being a considerable distance from

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<sup>49</sup> Measures that are an integral part of a proposal, such as rate and depth of groundwater abstraction.

the ground surface. Unless that depth is carried through into a condition of any subsequent consent, preventing the construction of screens at a shallower depth, the analysis made may be invalid.

Similarly the prediction of particulate emission will depend on a range of factors such as type of fuel used, furnace configuration, control settings, height of stack etc. Unless these are subsequently incorporated as conditions, the prediction will again be invalid. The challenge is to separate changes resulting in improvements from those that do not<sup>50</sup>, so regulations do not become impediments to improved impacts.

This Chapter outlines a number of risk management practices useful to EIA, including the need to understand a problem before matching it with an analytical technique; that the problem may be better understood by placing it along a series of axes, categorising it; that existing control measures should be expressly recognised in the analysis; that criteria exist for the selection of appropriate techniques; and that there are a range of quantitative, semi-qualitative and qualitative techniques available for analysis.

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<sup>50</sup> For example a stack might be described as twelve meters high and purple. Changing colour should not require an application to change conditions, however the height might be a critical mitigation measure used to decide effects were minor.

## 10 MEASUREMENT AND ASSESSMENT ENDPOINTS

*The correct measure of risk, or more precisely of the consequences, depends on the problem's aim and often needs careful thought.*

Another risk management concept EIA practice could benefit from is the selection and use of measurement and assessment endpoints.

### 10.1 USE OF MEASUREMENT AND ASSESSMENT ENDPOINTS

Suter (1990) considers the selection of the correct end-point fundamentally important when assessing risks to ecosystems. Zach (1998) reviewed risk management techniques for use in evaluating environmental risk resulting from multiple oil spills in Whangarei Harbour, New Zealand. Her thesis proposes a number of improvements including clear definition of an assessment endpoint.

Suter (1990) distinguishes between 'assessment endpoints' and 'measurement endpoints', a distinction adopted by the US Environmental Protection Agency's Ecotoxicology Subcommittee (Hinckley, 1989). Assessment endpoints are the highest values that can be assessed formally. They must be valued by society, but are not ultimate values. A measurement endpoint on the other hand is an expression of an observed or measured response to the hazard; it is a measurable environmental characteristic that is related to the valued characteristic chosen as the assessment endpoint. Suter (1990) sets out a number of criteria for the selection of good endpoints, listed in Tables 10 and 11:

**Table 10 : Characteristics of Good Assessment Endpoints (After Suter, 1990)**

1. Social relevance
2. Biological relevance
3. Unambiguous operational definition
4. Accessible to prediction and measurement
5. Susceptible to the hazard

**Table 11: Characteristics of Good Measurement Endpoints (After Suter, 1990)**

1. Corresponds to or is predictive of an assessment endpoint
2. Readily measured
3. Appropriate to the scale of the disturbance/pollution
4. Appropriate to the route of the exposure
5. Appropriate temporal dynamics
6. Low natural variability
7. Diagnostic
8. Broadly applicable
9. Standard
10. Existing data series.

For further reading on each of these characteristics, see Suter (1990).

Taking the three case studies described in Chapter 1, impacts on the environment can be measured as:

- decibels of noise emitted by the installation of a bore;
- metres drawdown of water level in surrounding bores; and
- concentration of fine particulate in air a certain distance from the discharge of combustion products.

Such measurements may be a waste of time and effort unless there is a clearly defined assessment endpoint to which they can relate. A clearly defined assessment endpoint not only indicates what is worth measuring, but also how intensively it must be measured. For example unless there is a concern about noise, something valued by society (or rather, lack of noise), there is little point collecting data on decibels of noise emitted as a bore is being installed.

Similarly unless the drawdown can be related to something valued, such as economic return from crops, or reliability of potable water supply, or reduced income due to additional power costs, its measurement will be a waste of time and effort. And thirdly if a particular concentration of fine particulates cannot be linked to something valued, such as human health, it also has little relevance.

The Methodology produced by ERMA refers to the use of “common units of measurement to combine groups of risks, costs and benefits”. It further refers to the “approach to risk embodied in decision-making ... being described within a framework that will enable the implications of the precedents to be analysed and used to promote consistency in future decisions”. While details of how this will be effected are not provided, the selection and use of assessment endpoints representing a broad range of societal values can be a useful way of relating diverse effects, key to the promotion of consistency. Selecting the right ones will also help the evaluation process and avoid waste by focusing monitoring effort.

Taking the second case study described in Chapter 1, involving pumping of groundwater, one effect is the drop in water level in surrounding bores. How does one evaluate a drop in water level of one metre and determine whether the effect is more than minor, or acceptable? While ‘metre’ may meet many of the characteristics of a good measurement endpoint set out in Table 11, it misses out on the first characteristic, namely corresponding to, or being predictive of, an assessment endpoint. What biological or social relevance does a metre drop in water level have?

A drop of one metre can have several flow-on effects. It can result in extra pumping costs for neighbours, because their water has to be raised an extra metre to reach the ground surface; or it can result in less water available for irrigation, because the pump delivers less water to compensate for the extra energy required to bring it to the surface; or it can result in the water level dropping below the intake of the neighbour’s pump, resulting in loss of potable supply.

But there are also positive effects, such as irrigators saving on the time and inconvenience of having to shift irrigators. Is loss of irrigation water in itself really of concern, or is it the loss of crop yield, or the inability to grow certain crops? These types of effect are starting to have social relevance, but again one could question whether even loss of yield, or inability to grow certain crops, is really of ultimate importance. While some farmers will undoubtedly consider inability to grow their favourite crop a significant loss, others would be perfectly happy if they were reimbursed for their loss of income and they had to grow alternative crops. Loss of income could therefore be a more useful assessment endpoint than drop in water level. And ‘dollars’ as the measurement endpoint corresponds well to that choice of assessment endpoint, relating effects as diverse as loss of irrigation water, extra pumping charges and even loss of



potable supply. While not without its challenges, loss of income is considerably easier to evaluate than drop of water level.

How does choice of income as an assessment endpoint help promote consistency? Because it provides a common denominator by which not only dissimilar effects resulting from the same abstraction may be compared, but also allows comparisons between different abstraction points to be compared. A one metre drop in water level in a bore one hundred metres deep with water twenty metres below the ground surface will have very different consequences for neighbours' irrigation and reliability of potable supply than a one metre drop in a bore ten metres deep with water five metres below the surface. The social significance of the one metre drop is very different from one bore to the next. It is useless therefore as any form of 'standard' or 'significance threshold' for use in promoting consistent decision-making.

By converting drop in water level to loss of income, a 'significance threshold' can be established. While it will bring additional challenges such as calculation of the actual loss and whether it should be expressed as a percentage or absolute amount, the figures are comparable from place to place and over time in a way that drop in water level is not. Not only is consistency between similar activities promoted, but also consistency between dissimilar ones. If the discharge of combustion products in the third case study took place next to a pristine lake, resulting in deposition of sulphur dioxide on its surface, lake water could become acidified, creating stress on fragile ecosystems. Pumping groundwater hydraulically connected to the lake could also result in stresses resulting from loss of nutrient, change in temperature or drop in level.

Adverse effects caused by these activities are traditionally measured using a range of parameters, such as temperature, pH, nutrient concentrations, water level and visual clarity. What is the social or biological relevance of these measures, or what connection is there between these measures and endpoints that are socially and biologically relevant? The connections are difficult to establish, even if trends in water chemistry are detected above natural variability and background 'noise'. If the ecosystems within the lake water are our primary concern, then use of measurement endpoints such as indices of species diversity and abundance can provide us with a direct connection to matters that concern us. This then allows us to relate the effects of sulphur dioxide deposition with effects resulting from the abstraction

of hydraulically connected groundwater, which in turn allows us to make consistent decisions based on the effects each of these has on matters important to us.

The above example highlights the third advantage of using assessment endpoints. Instead of wasting effort monitoring a range of physical and chemical parameters<sup>51</sup> in the hope that these will reveal something about effects on more important matters, using measures with direct connection to assessment endpoints allows focusing of monitoring effort.

## **10.2 SEARCH FOR RELEVANT ASSESSMENT ENDPOINTS**

Some effects do not allow a clear separation between measurement and assessment endpoints. Examples include psychosomatic effects such as noise, odour and landscape effects. While we can measure the noise from bore installation in decibels, the size and significance of the effect cannot be determined by a simple analysis of the range of decibels over a given time period. This is because psychosomatic effects involve a human reaction and the size of that reaction will be influenced by factors such as predictability and individual sensitivity.

However by their inseparability such effects have the advantage of establishing a clear connection between measurement and socially relevant assessment endpoints. Finding socially and biologically relevant endpoints to represent other effects ultimately involves the application of human value judgements - this does not suggest the environment holds no intrinsic value, neither is this thesis advocating an anthropocentric view whereby the only valid values attached to the environment are those imputed by humans. It is simply an acknowledgement that decisions about environmental significance in the context of resource management are human decisions made with human values. That does not mean such values cannot incorporate values carried by nature; but we do not seek the views of earthworms or sparrows when making decisions on environmental significance, though we may purport to represent them.

The last few decades have seen the development of many measurement endpoints with numerical upper limits designed to protect assessment endpoints from unacceptable harm. The

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<sup>51</sup> For example the range of chemicals and oxygen demand commonly measured in waters receiving sewage, compared with the direct measurement of loss of biodiversity or life support capacity.

connection between the two endpoints is not always clear, neither are the values determining how acceptability was determined. Justifications for the adoption of upper limits are often deeply imbedded in supporting documentation. Although there are many benefits from the use of assessment endpoints, the potential difficulties should not be underestimated. When adverse effects are expressed in terms that incorporate human values, people are empowered to have input on an equal basis to the technocrats who have traditionally had significant input into the development of standards. Decisions about values as fundamental as life itself are extremely difficult to make and defend and may cause considerable discomfort for decision-makers. However such decisions must be made and it flies in the face of desire for transparent and accountable decision-making for these decisions to be obscured from public scrutiny

What kinds of values should be used in the development of socially and biologically relevant assessment endpoints? In his search for an environmental ethic Rolston (1988) compiled a list of fourteen values carried by nature, summarised in Table 12.

**Table 12: Values Carried by Nature**

Value	Explanation
Life Support Value	No matter how urbanised society becomes, we remain firmly reliant on nature to provide the air we breathe, water we drink and the food we eat.
Economic Value	Even before human work adds value to them, parts of nature such as crude oil and building stone have economic value.
Recreational Value	Nature can be our gymnasium and our theatre. We use it to show what we can do, and to touch base with something missing from our built environments.
Scientific Value	Whether for pay or play, nature holds endless fascination for many and typically the oddest, seemingly most useless and rarest things typically have highest scientific value.
Aesthetic Value	This value is very dependent on our individual perception and understanding, hence the field of thistles disturbing one person's sleep may be a source of artistic inspiration for another.
Genetic Diversity Value	Humans eat very few plant species (around 30 of about 300,000) and ten provide 80% of the world's calories. Many are bred for high performance at the expense of natural defence systems, making them and us vulnerable to build up of resistance to pesticide etc. Maintaining genetic diversity is essential for a sustainable future for humans, let alone the good of the plant or animal.
Historical Value	Many cultures have historical memories associated with nature: the Germans with the Black forest; Russians and the steppes; Dutch with the sea; Canterbury's early settlers with swamp, Podocarps and grassland; Maori with rivers and coastline. We need a

	museum of what nature was like so future generations can enjoy and taste some of the experiences of their forbears.
Cultural-Symbolisation Value	Many countries have adopted animals and plants as symbols: the British lion; Russian bear; American eagle and New Zealand Kiwi. No culture develops independently from the environment it inhabits and many natural features are inextricably linked with the culture of the community that lives there. Christchurch would not be the same without the Avon and Port Hills, or Rotorua without its geothermal activity.
Character-Building Value	The great outdoors teaches us many valuable lessons, extending our independence, self-reliance, humility, frugality and creativity. The natural rhythms we find in nature are very therapeutic and uncomplicated in a stressed and complicated world.
Diversity-Unity Values	We can appreciate both the rich diversity of life and the unity that permeates all nature, at the same time. The intricate web connecting plants and animals within ecosystems allows us to appreciate intricate detail and unity of the whole at the same time.
Stability and Spontaneity Values	While nature has many regular processes, no two leaves falling off a tree are precisely the same. Neither will we know where the last leaf falling off a tree lands, until it does. Nature does not follow a deterministic pathway, despite our ability to understand and learn the forces and laws that drive it.
Dialectical Value	Nature places pressures on us that help shape us. Nature does not give in to us easily – it makes us work to eat and survive. Many plants and animals hurt us and we learn a valuable lesson when we respect them despite their provocation and opposition.
Life Value	We may value nature for the life it contains, simply out of respect for life itself, or for its organic, aesthetic, intelligible or interest values.
Religious Value	We may value nature as an object of worship; or for the 'cathedral' setting it provides and cosmic questions it elicits; or for the many analogies it provides religious texts.

Note these are only values carried by nature whereas the RMA deals with more than just effects on nature. The definition of 'environment' includes people and communities and we hold values not listed above that are nevertheless affected by activities occurring within our environment. For example values such as economic well being and quality of life are adversely affected by activities that cause drop in property value and assail our senses with unwanted stimuli.

### 10.3 CASE STUDIES

Referring back to the three case studies, the following types of values are affected by the range of environment effects caused, and could be used in the development of assessment endpoints with social and biological relevance:

### **Installation of Bores to Tap Groundwater**

Noise during installation: *Economic Value, Recreational Value, and Aesthetic Value.*

Vibration and consequent damage to structures: *Life Support Value, Economic Value, and Historical Value.*

Allowing contamination of groundwater: *Life Support Value, Economic Value and Cultural-Symbolisation Value.*

Reducing groundwater pressure: *Life Support Value, Economic Value, Recreational Value, Scientific Value and Aesthetic Value.*

### **Abstraction of Groundwater**

Lowering level of water in surrounding bores: *Life Support Value and Economic Value.*

Reducing availability of groundwater for other users: *Life Support Value and Economic Value.*

Reducing level of water in streams and wetlands: *Life Support Value, Economic Value, Recreational Value, Scientific Value, Aesthetic Value, Genetic Diversity Value, Historical Value and Religious Value.*

### **Discharge of Combustion Products**

Human health effects resulting from the discharge of small particulates: *Life Support Value, Economic Value and Aesthetic Value.*

Human health effects resulting from the discharge of sulphur dioxide: *Life Support Value, Economic Value and Aesthetic Value.*

Contribution to greenhouse gases: *Life Support Value, Economic Value and Aesthetic Value.*

The above analysis highlights: the large degree of commonality of consequences to human values caused by activities and effects that have little in common; the large number of environmental effects affecting life-support and economic values; and the significant opportunity for development of assessment endpoints. Their development provides significant opportunity for the improvement of EIA practice by promoting consistent, transparent, accountable and participative decision-making; and focusing of monitoring efforts.

## 11 DEALING WITH UNCERTAINTY

*The principle of consistent crudeness can assist in matching the precision of a probability assessment technique to the quality of the information it uses.*

Sources of uncertainty are commonly divided into two sources: variability and uncertainty. While both contribute to the probability distribution of a prediction, variability of natural systems, such as changes in groundwater levels and wind direction, will always remain whereas other sources such as incomplete data, bias, model or measurement error can normally be reduced with further effort.

Pyle and Gough (1991) categorise sources of uncertainties as:

1. Completeness uncertainties – due to the analyst's inability to conceive of all possible scenarios, such as the errors made by the personnel operating a plant;
2. Modelling uncertainties – due to wrong assumptions or wrong equations being used to model scenarios; and
3. Data uncertainties – due to uncertainties and errors in data used in the models.

To these can be added a fourth, namely uncertainty of the consequences.

If the probability distribution function of each of these sources can be estimated, the range of risk estimates can be calculated or at the very least, the sensitivity of the final answer to variation in input can be analysed.

Finkel (1990) developed a set of guidelines for quantifying uncertainty that includes six steps, specifying probability density functions for each input variable once the equation and measure have been selected. The process is shown in Figure 14.

Figure 14. General mechanics of a quantitative uncertainty analysis. After Finkel (1990).

Uncertainty need not always be known with precision. Common sense, or a simple sensitivity analysis, will often identify the need for degree of certainty. Consequences of exceedance will be the primary driver for the need to analyse uncertainty. Often, safety factors obviate need to precisely analyse uncertainty. Use of safety factors is common in areas such as engineering design and development of environmental standards.

### **11.1 CALCULATION OF UNCERTAINTY**

Risk management has a long history of dealing with uncertainty and in some areas has developed complicated techniques for calculating ability to resist additional stressors<sup>52</sup>. Risk management has developed techniques for incorporating uncertainty into calculations of probability distributions. Using probability distributions of input data as shown in Figure 15, together with Monte Carlo or Latin Hypercube sampling to generate variability, probability distributions of the prediction can be simulated.

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<sup>52</sup> In engineering design of structures it usually applies to a force such as wind or weight. When applied more generally, as here, it is synonymous with 'sources of harm'.

Equations have been produced which attempt to simulate groundwater drawdown around a pumping bore (Theiss, 1935) or describe the transport, diffusion and deposition of contaminants in air (Lorimer, 1986). Analysis of uncertainty attached to predictions made by these equations would identify need for more accurate data or alternatively give decision-makers (and other actors) a clear indication of the level of confidence they can have in the prediction. Moore and Callander (1999) have successfully used a computer programme (Palisade Corp, 1996) to estimate the probability distribution of groundwater drawdown at various locations in Canterbury, New Zealand. The programme is equally able to analyse variability in the other equations. The principle of consistent crudeness (Elms and Turkstra, 1992) is particularly relevant here, assisting in the match between the precision of a probability assessment technique to the quality of the information it uses.

## 11.2 PROBABILISTIC VS DETERMINISTIC STANDARDS

Moore and Elliot (1996) ask why risk assessments rarely conform to the available state of the art for dealing with uncertainty, given the ready availability of 'proven' methods. Such probabilistic methods provide better estimates of risk than deterministic methods, leading to better decision-making. They point out the long history of probabilistic methods in fields such as safety assessments of nuclear reactors, the design and manufacture of household appliances and electronic products, conservation biology, economic forecasting, and highway planning (e.g., Kosko and Isaka, 1993; Hattis and Burmaster, 1994; Ferson and Burgman, 1995).

Moore and Fairburn (1999) also criticised the deterministic approach in which point estimates are applied to produce a single estimate of environmental effect. Uncertainty is accommodated through selection of point estimates that incorporate conservative assumptions, ending up with a 'worst case estimate' that has a low probability of being exceeded. Over-reliance on a deterministic approach by regulators has come under heavy criticism elsewhere e.g. Dwayne *et al* (1996); Anderson and Yuhas (1996) Burmaster (1996); and Rosenthal, *et al* (1992).

While such an approach may be in keeping with societal desire for regulators to adopt the 'precautionary principle', Moore and Fairburn claim it can also lead to expensive mitigation measures for effects posing little or no threat to human health, resulting in waste of resources. Using @Risk (Palisade Corp. 1996) to generate a probabilistic estimate of environmental



effect, they demonstrated compliance with the criteria set out in drinking water standards at a lower mitigation cost than that typically required by consent authorities. They conclude that risk analysis techniques set out in AS/NZS 4360:1999 can improve EIA.

Zach (1998) reviewed risk management techniques for use in evaluating environmental risk resulting from multiple oil spills in Whangarei Harbour, New Zealand. Her thesis proposes a number of improvements that included use of probabilistic rather than deterministic analysis to overcome limitations in the use of 'average' or 'worst case' scenarios; and analysis of uncertainty.

Risk management highlights and reinforces the two dimensions of an environmental impact – the probability or frequency of its occurrence and its magnitude. While recognition of this is essential when dealing with natural systems, it does not make EIA any easier. While Moore and Fairburn (1999) were able to use and benefit from the probabilistic framework set out in the New Zealand Ministry of Health recommended Drinking Water Standards (Ministry of Health, 2000) when evaluating their prediction, most environmental standards are prescribed as a single real number, the 'bright line test' (Rosenthal *et al*, 1992).

Probabilistic analyses need probabilistic frameworks to determine the acceptability or unacceptability of an impact. This involves decisions on the acceptability or unacceptability of distributions of the impact. Burmaster and Thompson (1995) explored several alternative ways of defining such a distribution to calculate cleanup targets for a contaminated site, but the difficulty in both generating and using such distributions should not be underestimated, as desirable as they are.

The alternative is to choose a percentile of the distribution, commonly referred to as a 'worst case scenario', shown in Fig 15. However worst case scenarios rarely ever are, for they invariably involve some moderation to avoid generating plainly unrealistic predictions. No dwellings are designed to withstand a direct meteor strike. However as Moore and Fairburn point out, use of worst case scenarios this can lead to an unfair financial burden and waste of resources. It also allows regulators to 'ratchet' higher standards without the accountability and transparency inherent in a probabilistic analysis where decisions on probability are required to be an integral part of the decision.

Figure 15. Worst case Scenarios.

### 11.3 CASE STUDIES

For example prescribing an absolute noise limit for the installation of a bore can result in expensive mitigation measures, or use of alternative and more expensive installation techniques, or perhaps a decision not to go ahead with the bore due to the threat of penalties. However in most cases neighbours can tolerate short bursts of noise, particularly if there is some advance warning. Similarly if the one metre drawdown in neighbouring bores only occurs two days every ten years and there is a week's warning. The deterministic paradigm cannot cope with such reality, possibly resulting in burdensome controls. And while the answers are difficult, EIA would do well to watch existing and evolving practice in risk management to ensure opportunities for developing better practice in dealing with variability in EIA are fully explored. Risk management practices developed to implement the principle of consistent crudeness would have immediate benefit to EIA practice.

## 12 CATEGORIES OF IMPACT

*Risk can be categorised as: estimated, observed, perceived and real.*

The above categories are identical to those used by Pyle and Gough (1991) though 'estimated' is replaced with 'predicted' and 'observed' with 'statistical'. Table 13 sets out these categories and their nature and problems as well as what each is good for.

Table 13. Types of Risk (After Elms, 1998b)

Though simple in concept, use of such typology in EIA could draw immediate links between an impact and the validity of its analysis. Debates about the validity of analytical techniques can take up considerable time and effort. Use of this simple typology would allow immediate linkage between an impact and the questions that might be asked by someone reviewing its validity. If it is estimated, how was it estimated, using what techniques, assumptions and data? If observed, how often and how transferable are the results? And if the impact is perceived, how valid is the belief on which that perception is based? Perception, otherwise referred to as 'expert opinion', is frequently used to analyse impacts within EIA.

Categorising the problem type encourages accountability, transparency and consistency in the selection and use of analytical techniques. Table 14 sets out how Table 13 might be adapted for use within EIA.

**Table 14. Types of Impact**

Impact Type	Description	Problems	Good for	Validation Checks
<b>Estimated</b>	Quantitative Usually involves equations or event/fault trees Usually objective	Taking account of intangibles and incomplete understanding; Limitations of equations to describe natural systems; Data limitations	Where no observed data available Comparative estimates Low probability impacts. Providing cost-effective predictions of impact.	Field validation of equation in affected environment. Validity of data inputs Accounting for variability and data uncertainties Allowance for intangibles and incomplete understanding.
<b>Observed</b>	Transfer data measured for similar activity. May involve extrapolation from scaled trials.	Transferability of results - the general does not always apply to the particular Inaccuracies from extrapolation of data. Data covering all events Expensive	Benchmarking Confirmation of estimated or perceived impacts.	Transferability of data from other environments and systems Data gaps – time and scale. Degree of extrapolation from scale models.
<b>Perceived</b>	Subjective Personal opinion, sometimes expert.	Inconsistent Not always related to facts Easily swayed, usually towards greater severity	Can be very cost-effective. Essential to consider when involving the public.	Validation of previous opinions Expertise for similar activity, system and environment? Views of peers.

### 13 ZONES OF SIGNIFICANCE

*Risks can be divided into zones of acceptability, unacceptability and tolerability.*

The Methodology (ERMA, 1998) produced by the ERMA uses a frequency-consequence graph to define the boundaries between various risk zones (Figure 16). The boundary between negligible and tolerable risks is defined by threshold regulations and the boundary between tolerable and unacceptable risks is defined in the first instance by Schedule 2 of the HSNO specifying organisms such as snakes, squirrels and moles. Over time, as decisions are analysed, boundaries will be strengthened.

Figure 16. Frequency - consequence graph used by ERMA (ERMA, 1996).

A similar graph could be prepared for thresholds under the RMA. Figure 17 shows a line representing the boundary between negligible effects and those requiring written approval (i.e. above '*de minimus*'). The second line defines the upper limit of what constitutes a minor adverse effect; and the third line defines the upper limit of effects larger than minor, requiring notification, but still consistent with the purpose of the RMA. Effects outside this boundary are unacceptable.

**Figure 17. Frequency - consequence graph for RMA.**

Use of such a graph would not only promote transparency but also consistency and defensibility of EIA decision-making. Each graph could for example be used to represent a particular effect, preferably an assessment endpoint representing many types of impact. Given the importance of context and perception, each graph will need to be prepared with considerable care.

The boundaries could be used by those preparing EIAs to decide which effects to include in their EIA, and to what level of detail. Effects below the first boundary would not for example need to be included in the EIA, while effects above minor would require more detail than those that are minor, though the EIA would need to demonstrate that. Boundaries can be represented by an equation, allowing computer-aided decision-making and perhaps fuzzy logic systems to promote analysis and consistency.

Such a graph could be used to describe how a short burst of noise from installing a bore is similar in acceptability to less noise over a prolonged period, and both are minor. They could be referenced to BIA determinations for comparative purposes. Graphs could be used to show that the occasional loss of water from a domestic bore is similar in significance to a small decrease in level over a prolonged period, having a discernible but noticeable effect on power consumption. And in the case of contaminant discharges it is particularly useful for promoting consistency and comparisons between different contaminant types.

## 14 AREAS FOR FURTHER STUDY.

Many of the areas explored in this thesis have potential for further study to uncover more opportunity for improving EIA using risk management ideas, concepts and principles. Decision-making in other areas of risk management involving the public interest to see how the public is involved and their interest included would be very profitable if it gave ideas and insights that could be applied to EIA decision-making.

Table 15 sets out number of areas not explored further in this thesis but again with potential to improve EIA practice. The list is by no means exhaustive but could be a similar mine of opportunity presented by most areas already explored further in this thesis.

### **Table 15, Areas of Risk Management Practice with Potential to Develop Best Practice in EIA, for Further Research.**

1. Developing the right attitude
2. Classification of problem types
3. Management of information flows
4. Predicting low probability, high consequence impacts.
5. Including intangibles during evaluation
6. Strategy for dealing with adverse impacts
7. Integration of environmental management within organisations
8. Management responsibility.

How to approach EIA with the right attitude and appropriate mindset, having a systems view, is one such area, given that in risk management it has the potential to result in failure. Along a similar theme, emphasis on ensuring the EIA process delivers insights rather than simply a final document is worth exploring further.

Understanding problem type and relating this to selection of analytical technique and development of an EIA approach that deals with the three classifications promulgated by Elms (1998) is worth further research, particularly as it relates to an acceptance of the relationship between desired standard of living and living with adverse effects.

The management of information flows during the EIA process as well as ensuring feedback through monitoring is another area of opportunity. What data to collect and how to process that data to turn it into meaningful information about environmental effects, giving adequate time to take corrective actions before disaster occurs.

Taking account of intangible and unquantifiable factors, and structuring them into the analysis to give equal standing with quantifiable factors is a challenge faced by all EIA practitioners and can be a prime motivator for public concern at level of analysis and loss of common sense. Selection of an appropriate strategy to deal with residual risk is another area touched on lightly with respect to practice in the insurance industry, but probably worth an entire thesis on its own to research other practices and identify opportunity for 'cross-pollination'.

And finally, gaining the support of all levels within an organisation use natural resources so responsibility for impacts is collectively owned and not avoided is a challenge for everybody if EIA is to be more than a process for making decisions.



## 15 CONCLUSION

Environmental impact assessment is here to stay, but needs a heavy dose of better practice if it is to be an effective and meaningful tool for the management of natural and physical resources in New Zealand. The Resource Management Act relies heavily on both strategic and project level EIA for its successful implementation hence better EIA may help reduce some of the criticisms directed at the RMA.

The field of risk management is a mine of best practice opportunity for EIA. From the simple definition of terms to enable effective communication between practitioners, through to more complex concepts and principles, risk management has much to offer EIA. This thesis explores some of them and other possible opportunities.

There would be considerable benefit in a national Standard or Methodology for conducting EIA under the RMA, similar to that produced by the ERMA for implementation of the HSNO Act. Provided it was carried out in a consensus-seeking manner it could have immense benefit by defining a logical and systematic process for conducting EIA and defining key terms so practitioners can communicate effectively and have a common point of reference.

Other simple concepts such as the expression of impacts using frequency-consequence curves, both to highlight the trade-off that can occur between magnitude and frequency and to promote consistency of decision-making; and categorisation of impact types to improve transparency and accountability have immediate benefit to EIA practice. Dealing with uncertainty and selection of meaningful assessment and measurement endpoints are areas of practice with immediate potential to improve EIA practice in New Zealand.

The inclusion of context, both in the evaluation of adverse effects and in the focusing of particularly the scoping phase of an EIA has particular relevance in ensuring EIAs are as cost-effective as they can be, only addressing the decisions that need to be made. Focusing on the problem rather than techniques, and defining the problem to help select the right technique has been only superficially explored in this thesis. This is an area ripe for further research to determine opportunities within the broader field of risk management to address thorny problems such as some types of cumulative effects.

Risk Management has developed a number of approaches towards the communication of risk that are again of direct relevance to the communication of adverse impacts. Inclusion of public perceptions in decision-making and public participation in decisions that have public consequences is an area where risk management does not appear to offer many solutions. As practised in the Building Industry in particular, risk management may come under the same kinds of public pressure for accountability and involvement that resource management is under. Development of better practice for EIA in this area will rely heavily on the social sciences, particularly the behavioural and psychological sciences.

The Environmental Risk Management Authority has proposals in its Methodology which have the potential to address many of the criticisms listed in Table 1, by creating techniques to analyse past decisions and build up a 'case law' that can be used by applicants. It can also be used by other decision-makers, such as the BIA and consent authorities, adding credibility to the decisions made by all three authorities. If successfully implemented such techniques have the potential to single-handedly address many of the criticisms listed in Table 1 and ERMA should be encouraged to follow through on its intentions clearly stated in the Methodology.

Healthy systems methodology, though relatively new to risk management, appears to have significant potential in EIA. Many of the techniques discussed above have the potential to make EIA more demanding of technique and data. Healthy systems methodology has the potential to cut through this heavy demand using a framework able to accommodate intangibles and qualitative data, in a managed way. It can be applied at several levels in EIA, from analysis of resource management as practised under the RMA through to the development of effective monitoring programmes.

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## **18 APPENDICES**

### **18.1 APPENDIX A: APPLICATIONS OF RISK MANAGEMENT.**

(Adapted from AS/NZS 4360:1999)

The Standard has a range of applications including, but not confined to-

- asset management and resource planning;
- business interruption;
- change: organisational, technological and political;
- construction activity;
- contingency, disaster and emergency planning;
- design and product liability;
- directors' and officers' liability;
- employment procedures, training, discrimination and harassment;
- environmental issues;
- ethics and probity issues;
- feasibility studies;
- fire detection/fire prevention;
- foreign exchange operations;
- fraud prevention, detection and management;
- human, animal and plant health;
- information systems/computer networks;
- investments;
- legislative compliance;
- occupational health and safety;
- operations and maintenance systems;
- project management;
- public risk and general liability;
- purchasing contract management;
- professional advice;
- reputation and image issues;
- security;
- transport including air, sea, road, rail; and
- treasury and finance

## 18.2 APPENDIX B: NATIONAL ENVIRONMENTAL STRATEGY.

In 1995, after an extensive process of public consultation, the Government adopted the Environment 2010 Strategy setting out Government's longer-term view of New Zealand's environmental priorities and directions. The aim was to identify a common vision for the environment and to bring a consistency of approach to the work programmes of the various central government agencies involved in policies that affect the environment. It establishes the framework within which central and local government and the private sector can develop their own policies and plans (MfE, 2000).

The vision for the New Zealand environment to 2010 is:

*a clean, healthy and unique environment, sustaining nature and people's needs and aspirations.*

A six-part Environmental Management Agenda has been adopted to help achieve the vision. The goals of the Environmental Management Agenda are:

1. To integrate environmental, social and economic factors into the mainstream of decision making in all sectors, at all levels.
2. To develop and maintain an effective, coherent body of law and practice for achieving efficient and sustainable management of the environment.
3. To develop a range of policy tools, to be used within the framework of law, to achieve the desired environmental outcomes that most benefit society and the economy.
4. To achieve a comprehensive and reliable information base on the environment which will aid informed and sound decisions on the protection and sustainable management of New Zealand's natural and physical resources.
5. To encourage environmentally responsible behaviour and informed participation in decision making by promoting environmental education throughout the community.
6. To ensure that people have the opportunity for effective participation in decision making that affects the environment".



## **18.3 APPENDIX C: PRINCIPLES AND GOALS IN THE ENVIRONMENT 2010 STRATEGY.**

### **Principles**

The Government has developed 11 principles for integrating environment, society and economy. The principles are:

1. Sustainably managing natural and physical resources
2. Applying the Precautionary Principle
3. Defining environmental bottom lines
4. Internalising external environmental costs
5. Specifying property rights to achieve sustainable outcomes
6. Ensuring that "least cost" policy tools are adopted
7. Ensuring that social and environmental goals are mutually supportive
8. Following full cost pricing principles in pricing public utility infrastructure
9. Considering local, national and international dimensions of sustainable resource management in determining publicly funded research priorities
10. Defining the limits of resource use and substitution
11. Protecting our international competitiveness

### **Priority Issues**

The Environment 2010 Strategy identifies eleven priority issues which New Zealand must deal with if we are to improve the quality of our environment and achieve the vision. The priority issues are:

1. Managing our land resources
2. Managing our water resources
3. Maintaining clear, clean breathable air
4. Protecting indigenous habitats and biological diversity
5. Managing pests, weeds and diseases
6. Sustainable fisheries
7. Managing the environmental impacts of energy services
8. Managing the environmental effects of transport
9. Managing waste, contaminated sites and hazardous substances
10. Reducing the risk of climate change
11. Restoring the ozone layer

### **Goals**

The Strategy spells out some goals that the Government believes New Zealand can and should aspire to. The goals are concerned with the quality of both the rural and urban environment, and relate to the eleven priority issues listed above:

1. To maintain and enhance the quality, productivity and life-supporting capacity of our soils, so that they can support a variety of viable land use options.
2. To manage the quality and quantity of surface water, groundwater, coastal and geothermal water so that it can meet the current and future needs of ecological systems, communities (including Maori), primary production and industry, by:
  - maintaining sufficient water in water bodies to meet current and future needs;

- ensuring New Zealand's surface freshwaters and coastal waters are of a quality suitable to meet community needs such as swimming, fishing and shellfish gathering, and that aquatic life is not significantly affected by discharges;
  - preventing further degradation of, and restoring, groundwater quality and quantity;
  - preventing degradation of quality and flow of identified water resources of national significance to New Zealanders for recreational, scenic, scientific or cultural reasons.
3. To maintain air quality in parts of New Zealand that enjoy clean air, and improve air quality in places where it has deteriorated.
  4. To protect indigenous habitats and biological diversity by:
    - Maintaining and enhancing the net area of New Zealand's remaining indigenous forests and enhancing the ecological integrity of other remaining indigenous ecosystems;
    - Promoting the conservation and sustainable management of biological diversity so that the quality of our indigenous and exotic ecosystems is maintained or enhanced to guard against extinctions and permit adaptation to changing environmental conditions.
  5. To manage pests, weeds and diseases by reducing the risks they pose, to levels consistent with New Zealand's established objectives for:
    - biological diversity of ecosystems;
    - people's health; and
    - biosecurity of the economy.
  6. To conserve and manage New Zealand's fisheries for the benefit of all New Zealanders by providing for sustainable utilisation of fisheries resources, including commercial, recreational and Maori customary take.
  7. To manage sustainably the environmental impacts of producing and using energy services.
  8. To manage the provision of transport services in a manner which minimises adverse effects on the natural and physical environment and human health.
  9. To manage waste, and thereby reduce risks to environmental quality and public health to levels that are widely agreed as being socially acceptable;
    - To clean up contaminated sites to reduce risk to the environment, people and the economy; and
    - To manage or prevent the harmful effects of hazardous substances in order to protect the environment and wellbeing of people and communities, so as to enable the maximum net national benefit to be achieved.
  10. To take precautionary actions to help stabilise atmospheric concentrations of greenhouse gases in order to reduce risk from global climate change, and to meet New Zealand's commitments under the UN Framework Convention on Climate Change, including:
    - To return net emissions of carbon dioxide to no more than their 1990 levels by the year 2000 (but aim for a reduction in net carbon dioxide emissions to 20 percent below their 1990 levels by the year 2000 if this is cost-effective and will not harm our trade) and to maintain them at this level thereafter; and
    - To reduce net emissions of other greenhouse gases, particularly methane, by the year 2000 where possible and maintain them at those levels thereafter.
  11. To help achieve the full recovery of the ozone layer and constrain peak levels of ozone destruction by phasing out imports of ozone depleting substances as quickly as possible and at rates no less than those agreed internationally, and by limiting, where practical, emissions of those substances that are imported.

**18.4 APPENDIX D: PRINCIPLES OF ENVIRONMENTAL IMPACT ASSESSMENT  
BEST PRACTICE.**

**18.5 APPENDIX E: FOURTH SCHEDULE TO THE RESOURCE MANAGEMENT ACT.**

## 18.6 APPENDIX F: COMMUNICATION OF ADVERSE IMPACTS.

**Catastrophic potential:** The public is more concerned about fatalities and injuries that are grouped in time and space (e.g., airplane crashes) than about fatalities and injuries that are scattered or random in time and space (e.g., automobile accidents).

**Familiarity:** The public is more concerned about risks that are unfamiliar (e.g., ozone depletion due to emissions of fluorocarbons) than about risks that are familiar (e.g., household accidents).

**Understanding:** The public is more concerned about activities characterised by poorly understood exposure mechanisms or processes (e.g., exposure to radiation) than about activities characterised by apparently well-understood exposure mechanisms or processes (e.g., pedestrian accidents or slipping on ice).

**Uncertainty:** The public is more concerned about risks that are scientifically unknown or uncertain (e.g., recombinant DNA experimentation) than about risks that are relatively known to science (e.g., actuarial data on automobile accidents).

**Controllability:** People are more concerned about risks that they perceive to be not under their personal control (e.g., travelling as a passenger in an airplane or in an automobile) than about risks that they perceive to be under their personal control (e.g., driving an automobile or riding a bicycle).

**Voluntariness of exposure:** People are more concerned about risks that they perceive to be involuntary (e.g., exposure to unlabelled food additives or to air or water pollutants) than about risks that they perceive to be voluntary (e.g., smoking, sunbathing, or mountain climbing).

**Effects on children:** People are more concerned about activities that put children specifically at risk (e.g., school bus accidents or exposure to toxic chemicals by pregnant women) than about activities that do not put children specifically at risk (e.g., adult smoking).

**Effects on future generations:** People are more concerned about activities that pose risks to future generations (e.g., genetic effects due to exposure to radiation) than to risks that pose no special risks to future generations (e.g., skiing accidents).

**Victim identity:** People are more concerned about risks to identifiable victims (e.g., a yachtsman lost at sea or a trapped coal miner) than about risks to statistical victims (e.g., statistical profiles of automobile accident victims).

**Dread:** People are more concerned about risks that are dreaded and evoke a response of fear, terror, or anxiety (e.g., exposure to potential carcinogens from toxic waste dumps or to nuclear radiation) than to risks that are not especially dreaded and do not evoke a special response of fear, terror, or anxiety (e.g., common colds or household accidents).

**Trust in institutions:** People are more concerned about situations characterised by a lack of trust in the responsible risk management institutions (e.g., criticisms of the Nuclear Regulatory Agency for its perceived close ties to industry) than they are about situations characterised by trust in the responsible risk management institutions (e.g., trust in the management of recombinant DNA risks by universities and by the National Institutes of Health).

**Media Attention:** People are more concerned about risks that receive much media attention (e.g., airline crashes) than about risks that receive little media attention (e.g., on-the-job accidents).

**Accident History:** People are more concerned about activities that has a history of major and sometimes minor accidents (e.g., nuclear power plant accidents such as the accident at Three Mile Island) than about activities that have a history of no major or minor accidents (e.g., recombinant DNA experimentation).

**Equity:** People are more concerned about activities that are characterised by a perceived inequitable distribution of risks and benefits (e.g., off-shore oil exploration) than about activities characterised by a perceived equitable distribution of risks and benefits (e.g., vaccination).

**Benefits:** People are more concerned about risky activities that are perceived to have unclear benefits (e.g., nuclear power generation) than about risky activities that are perceived to have clear benefits (e.g., automobile driving).

**Reversibility:** People are more concerned about activities characterised by potentially irreversible adverse effects (e.g., acid rain) than about activities characterised by reversible adverse effects (e.g., injuries from sports or household accidents).

**Personal involvement:** People are more concerned about activities that they believe place them (or their families) personally and directly at risk (e.g., drinking contaminated water due to local dumping of hazardous waste at sea or in other remote sites)".

## 18.7 APPENDIX G: SITUATIONS WHERE STANDARDS ARE APPROPRIATE.

(From Fischhoff, 1983)

**When no choice between options is possible:** Many hazard managers do not have the opportunity to weigh the relative merits of competing options. Rather, they must judge each on its own merits, without explicitly considering what will come instead if it is rejected or what will be foregone if it is accepted. For example, industrial trade associations are seldom empowered to decide which product is best; government regulators typically must act independently upon each option presented to them. A general standard will allow them to treat all options in a consistent manner.

**When no choice between options is required:** Much of the effort required by decision-making schemes is invested in ordering all available options so as to identify the best one. That effort will be wasted if it is possible to choose several options, or none at all. For example, society need not restrict itself to one energy source, nor need it accept any member of a new family of prescription drugs. In such cases, all that is required is an accept/reject rule.

**When predictability is important:** Standards can simplify life for hazards as well as for their managers. They offer a clear and fixed target that a technology's designers can strive to meet. Once the standard has been met, approval is irreversible, allowing the designers to concentrate on factors other than safety (e.g., cost containment, market share). The desire for predictability has led the nuclear industry to propose that the U.S. Nuclear Regulatory Commission (50) adopt an overall safety standard. Once a power plant has met this standard, it would no longer be subject to the Commission's case-by-case decisions regarding what designs and procedures to adopt. Although meeting the overall standard might be more expensive than abiding by the local decisions, doing so would eliminate worry about retrofitting and the withdrawal of operating permission.

**When regulators hope to shape future options:** When regulators do not like the choice of options offered to them (or to the public), they may set a standard that is clear, predictable, but out of reach. Such "technology/forcing" standards are intended either to require a particular product or to give a competitive advantage to those who produce it. U.S. automobile fuel economy goals, for example, were intended to do the former, but ended up doing the latter as well. Designed to reduce the environmental and national security risks from excessive gasoline by coercing manufacturers to produce more efficient cars, they inadvertently helped the industry meet foreign competition. On the other hand, when standards mandate a particular technical solution, they can stifle innovation, perhaps even increase monopoly pressures. For example, requiring the catalytic converter as a solution to pollution control greatly benefited General Motors, the leader in its development. Standards generally favour large corporations which have greater resources to track, fight, shape and adjust to them. Anything that decreases competitive forces will also tend to reduce innovation.

**When competing technologies fall in the same jurisdiction:** Standards are meant to apply to a category of options. If that category includes one method of accomplishing a particular task, it should include its competitors as well (e.g., all ways to generate electricity, all modes of urban transport). If competing options are subject to stronger or weaker standards (or none at all), then these inconsistencies may be exploited. For example, tough standards on hazards with acute health effects will, over time, encourage the development of competing products and processes with primarily chronic health effects. If a stricter overall

standard is adopted for nuclear power than for other energy technologies, then it will be at a disadvantage relative to its competitors (which have at the moment no such standard). The range of a standard may change over its working life. Each technology affected by a standard may try to be released from its constraints or to have them extended to its competitors.

**When category members are homogeneous:** Having one standard for all category members inevitably means that it will be more suited for some than for others. For example, a uniform standard for atmospheric asbestos levels will allow quite different risks in workplaces with high and low proportions of smokers. It may exact quite different costs of compliance in different settings (and, hence, implicitly assign different values to human life and health). A standard that allows a level of risk that is commensurate with the benefits derived from the average member will seem unduly restrictive when applied to a member with particularly high benefits. The extent of such “injustices” should depend upon the heterogeneity of the technologies within its jurisdiction. It is possible, in principle, to develop a standard with correction factors to cope with special cases. However, doing so produces a standard that is more complicated, more discretionary, more situation-specific and less a standard.

**When an explicit policy statement is attractive:** When a decision is made, observers may see just the act of choice, which reveals little about its underlying rationale. When that rationale is explicated, it may involve a complex trade-off between diverse considerations. By contrast, many standards offer a tidy statement of principle saying, “This is what we allow.” That statement may tell the whole story, or it may just summarise the results of more complex deliberations. For example, after weighing many factors in deciding to allow fishing in Chesapeake Bay but not in the James River, the Environmental Protection Agency announced a standard for Kepone in fish that lay between the levels found in those two bodies of water. That statement may be meant literally or figuratively, as an expression of policy makers’ concerns. For example, Eastern European countries want strong standards for worker protection on their books, even if economic problems limit their realisation. The Delaney Amendment made a similarly strong, if impractical, statement of American values toward health and food. Whatever their original motivation, simplifications may develop lives of their own. They create both precedents and expectations (on the part of producers, workers, and consumers).

**When value issues are sensitive:** Because they always tell some story, but need not tell the whole story, standards can be used to blur value issues (as well as to highlight them). Unlike formal decision-making methods, such as cost-benefit analysis or decision analysis, standard setting need not leave an audit trail explaining its rationale. Such vagueness may cover confusion or it may be designed to obscure what the standard was walling in and walling out. It might, then, serve vested interests who want a high-sounding rule to legitimate their actions, or regulators who must make political decisions, but lack the mandate to do so, or warring parties who can negotiate a compromise within the context of a standard that hides what each has conceded.

**When political resources are limited:** Every decision is a political act, requiring a statement of values regarding the appropriate trade-offs between conflicting objectives. Particularly where the trade-offs are difficult and society is divided, it may be hard to muster the political resources needed to reach a decision. When many tough decisions must be made, one way to keep the political system from being overwhelmed is to replace some “small” decisions with one big one, by choosing a general standard. That standard can then be applied administratively by technical experts. Three conditions for this strategy to work are: (a) The standard settlers tackle and resolve the value issues; (b) The operational standard leaves little room for discretion; and (c) The technicians receive adequate resources



to apply the standard faithfully. For example, the Toxic Substances Control Act made a strong value statement, but failed to provide sufficiently precise guidelines or adequate funds for the Environmental Protection Agency to devise a defensible plan ensuring that the tens of thousands of existing chemicals receive equal justice under the standard.

**When process is unimportant:** By concentrating political attention on the standard setting process, standards do away with the repeated discussion of value issues that comes with case-by-case decision-making. To realise these potential increases in efficiency, the standard setting process must be able to replace the political and intellectual functions of repeated decision-making. Part of the political function can be served by ensuring that varied parties interested in an issue are represented in setting the standard for it. Concentrated participation in a standard is not, however, the same as continued participation in individual decisions, each of which offers an opportunity to educate oneself, monitor the regulators, and generate public discussion. The intellectual functions are most likely to be filled when the issues are well understood in advance, so that standard setting centers on the resolution of known conflicts. The very act of grouping options into categories and searching for a consistent rule may even generate new insights. However when problems are too new or complex to be understood in advance, they defy the setting of informed, lasting standards. Although it is possible to have a standard evolve through trial-and-error learning, doing so would be contrary to the notion of a general rule. Thus, standards are inappropriate where a political or learning process is essential.

**When awkward applications can be avoided:** Once any policy has been made (in the form of a decision or standard), those affected adversely may try to overturn it. Standards are inherently vulnerable to attacks that focus on specific cases in which the general rule seems ill suited. For example, standards look bad when they reject otherwise attractive alternatives whose risk levels are just beyond their threshold of acceptability, especially when it would be very expensive to gain the small decrease in risk needed to achieve compliance. Even if they cannot have the standard overturned on the basis of one sticky example, critics may still obtain a precedent-setting relaxation. One way to defend a standard is to avoid awkward applications, perhaps by specifically excluding them or showing how to bend the standard deliberately (to keep it from being spoken).

In summary, reliance on standards differs from case-by-case decision-making in certain fundamental ways. From these, it is possible to derive a set of conditions that are particularly conducive to standards. When standard setting is mandated, consideration of these conditions can help one to anticipate and perhaps avoid some of the problems that will be encountered. When a choice can be made between a general standard and specific decisions, then this kind of analysis can point to the trade-offs that should underlie that choice. A typical trade-off question would be whether the timeliness and predictability of a standard's application would compensate for its occasional injustices.