Innovative land-use planning for natural hazard risk reduction in New Zealand

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ABSTRACT

New Zealand is susceptible to a number of natural hazards, yet some land-use planning decisions can lead to developments being located in at risk locations. This can lead to an increase in risk rather than risk reduction, which does not promote the principles of sustainable development. The aim of this research is to develop a risk-based framework for innovative land-use planning that allows risks from natural hazards in New Zealand to be reduced, and encourages better decision making for natural hazard risk reduction. Research methods employed included Participatory Action Research, a literature review, use of case studies, qualitative content analysis, interviews, and workshops. The conceptual foundation of this research integrates insights from innovation scholarship, natural hazards planning, participatory planning and risk governance.

The case studies highlighted that an innovative risk governance approach is required to address the shortfalls of existing risk governance arrangements. The state, market and civil society are key to an integrated risk governance approach; however risk creation, bearing and sharing may not be equal between these players, and economic imperatives often override social and environmental concerns. Barriers to and opportunities for innovation for risk reduction included prevailing governance, leadership, legislation, research, second generation plans, cost, liability, skills/ experience/resources, awareness and understanding.

There is a variety of guidance available to local government on various natural hazards. But in order to appropriately manage these hazards the risk must first be quantified and qualified – for which there is limited guidance available. This research bridges this gap by outlining an approach to risk governance that is framed around three key steps: 1) articulating and addressing consequences of events; 2) assessing the likelihood of these consequences; and 3) taking a risk-based approach to planning based on Steps 1 and 2. The result is a planning framework that becomes more restrictive as risk increases. With a focus on risk management principles and processes, the framework assists planners by providing policy and resource consent activity status criteria that enable hazard risks to be categorised via risk-based land-use planning. This provides an alternative to the current planning approach that can be used to assess risk implications within the existing planning system.

Planning has a vital role to play in reducing risks from natural hazards, but a new approach is required to ensure that planning decisions do not result in an increase in

risk to people and property. Legislative changes are needed to ensure consistency, integrate legal provisions and provide effective monitoring of risk reduction policies and outcomes. The risk-based framework presented provides a significantly new approach where consequences are the primary concern, rather than likelihood; and it allows for levels of risk to be defined. The result is a framework that can assist decision makers to reduce risks to people and property from natural hazards, and encourages sustainable development.

PREFACE

He aha te mea nui o te ao?
He tangata! He tangata! He tangata!

What is the most important thing in the world?
It is people! It is people! It is people!

Māori proverb

Don't build your house on the sandy land
Don't build it too near the shore
Oh it might be kind of nice
But you'll have to do it twice
And you'll have to build your house once more
You better build your house upon the rock
And put a sure foundation on the solid spot
And though the storms may come and go
Peace of God you'll know.

Children's Sunday School song

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ABBREVIATIONS

2GP	Second generation plans
AEP	Annual exceedance probability
ALARP	As low as reasonably practicable
AR	Action research
AS/NZS	Australian/New Zealand Standard
BOPRC	Bay of Plenty Regional Council
CAENZ	Centre for Advanced Engineering New Zealand
CDEM	Civil Defence & Emergency Management
CDEMA	Civil Defence Emergency Management Act 2002
EQC	Earthquake Commission
EW	Environment Waikato
IAP2	International Association of Public Participation
IBHS	Institute for Business and Home Safety
ICNZ	Insurance Council of New Zealand
LIM	Land information memorandum
LGA	Local Government Act 2002
LGNZ	Local Government New Zealand
LTCCP	Long term council community plan
MCDEM	Ministry of Civil Defence and Emergency Management
MfE	Ministry for the Environment
NZCPS	New Zealand Coastal Policy Statement 2010

ODESC	Office of Domestic and External Security Group
PAR	Participatory action research
RMA	Resource Management Act 1991
RPS	Regional Policy Statement
TCDC	Thames-Coromandel District Council
WRC	Waikato Regional Council

CHAPTER 1 Introduction

1. Introduction

There is great deal of research on natural hazards (e.g. Burton, Kates, & White, 1993; DPMC, 2007; Ericksen, 1986; Gregg & Houghton, 2006; Mileti, 1999; White, 1974; Wisner, Blaikie, Cannon, & Davis, 2004); land-use planning (e.g. Friedmann, 1998; Gunder & Mouat, 2002; Healy, 2009; Jepson, 2001; Krek, 2005); and an increasing amount of research that combines the two paradigms (e.g. Berke, Song, & Stevens, 2009; Burby, 1998a, 1999; Burby, Deyle, Godschalk, & Olshanksy, 2000; Ericksen, Berke, Crawford, & Dixon, 2003; Godschalk, Brody, & Burby, 2003; Gunne-Jones, 2003; Mamula-Seadon, 2006). However, very limited research has been undertaken linking the concepts of risk governance, natural hazard risk reduction, land-use planning, and innovation, either in New Zealand or internationally (refer Section 7 of this chapter for a discussion of definitions of these terms). Friedmann (2003, p78) addressed this gap in part by stating that "… innovative planning looks toward creative solutions to the social, physical, and environmental problems that arise to political consciousness in the public domain". However, Friedmann does not elaborate on what innovative planning is, or how to implement and measure its effectiveness, or what it means for land-use planning and natural hazard risk reduction.

This research proposes to bridge this gap, and advance understanding about what constitutes innovative natural hazards planning. The emphasis is on a departure from traditional measures for mitigating risk, to a new way of reducing risks via an innovative solution of quantifying and qualifying risk that encourages sustainable development. This departure includes new ways of thinking about potential perils, developing strategies for reducing risks from them in advance, and becoming better prepared for threats that could eventually result in disaster (Kendra & Wachtendorf, 2006). Being unconventional is the key: if we continue do what has always been done, with the same mindset, we will end up with the same result, which is often what created the problem in the first place. Responding in the 'business as usual' routine ways will not address current problems. The cultural attributes and attitudes that made many communities great and successful in the past, are precisely those that are likely to constrain them in the future unless innovative solutions are provided (Landry, 2005).

The overall aim of the thesis is to develop a risk-based framework for innovative land-use planning which reduces risks from natural hazards in New Zealand**.** To establish a basis for this aim, the purpose of this introductory chapter is to introduce the natural hazardscape of New Zealand, and outline the problem this hazardscape has on

implementing effective risk reduction measures within land-use planning. It presents the rationale for the study, aim and objectives of the thesis, and summarises the key concepts of this research (being sustainable development, risk governance, natural hazards, planning, risk reduction, risk, and innovation) within the context of land-use planning. The following section provides a brief overview of the various natural hazards that have the potential to affect New Zealand communities.

2. The New Zealand hazardscape

Located on the active boundaries of the Pacific and Australian plates, New Zealand is subject to a wide variety of geological natural hazard events, as well as extreme meteorological events due to the mountainous topography and long angular nature of the islands (see Figure 1.1). While flooding is considered to be the most frequently occurring natural hazard (Glavovic, Saunders, & Becker, 2010), communities also face risks from landslides, coastal storms and erosion, severe winds, snow, drought and the potentially catastrophic impacts of earthquakes, tsunamis and volcanic eruptions (ODESC, 2007).

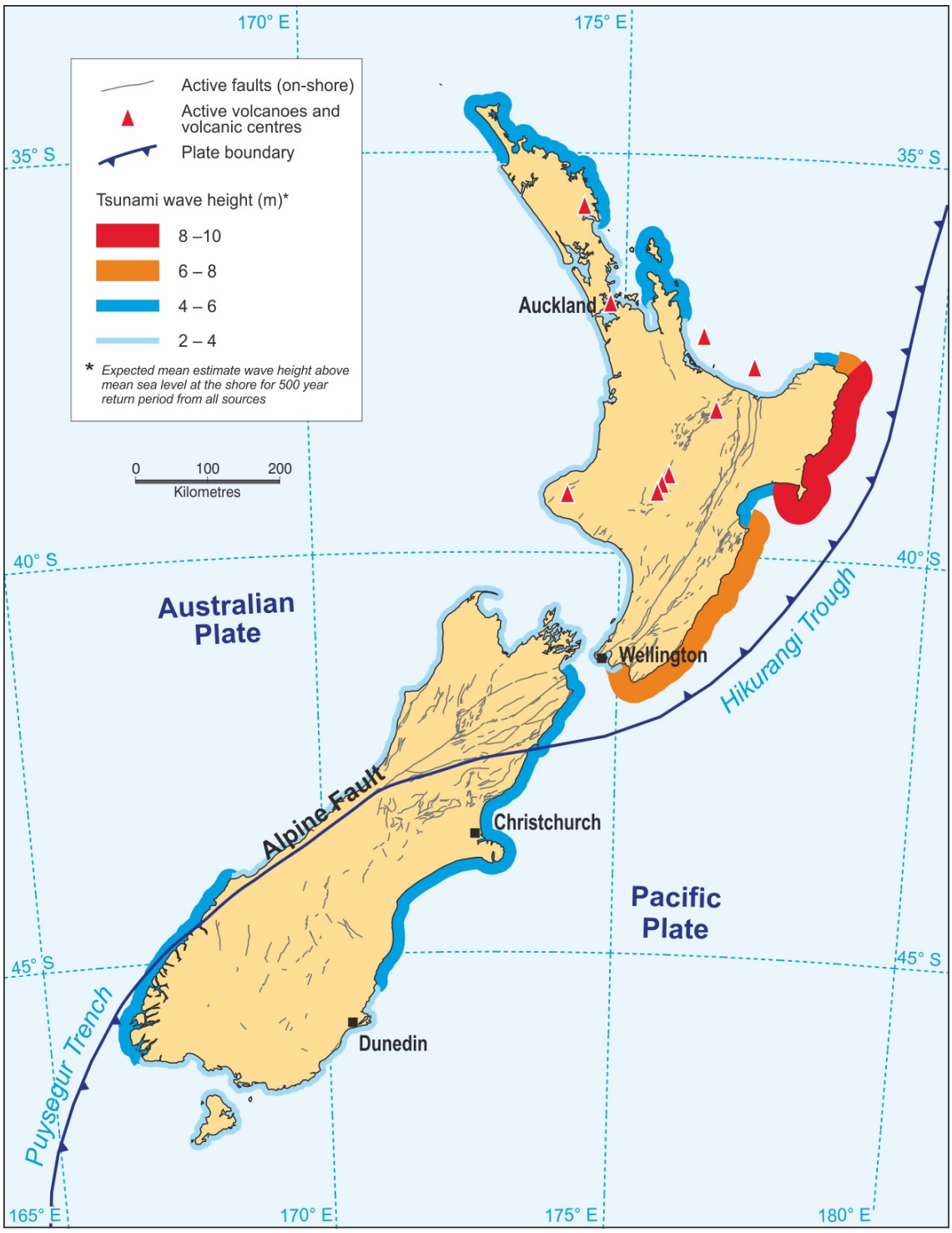

Figure 1.1 The New Zealand geological setting (adapted from Glavovic, et al., 2010, p680).

Although an awareness of these hazards exists, communities are increasingly at-risk. As communities sprawl and new developments are created, natural systems are often compromised as the environment is transformed from natural to built (Pawson & Brooking, 2002). This often results in increasingly putting people in harm's way, increasing hazard risks (Glavovic, et al., 2010). Increasing urbanisation has

concentrated the New Zealand population in cities and towns, many of which are vulnerable to hazards — for example coastal and volcanic hazards in Auckland, and landslide and seismic risks in Wellington. In recent years, the exposure to coastal storms and erosion has increased (Bell & Gorman, 2007; Blackett, Hume, & Dahm, 2010), as rapid development intensification along the coast has occurred (Cheyne & Freeman, 2006; Freeman & Cheyne, 2008). Additionally, climate variability and change will compound the risks many communities face, especially those on floodplains and along low-lying coastal margins, due to the projected sea-level rise and increase in the intensity and frequency of storms (Bell, Hume, & Todd, 2002; Jacobson, 2004b, 2005; MfE, 2008c; Parry, Canziani, Palutikof, van der Linden, & Hanson, 2007).

In the last decade, many practical guidance documents have been produced to assist planners and other council[1] staff to manage natural hazards. For the purpose of this research, guidance is defined as those documents prepared for the explicit purpose of providing a practical interpretation of policy on a regulatory issue (in this case, natural hazards). Guidance documents provide direction and advice on a course of action, applicable to local government. Within the context of this research, guidance documents do not include academic literature as such, because it is often not directly accessible to local authority staff, and is not written for their immediate needs. An example (i.e. this is not an exhaustive list) of guidance documents available is provided in Table 1.1.

[1] Council staff refers to those who work at regional and unitary councils and territorial authorities (city and district councils).

Table 1.1 Examples of guidance provided for natural hazard management in New Zealand.

Agency	Year	Publication
Ministry for the Environment	2003	Planning for the development on land on or near active faults (Kerr et al., 2003)
	2008	Coastal hazards and climate change: a guidance manual for local government in New Zealand (MfE, 2008a)
	2008	Quality Planning 'natural hazard' guidance note (MfE, 2008b)
	2009	Preparing for coastal change: a guide for local government in New Zealand (MfE, 2009)
	2010	Tools for estimating the effects of climate change and flood flow: a guidance manual for local government in New Zealand (MfE, 2010c)
	2010	Preparing for future flooding: a guide for local government in New Zealand (MfE, 2010a)
Standards New Zealand	2004	Risk management guidelines: companion to AS/NZS 4360:2004 (Standards New Zealand, 2004)
	2008	Managing flood risk: a process standard NZS 9401 (Standards New Zealand, 2008)
	2009	Risk management – principles and guidelines AS/NZS 31000 (Standards Australia/New Zealand, 2009)
GNS Science	2007	Guidelines for assessing planning policy and consent requirements for landslide prone land (Saunders & Glassey, 2007)
	2008	Pre-event recovery for land use in New Zealand (Becker, Saunders, Hopkins, Wright, & Kerr, 2008)
	2011	Incorporating tsunami inundation modelling into land-use planning (Saunders, Prasetya, & Leonard, 2011)

Agency	Year	Publication
Centre for Advanced Engineering (CAE)	1998	Owning the future: integrated risk management in practice (Elms, 1998)
	2004	Planning for natural hazard risk in the built environment (CAENZ, 2004)
	2009	Land-use planning for natural hazards: stewardship for the future (CAENZ, 2009)
Other	1986	Creating flood disasters? (Ericksen, 1986)
	2003	Planning for sustainability: New Zealand under the RMA (Ericksen, et al., 2003)

Currently there is only limited guidance specific to land-use planning on liquefaction, lateral spreading, volcanic or geothermal hazards.

3. Rationale for study

For sustainable development to occur in New Zealand, a number of factors need to be taken into account, particularly with regard to development and the interaction of the economy, society and environment (refer Parliamentary Commissioner for the Environment, 2002). As such, natural hazards are only one factor to be considered within the concept of sustainable development, and often they are not given the attention they warrant due to other issues and concerns (Berke & Smith, 2009). As outlined in the previous section, New Zealand is susceptible to a number of natural hazards, yet development continues to occur in at-risk locations (Glavovic, et al., 2010). Therefore greater attention needs to be accorded to natural hazards in order to provide for developments in safe locations. To ensure natural hazards are given appropriate consideration, many land use planning documents (e.g. regional policy statements, district/city plans) contain policies and restrictions for land subject to natural hazards. However, as discussed further in Chapter 4, often these policies refer to an 'acceptable level of risk', which is not defined. Defined and measurable indicators of acceptable levels of risk need to be used so that progress towards safe and sustainable development can be monitored. While there is a variety of guidance

available to local government on various natural hazards (Table 1.1), in order to appropriately manage natural hazards, a level of risk (i.e. tolerable, acceptable, intolerable, further discussed in Chapters 2 and 6) must first be quantified and qualified – for which there is limited guidance available (i.e. Saunders et al. 2011 does include guidance, based on this research). While most of the publications in Table 1.1 recommend a risk-based approach, discussions with local government staff have raised the issue that the guidance does not go far enough in how to implement the measures. This research seeks to contribute to bridging this gap by providing a risk-based framework for innovative land-use planning for risk reduction, framed around articulating and addressing consequences of events and levels of risk (i.e. acceptable, tolerable, intolerable). This approach prioritises consequences of events ahead of the likelihood of an event occurring, which requires a change in how natural hazards are managed through land use planning (existing practice is for likelihood to be the determining factor when calculating risk, as outlined in Chapter 3).

Risk reduction is the focus of this research, as often new development increases risks to life and property, rather than reducing risks. Case law in 2008 and 2010 has provided two examples where risks to life and property are increased by proposed mitigation measures, and certainty around levels of risk would have been beneficial (these cases are discussed further in Chapter 4). If risks are increased with development, it becomes questionable whether sustainable management and development[2] is occurring within the context of natural hazards. In 2010, the Holt case (Environment Court 2010 decision 120) highlighted the importance of specifying levels of risk area (e.g. acceptable, tolerable, intolerable). In the Holt case, the proposal was to build a house on a flood hazard area on stilts to ensure the floor level was 3.7m above mean sea level, with a boat tethered to the foundation poles for evacuation purposes. Within the relevant district plan, “an acceptable level of risk” is required, but this level is not defined. The Regional Policy Statement also refers to avoiding or mitigating[3] adverse effects of natural hazards to acceptable levels, but again this risk

[2] In New Zealand, the terms ‘sustainable management’ and ‘sustainable development’ are used in different contexts, and therefore cannot be interchanged. Further elaboration is provided in Chapters 2 and 4.

[3] In New Zealand, mitigation and avoidance are separate management options. While in other countries (e.g. USA), mitigation includes avoidance, under the Resource Management Act 1991, natural hazards are either avoided or mitigated. Unless specified, mitigation does not include avoidance. This issue is discussed further in Chapter 4.

level is not quantified or qualified. However, while the risks may have been acceptable to the applicants, it was unacceptable to other sectors of the community (including the city and regional council). As acceptable risk was not defined in the Regional Policy Statement, and the applicants accepted the risk and proposed mitigation measures, the development was able to proceed. A discussion on reconciling avoidance and mitigation is provided in Chapter 4, but in summary an applicant can either avoid or mitigate the effects of natural hazards, with no requirement for the mitigation measure to reduce risks. This case (and others) have highlighted that the existing framework can be improved, in particular highlighting the importance of quantifying and qualifying risk so that the Holt example is not repeated.

Land use planners have an irrefutable and essential role in the social and physical development of the built environment. Planners are integrally involved in establishing land use development control systems, and therefore have a real, immediate, and tangible responsibility to plan for community safety. Planners have a delegated responsibility to plan for the future of our cities to ensure that the safety and security of present or future communities are not compromised by urban growth, development and renewal (Britton & Lindsay, 1995). As such, land-use planning is often described as an opportune tool available for reducing or even eliminating risks to natural hazards (Burby, 1998a; Mileti, 1999). Risk reduction measures can be either regulatory (e.g., rules in city/district/regional plans), or incorporated into non-regulatory approaches (e.g. structure plans, which can set aside at-risk land for recreational purposes).

To assist planners in defining levels of risk and promote a risk-based approach to land-use planning for natural hazards, the following aim and objectives are proposed.

4. Overarching aim and objectives

The aim of this research is to *develop a risk-based framework for innovative land-use planning which reduces risks from natural hazards in New Zealand*. In order to meet this aim and address the problems outlined in Section 2, the overarching question of this thesis is "*How can the existing risk-based land-use planning framework be improved to encourage better decision making for natural hazard risk reduction?*

In order to achieve this aim and answer the subsequent research question, the objectives of the research are to:

1. Provide the context to the rationale for the study, based on an international literature review around sustainable development, risk governance, natural hazards, land-use planning, risk, and innovation (Chapter 2);

2. Undertake ethical research based on appropriate research methods (Chapter 3);

3. Outline and critique the regulatory context for managing natural hazards in New Zealand (Chapter 4);

4. Describe what innovation is, and its relevance to land-use planning within the context of the Thames-Coromandel district (Chapter 5);

5. Outline approaches to risk governance within land-use planning and present a framework for innovative land-use planning for natural hazard risk reduction (Chapter 6); and

6. Summarise key findings of research and their implications for decision making and future research (Chapter 7).

An overview of these objectives and their relationship to subsequent chapters is provided in the following section.

5. Overview of research

The aim and associated objectives of the research will contribute to the existing body of knowledge on land-use planning and natural hazard risk reduction. This chapter contributes to this aim by defining the key concepts used in this research, so that these concepts are defined within the context of the aim and objectives. This chapter also describes the key concepts associated with sustainable development, risk governance, natural hazards, land use planning, risk reduction and mitigation, risk, and innovation. These concepts are further explored in Chapter 2.

Chapter 2 provides the context to the rationale for the study, based on an international literature review around sustainable development, risk governance, natural hazards, land use planning, risk, and innovation. The risk governance context has been largely based on Renn (2008), whose approach incorporates participatory methods, governance, and use of scientific knowledge and innovation. The implications of each

of these six themes within a New Zealand context are provided in subsequent chapters.

Chapter 3 presents the methodologies employed for the design of the research. Two key methodologies were the focus of the research: participatory action research (PAR), where research is undertaken *with* organisations rather than *for* organisations (Cameron, 2007) and promotes engagement and subsequent implementation and use of concepts provided; and the use of a case study. PAR was considered the most appropriate method for the research approach; the results outlined in Chapter 6 required support and participation from council staff to ensure the risk-based approach designed was practical for their purposes, useful, and could be implemented. This approach proved its value, with one council taking up the research findings before they were completed (discussed in Chapter 6). A case study approach was also taken within the PAR framework. This case study focused on the Thames-Coromandel district, and interviews were undertaken with representatives from the state, market and civil society at national, regional and district levels.

Chapter 4 provides the regulatory context for managing natural hazards in New Zealand in regards to four key statutes: the Resource Management Act 1991; Building Act 2004; Civil Defence Emergency Management Act 2002, and the Local Government Act 2002. According to Healey (2004), the legal framework forms a key input into effective governance. A critique of the legislation includes a discussion of their purposes; reconciling avoidance with mitigation under the Resource Management Act; timeframes for managing natural hazards; the role of the planner; and opportunities for improving the current management of hazards.

Innovation has historically been the domain of the business world, but its use and application is becoming more apparent in land-use planning. Chapter 5 describes types of innovation within business and their transfer into a land-use planning context. The results of the case study of Thames-Coromandel is presented and discussed with regard to participant knowledge of hazards in the district; perspectives on innovative risk reduction measures taking place in the district; and perceived barriers and opportunities for innovation.

Chapter 6 presents a risk-based framework for reducing risks to natural hazards through innovative land use planning. This framework is set within the wider context of risk governance with a focus on Renn (2008) and linkages to the New Zealand Risk Management Standard (Standards Australia/New Zealand, 2009). Three planning

approaches to natural hazard risk are outlined: the risk-based, precautionary and participatory approaches. Based on the findings of the previous chapters, a new, innovative approach to land-use planning for natural hazards is presented. This approach includes a risk-based framework which is focused on the consequences of an event rather than the likelihood of it occurring. Consequences are based on the underpinning well-beings of sustainable development: health and safety, social, economic, and environmental. While the framework provides four types of consequences and associated levels of risk based on these well-beings, which are also outlined in New Zealand legislation (discussed in Chapter 4), it is to be used as a guide only for local authorities – it is up to the individual councils and their communities to develop their own criteria for their levels of risk and the consequences they face via a participatory decision making process. The result of the chapter is an adaptive risk-based approach to planning policy, resource consents and associated planning tools. It allows for innovation to occur both within planning policy, and market initiatives. An example of how a Council is applying this methodology is outlined, along with the current limitations of this approach and future research in the area.

A summary of the research and conclusions is provided in Chapter 7.

6. Scope and limitations

This research is focused on land-use planning for natural hazard risk reduction in New Zealand, taking an all-hazard approach. While acknowledging the importance of other aspects of hazard research, in particular the holistic nature and requirement of undertaking and linking into multidisciplinary hazard fields, this research deals with one aspect of the natural hazard field of enquiry – land-use planning. Due to this limited scope the research does not include an assessment of the psycho-social implications; personal levels of risk; perceptions of risk; or specifically focus on power relationships within decision making and institutions (although this is implicit in the participatory planning process and the democratic nature of planning), which is acknowledged as being critical to the success of the research. However, this is in part addressed through the participatory philosophy which underpins the research and explicitly confronts the issue of power.

While this research does refer to governance arrangements, it does not provide an exhaustive review of governance concepts and issues. Rather, it has a focus on how risk is managed through existing governance arrangements, that is, through legislation,

policies, and the way in which risk is perceived and addressed through interactions between the state, market and civil society.

The framing of this research has been influenced by the professional experience and background of the author, who works full time at GNS Science, New Zealand's leading supplier of geological research. At GNS Science I am based within the Social Science team within the Hazards Group, a position I have held since January 2005. My specific area of focus is land-use planning for natural hazards which involves working with local authorities, including those case study councils outlined Chapter 3. There was no potential conflict of interest identified between this research and my role at GNS Science; however my role does make me accountable for any published material, and GNS Science liable. During the course of this research I was not paid by a council for commercial gain, and all findings are freely available at no cost. While funding was received (from the EQC and Bay of Plenty Regional Council) for an associated project to which this research contributed, this funding was for a report in which no commercial gain was received by GNS Science or the funders, and the report is again freely available at no cost.

My background has provided a strong basis for this research. Prior to joining GNS Science in 2005, I was employed as a resource management planner for Opus International Consultants, which gave me the opportunity to gain experience in land-use planning from both a consultant and council perspective. In 1999/2000, I was the Hazards and Emergency Management Officer for the Wairarapa Division of the Wellington Regional Council, which provided me with experience in emergency management engineering lifeline issues and processes. These employment opportunities have provided key insights into land-use planning and natural hazards for this research. With this background, the research has been undertaken from a rational, process-based approach, reflecting the context in which I am employed.

This research was conducted part time while working at GNS Science. In the last five months of the research, numerous 'distractions' were encountered, namely unexpectedly finding out I was 18 weeks pregnant in January 2011, followed by the devastating Christchurch earthquake on 22 February 2011; and the Japanese earthquake and tsunami on 11 March 2011. The first of these three events prioritised commitments to complete the PhD before my due date; the second event provided a difficult distraction, as it had large implications for work at GNS Science and future research directions; and the Japanese event coincided with the finalisation of a

GNS/EQC project on incorporating tsunami inundation modelling into land-use planning. The second and third events emphasised how important this type of research is to assist planners in achieving sustainable development outcomes.

7. Key concepts of research

There are a number of key concepts used in this research, each of which has numerous definitions. The definitions below clarify how these terms are used in this research. The theoretical context for these concepts is discussed in Chapter 2.

7.1 Sustainable development

The widely accepted definition of sustainable development is from the Brundtland Commission, who defined it as "… meets the needs of current generations without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987, p23).

7.2 Risk governance

Risk governance is a subset of the general term 'governance' and involves the interpretation of existing governance principles into the context of risk and decision making (Gunningham et al., 1998, cited in Renn, 2008). Renn (2008, p8-9) expands this definition, stating that risk governance:

> …includes, but also extends beyond, the three conventionally recognized elements of *risk analysis* (risk assessment, risk management and risk communication). It requires consideration of the legal, institutional, social and economic contexts in which a risk is evaluated, and involvement of the actors and stakeholders who represent them. Risk governance looks at the complex web of actors, rules, conventions, processes and mechanisms concerned with how relevant risk information is collected, analysed and communicated, and how management decisions are taken. Encompassing the combined risk-relevant decisions and actions of both governmental and private actors, risk governance is of particular importance in, but not restricted to, situations where there is no single authority to take a binding risk management decision, but where, instead, the nature of the risk requires the collaboration of, and coordination between a range of different stakeholders. Risk governance, however, not only includes a multifaceted, multi-actor risk process but also calls for the consideration of contextual factors such as institutional arrangements (e.g. the regulatory and legal framework that determines the relationship, roles and responsibilities of the actors, and coordination mechanisms such as markets,

> incentives or self-imposed norms) and political culture, including different perceptions of risk.

7.3 Natural hazard

A natural hazard can is defined as “an extreme natural event that poses risks to human settlements” (Deyle, French, Olshansky, & Paterson, 1998, p121). Under the Resource Management Act 1991, a natural hazard is defined as:

> Any atmospheric or earth or water related occurrence (including, but not limited to, earthquake, tsunami, erosion, volcanic and geothermal activity, landslip, subsidence, sedimentation, wind, drought, fire, or flooding) the action of which adversely affects or may adversely affect human life, property, or other aspects of the environment ("Resource Management Act," 1991).

In New Zealand the terms ‘natural hazard’ and ‘risk reduction’ are often used together i.e. natural hazard risk reduction, rather than ‘disaster risk reduction’. Preference is given to the term natural hazard risk reduction, as hazards are not disasters in their own right (Perry, 2006) and in many cases a ‘disaster’ is not necessarily required to produce unacceptable/intolerable consequences. For example, the 4th September 2010 Darfield earthquake caused damage to the CBD and surrounds, but was not deemed a disaster, even though there were social, economic, cultural, and built environmental consequences. In contrast, the subsequent 22 February 2011 Christchurch earthquake caused more extensive damage to the CBD and suburbs, and resulted in a large loss of life and significant injuries, which in many cases were considered intolerable and therefore considered a disaster (see following definition). Also the wording of the Resource Management Act 1991 specifies that natural hazards, not disasters, are to be managed via land-use planning.

For decades, scholars have differentiated between natural hazards and disasters (e.g. Burton, Kates, & White, 1978; Ericksen, 1986; Mileti, 1999). It is commonly agreed that a natural hazard becomes a disaster when humans and their livelihoods are affected beyond their ability to cope. For example, as Paton (2006, p6) explains:

> Hazards impact on people, they affect communities, and they disrupt the community and societal mechanism that serve to organize and sustain community capacities and functions. When hazard activity results in significant loss or disruption to established social processes, function, activities and interactions, it can be defined as a disaster.

7.4 Land-use planning

The term “planning” has many definitions based within many contexts. For the purposes of this research, the focus is on land-use planning, which is defined as:

> … a particular planning type, is focussed upon establishing the best spatial arrangements of land use, development, and management … To do this, land-use planning is confronted with the task of establishing which of the many potential patterns and organisations of land use are likely to be the most advantageous in the future, in a particular place, and for a particular community (March & Henry, 2007, p17).

Within this context, the methods of participatory planning (referred to as communicative planning by some, for example Fainstein (2003)) are key to the success of the research results. Participatory planning advocates a high degree of involvement by an active and informed community. It is concerned with enabling or creating opportunities for the public to participate in the planning process within the environments in which the community lives (Fookes, 1996).

7.5 Risk reduction and mitigation

The Ministry of Civil Defence Emergency Management defines risk reduction as:

> Identifying and analysing long-term risks to human life and property from hazards; taking steps to eliminate these risks if practicable, and, if not, reducing the magnitude of their impact and the likelihood of their occurring (MCDEM, 2008a, p5).

Risk reduction includes both avoidance and mitigation of effects.

The term mitigation is not defined in legislation in New Zealand, although under the Resource Management Act 1991 mitigation does *not* include avoidance, which is a separate option (refer Chapter 4). This subtlety is not consistent with its usage internationally, where mitigation *includes* avoidance (e.g. USA). Under the Risk Management Standard 31000:2009, mitigation is the process followed to modify risk. Mitigation may involve (but is not limited to) removing the risk source; changing the likelihood; changing the consequences; sharing the risk with another party or parties (including contracts and risk financing); and retaining the risk by informed decision (Standards Australia/New Zealand, 2009).

7.6 Risk

Risk is defined as the likelihood and consequences of the hazard, i.e. R = L x C ("Civil Defence & Emergency Management Act," 2002; Standards Australia/New Zealand, 2009). For the purposes of this research, risk is defined as R = (C x L) – T, where T = risk treatment, which in this case is via land-use planning. In this approach, consequences are assessed before the likelihood. Generally, levels of risk are divided into three categories (Standards New Zealand, 2004):

1. Acceptable risks, where positive or negative risks are negligible, or so minimal that no mitigation measures are required;

2. Tolerable risks, where costs and benefits are taken into account, and opportunities are balanced against potential adverse consequences. Tolerable does not equate to acceptable; rather, it is a willingness by society (although perhaps not specific individuals) to live with risk in order to gain certain benefits. The risk is undertaken on the assumption that it is one worth taking, and that that risk is being managed in some way (Health & Safety Executive, 2001); and

3. Intolerable risks, where the risks are intolerable regardless of the benefits the activity may bring, and risk reduction measures are essential no matter the cost.

One of the issues with defining levels of risk (as discussed in Chapter 6) is that communities are not homogeneous, and other influences such as short-term commercial gain outweigh actual risks (Handmer, 2008).

7.7 Innovation

Innovation can refer to the inventive process by which new things, ideas, and practices are created; it can mean the new thing, idea, or practice itself; or it can describe the "process whereby an existing innovation becomes a part of an adopter's cognitive state and behavioural repertoire" (Zaltman et al., 1973, p7-8, cited in Goldsmith & Foxall, 2003), thereby going beyond pure creativity. Within the context of land-use planning and natural hazard risk reduction, innovation is defined as an opportunity to plan for positive social, economic, and environmental outcomes in a new way, based on old and new planning principles within planning theory and practice. It requires a vision, leadership, and belief which extends beyond political cycles; is comprehensive and integrated with policies and plans from different sectors; and involves the active and

meaningful participation of the community. The outcome of innovative land-use planning is hazard-resilient, sustainable communities (refer Chapter 5).

8. Summary

New Zealand is subject to a number of natural hazards, with many communities susceptible to the impacts of a severe natural event. Table 1.1 showed there is a variety of guidance to councils to assist in managing their risks. However, with the exception of Saunders et al. (2011), which is based on this research, there is no guidance which explicitly provides details on how to quantify or qualify risks for land-use planning. To assist in bridging this gap, an innovative risk-based planning approach is required to ensure that sustainable risk reduction is achieved in the future.

There appears to be only limited literature on innovation in land-use planning, with Healey (2004) and Friedmann (2003) providing key contributions to this area; and even less linking innovation, land-use planning and risk reduction. It is within this context that the aim and objectives of the research are presented: to develop a risk-based framework for innovative land-use planning to reduce risks from natural hazards in New Zealand. Six objectives are required to achieve this aim, and correspond to the following chapters: theoretical context (Chapter 2); research methods (Chapter 3); the regulatory context for hazard management (Chapter 4); innovation and its practice in Thames-Coromandel (Chapter 5); a risk-based planning and innovative land-use planning for natural hazard risk reduction (Chapter 6); and a summary and conclusion (Chapter 7).

This research focuses on the role of land-use planning for natural hazard risk reduction. While it acknowledges that a holistic approach is required to address hazards from a number of sectors e.g. emergency management, building and construction, its focus is on the issues, barriers and opportunities around land-use planning for natural hazards.

There are six key concepts which underpin this research: sustainable development; risk governance; natural hazards; land-use planning; risk; and innovation. Each of these concepts is briefly defined in this chapter to provide context to the issues being discussed and expanded on in the following chapters.

CHAPTER 2 Theoretical Context

1. Introduction

This chapter provides the overarching theoretical context for the following chapters, set within the wider context of promoting safe and sustainable development. It provides a critical presentation of the research problem and themes outlined in Chapter 1, within the wider context of international research literature on sustainable development. This is followed by a review of the key concepts of risk governance, natural hazards, land-use planning, risk, and innovation. The purpose of the chapter is to provide a theoretical context for why the integration of often disparate, but interlinked, strands of scholarship require further integration to improve natural hazard risk reduction through innovative land-use planning (as further elaborated upon in the forthcoming chapters). These relationships are not new – in 1999 Mileti (p7) noted that

> … land use planning, hazard mitigation, and sustainable communities are concepts with a shared vision in which people and property are kept out of the way of hazards, the mitigative qualities of the natural environment are maintained, and development is resilient in the face of natural forces.

Mileti goes on to note that within the U.S. context there is no guidance provided on developing in hazard-prone areas, and VoB and Kemp (2006) call for new forms of problem solving for sustainability – both of which this thesis aims to contribute to within the context of New Zealand, as outlined in Chapter 6. This chapter begins with an overview of sustainable development, which provides the overarching context for the research. This is followed by an overview of the relationship of sustainable development to risk governance, natural hazards, land use planning, risk, and innovation. Each of these themes are further outlined in subsequent chapters, and as such provides context for these latter chapters of this thesis.

2. Sustainable development

While the term ‘sustainable development’ has many definitions and is the subject of much debate (e.g. Adger & Jordan, 2009; Berke, 1995; Berke & Conroy, 2000; Campbell, 1996; Kemp & Parto, 2005; Lele, 1991; May et al., 1996; Parliamentary Commissioner for the Environment, 2002), the widely accepted definition is from the Brundtland Commission, who defined it as “… meets the needs of current generations without compromising the ability of future generations to meet their own needs” (World Commission on Environment and Development, 1987, p23). Much of the debate around the definition includes the term being too vague and reconciling the different dimensions of sustainable development remains elusive, with a tendency for economic considerations to override other considerations (e.g.

Lele, 1991; Robinson, 2004; Vallance, Perkins, & Dixon, 2011). This brings into question whether sustainable development, or sustainability, is at the crux of the issue (Robinson, 2004). For example, Robinson (2004, p370) states that:

> … development is seen as synonymous with growth, and therefore that sustainable development means ameliorating, but not challenging, continued economic growth. On this view, the preferred term 'sustainability' focuses attention where it should be placed, on the ability of humans to continue to live within environmental constraints.

Three key elements underpin the concept of sustainable development: economic, environmental, and social well-beings (e.g. Berke & Conroy, 2000; Campbell, 1996; Lele, 1991). Often presented in a schematic form e.g. as a triangle (i.e. Paehlke, 2004) or a stool (i.e. Berke & Smith, 2009; Godschalk, Kaiser, & Berke, 1998), the interaction and reconciliation of these three well-beings is critical to the pursuit of sustainable development. Social (or human) well-being is key to providing a certain standard of living; the environment must be healthy, productive and diverse in order to support life and to ensure a standard of living; and a healthy economy is required so that communities can provide for people's health, wealth, and happiness (Parliamentary Commissioner for the Environment, 2002; Prescott-Allan, 2001). In New Zealand, additional to these three well-beings, cultural well-being also requires consideration under legislation. Trade-offs between the well-beings is often required, and political will is a key input into the success of sustainable development Reconciling these often contending dimensions lies at the heart of the sustainability challenge. These well-beings are discussed further within the New Zealand context in Chapter 4, and form the basis of the risk-based approach outlined in Chapter 6.

Definitions of sustainability need to be located within the appropriate context so that progress towards goals can be gauged (Mileti, 1999). In New Zealand, various statutes refer to both *sustainable development* and *sustainable management* (Chapter 4 discusses this in further detail). In summary, the Resource Management Act 1991 (RMA) is the principle environmental legislation in New Zealand, and like the Civil Defence Emergency Management Act 2002 (CDEMA), sustainable *management*, rather than *development* is the focus. Under the RMA, sustainable management is defined as:

> … managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural wellbeing and for their health and safety while—
>
> a. Sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and

b. Safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and

c. Avoiding, remedying, or mitigating any adverse effects of activities on the environment.

In contrast, the Building Act 2004 and Local Government Act 2002 (LGA) both refer to sustainable development, which is not defined. This is discussed further in Chapter 4. The Parliamentary Commissioner for the Environment (an independent Officer of Parliament who has wide-ranging powers to investigate environmental concerns) supports a 'strong' sustainability model, which recognises the limits within which society and the economy must operate in order to function with sustainable outcomes. Within this model, society and the economy are constrained by the natural environment. The economy is a subset of society, as many important aspects of society do not involve economic activity. However, in practice the 'weak' sustainability approach has had more emphasis, with a focus on economic growth as a priority (Parliamentary Commissioner for the Environment, 2002). Regardless of the subtleties of terminology used, the concept of sustainability incorporates the issue of building communities – now and in the future – that are resilient to natural hazards. In order to achieve this, risks must be reduced within (but not limited to) the context of social, economic, environmental and cultural well-beings.

As outlined in Chapter 4, sustainable development is the focus of legislation in New Zealand. There is merit in the sustainability/development terminology being vague in that it provides an opportunity for communities to develop their own common understanding of what sustainability means for their community; and provides them with an opportunity to reconcile the different dimensions of sustainability. To assist in monitoring progress towards sustainable development, a degree of monitoring and evaluation is required, which may include both quantitative and qualitative assessments. Within the sustainable development paradigm is the explicit need for natural hazard risks to be recognised and managed (as discussed in later sections). As such, for sustainable development to occur, governance structures and practices need to be in place, as discussed in the following section.

3. Risk governance

Within the context of natural hazard management, there is a hierarchy of governance structures that influence the effectiveness of risk reduction outcomes as shown in Figure 2.1. While natural hazard management encompasses many options for reducing risks (e.g. building codes, emergency management response and recovery, engineered structures), this research highlights the role of land use planning in reducing risks to people and property. Chapter 4 provides a discussion on the other options available for reducing risks.

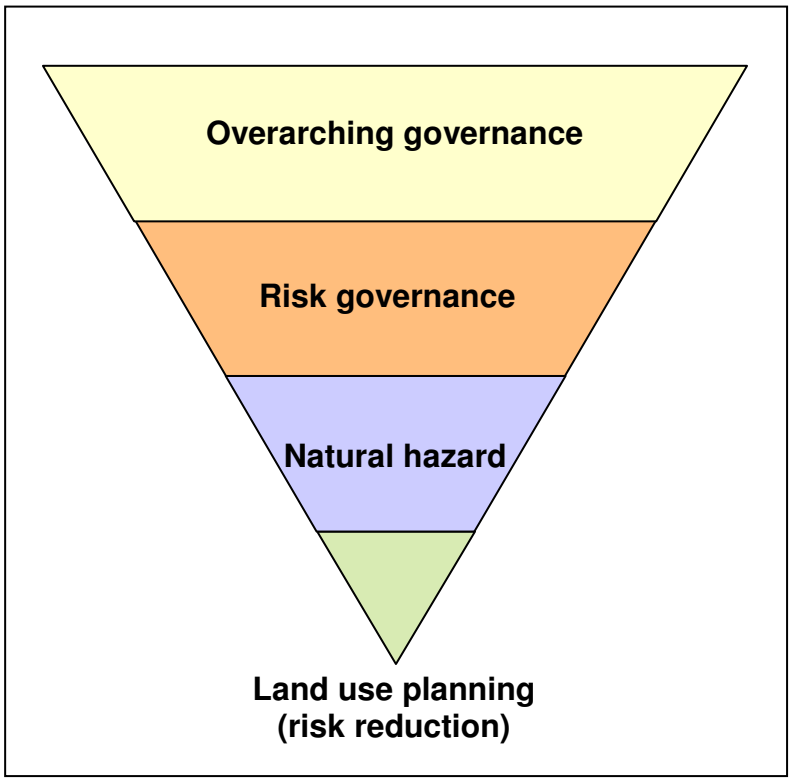

Figure 2.1 Hierarchy of governance arrangements for natural hazard risk reduction.

At the top of the hierarchy, governance structures and risk governance practices are key to the successful outcomes of sustainable development. Jager (2009, p143) states:

> Governance *for* sustainable development … implies the deliberate adjustment of practices of governance in order to ensure that human development proceeds along a more sustainable trajectory. Governance for sustainable development is the effort to link the systems of governance with the objective of sustainable development.

With that in mind, governance within a sustainable development context needs to:

> …foster, guide and coordinate positive work by a host of actors on a vast complex of issues, through webs of interconnection and across multiple levels and scales, with sensitivity to their contexts and respect for uncertainties … [sustainable development] encompasses the multiple and diverse strengths, motives and capabilities, not just of conventional government agencies and business interests, but of the full set of public, private and civil society players, collective and individual, plus their myriad interrelations (Kemp & Parto, 2005, p26).

Governance structures that embrace sustainable development principles are therefore key to attaining positive outcomes. As with the definition of sustainable development, the associated principles can vary on the context. However, the OECD provided a checklist in

2002 (summarised in Adger & Jordan, 2009, p18) for improving governance for sustainable development. The checklist was based around five key areas: a common understanding of sustainable development; clear commitment and leadership; specific institutional mechanisms to steer integration; effective stakeholder involvement; and efficient knowledge management. 'Good' governance also includes effectiveness and efficiency; the rule of law; participation; accountability; transparency; respect for human rights; the absence of corruption; toleration of difference; and gender equity (Meadowcroft, 2008).

Governance is the wider setting within which risk-based natural hazard management and planning takes place. A risk-based planning approach primarily based on elements of Renn's (2008) governance framework underpins this research. The role of governance is important in this research, as any risk reduction measures undertaken within a land-use planning framework require governance arrangements that will support risk reduction and innovation. Governance incorporates collective action arrangements that have beneficial outcomes (Healey, 2004). Collective action has a dual role, on one hand being constraining, disciplining and stabilising, while also being enabling, releasing capacity and allowing for innovation. The challenge is to find a balance between these inputs and outputs via the governance framework (Gonzalez & Healey, 2005; Healey, 2004). Renn (2008, p364) states that governance includes:

> …matters of institutional design, technical methodology, administrative consultation, legislative procedure and political accountability on the part of public bodies, and social or corporate responsibility on the part of private enterprises. But it also includes more general provision on the part of government and commercial and civil society actors for building and using scientific knowledge, for fostering innovation and technical competencies, for developing and refining competitive strategies, and for promoting social and organisational learning.

In its broadest sense, governance refers to how society makes social choices and it can also be applied to how any organisation (at a national, regional or city level) is run. According to Warburton and Yoshimura (2005), governance is about the process and political, legal and administrative institutions through which decisions are made; and how these processes and institutions are managed and are accountable. Governance processes include and go beyond governments – systems of governance are required that combine state governments, global governance structures, local governance, civil society, and corporate activities (Warburton & Yoshimura, 2005).

The governance arrangements at the top of the hierarchy shown in Figure 2.1 lead the success or otherwise for effective risk governance (e.g. Adger & Jordan, 2009; Brownill & Carpenter, 2009; Duit & Galaz, 2008; Healey, 2004; Kooiman, 2003; Ploger, 2001), natural hazard management and risk reduction. Within the context of this overarching governance framework, risk governance is a subset of governance arrangements and has been the subject of rigorous discussion (Ahrens & Rudolph, 2006; Benn, Dunphy, & Martin, 2009; May, et al., 1996; Renn, 2008, 2009). Risk governance is a process which includes and goes beyond risk assessment, management and communication (Renn, 2008). Renn (2008) outlines parallel elements of risk governance and factors which contribute to inclusive risk governance, as presented in Figure 2.2.

The key participants in Renn's risk governance framework are the government (state), economic players (market), civil society organisations and scientists. Crucial to the framework is communication and participation in the process with key actors. This approach by Renn is consistent with the elements of successful governance by Healey (2004) in that it is:

- Process based, integrated within the culture of an organisation;
- Based within a legal framework and institutional design;
- Engages networks between experts, economic systems, civil society and political system;
- Requires scientific knowledge/experience of actors;
- Outputs ideally are enabling and allow for innovation; and
- Incorporates collective action via communication and engagement.

It is within this risk governance framework that opportunities are available to improve land-use planning for natural hazard risk reduction in New Zealand, as discussed in Chapter 6. The following section will provide an overview of the relationship between sustainable development and natural hazards.

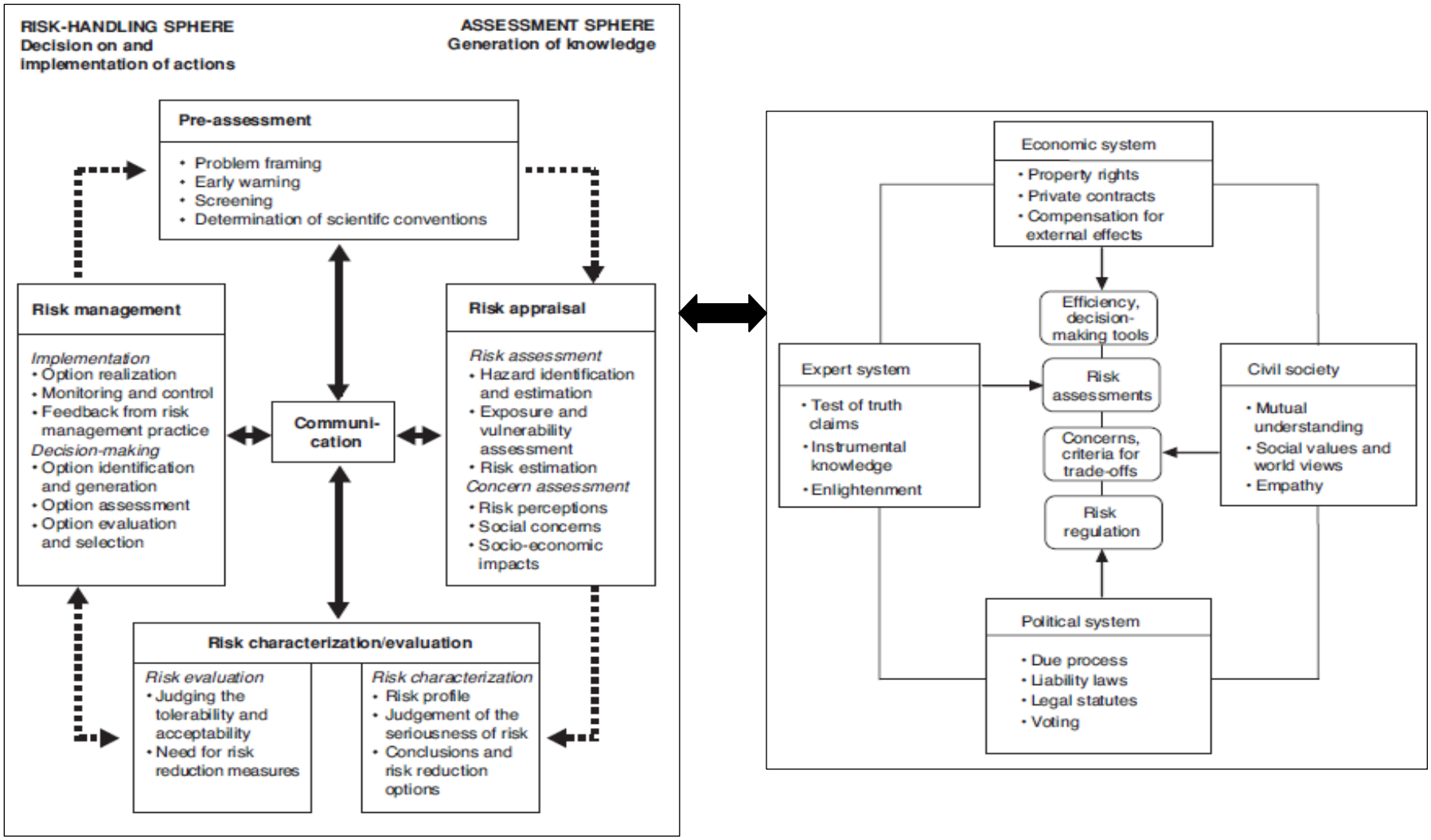

Figure 2.2 Elements of risk governance (left) and inclusive risk governance (right) (Renn, 2008, p365, 367).

4. Natural hazards

Within the context of sustainable development, natural hazards require consideration as one important component of policy to ensure that a quality of life is provided and available for existing and future communities (Burton, et al., 1993). Implicit within the sustainable development discussion is reducing losses and risks from natural hazard events. The implications are twofold: 1) adverse consequences from natural hazard events are more likely to occur where unsustainable development has taken place; and 2) the occurrence of the consequences from an event hinders the goal of sustainability due to the resulting environmental, economic, and social costs (Berke & Smith, 2009; Mileti, 1999). Initiatives that assist communities in reducing their level of risk while providing for their social, economic and environmental needs strengthens overall sustainability and resiliency to other issues and concerns, and vice-versa (Mileti, 1999).

The term 'resiliency' refers to the link between sustainable development and risk reduction, where market investments are avoided or limited in at-risk locations; the natural risk reduction properties of the environment are maintained; and where opportunities for reducing risks during recovery are implemented (Berke & Conroy, 2000; Folke, Colding, & Berkes, 2003; Godschalk, et al., 1998). The term resilience is often described as the ability to 'bounce back' after an event, and implies a capability to return to a previous state (Paton, 2006). Adger (2000) defines social resilience as the ability of groups or communities to cope with external stresses and disturbances as a result of social, political, and environmental change. These usages, however, captures neither the reality of disaster experiences nor its full implications. Even if people wanted to return to a previous state, changes to the physical, social, and psychological reality of societal life emanating from the disaster can make this untenable. The 'bouncing back' definition also fails to capture the new possibilities opened up by the changes wrought by a disaster (Paton, 2006). Therefore, resilience in the context for this research is a measure of how well people and societies can adapt to a changed reality and capitalize on the new possibilities offered (Paton, 2006).

To cope with natural hazards, people and their societies adjust and adapt. These actions are variously termed human responses, coping actions, risk reduction actions, adjustments, mitigation, and adaptations. White, Kates and Burton (2001) suggest there are generic sets of adjustments applicable to all hazards, but the capacity to undertake them may be severely limited for any individual or group. Over time some

short-term adjustments become part of adaptation and are integral in the behaviour of life and livelihood.

Burton, Kates and White (1993) offer a range of purposeful and incidental adjustments, as shown in Figure 2.3. The focus of this research is on the purposeful adjustments of reducing losses via preventing and/or modifying effects (i.e. avoidance and mitigation); and to a lesser degree on changing location and/or use. The other option available is to accept the losses e.g. sharing losses via insurance, or bearing losses. Any decision of this category needs to be made with the best available information and understanding of the risks involved.

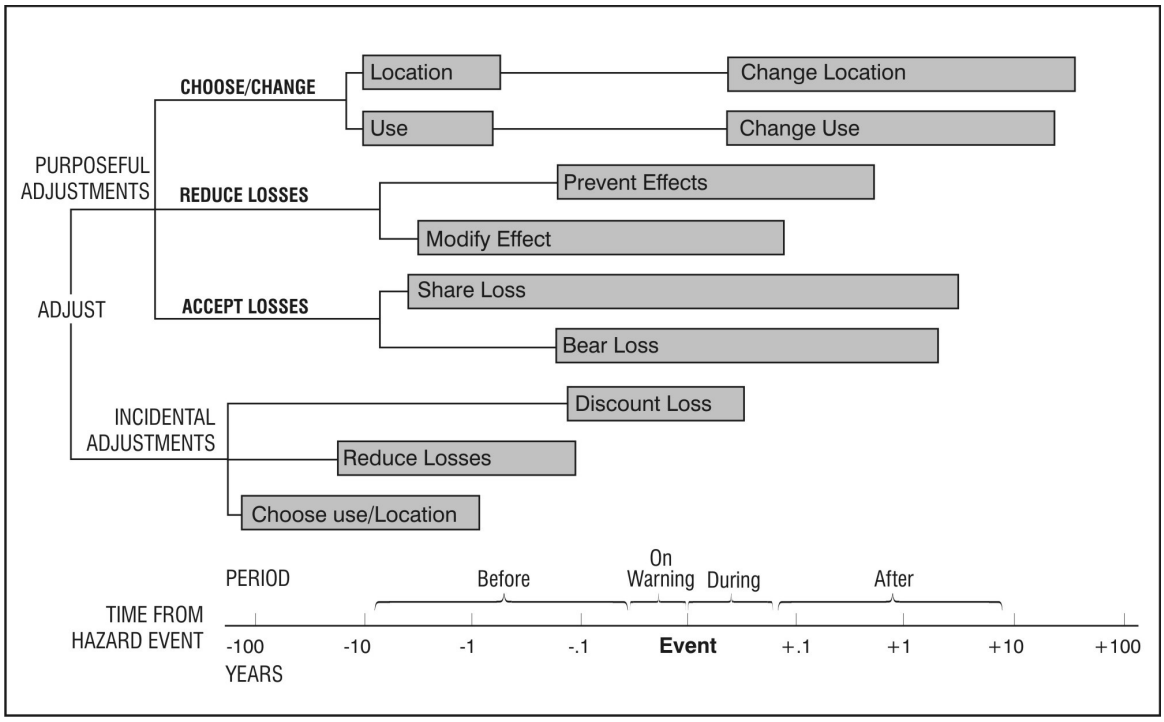

Figure 2.3 A choice tree of adjustment (Burton, Kates & White, 1993, p58).

Within the context of the ever-increasing literature on the human dimensions of global climate change, adaptation usually refers to a process, action or outcome in a system (household, community, group, sector, region, country) in order for the system to better cope with, manage or adjust to some changing condition, stress, hazard, risk or opportunity (Smit & Wandel, 2006).

Brooks (2003, p8), describes adaptation as ‘‘adjustments in a system’s behaviour and characteristics that enhance its ability to cope with external stress’’. Smit, et al., (2000, p225), in the climate change context, refer to adaptation as ‘‘adjustments in ecological-socio-economic systems in response to actual or expected climatic stimuli, their effects

or impacts.'' Pielke (1998, p159) also in the climate context, defines adaptation as the ''adjustments in individual groups and institutional behaviour in order to reduce society's vulnerability to climate'' (in Smit & Wandel, 2006). Therefore, adaptation is a function of adjustments, and *vice versa.* Nevertheless, incidental adjustments and cultural adaptations are of basic importance in as much as they create the level or capacity of individuals, managerial units, and social systems to absorb the effects of extreme environmental fluctuations (Burton, et al., 1993).

Burton, Kates & White (1978, 1993) offered a theoretical range of responses which encompasses all the ways in which a society may act to reduce the effects of, or increase the benefits of a hazard. These are graded from immediate actions in the face of danger (such as warning systems, emergency evacuation) to long term actions (such as the construction of buildings designed to resist earthquakes). Other responses include the long-run adaptation of a culture to the extremes of its environment (Burton, et al., 1993).

In Figure 2.3, adjustments may be separated into those that are purposefully adopted, and those activities and characteristics of individual behaviour that may not be primarily hazard-related but have the effect of reducing potential losses. Such adjustments are described as incidental. A response initially adopted as an adjustment, either purposeful or incidental, may gradually become transformed into cultural adaptation. Some adjustments, such as changes in land use, can only be effective if begun well in advance of an event (Burton, et al., 1993). The focus of this thesis is on what purposeful adjustments/adaptations in innovative communities reduce risks to natural hazards within acceptable levels, and, in particular, the role of land-use planning in achieving such outcomes.

Adjustments begin with an initial choice of a resource use, livelihood system, and location. For that choice, various incidental and purposeful adjustments are available, at somewhat different time scales for initiation. The most radical choice is to change the original use or location (Burton, et al., 1978). Mileti (1999) has taken this further, highlighting that the adjustment paradigm uses the so-called bounded-rationality model of individual decision making (individuals make decisions based on limited knowledge and within constraints set by their social system). In this way they obtain outcomes (though not necessarily optimal outcomes). This decision making model, coupled with the adjustment concept, generated the following five-step strategy for copying with hazards (Mileti, 1999):

1. Assess vulnerability;
2. Examine possible adjustments;
3. Determine the human perception and estimation of the hazard;
4. Analyse the decision making process; and
5. Identify the best adjustments, given social constraints, and evaluate their effectiveness.

However, without the power to choose, or to have one's concerns listened to and weighed justly, knowing the possible adjustments is of little use (Mileti, 1999).

The strength of economic forces favouring unfettered property development, the amount of existing development, deeply rooted social values and legal precedents supporting individual property rights, define and constrain the politically viable hazard mitigation (adjustment) policy options. As a result, the public policy response to hazards vulnerability does not adhere to the *precautionary principle* (refer Chapter 6), but rather a *loss reduction* paradigm that accepts development of vulnerable land and attempts to reduce the impacts of hazard events through adaptive risk reduction initiatives. Adaptive risk reduction includes land development regulations, engineered solutions, emergency preparedness and response, and a combination of market and government-subsidised insurance (Puszkin-Chevlin, Hernandez, & Murley, 2006).

In current thinking, human adjustments to disasters take place throughout a cyclical process that has four stages within the New Zealand '4 R' context: readiness, response, recovery, and reduction. Reduction refers to identifying and analysing long-term risks to human life and property from natural or man-made hazards; taking steps to eliminate these risks where practicable; and, where not, reducing the likelihood and the magnitude of their impact (MCDEM, 2004). Good practice would see these measures in place before a hazardous event occurs.

Burton, Kates and White (1993) make a basic distinction between extreme events in nature, which are not necessarily hazardous to people, and the character of hazard events. The interaction of the natural events system (being wind, water, and earth processes) and the human use system not only creates resources, but also creates hazards which can take away or heavily impact resources. An extreme event may create a productive resource and a hazard at the same time, such as a flood which

may destroy farmland, but also fertilises the paddocks. The actual hazard, not the natural event, is the subject of inquiry (Burton, et al., 1993). Many disaster losses, rather than stemming from unexpected events, are the predictable results of interactions among three major systems: the physical environment, which includes hazardous events; the social and demographic characteristics of the communities that experience them; and the buildings, roads, bridges, and other components of the constructed environment. Growing losses worldwide result partly from the fact that the capital stock in nations is expanding, but also from the fact that all these systems and their interactions are becoming more complex with each passing year (Mileti, 2007). While hazards result from the interaction of natural and human use systems, the two cannot be compared or 'blamed' as causes. By using natural features for economic, social, and aesthetic purposes, it is society that transforms the environment into resources and hazards (Burton, et al., 1993). The natural and human use systems are integrated systems; no longer do the two systems exist independently of each other, and any natural hazard management approach must appreciate this interdependency.

To achieve sustainable communities resilient to natural hazards, a balance must be reached between economic development and the preservation of the environment, which sustains our communities. Berke and Smith (2000) offer four criteria that developments should be evaluated against to ensure sustainable, resilient communities: 1) risk reduction functions of natural systems should not be disrupted; 2) land use decisions on risk reduction initiatives should support economic vitality; 3) environmental and economic benefits of risk reduction initiatives should be distributed equally across the community; and 4) all stakeholders should participate in the risk reduction planning process. The role of land use planning in reducing risks from natural hazards, and therefore contributing to sustainable development, is outlined in the following section.

5. Land-use planning

There are many definitions of land-use planning (Friedmann, 2003). For the context of this research, March and Henry (2007) provide a concise discussion on what planning, and more specifically land-use planning, is. They state:

> A simple definition of planning is 'determining a desired future outcome, and then causing that outcome to occur' (Ackoff, 1970). Land-use planning, a particular planning type, is focussed upon establishing the best spatial arrangements of land use, development, and management … To do this, land-use planning is confronted with the

> task of establishing which of the many potential patterns and organisations of land use are likely to be the most advantageous in the future, in a particular place, and for a particular community (March & Henry, 2007, p17).

Therefore land-use planning is an important mechanism for the reduction of risks in the built and natural environments (March & Henry, 2007). Although planning cannot avoid all natural hazards, intelligent location and design of structures and land uses can reduce the risks (Randolph, 2004), as well as incorporating an early warning and response system.

There are four basic approaches to planning (Ericksen, et al., 2003; Kaiser, Godschalk, & Chapin, 1995; Randolph, 2004):

1. The **rational** approach is based on scientific method and incorporates the five basic steps of objectives, information, alternatives, impact assessment, and evaluation.

2. The **rational-adaptive** approach involves a series of steps, the outcomes of which are, at key stages, tested by consultation with the stakeholders in the affected community.

3. The **incremental** approach accepts limitations in human knowledge and understanding, and as a result, focuses on short-term goals and objectives and small sequential actions. Adaptive planning is referred to as a modern-day form of incrementalism.

4. The **participatory** approach suggests that neither the rational nor the incremental approach deals explicitly with diverse stakeholder perspectives and conflicting values; it aims to inform and involve the public in planning and decision making. It recognises that interested stakeholders do not speak with one voice but often form groups to fight for their special interests.

The rational model does not allow for the adaptations that land use plans must go through in order to engage and gain community acceptance and respond to change (Kaiser, et al., 1995). Planning using a rational-adaptive approach involves a series of steps that are tested by consultation with the stakeholders in the affected community. Thus, for plans dealing with environmental management, scientific methods provide data that informs policy development while public participation shapes the policy and builds commitment to its implementation. Each aspect (rationality and participation)

moderates the selection of policy options and desired outcomes (Ericksen, et al., 2003). The New Zealand planning framework is based within the context of the Resource Management Act 1991 (RMA), the dominant (and rational-adaptive) environmental legislation in the country (Ericksen, et al., 2003; Ericksen, Dixon, & Berke, 2000). Therefore the rational-adaptive model of planning is the focus of this research.

Land use planning is a tool that assists in achieving sustainable development principles because it influences the location, type and scale of human settlement and developments. Therefore the implementation of land use planning is highly relevant to reducing the risks from natural hazards and encouraging more resilient communities (Berke & Smith, 2009). As discussed in Section 2.1, the definition of sustainable development is contested. To assist planners in defining their role in sustainable development, Berke & Conroy (2000, p22) suggest that:

> …planners must foresee and shape the scope and character of future development, identify existing and emerging needs, and fashion plans to assure that those needs will be met and that communities will be able to continuously reproduce and revitalize themselves. By this definition, built environments become more livable [sic]; ecosystems become healthier; economic development becomes more responsive to the needs of place rather than furthering the profits of a powerful few; and the benefits of improved environmental and economic conditions become more equitably distributed.

Berke & Conroy (2000) assessed 30 comprehensive plans to see how they supported sustainable development principles. The key findings included that planners have a critical role in promoting the discussion around sustainability (both development and management), and in developing public policy solutions that promote community sustainability; there should be a strong focus on the decision making process; innovative land use and urban design solutions are required; and planners need to become more aware of linkages between plans, regulations, standards and outcomes. Berke & Conroy conclude their discussion by outlining the future challenge of narrowing the gap between theory and practice. A contribution to this challenge is provided in Chapters 4, 5 and 6.

Land-use planning is therefore an adjustment tool, and has long been recognised as a valuable tool in the long term reduction of human vulnerability and loss potential to natural hazards. A number of commentators have suggested that planning, through its regulation of development and control of land use, is a legitimate pro-active mechanism

for reducing vulnerability. Land-use planning is a process of determining the most desirable way that land should be used and therefore can help to mitigate and reduce risks by directing development away from hazard prone areas (Gunne-Jones, 2003). Land-use planning, as a series of informed decisions, can incorporate and build knowledge about natural hazards in seeking to reduce risks and associated uncertainties in communities. This reduction in risk plays out along two related dimensions. First, it can decrease the likelihood of hazards causing harm, by determining that a development should simply not occur in certain high-risk locations. Second, planning can modify the design and quality of settlements, which of course can never be completely free of risk, so that the consequences of any events that do occur are reduced (March & Henry, 2007).

Innovative land-use planning initiatives can be incorporated into purposeful adjustments via reducing losses through risk reduction measures. For example, in the pre-event phase, there is time for assessing options, considering different strategies for reducing risks, and evaluating and adjusting new methods or techniques as their effects are observed. Sometimes these risk reduction initiatives can include small, minor efforts, but often these are large-scale, policy-level shifts intended to change people's perceptions of risk or risk-reducing action that they can take, or to actually change the way people understand and interact with the natural environment (Becker, et al., 2008; Kendra & Wachtendorf, 2006).

Land use planning has a key role in reducing risks from natural hazards, thereby fostering sustainable development. In New Zealand, this is achieved primarily through the RMA, the principle environmental statute that has now been operating for more than 20 years (other statutes also contribute to sustainable development in New Zealand, including the Local Government Act 2002 and Building Act 2004, as further discussed in Chapter 4). As plans made under the RMA have a lifespan of 10 years, Councils are now starting the process of reviewing and redrafting new plans, referred to as 'second generation' plans (bearing in mind that many plans took up to10 years or more to become operative). With second generation planning underway (and continuing to develop over the next decade), it is essential that planners have a framework to help guide them when reassessing natural hazard policies. If this opportunity is not taken at this time, it may be another 10-15 years before the next round of new plans are drafted and appropriate policy can be incorporated into city, district, and regional plans. This provides a critical opportunity to greatly improve natural hazard planning policy across New Zealand. By providing an alternative

framework that allows for policy planners to encourage innovative risk reduction initiatives, new and improved policies can be incorporated into these second generation plans. This will result in improved decision making for development applications at local government level in regard to natural hazard risk reduction, which in turn will lead to increased community resilience and sustainability within communities. Chapter 4 outlines and critiques the regulatory context for managing natural hazards in New Zealand.

As previously mentioned, participatory planning aims to inform and involve the public in planning and decision making, and is a vital element in enabling civil society and the market to be heard. Within the context of this research, the overarching theme of participatory planning embraces the levels of participation outlined by the International Association of Participatory Planning (IAP2), discussed below, with a preference for the right hand side of the spectrum (see Figure 2.3). Ideally, participatory processes engage all the people who have a stake in the outcome of the decision being contemplated. It encourages the identification of concerns and issues, promotes the wide generation of ideas for dealing with those concerns, and helps those involved find a way to reach agreement about solutions. It results in the production and dissemination of important, relevant information, fosters a sense of community, produces ideas that may not have been considered otherwise, and engenders a sense of ownership on the part of the community for the final decision (Monday, 2002).

Participation in the planning process is required if the implementation of an initiative is to be successful. This is based upon consensus as the foundation for implementation. Public support is achieved by creating authentic opportunities for expressing one's views and acquiring information necessary for understanding others' viewpoints and reaching agreement. Thus, through participation in the planning process, it is expected that people will be supportive of the political decisions needed for fulfilment of plans (Catanese, 1984).

Community involvement and participation has become an important theme in planning theory and practice, and is based on the recognition that people are willing to become actively involved in the decision making process that affects their lives and well-being (Krek, 2005). In 1969, Sherry Arnstein published her 'ladder of citizen participation', where each of the eight rungs of the ladder corresponds to the extent of citizens' power in determining a final result. While the ladder is a simplification, it does illustrate the graduations of citizen participation ranging from manipulation (non-participation) to

citizen control (citizen power) (Arnstein, 1969). Arnstein's 'ladder' has been developed further by the IAP2 (Figure 2.4), to demonstrate a spectrum of possible types of engagement with stakeholders and communities. It also shows the increasing level of public impact as you progress from 'inform' through to 'empower'.

The legislative requirements of the RMA promote consultation (refer Chapter 4 for a discussion of the RMA). Under the IAP2 structure, the requirements of the RMA enable communities to be involved up to consultation level, although Councils can go beyond their consultation requirements to further involve communities. However, it is questionable how often this occurs to more than a token level (Gunder & Mouat, 2002). In contrast, the Local Government Act 2002 potentially offers a more participatory mode of planning, with an emphasis on community involvement and participation in local government decision making (Bond & Thompson-Fawcett, 2007).

Consultation is one method of public participation. It requires sufficient time to consult, sharing and increasing understanding of information, and the likelihood of a change in the proposal. Consultation involves dialogue and feedback, and listening is just as important as talking. Meaningful consultation helps people to understand each other's point of view and what is happening. It develops trust and partnership between people and allows them to contribute to tasks as equals. It increases the power and influence of both parties in a relationship (Fookes, 1996).

INCREASING LEVEL OF PUBLIC IMPACT

INFORM	CONSULT	INVOLVE	COLLABORATE	EMPOWER
Public Participation Goal:	**Public Participation Goal:**	**Public Participation Goal:**	**Public Participation Goal:**	**Public Participation Goal:**
To provide the public with balanced and objective information to assist them in understanding the problems, alternatives and/or solutions.	To obtain public feedback on analysis, alternatives and/or decisions.	To work directly with the public throughout the process to ensure that public concerns and aspirations are consistently understood and considered.	To partner with the public in each aspect of the decision, including the development of alternatives and the identification of preferred solution.	To place final decision-making in the hands of the public.
Promise to the Public:	**Promise to the Public:**	**Promise to the Public:**	**Promise to the Public:**	**Promise to the Public:**
We will keep you informed.	We will keep you informed, listen to and acknowledge concerns and provide feedback on how public input influenced the decision.	We will work with you to ensure that your concerns and aspirations are directly reflected in the alternatives developed and provide feedback on how public input influenced the decision.	We will look to you for direct advice and innovation in formulating solutions and incorporate your advice and recommendations into the decisions to the maximum extent possible.	We will implement what you decide.
Example Tools:	**Example Tools:**	**Example Tools:**	**Example Tools:**	**Example Tools:**
• fact sheets • web sites • openhouses.	• public comment • focus groups • surveys • public meetings.	• workshops • deliberate polling.	• citizen advisory committees • consensus-building • participatory decision-making.	• citizen juries • ballots • delegated decisions.

Figure 2.4 IAP2 Public Participation Spectrum (IAP2).

One approach to participatory planning is communicative planning, where the planner's primary function is to listen to people's stories and assist in forging a consensus among differing viewpoints (Fainstein, 2003). Forester's communicative planning approach (1989) asserts that, through communicative strategies complementing their technical

work, planners can alert communities to the issues of the day, arm them with technical and political information, and otherwise encourage community-based planning actions. It would then be necessary for the planners and community participants to formulate consensus policies based on a wide variety of views expressed by diverse interest groups (Hemmens & Stiftel 1980; Sager 1994, cited in (Stiftel, 2000). Leadership consists not in bringing stakeholders around to a particular planning solution, but in getting people to agree and in ensuring that no one group's interest will dominate, whatever the position of participants within the social-economic hierarchy (Fainstein, 2003).

The communicative approach has been criticised by a number of authors. Concerns include that although representatives of all affected groups may be encouraged to participate, the communicative model offers no guidance on empowerment. If less powerful groups do not have the capacity to influence policy implementation after they leave the negotiating table, consensus-based agreements may be altered and unfairly implemented to preserve the interests of those in power (Berke, 2002). To achieve un-coerced inclusive participation, two further criteria must be met – there must be both equal access to participate in the process, and inclusivity within the argumentative arena (Bond & Thompson-Fawcett, 2007). Also, the communicative school asks questions generally about *how* is current practice conducted and not about *what* its effects are or *why* it is likely be so (Huxley & Yiftachel, 2000).

Within the context of natural hazards, risk communication is often based on the assumption that people make wrong decisions because they are uninformed about the consequences of their actions. Disseminating scientific information would presumably change people's beliefs about a hazard and in turn lead to the adoption of appropriate mitigation strategies. However, this assumption oversimplifies the adoption process and ignores variations in the source, channel, and receiver of the message, and also the impediments to information processing, such as competing demands for attention, and conflicts with existing beliefs (Mileti, 1999). Therefore the participatory approach to planning infers a substantial role for public participation, and is fundamental to planning (Lane, 2005) and risk reduction. The concept of risk is outlined in the following section.

6. Risk

To understand risk governance and how land use planning can reduce risks to natural hazards, it is important that the concept of risk is understood. While there is no one definition of risk (e.g. Australian National Committee on Large Dams Inc, 2003; Jaeger, Renn, Rosa, & Webler, 2001; Mileti, 1999; UN/ISDR), in 2009 the International Organisation for Standardization (ISO) developed the first international risk management standard which succinctly defined risk as the "effect of uncertainty on objectives" (ISO., 2009, p1), where uncertainty is the state of the information, understanding or knowledge of an event, its consequences, or likelihood (ISO., 2009). In addition to this definition, risk can also be expressed as a combination of the *consequences* of an event and *likelihood* of occurrence, where consequences result from the outcome of an event which affects objectives; and likelihood is the chance of something happening, which is measured through mathematical terms (probability) (ISO., 2009).

Risk may be expressed by the notation Risk = Hazards x Vulnerability (Manyena, 2006; UN/ISDR). Some disciplines also include the concept of exposure to refer particularly to the physical and social aspects of vulnerability, such as Wisner (2003), who expands the notation as follows:

$$R = [H \times V] - M$$

where M is mitigation, which is the ability of government agencies, other groups and institutions, or households to prevent or mitigate (in this context from the US, mitigation includes avoidance), and prepare for, hazard events. For the purpose of this research, the following notation is used:

$$R = [C(HS + S + Ec + En) \times L] - T$$

is used, where C (consequences) comprises health and safety, social, economic, and environmental consequences i.e. those well-beings that underpin sustainable development; L can be expressed as probability; and. treatment (T) is the risk reduction initiative. This is discussed in detail in Chapter 6.

Acceptable risk can be defined as an "informed decision to take a particular risk" (ISO., 2009, p9); or "a risk which, for the purposes of life or work, everyone who might be impacted is prepared to accept assuming no changes in risk control mechanisms" (Australian National Committee on Large Dams Inc, 2003, p134). The UN/ISDR

extends this, by stating that acceptable risk is the level of loss a society or community considers acceptable given existing social, economic, political, cultural, technical and environmental conditions (UN/ISDR). However, differing levels of risk can be deemed acceptable to different sectors of communities and societies (Handmer, 2008). For example, a developer may take on a short term risk for commercial gain.

The perception of risk and its acceptability is influenced by the risk/benefit ratio. This is the level of risk an individual or group is prepared to accept or tolerate depending on the benefits associated with exposure to that risk. For example, travelling in a motor vehicle is one of the highest risk activities an individual is likely to expose themselves to in New Zealand. However, the risk associated with this activity has continued to be tolerated because of the benefits it accrues (Tonkin & Taylor, 2006). Within a land use hazard context, the risk of living within a coastal hazard zone is tolerated due to the perceived benefits of direct access to the beach, recreational opportunities, views, and high amenity values.

International best practice for quantifying tolerable levels of risk comes from the Health and Safety Executive (HSE) in the UK, who outlined a framework for decision making for risk (Bandle, 2007; Health & Safety Executive, 2001; Le Guen, 2007; Taig, 2007). While based within an industrial health and safety context, the approach can be incorporated into land-use planning in New Zealand. Other international examples of health and safety best practice from the Netherlands and Hong Kong are also available (Ale, 2002; Australian National Committee on Large Dams Inc, 2003; Ball & Floyd, 1998; Planning Department, 2009; Trbojevic, 2004; Vrijling, van Gelder, & Ouwerkerk). However, the HSE guidance forms the basis of this research, as their information is widely available in a format that can be transferred into a New Zealand context, and it is widely referenced in risk publications both in New Zealand and Australia (Australian National Committee on Large Dams Inc, 2003; Riddolls & Grocott, 1999; Taig, 2007). However, it must be recognised that any transfer of the HSE approach into the New Zealand context requires careful consideration, to ensure the guidance is applicable to the socio-political-cultural context of the receiving environment.

In 2005, a review of New Zealand's tsunami hazard, risk and preparedness was undertaken in response to the Indian Ocean tsunami in 2004 (Berryman, 2005; Webb, 2005). Within the hazard and risk review, guidelines for acceptable levels of personal risk were outlined (Taig, cited in Berryman, 2005, p101), and reflect the HSE's recommendations (Health & Safety Executive, 2001). This health and safety aspect of

consequences has formed the criteria for levels of tolerability, where people's health and safety is the first priority.

Table 2.1 provides a comparison of tolerability between the UK, Netherlands, Hong Kong, Australia, and New Zealand. The risk-based tolerability levels in Table 1 are within the context of major hazardous installations and facilities (including dams), landslides and tsunami.

Table 2.1 Risk-based international boundary levels of tolerability for health and safety

Organisation / Country	Boundary levels of tolerability		
	Broadly acceptable & tolerable (low level of risk)	**Tolerable and generally intolerable (high level of risk)**	**Intolerable (extreme level of risk)**
HSE (2001) (UK)	Individual risk of death of one in a million per annum for both workers and the public (1×10^{-6}).	1 in 10,000 per annum for members of the public who have risk imposed on them 'in the wider interest of society' (1×10^{-4}).	Risk of accident causing the death of 50 people or more in a single event if the frequency is more than one in 5,000 per annum (1×10^{-2}).
Netherlands (Ale, 2002)		1×10^{-5} per annum for existing installations; 10^{-6} per annum for proposed installations.	
Hong Kong (Planning Department, 2009)	Greater or equal to 1×10^{-9} to less than or equal to 1×10^{-5}	Maximum level of off-site individual risk 1×10^{-5} per annum.	Minimum level of greater than 1×10^{-3} per annum for societal risk.
ANCOLD (2003) (Australia)		1×10^{-4} limit for individual risk to the person or group most at-risk.	
New Zealand (Berryman, 2005)	$1 \times \sim 10^{-5}$ to $\sim 10^{-7}$/year or lower	$1 \times \sim 10^{-3}$ to $\sim 10^{-5}$/year	1×10^{-2} to 10^{-3}/year

From the table it can be seen that the five organisations/countries are generally consistent with each other.

The HSE have criteria for advising against a greenfield development due to the societal risks that may result. These criteria are based on the level of individual risk per year,

calculated for a hypothetical person on receiving the impacts of an event, together with certain characteristics of the development (Health & Safety Executive, 2001). For example, they are satisfied with planning permission on safety grounds for developments where individual risk is less than 1 in a million per year (considered broadly acceptable and tolerable in Table 2.1). Cases of proposed housing developments where the individual risk of death per annum is between 1 and 10 in a million per year are scrutinised more closely, taking into account a more detailed assessment of the individual risk, the area of the development, the number of people involved, their vulnerability and how long they are exposed to the risk (tolerable and generally intolerable in Table 2.1). They advise against granting planning permission for any significant housing development where individual risk of death for the hypothetical person is more than 10 in a million per year; this sits in between the low and high level of risk boundaries (Health & Safety Executive, 2001).

Different criteria are applied to sensitive developments where those exposed to the risk are more vulnerable, e.g. schools, hospitals, senior citizen accommodation, or to industrial or leisure developments, reflecting the different characteristics of the hypothetical person used to assess individual risk (Health & Safety Executive, 2001). This is an approach that has been adopted in Canada, where levels of risk are based on land use. For example, where there is a risk level of 10^{-4} and below, land uses should be avoided; 10^{-4} to 10^{-5} is appropriate for open space, warehouses, manufacturing plants; 10^{-5} to 10^{-6} is appropriate for commercial uses, low-density residential, and offices; and 10^{-6} and greater risk levels are not subject to restrictions (MIACC, 1995).

6.1 Measuring life safety risk

When discussing people at-risk, a distinction must be made between individual risk, and the overall societal risk (Health & Safety Executive, 2007; Kulig, Edge, Reimer, Townshend, & Lightfoot, 2009). Individual risk relates to the likelihood that a person in a particular location will be killed or seriously harmed in the event of an incident, regardless of the size of the population. In contrast, societal risk takes into account the total number of people who may be harmed at the same time by a single incident (Health & Safety Executive, 2007). It must be acknowledged, however, that individuals may be vulnerable within communities that are resilient, and vulnerable communities may hold resilient, low risk individuals (Kulig, et al., 2009).

Much research has been undertaken focusing on individual and societal risks within the industrial health and safety sector for major hazardous installations in the UK (see www.hse.gov.uk). There are two schools of thought for preferring either individual or societal risk when undertaking risk assessments. These two preferences are discussed below.

6.1.1 Individual risk

Individual risk is considered by Taig (2007) to be the primary safety consideration in most situations in New Zealand where local hazards might be of national significance. Only once the individual risk has been considered and managed, then it may be useful to consider whether there is something above and beyond the issue of risks to individuals which is a matter of real national significance (Taig, 2007).

However, using individual risk as the basis for measuring risk on land subject to natural hazards does not take into account the total number of people that could be affected by an event. If guidance to local planning authorities is based largely on individual risk, it will fail to make allowance for the total number of people that could be affected by an event. This, in turn, will allow for higher densities of development, within hazardous areas that would have otherwise been reduced if societal risk had been taken into account. (Health & Safety Executive, 2007). Even so, individual risk is a more reliable estimation of risk than societal risk, as estimating societal risk is not exact; is largely dependent on how impacts are modelled; and it can be difficult to technically quantify a community's risk profile (Health & Safety Executive, 2007).

An algebraic formula can be used to determine the trade-off between reducing risk and the development of land (Health & Safety Executive, 2007). However, it does not take into account economic, social, environmental, or cultural impacts. The inputs into the equation are limited to the number of people per household, the value of a statistical life, the level of risk, the discount rate and period. Due to the limitations of this equation, and its failure to take into account other societal factors, it has not been explored further in this research as it does not provide an accurate 'cost' of a development versus risk reduction.

6.1.2 Societal risk

When societal risk has been taken into consideration, there is an expectation that there will be a reduced loss from casualties, property, and economic infrastructure. However, a trade-off is required between reducing risk and developing the land. If avoidance is not considered an option, societal risk for a specific location can be managed in three different ways:

1. By carrying out additional mitigation measures on-site;

2. Maintaining the existing density of development and/or wherever possible reducing development density to ensure population in the vicinity of major hazard sites remains below that which would increase societal risk to the point at which it becomes a concern; or

3. By a combination of the above (Health & Safety Executive, 2007).

Managing societal risk generates both benefits and costs to the community in question. The challenge is to manage the risk in a way that is consistent with the social, economic and environmental values of that community i.e. the risk is managed in a way where the principles of sustainability are achieved. For example, the introduction of measures to manage societal risk may have negative effects on society and the economy, including reduced provision of new and more affordable housing; reduced provision of new and better local amenities; restricted economic growth at the local level; and potential decline in local house prices as perceptions of risk may be affected even though individual risk at hazardous sites would remain unchanged (Health & Safety Executive, 2007).

In order to quantify societal risks, f/N (or F/N) curves (complementary cumulative distributions relating the frequency of events with greater than or equal to a given number of fatalities, to that number of fatalities) are used (e.g. www.hse.gov.uk, Australian National Committee on Large Dams Inc, 2003). However, these have not been used in this study due to their limitations, namely (Taig, 2007):

- They are prone to mathematical complexity and possibility of inadvertent error;

- The significance of points or lines resulting from assessments in relation to such graphs is difficult to interpret; the related criteria have no particular ethical or scientific basis; and

- There are very often many other attributes of the risk in question, beside the number of people killed in one event, that strongly influence people's perceptions and expectations in relation to it – i.e. size of event in terms of number of casualties can easily mislead.

In addition, ascertaining societal risk is dependent on how impacts are modelled, which is not an exact science, and as such is less reliable than the estimation of individual risk (Health & Safety Executive, 2007).

A challenge (and opportunity) exists to improve land-use planning for sustainable development that reduces risks from natural hazards. For the risk-based approach outlined in Chapter 6, an adaptive approach is taken to life safety, in that either individual or societal risk can be used depending on the preference of the community and decision makers. This flexibility allows for innovation to occur in managing the life safety risk while not making the parameters too prescriptive. The concept of innovation and its relevance to this research is outlined in the following section.

7. Innovation

A concept that is gaining momentum in the planning sector, and is required for sustainable development, is 'innovation'. As outlined in Chapters 1 and 5, innovation can refer to the inventive process by which new things, ideas, and practices are created; it can mean the new thing, idea, or practice itself; or it can describe the "process whereby an existing innovation becomes a part of an adopter's cognitive state and behavioural repertoire" (Zaltman et al., 1973, 7-8, cited in Goldsmith & Foxall, 2003), thereby going beyond pure creativity. The term 'innovation' was typically based within the business profession. Up to eight types of innovation have been defined (Sternberg, Pretz, & Kaufman, 2003), ranging from purely new ideas, to changes in an existing concept (refer Chapter 5). Innovation has now been extended into the realms of social and community innovation, environmental and sustainable innovation, innovation and governance, as well as innovation and land-use planning. Innovation has yet to be defined within the land-use planning context, hence there is no guidance for planners on what constitutes innovation in land-use planning, nor how to measure the effectiveness of innovative land-use planning for natural hazard risk reduction. This leads to the term being used somewhat superficially and inaccurately, and ineffective mitigation measures being incorporated into developments.

Within the context of natural hazards, it is assumed that innovative solutions can provide successful risk reduction to the risk of a natural hazard affecting people and property. Innovation is important to natural hazards planning, for if no development were to occur in at-risk areas, development would be severely limited in New Zealand due to the country's hazardscape. For example, if development was restricted in areas susceptible to slope instability, the alternative may be to develop on a flood plain, which would also be restricted. This is the dilemma facing many territorial authorities across the country – namely that hazard risk-free localities for physical development are extremely limited. Therefore effective innovative solutions are required to find the balance between development imperative and risk. In order for these solutions to be implemented, planning policy and consent requirements need to be flexible to encourage effective innovations.

Innovation within the planning sector is important, especially in regards in risk reduction. As outlined briefly in Chapter 1 and further in Chapters 4, 5 and 6, the existing planning mechanisms for reducing risks to natural hazards are not providing outcomes that are acceptable to communities. Innovation is required to encourage planning in different ways, in particular to ensure that risks are reduced, not increased. A definition of innovative land use planning is provided in Chapter 4, with a discussion of the background use of the term from the business sector and its relationship to sustainability, risk governance, and land-use planning. The risk-based framework provided in Chapter 6 presents an adaptive process which allows for innovation to take place, both within the policy setting environment of councils, and with those making resource consent applications.

8. Summary

This chapter meets the first objective of this research, by providing the context to the rationale for the study, based on a literature review around sustainable development, risk governance, natural hazards, land use planning, risk, and innovation. Each of these themes is discussed in further detail in subsequent chapters within the New Zealand context.

The chapter begins with a brief overview of sustainable development, which is integral to reducing risks to natural hazards. The implications of locating communities in at-risk areas is twofold – firstly, the likelihood of adverse consequences occurring are increased; and the resulting economic, environmental and social costs prevents the

goal of sustainable development being achieved. Clarification of whether a ‘strong’ or ‘weak’ sustainability model is a priority for development. Currently there is tension between economic priorities and the more holistic environmental-social-economic approach. This has been shown to lead to mitigation initiatives that actually increase future risks to people and property. Renn provides a risk governance framework to assist in reducing risks, which forms part of a hierarchy of arrangements for effective risk reduction. This hierarchy starts with overarching governance arrangements, followed by risk governance, natural hazard management, and land use planning as one option for achieving risk reduction. Land use planning has a key role to play in reducing risks to natural hazard events, through the control of land use. This can be achieved by two primary processes: 1) by avoiding development in high-risk locations; and 2) by modifying the design and construction requirements of communities, so that consequences are reduced. However, this exiting approach does not always provide satisfactory outcomes, and innovation is required within planning policy and when planning for developments, to improve risk reduction and consequences. By allowing for and practicing innovative planning, planning policy can be improved, resulting in better decision making for at-risk areas, which will lead to increased community resilience and sustainable development. A risk-based framework that allows of innovative land use planning is presented in Chapter 6.

Based within the context of sustainable development, the following chapter presents the research design for this thesis. The primary method for undertaking the research is participatory action research.

CHAPTER 3 Research design

1. Introduction

In order to meet the aim and objectives for the thesis outlined in Chapter 1, the aim of this chapter is to outline of the design and methods employed in the research. A research design is the logic that links the data to be collected (and the conclusions to be drawn) to the initial questions of study (Yin, 2003). This research is classified as "applied" research, in that it has been designed with the purpose of achieving a practical outcome (Tolich & Davidson, 2003) – an innovative framework for land-use planning which enables risks from natural hazards to be reduced. Six key research methods were applied in this research:

1. Participatory action research;
2. Review of literature;
3. Case studies;
4. Interviews;
5. Content analysis of interview transcriptions; and
6. Workshops.

The basis for the research was Participatory Action Research (PAR), where the research was undertaken both *for* and *with* institutions (Cameron, 2007). As part of this approach, a case study based on the Thames-Coromandel district was undertaken, with associated interviews, content analysis and findings (refer Chapter 5). From the case study, findings, literature review and previous engagement with councils, a risk-based planning framework was developed (refer Chapter 6). This also engaged PAR principles, as workshops and reviews were undertaken with council staff.

To achieve the aim of this chapter, an overview of PAR and why it was deemed the most appropriate method will be presented. Following this explanation the other methods employed are outlined: ethical procedures, the literature review, case study, interviews, content analysis, workshops, and implications of the methods used. The result of this approach is an innovative contribution to land-use planning by advancing the understanding of how risks of natural hazards can be incorporated into planning to achieve effective risk reduction.

The results of this approach have been incorporated into an EQC project (Saunders, et al., 2011), which utilised the findings of the research on risk-based land-use planning (Chapter 6).

2. Participatory action research (PAR)

PAR was the choice of approach for this research. Rather than undertaking research independent of the practical end user (i.e. council staff), which could lead to results that have no support or are not able to be implemented, the PAR approach involves councils with the research (Cameron, 2007), promotes engagement and subsequent implementation and use of concepts provided, and benefits future risk reduction initiatives. The Councils acknowledged how well this approach worked for them, as they learned along the way. Since undertaking this research, two positive outcomes of this approach have surfaced: the approach outlined in Chapter 6 has been included in the Proposed Bay of Plenty RPS; and the Thames-Coromandel District Plan Committee are considering this approach in their district plan review. Using the PAR approach gained support from the councils for this research, rather than the 'traditional' approach of research scientists undertaking research siloed from the people who could benefit from the research. Munford and Sanders (2003, p263), state that action research stems from:

> …the idea that research should do more than understand the world: it should help change it … the goal of action research is to *improve* the situation.

This was the aim of this research – to improve risk reduction via land-use planning. According to (Greenwood & Levin, 2007, p3-4), action research is:

> … social research carried out by a team that encompasses a professional action researcher and the members of an organisation, community, or network ("stakeholders") who are seeking to improve the participants' situation. AR [action research] promotes broad participation in the research process and supports action leading to a more just, sustainable, or satisfying situation for the stakeholders ... together, the professional researcher and the stakeholders define the problems to be examined, cogenerate relevant knowledge about them, learn and execute social research techniques, take actions, and interpret the results of actions based on what they have learned.

This was the philosophy used for this research. Cameron (2007) describes three types of PAR, as shown in Table 3.1. Of these PAR approaches, types II and III were utilised in this research, i.e. researching for and with councils.

Table 3.1 Three types of participatory action research (Cameron, 2007, p207)

	Main Characteristics	Main Challenges
PAR type I: liberatory projects	• Research undertaken with oppressed groups and exploited groups • Aims to transform people's day-to-day lives • Often based on opposing (or exposing) the oppressive and exploitative practices of institutions	• How do researchers best work with oppressed and exploited groups? • How can findings be used to change institutional practices?
PAR type II: researching for institutions	• Research undertaken on behalf of institutions. • Aims to produce insights and recommendations for institutions to respond to.	• How do researchers retain the liberatory potential of PAR? • How do researchers ensure that institutions act on findings?
PAR type III: researching with institutions	• Representatives from institutions participate as co-researchers. • Aims to build institutional commitment to act on findings	• How do researchers negotiate institutional cultures? • How do researchers ensure that institutions act on findings?

Having members of institutions participate as co-researchers along with other participant groups, has been one way to address the challenge of getting institutions to act on recommendations, and can generate transformations for those involved and for the institutions themselves (Cameron, 2007). It was the focus of this research so that 1) the research would have benefit for councils and would fill a gap in their knowledge; and 2) any findings and subsequent recommendations would have buy-in from councils to enable them to act. This research fits the criteria outlined by Munford and Sanders (2003), Greenwood and Levin (2007) and Cameron (2007), in that Chapter 6 outlines an innovative risk governance framework for improving the management of natural hazards through land-use planning. The risk-based approach was designed and developed using participatory action research with regional council and territorial authority planning and emergency management staff.

While there is no fixed formula for designing, practicing, and implementing PAR projects, nor one overriding theoretical framework that underpins PAR processes (McIntyre, 2008), there are 'spirals' of action which present a basic methodology. In

1988, Kemmis and McTaggart published their action research spiral; this has three main steps which repeat: to plan, act and observe, and reflect. These three steps are included and built on by McIntyre (2008), who presents PAR as a recursive process that involves a spiral of adaptable steps that include the following:

- Questioning a particular issue;
- Reflecting upon and investigating the issue;
- Developing an action plan; and
- Implementing and refining said plan.

While there is some variation in action research models, each involves the same core activities. Any action research project requires several practical steps (Hinchey, 2008, p52):

- Developing a question;
- Formulating a research plan;
- Systematically collecting data;
- Analysing the data;
- Developing and implementing an action plan; and
- Recording the project in writing

Many models additionally suggest sharing the study with others.

The research continued to change focus as it progressed. First, it looked at innovative land-use planning for natural hazard risk reduction. This then shifted towards innovative risk governance, as it became apparent that effective risk reduction cannot become reality unless there is a supporting risk governance framework operating. This change of focus resulted in the research direction (aim, objectives) being redesigned to incorporate the risk governance framework that was developed.

This research is based on a combination of both the McIntyre (2008) and Kemmis & McTaggart (1988) spirals, and steps from Hinchey (2008). To reflect this integration, the steps taken for the research are summarised in Table 3.2 below:

Table 3.2 Summary of PAR steps employed in this research

STEP	ACTION	OUTCOME
Question	Question, reflect	How can the existing risk-based land-use planning framework be improved to encourage better decision making for natural hazard risk reduction?
Plan	Develop a research plan, investigate, reflect	Develop a research strategy – case study, interviews, workshops, selection of case study and participants.
Act and observe	Implement plan, observe, analyse	Undertake case study policy plan review and interviews; content analysis of results.
Reflect	Reflect, review, investigations, more questions …	Reflect on results of above, review thinking, investigate more supporting literature, questions raised on implications of findings on risk reduction
Plan	Investigate, reflect, develop a research plan	Develop strategy for developing risk-based framework. Investigate what existing guidance is available (nationally and internationally) on risk-based approach to natural hazard planning.
Act and observe	Implement plan, observe, analyse	Develop draft framework, workshop draft findings, analyse feedback from workshop.
Reflect	Reflect, review, investigations, more questions …	Reflect on workshop feedback, review draft framework incorporating feedback, further investigations required into approach.
Plan	Investigate, reflect, amend research plan	Second workshop to review draft framework. Reflect on workshop results, review framework
Act and observe	Implement plan, observe, analyse	Continue to further develop framework, send final draft to Council staff for their feedback
Reflect	Reflect, review,	Reflect on feedback, review framework in light of feedback

STEP	ACTION	OUTCOME
Record	Record project	This thesis; project report for EQC.

When developing a question for action research, Kemmis & McTaggart (1988) suggest the following format for the first round of questioning: 'We intend to do X with a view of improving Y'. This format is recommended for three reasons:

1. It implies some shared understanding of what is happening already;

2. It assumes that improvement can be monitored in some way; and

3. It envisages an evolution of understanding in concert with the improvement of practice as collective action is implemented and refined in practice (Kemmis & McTaggart, 1988).

In light of this guidance, the following question was formulated for the PAR methodology: How can the existing risk-based land-use planning framework be improved to encourage better decision making for natural hazard risk reduction?

The purpose of this question was to ascertain if there was another way of incorporating risk management for natural hazards into land-use planning. The question acknowledges there is an existing risk-based framework; it assumes this existing framework can be improved; and envisages an improvement in decision making practice as the framework is implemented across New Zealand. It relates to the overall research question provided in Chapter 1 in that the results provide an innovative framework for land-use planning which will enable risks from natural hazards to be reduced.

Critical to the completion of action research are relationships, and often the quality of the data gathered is a direct result trust and the quality of the relationships between researcher and participants (Munford & Sanders, 2003). The author was fortunate in this instance that relationships were already developed with staff at the selected councils through existing professional linkages. This existing relationship and trust between staff assisted in recommending other contacts (i.e. for interviews), and with the uptake and understanding of the concepts being developed. One potential issue with the PAR approach is that can be more time consuming for those involved (i.e. interview time, reviewing transcripts, reviewing draft findings) and expensive (i.e. cost

of travel for researcher for interviews and workshops, time cost). However, overall the PAR process built trust between researcher and participants, which has resulted in a positive and continuing relationship with many council staff involved.

2.1 Ethical procedures of approach

Institutional review boards are required to ensure ethical informed consent is gained for research with human participants (Berg, 2007). At Massey University, this requirement is met via the Massey University Human Ethics Committee. As such, the ethical procedures of Massey University were followed for this research. This included the completion of a low-risk assessment form, an information sheet on the research for participants, and a participant consent form. The information sheet and participant consent forms were completed in the Massey University ethical format (see Appendix 1).

Interviews and some workshops were recorded and transcribed. The transcriptions were sent to participants for their confirmation of their being a true and correct record, and provided the opportunity to edit the transcript if required (often to make sentences flow). Some requests by participants were made to review the use of content. The transcriber also signed confidentiality agreement.

No conflicts of interest were identified in my roles of GNS employee and student researcher. However, as a staff member of GNS Science, GNS Science was accountable and liable for my research methodology, subsequent findings and any publications.

3. Review of literature

An input into the PAR approach is the findings of a literature review. The aim of the literature review is to provide a comprehensive and critical review of existing works on the topics considered in the research (Berg, 2007). It is used to develop the research position, provide a means to justify findings within the context of existing works, and provide support to any findings that are a new contribution to a body of knowledge (Flick, 2006). To achieve this aim, five primary areas required a thorough literature review to be undertaken: the New Zealand regulatory context for managing risk (i.e. institutional analysis); natural hazards; land-use planning; risk; and innovation. These themes reflect the overall research objectives of this thesis as outlined in Chapter 1:

The purpose of reviewing literature in these three key areas was to gain an understanding of the current state of knowledge in these areas. This provided an opportunity to critique the current regulatory environment for managing natural hazards aided by my own knowledge and experience in working full time in the natural hazard planning field. In particular, the institutional analysis of statutes that contribute to natural hazard management yielded some surprising inconsistencies in their approaches (discussed in Chapter 4). Also, there appears to be only limited literature on innovation in land-use planning, with Healey (2004) and Friedmann (2003) providing key contributions to this area. Therefore this thesis does provide a contribution to the existing body of knowledge, by utilising key concepts from Healey and moving them forward into a New Zealand hazard management and land use context.

Sources for the literature review for this research included peer-reviewed journal articles, textbooks, technical reports, guidelines, websites (e.g. government departments, councils), legislation, case law, plans (e.g. regional policy statements (RPS), district plans, hazard mitigation plans); conference proceedings, unpublished reports, and personal communications where published literature was not available (e.g. in Chapter 4 when determining the definitions of sustainable management and development under legislation). The results of the literature review are incorporated within Chapters 4, 5 and 6, although the other chapters have also benefited from the literature review (i.e. the Introduction and this chapter with a review of social science research methods literature).

All literature reviewed was recorded in Endnote, a reference management software package. This software was preferred as it was already widely used within my workplace, and ensured consistency and compatibility within the social science team at GNS Science.

4. The case study – setting the context

The case study methodology is defined by Berg (2007, p283) as:

> … an approach capable of examining simple or complex phenomena, with units of analysis varying from single individuals to large corporations and businesses; it entails using a variety of lines of action in its data-gathering segments, and can meaningfully make use of and contribute to the application of theory.

A case study approach allows the researcher to use multiple research methods and collect data from multiple sources using a variety of techniques, for example interviews,

surveys, and documents. The aim is to collect a wide range of information about a single 'case' (Jones, 2006). Unlike research based on samples, the case study keeps attention focused on contexts, never extracting variables from the conditions in which they arise. The case study is therefore very suitable for aiding professional practice (Shipman, 1997), in this context the professional practice of land-use planning. As the research question in this study is a 'how' question, interviews and case studies are relevant strategies to be employed (Yin, 2003).

A holistic, multiple-case study approach has been taken, based on Figure 3.1.

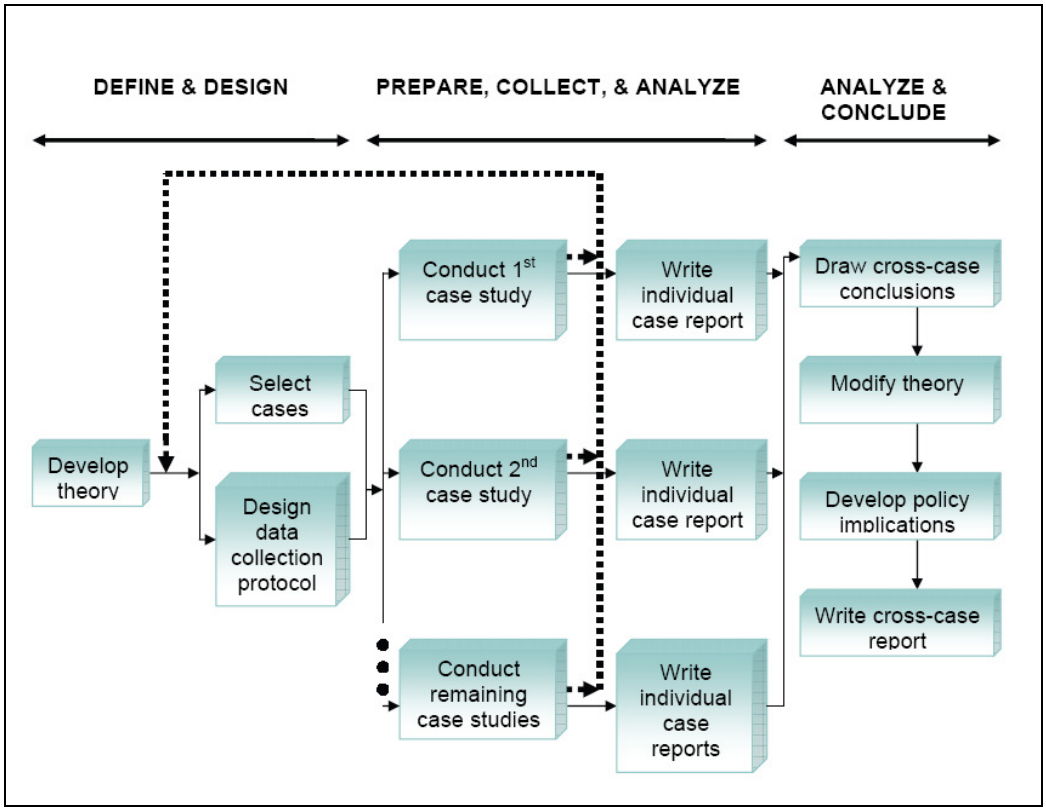

Figure 3.1 Multiple case study method (Yin, 2003, p50).

Figure 3.1 indicates that the initial step in designing the study must consist of theory development, which in this case is discussed in Chapters 4-6. Case selection and the definition of specific measures are important steps in the design and data collection process (the case selection process for this research is outlined in a following section). Each individual case study consists of a "whole" study, in which convergent evidence is sought regarding the facts and conclusions for the case; each case's conclusions are then considered to be the focus of a summary report (see Chapter 7). For each individual case, the report should indicate how and why a particular proposition was (or was not) demonstrated (Yin, 2003). An important part of Figure 3.1 is the dotted line

feedback loop, which represents the situation where an important discovery occurs during the conduct of one of the individual case studies – for example, one of the cases did not fit the original design. A second feedback loop (not shown) could represent the situation in which the discovery led to reconsidering one or more of the study's original theoretical propositions (Yin, 2003).

The rationale behind the selection of case study locations is provided in a following section. Two case studies were undertaken: 1) to provide an overview of issues around innovative land-use planning for natural hazard risk reduction from the state, market, and civil society perspectives within the context of one geographical and political district (Chapter 5); and 2) to assist in developing an innovative risk-based planning framework (Chapter 6).

4.1 Selection of case study area and subgroups

The Thames-Coromandel district, located in the Waikato region, was selected as the primary case study area for the reasons outlined below:

- It is susceptible to a number of natural hazards, including flooding (Ericksen, 1986; WCDEMG, 2005), debris flow (McSaveney & Beetham, 2006), landslides (AECOM, 2010), tsunami (Pickett & Prasetya, In press; WCDEMG, 2005)), coastal erosion (Stewart et al., 2007), active faults (WCDEMG, 2005), fire, severe weather (Walton et al., 2004) and volcanic ashfall (WCDEMG, 2005);

- Being within two hours of Auckland and Hamilton, the Coromandel Peninsula is under development pressure especially around the existing communities of Pauanui and Whitianga (market implications);

- Although having a high proportion of non-resident population, the community within the district is highly engaged in local issues, for example the mining debate which resurfaced during 2010 (civil society implications);

- An Environment Court decision in 2008 resulted in a proposed development being located on a floodplain. Emergency management measures were incorporated into the consent conditions (see Chapter 4 Section 3.1) to mitigate the risk (state and civil society implications);

- After the 2002 'weather bomb' event[4], national, regional and district agencies came together to manage and reduce future risks (previously unprecedented in New Zealand);
- The Council was supportive of the research; and
- The author had undertaken previous research in the district (Saunders, 1999), and so was familiar with the issues of the area.

If there are subgroups within a case study, Yin (2003) recommends there should be at least two individual cases researched for each subgroup, so that the theoretical replications across subgroups are complemented by literal replications within each subgroup. This has been achieved and is discussed below with Table 2.3. There are three are case study subgroups in this research: the state, market, and civil society, as shown in Figure 3.2.

Case study 1 Setting the context

Selection of case	Case study 1 - state - Thames-Coromandel
	Case study 2 – market
	Case study 3 – civil society

Case study 2 Developing the risk-based framework

Selection of cases	Case study 1 – Environment Waikato / Thames – Coromandel District Council
	Case study 2 – Gisborne District Council
	Case study 3 – Bay of Plenty Regional Council / territorial authorities

Figure 3.2 Subgroups within the case study framework

[4] On 21 June 2002, an extreme weather event hit the Thames-Coromandel district, resulting in two Civil Defence emergencies being declared in the Thames-Coromandel and South Waikato Districts The event is now referred to as the 'weather bomb'.

These subgroups for the first case study were selected as they reflect the key participants in land-use planning outlined in Chapter 4 Section 5, and Chapter 5 Section 2.4. The state subgroup also includes representation from central, regional, and local government. A summary of the representatives of the subgroups is provided in Table 3.3. As recommended by Yin (2003), with one exception at least four key stakeholders were included in each subgroup.

Table 3.3 Representatives included in case study research

Subgroup	Representation
State (National)	Ministry for the Environment (x2) (MfE)
	Ministry of Civil Defence Emergency Management (MCDEM)
	Local Government New Zealand (LGNZ)
	Environment Court Judge
State (Regional)	Waikato Regional Council (WRC) • Hazard analyst • Policy planner x2
	Hazard management consultant
State (District)	Thames-Coromandel District Council (TCDC) • Senior politician • Member of the Policy and Planning Committee • Planner • Service delivery representative • District planner • Emergency management officer • Policy and planning senior representative Earthquake Commission (EQC)[5] • Ex-senior manager

[5] The EQC is a state insurance company, as it is a compulsory government insurance scheme that does not make commercial profit from set premiums.

Subgroup	Representation
	• Insurance manager
Market	Holdsworth Group
	Hoppers Development
	Real estate agent
	Insurance Council of New Zealand (ICNZ)
Civil society	Hauraki Herald[6]
	Coromandel Watchdog
	Ngati Hei
	Environmental Defence Society (EDS)

Twenty-three interviews were undertaken, with the three participants at WRC meeting together for a joint interview, and two participants preferring a joint interview at MfE (25 participants involved in total).

For the development of the risk-based approach, the participants for the second case study were drawn from beyond the TCDC boundaries. While participants included representatives from Thames-Coromandel and WRC (as they were a focus of primary case study), Gisborne District Council and Bay of Plenty Regional Council (BOPRC) and associated territorial authorities of the region were involved. Gisborne District Council was selected as it is a unitary authority with history of natural hazards, and staff were very supportive of the research; and BOPRC and territorial authorities within

[6] While owned by Fairfax Media, the Hauraki Herald is considered a community newspaper, as it is free (published twice a week, funded via advertising revenue), represents the community voice, and provides information to the community.

the region were interested in research and requested to be involved. The methodology for developing the risk-based approach is outlined in Section 6 of this chapter. Interviews formed the basis of the first case study, as outlined in the following section.

5. Interviews

One of the most important sources of case study information is the interview (Yin, 2003). The aim of the interview is to conduct a conversation with a purpose (Berg, 2007), in this case to ascertain participant views on natural hazards, risk reduction, roles and responsibilities, and innovation. Interviews were undertaken for the case study (see Chapter 5 for findings), and with the Regional Planner at BOPRC for their insights into implementing the risk-based approach outlined in Chapter 6, Section 5.

Focused semi-structured interviews were undertaken with specific planning, emergency management and other staff with an interest/role in natural hazard management. Interviews allow a focus on a specific topic, which respondents are asked to discuss, thereby providing their views and opinions on the research question. Focused interviews are aimed at maximising the potential of the study, by allowing the discussion to go beyond the originally planned themes and topics, and by encouraging the respondents to discuss as many issues of the themes as possible (Sarantakos, 1998). The benefit of interviews is that they allow the researcher to be flexible, obtain pre-coded responses, probe deep, be adjusted to circumstances, and can increase rapport (Shipman, 1997).

The following subsections outline the selection of participants for the case study interviews; the semi-structured questions for the interviews; and the questions for the interview with the regional planner at BOPRC.

5.1 Selection of participants for case study interviews

As discussed in Section 3.1, the case study area was the Thames-Coromandel, which is governed by the TCDC and WRC.

In order to select participants at a national, regional and district scale, an initial conversation with a key informant at the respective councils was undertaken to gauge their support for the research, and their participation. From liaising and discussing options with a key informant at each council, a list of council staff, state and market representatives was drafted with their contact details. Each was approached with

either an email or in some cases a phone call to gain their support and agreement to participate.

Of all the representatives on the initial list, only one did not agree to participate – the local Coromandel Member of Parliament declined via her secretary, despite repeated phone calls to her Wellington and Thames offices, emails, and a personal visit to her Thames office. The reluctance to be involved may have been due to other political pressures on at the same time – in particular, the government proposal to reinstate mining the Coromandel (and other national parks around the country). All other national state representatives were supportive. National agencies approached and their roles are outlined below:

- Ministry for the Environment – administer and provide support for the Resource Management Act 1991, which is the key statute for risk reduction;
- Ministry of Civil Deference & Emergency Management – administer and provide support for the CDEM Act 2002. Risk reduction is part of the 4R philosophy (readiness, response, recovery, reduction);
- Local Government New Zealand – administer the Local Government Act 2002 and provide support for local government; and
- EQC – administers a compulsory national insurance cover for specified hazardous events, and invests in research on risk reduction activities.

A national market representative was from the Insurance Council of New Zealand (ICNZ), a body which represents insurance companies in New Zealand. ICNZ was selected to provide an insurance viewpoint of issues and implications of natural hazards and innovative land-use planning. A local real estate agent who had been involved in marketing Kahikatea Estate (refer Chapter 4) was selected for his perspective on implications for the local market. Two developers based in Auckland were selected, due to the scale and perceived innovations of their developments in Thames-Coromandel district and within hazardous areas. From a civil society perspective at a national scale, the Environmental Defence Society participated, due to its involvement in many coastal development issues which often include risks from natural hazards. At a local level, civil society representatives included those from:

- The Hauraki Herald, to provide a perspective from a local media representative who had a good knowledge and understanding of the history of natural hazards and their management within the District;
- Iwi, to gain a cultural perspective of issues; and
- Coromandel Watchdog, at the time involved in an anti-mining campaign, but previously aware of and involved in issues of development in at-risk areas.

Once participants were selected and agreed to be involved, semi-structured interview questions were pre-circulated for their information, as discussed in the following section.

5.2 Semi-structured questions for case study interviews

Semi-structured interview questions allow the researcher to ask predetermined questions of an interviewee in a systematic and consistent order, with the ability to digress and probe beyond their original questions (Berg, 2007). Berg (2007, p93) outlines the following key features of semi-structured interviews, in that they are:

- More or less structured;
- Questions may be recorded;
- Wording of questions is flexible;
- Level of language may be adjusted; and
- The interviewer may answer questions and make clarifications.

Due to the range of participants in the interview process (i.e. from central government representatives to special interest groups), it was imperative that the wording of the questions could be altered depending on the participant, and that the level of language could be adjusted. The interviews were recorded and transcribed.

Three types of questions were asked: essential questions (are central to the focus of the research); extra questions (to clarify a response, e.g. re-worded essential questions); and probing questions (to draw out further information) (Berg, 2007). When developing these research questions, Flick (2006) recommends the researcher asks the following to determine the relevance of the questions:

- What is the theoretical relevance?
- What is the link to the research question?
- Why did I ask this question?
- Why are the questions in this order?

The purpose of the interviews was to gauge perceptions and build understanding about the role that land-use planning can play in reducing natural hazard risk. In particular, who is responsible for risk reduction?; what constitutes and who instigates innovative risk reduction practices?; the role of land-use planning in natural hazard risk reduction; and what are the obstacles and opportunities for improving risk governance (how is governance perceived amongst a range of stakeholders?). Following is an example of the questions for participants. As discussed, the wordings of the questions were slightly amended for the different participants e.g. national and iwi contexts, and for the Environment Court judge. The questions are provided in italics, with the justification for them (as per Flick 2006, above) bullet pointed:

1. *Are natural hazards of concern to you, given the many priority concerns that face the Thames-Coromandel community? If so, what hazards?*
    - An ice-breaker question, with the purpose of easing into the interview process.
    - Enabled analysis of perceptions of natural hazards in the district i.e. are they a concern or not?
2. *There are management options for areas already developed in at-risk locations.*

    (a) In the case of known hazard risks, should we focus on keeping people out of harm's way (e.g. not allow new development in floodplains) or allow people to develop in risky locations and provide protection (e.g. stopbanks?).
        - Links to the interpretation issue of avoidance and mitigation as discussed in Chapter 4.
        - Good practice to avoid first, then mitigate
        - To gain an understanding of their view on avoidance versus mitigation.

(b) At what point should additional protective works (e.g. stopbanks, seawalls) be stopped, and communities relocated?

- To see if there is an acceptable level of risk that crosses into intolerable risk (refer Chapter 6)
- In order to achieve risk reduction, must be able to qualify and quantify what levels of risk are acceptable, tolerable or intolerable (Chapter 6).

3. Responsibility for risk reduction can lie with various parties in an area.

(a) What (if any) responsibility does each of the following parties have to reduce disaster risk: councils, market (e.g. developers), communities?

- To understand their view on what role and responsibilities each party (i.e. market, state, or civil society) has for risk reduction?
- Who should be taking the lead on risk reduction, the state, market or civil society? Has implications for what approach should be taken (Chapters 5 and 6).

(b) If development takes place in an area that increases the risk of disaster, what are the responsibilities and obligations of the property developer, the council, the purchaser of the property, and the wider community?

- To ascertain who is responsible for the risk i.e. market, state, or civil society?
- Implications for how risk governance (Chapter 6) is structured.

4. How should the (often) conflicting interests of economic, social and environmental pros and cons be balanced when there is an opportunity for development in a hazard prone area? For example, a commercial development in a known floodplain (e.g. a supermarket), which will have strong economic and social benefits for the community.

- To gain their view on how the economic, social and environmental elements can be weighted when decisions are being made (Chapters 4 and 6).

- Assists in the decision making process of the risk-based approach, in particular the economic, social and environmental consequences (Chapter 6).

5. *What innovative risk reduction measures are already being undertaken in Thames-Coromandel? What innovative measures should be taken?*

   - To gain their perceptions of innovation
   - Does it relate to the theoretical review of innovation in Chapter 5?

6. *Innovative risk reduction provides an opportunity to improve on traditional risk reduction measures.*

   (a) Why aren't more innovative risk reduction measures underway?

   - To understand their perceived barriers to innovation.
   - Implications for innovative framework (Chapter 6) i.e. need to provide options for overcoming any existing barriers.

   (b) What could be done to implement more innovative risk reduction measures?

   - To ensure all options are assessed for their availability to encourage innovation.
   - Implications for innovative framework (Chapter 6) i.e. ensure all opportunities are addressed.

7. *Do you think there are any changes required to laws, policies, procedures, etc. to promote innovative risk reduction?*

   - To consider what (if any) changes are required.
   - Assess answers against critique of existing legislative framework outlined in Chapter 4;
   - To consider any recommendations for changes to laws, policies, procedures etc. in the future (Chapters 4 and 7).

In some instances, an extra question was included to clarify the participants' position: *Do you think land-use planning has a role to play in reducing risks to natural hazards?*

A final question was asked of all participants: *Do you have any other issues or any details that weren't discussed that you would like to discuss?* This provided them with the opportunity to highlight any specific issues that had not been covered by the questions.

The questions were ordered as above to provide a cascading flow to the questions. They start with Question 1, setting the scene for natural hazards in the district. Question 2 then leads on to whether these hazards should be avoided or mitigated against, and at what time. Question 3 follows on from this, as to who should be responsible for the avoidance or mitigation of the risk. Appreciating the social, economic and environmental benefits of developing in a hazard prone area, Question 4 aims to gain their view on how these factors should be weighted. Questions 5 and 6 then focus on innovation, in particular what is considered innovative, and barriers to implementing innovative measures. Question 7 finalises the semi-structured questions to summarise what changes need to take place to encourage innovative risk reduction measures.

The questions were pre-circulated to allow participants to think and prepare for the interview. Interviews varied in time from 30 minutes to two hours, and took place at a location of the interviewee's choice. Locations varied from offices (workplace and home) to cafes. Interviews were undertaken on an individual level (i.e. single participant), except for interviews at WRC and MfE, where the participants were interviewed together at their request.

Transcriptions from the interviews were circulated to participants for their confirmation of it being a true and correct record. At this time participants were able to make any changes they felt necessary. The content of the transcripts was then analysed (see Chapter 5 for results).

5.3 Interview with Regional Planner, Bay of Plenty Regional Council

In Chapter 6, a section is devoted to how the BOPRC has applied the risk-based framework into their Proposed RPS. As well as analysing the Proposed RPS, an interview was conducted with the Regional Planner, who led the development of the natural hazard sections of the Proposed RPS. The following semi-structured questions were sent to the recipient for them to consider before the interview took place. As in subsection 4.2, the questions are provided in italics, with the justification for them bullet pointed:

1. *Why did the previous RPS natural hazards policies need improving?*
    - What implementation issues had been identified as requiring improvement?
2. *What needed changing?*
    - What specific aspects of the RPS needed changing to improve outcomes?
3. *Is this a new approach for the Council?*
    - Is the risk-based approach a new approach for Council, or is it already being implemented in other ways?
4. *How did you learn of this approach?*
    - Where did you learn of the approach e.g. this research?
5. *Where did you get information about this approach?*
    - Where did you source information for developing the approach outlined in the Proposed RPS?
6. *Who led this approach at the BOPRC? Why?*
    - Was it one person who led the approach, or many people?
    - Did the person have the skills, experience, and knowledge to provide the leadership for change?
7. *Have territorial authorities in the region supported this approach? Why?*
    - Are councils within the region supportive of this approach or not?
    - Why do they support the approach, or what issues do they have with it?
8. *What issues do you hope this approach will assist with overcoming?*
    - How will the risk-based approach assist in overcoming current issues with the RPS?
9. *Do you foresee any issues/barriers/opportunities in implementing this approach?*

- What issues/barriers/opportunities have already been identified in implementing the approach?
- How can the approach overcome the issues and barriers?
- How can opportunities be promoted?

10. Any other comments?

- Provides an opportunity for any other comments that have not been addressed in the previous questions.

Before the interview, the Regional Planner had completed his answers to each of the questions. In light of the thorough comments received, it was decided to not record the interview, but review the questions and answers provided to ensure the intent of the answers were clear. The answers to these questions have been incorporated into Chapter 6, Section 5.

6. Qualitative content analysis

Content analysis of planning documentation (namely regional policy statements, district plans, consent applications, Environment Court applications/evidence/ decisions, project documentation and other Council reports) is relevant in this research, in order to record the existing land use policies that are in place for particular hazards in specific areas. According to Yin (2003) and Sarantakos (1998), the strengths of using documentation in research is that documents are:

- Stable - they can be repeatedly reviewed;
- Unobtrusive – they are not created as a result of the case study;
- Exact – contains exact names, references, and details;
- Broad in coverage – long time span, many events, and many settings.

While documentation does have weaknesses (e.g. access, biased selectivity, and reporting bias (Sarantakos, 1998; Yin, 2003)), these limitations are not considered to be as prominent in this study because regional policies and plans are highly accessible, and have undergone a high level of community involvement in their

formulation. Consent applications and Environment Court decisions are likewise accessible and have been through a democratic process.

Once the units of analysis have been obtained (in this case, coding of content within policies, plans, consent applications and associated documentation and decisions), qualitative content analysis involves identifying and evaluating the items that appear to be theoretically important and meaningful. The researcher then relates them back to the central question of the study (Sarantakos, 1998). The logic of using content analysis for published material is the same as the logic for other kinds of research — one must have a hypothesis or research objective; variables are selected; a way of measuring the variation in the variables must be achieved; then a way of reporting the findings must be presented (Bouma & Ling, 2004).

For the process of undertaking content analysis for the case studies, a number of existing methodologies were reviewed, both international and New Zealand-based (Berke, Crawford, Dixon, & Ericksen, 1999; Berke, Roenigk, Kaiser, & Burby, 1996; Ericksen, et al., 2003; IBHS, 2001). Within the New Zealand context, Ericksen et al. (2003) provide a methodology for evaluating plan quality under the Resource Management Act 1991. In the light of an absence of international literature on robust methods for evaluating plan quality, Ericksen et al. (2003) developed their own. Each related question was coded (0, 1 or 2) and then used to create indices for each of the eight plan quality criteria or principles they used. While this methodology is specific to the New Zealand RMA context, it looks at the overall plan quality and is not natural hazard specific. However, the U.S. Institute for Business and Home Safety has produced a questionnaire for planners called the 'Community land use evaluation for natural hazards' (IBHS, 2001). Similar to the Ericksen et al. (2003) methodology, it has sections with specific questions, which are scored and rated.

For the purpose of this research, none of the evaluation criteria from IBHS (2001) or Ericksen et al. (2003) met the requirements of the research questions. Therefore new criteria were developed which would assist in answering the research questions in relation to plans that address natural hazards. A protocol was developed for coding the content to ensure that any plans being analysed were coded the same way.

Three plans (the Waikato CDEM Group Plan, WRC RPS, and the TCDC district plan) were analysed in detail to ascertain what natural hazards were included. This was then cross-tabulated against interview responses to a question asking which natural hazards were a concern to them for the Thames-Coromandel district (refer Chapter 6). A

relatively simple analysis was undertaken on the three plans to confirm what natural hazards were included in each plan. A table was constructed that highlights which hazards were included in each plan, and cross-tabulated with the responses from the interviews (refer Table 5.2, Chapter 5).

For the analysis of the interview transcriptions, Atlas.ti, a computer-based analysis tool, was used and is discussed in the following sub-section.

6.1 Computer aided analysis

Atlas.ti is a computer package specifically aimed at providing tools for qualitative data analysis. While there are other computer aided analysis packages available (e.g. NUD*IST, MAXqda and N-Vivo), Atlas.ti was selected for the analysis of the interview transcriptions as it was in use at my workplace at GNS Science. As such, using Atlas.ti kept other research analysis within the social science team in a consistent and compatible form.

Computer aided analysis was a method I had not used before, in turn up-skilling myself in using a computer package that assists in qualitative analysis. The key focus of Atlas.ti for this research was the coding of qualitative interview transcripts. As there were 23 transcripts to analyse, Atlas.ti provided the opportunity to use a computer aided analysis tool. The following codes were used for key themes from the transcripts:

Avoidance	**Balance**	**Balance: equal**
Barrier	**Benefits**	**Change required**
Civil Society	**Communication**	**Community responsibility**
Consequences	**Cost**	**Duty of care**
Economic considerations	**Emergency management**	**Finger point central govt**
Finger point council	**Finger point individual**	**Finger point insurance**
Finger point local	**Finger point market**	**Finger point national**
Governance	**Increase risk**	**Individual responsibility**
Individual risk	**Innovative**	**Insurance**
Land use	**Leadership**	**Legislation**
Liability	**LIMS/PIMS**	**Market**
Market responsibility	**Mitigation**	**Monitoring**
National guidance	**No increase in risk**	**Options**
Personal responsibility	**Planning**	**Pre-event planning**
Preparedness	**Property rights**	**Recovery**

Relocation	**Residual risk**	**Risk acceptance**
Risk awareness	**Risk magnitude**	**Risk management**
Risk reduction	**Site specific**	**State**
State responsibility	**Sustainability**	**Timeframes**
Tipping point	**Uncertainty**	**Urban vs rural**
Worsen the risk		

Once all the transcripts were coded, the analysis of the data could begin. The key themes from the interview questions were extrapolated into query reports. These were produced for the following coded themes: innovative, change required, leadership, barrier, risk reduction and mitigation. These themes were chosen as they either related directly to a question, or were a key result of a question.

From the query reports, further analysis was required without the aid of Atlas.ti to locate quotes that could be used to reinforce findings from the literature review and critique of the legislative provisions for hazard management (refer Chapter 5). While a useful tool, several limitations of computed aided analysis became apparent, as outlined below.

6.1.1 Limitations of approach

As a first-time user of computer aided analysis and Atlas.ti, limitations were experienced in the use of this tool. Many of these issues faced are a reflection of my lack of experience in using a package such as this:

- It took time to learn the program, as there are no formal training courses provided in New Zealand;
- Learning the program was via a 410 page handbook. It was often difficult to reconcile the examples provided to my research needs;
- Some interviews were over two hours long, and these took a lot of time to code;
- From the codes presented above, it is acknowledged that I over-coded the data due to the wealth of information that was available. While I coded all the themes being discussed, I only needed to focus on those specific to the questions answered.
- Once query reports were available following coding, they still needed further non-computer analysis (e.g. to find quotes), which again took time.

In spite of these challenges, I would use Atlas.ti again to assist with analysing large volumes of qualitative data. With further use and understanding of the tools the package has available, I would become more efficient in its use.

7. Workshops – development of risk-based approach

The purpose of workshops (also referred to as group discussions (Flick, 2006) and focus groups (Berg, 2007; Ruane, 2005)) is that they stimulate discussion, develop conversations, provides a forum to share opinions, and seek agreement on a problem (Flick, 2006). With this method, typically 6-12 people are assembled with the specific purpose of discussing a common issue (Ruane, 2005; Waldegrave, 2003).

Two workshops were undertaken in each of the three regions - Waikato, Gisborne, and Bay of Plenty. While the first workshop was primarily a scoping exercise to understand planning needs and wants, part of the aim of the second workshop was to outline and discuss the risk-based based approach (details are provided in the following subsections).

To ensure an outcome is reached, Flick (2006) recommends a structure for the workshop to follow. This includes an explanation of formal procedures (including ethical arrangements), the aim, purpose, expectations, and intended outcome; introductions of participants, including their roles and responsibilities; and a discussion stimulus – in this case, pre-circulated questions. As both moderator and researcher in the workshops, I took on an instrumental role (Ruane, 2005) to ensure the workshops ran smoothly and everyone had an opportunity to speak or offer feedback at breaks. Each workshop followed this structure.

7.1 Workshop 1

An initial scoping workshop with participating council staff was undertaken to ascertain what their differing needs, wants, and expectations are for tsunami inundation modelling (as required for a separate project, refer Saunders, et al, 2011). Questions were asked in regard to the required scale of modelling outputs, how it could be used, what return periods would suit their needs, the type of information to be included, managing uncertainty, existing policy around tsunami, opportunities for incorporating tsunami modelling into land-use planning, and the barriers and constraints related to this.

Workshop 1 was recorded with the approval of participants and transcribed. Following the PAR approach, the findings were incorporated into the development of the risk-based planning approach outlined in Chapter 6.

7.2 Workshop 2

The purpose of the second workshop was to canvas opinion and feedback on how issues raised in the first workshop were addressed, and to present the risk-based approach (outlined in Chapter 6). A draft concept document was pre-circulated with questions on the concepts presented. Pre-circulating the document allowed participants to become familiar with the concepts and associated figures, and consider prompting questions to encourage discussion and feedback.

The risk-based approach was presented, with a brief explanation of each step, how they are linked, and the expected outcome. To aid in the participatory discussion in the workshop, the following questions included in the draft concept document for the risk-based approach:

- Are the steps easy to understand?
- Is this approach useful/helpful?
- Is this an option to use?
- If not, what are the barriers to using this approach?
- What other information would be useful?
- Is there any other information that would be useful?

From the workshop discussion and feedback, the risk-based approach was amended and refined to reflect the input of the council staff. From the three workshops undertaken on the risk-based approach, similar feedback was received.

Once the final draft of the EQC report was ready, it was sent to all participants for their final review and feedback. This ensured they were actively involved, working *with* the project team (PAR type III) to ensure the results were relevant *for* (PAR type II) their purposes. Feedback from those involved in the process was very positive, and already staff are exploring ways of implementing the approach (e.g. BOPRC have incorporated levels of risk, reference to consequences into their proposed RPS – see Chapter 6).

In contrast to the first workshop, this second workshop was not recorded, as many of the prompts were visual in nature. As such, any discussions on the figures being discussed would not have been relevant when reading a transcription without having a clear understanding of what figure was being discussed.

8. Limitations and opportunities of workshops

From the two workshops, a number of limitations became apparent. However, many of these could also be managed by ensuring certain procedures were followed. The issues with the workshop format that were experienced are as follows:

- The group discussions became quite intense at times, with many participants talking at once as a particular issue was discussed. This made recording the views difficult. The groups were reminded of the 'one speaker at a time' rule to counter this.

- Ensuring everyone is heard. There were often a couple of participants in the workshops who had the potential to dominate the discussion with their views and ideas. It was important to individually ask those present for their views and ideas at each discussion point. If participants did not have anything to offer in front of the group, they were also approached during breaks and after the workshop for their views on the discussion. All participants were encouraged to send in any thoughts that were not considered in the discussion.

- Time factor – some groups wanted more time due to the good discussion that was taking place. Two hours was provided for the workshop, so that participants were not away from their other work commitments for a long period of time. To manage the time issue, participants were asked to carry on the conversation with others, and forward on any further comments/feedback they may have.

- Some participants grasped the concepts being presented at the workshop very quickly, and could see the real benefit in the approach. Consequently, some participants wanted to start using the concepts before they had been fully researched and finalised. This led to some information being used before the implications of the approach had been fully recognised. Participants were made aware of the nature of the research (i.e. it was continuing), and were happy to start using some of the concepts and feed back any issues or concerns into the research process (i.e. an ideal PAR approach).

Overall the workshops provided a great opportunity to build relationships with new contacts within councils, and test the concepts being proposed. These relationships have also proved beneficial for projects being undertaken as part of my role at GNS Science.

9. Implications of research design

In using PAR as the underlying research method, council staff became involved in the research at an early stage in the process. Through being part of the research, councils picked up the early development of the risk-based approach and were keen to implement parts of it faster than the research was progressing. This also created a snowball effect, where two regional councils were discussing it between them, and were both keen to implement various elements into their RPS development. There was therefore a demand for the research to be completed quickly so the results could be implemented. However, due to other work commitments and the nature of the research, there was a danger in rushing the process, which could have led to an approach that was not fully thought through or problems resolved. As many of these implications (refer Chapter 6) are yet to be resolved at this time, further research is planned to refine and develop this approach further with councils around the country. In order to assist with this, Envirolink Tools funding via the Ministry of Science and Innovation has been granted for a two-year project, part of which is to develop a methodology for assessing community levels of risk.

10. Summary

This chapter has met the first objective of this research outlined in Chapter 1 – to undertake ethical research based on reliable research methods. It has achieved this goal by outlining the research design, which included the research methods of PAR, ethical procedures, literature review, use of a primary case study, qualitative content analysis, interviews, and workshops.

From utilising the methods outlined in this chapter, the findings of the following chapters were able to be realised in a robust and reliable way. Chapter 4 provides an institutional review and critique of the regulatory context for managing natural hazards in New Zealand.

CHAPTER 4 The legislative context for natural hazard management in New Zealand

1. Introduction

In Chapter 1, six objectives for the research are outlined to meet the aim of the thesis. Objective 3 is to outline and critique the regulatory context for managing natural hazards in New Zealand, which this chapter addresses. This outline is critical to understanding the context of natural hazard management in New Zealand via legislation, and the associated strengths and weaknesses of these requirements.

Based on the research design outlined in Chapter 3, this chapter is the product of an extensive literature review, institutional analysis of legislation, and my own experiences in providing guidance and implementing hazard management policies. To avoid any bias, the research was undertaken in a systematic way, as outlined in Chapter 3. My experience in professional planning practice enabled me to critically assess the analysis and practical application of the issues raised; and allowed me to ask probing questions of the contemporary scholarship and legislative provisions. This chapter outlines and analyses the legislative context for the following chapters on innovation in land-use planning (Chapter 5) and taking a risk-based approach to land-use planning (Chapter 6). Any innovative land-use planning measures that achieve risk reduction must be undertaken within the legislative context (as per Renn 2008, outlined in Chapter 2).

The purpose of this chapter is to introduce the regulatory context of the management of natural hazards, which is largely determined by four key statutes: the Resource Management Act 1991 (RMA); Building Act 2004; Civil Defence Emergency Management Act 2002 (CDEMA); and the Local Government Act 2002 (LGA). The integrated nature of these statutes is discussed and critiqued within the context of their roles in hazard management. Included in this discussion is clarification of the terms avoidance, mitigation and risk reduction, each of which have their own subtle definition. Timeframes for planning for natural hazards under legislation are outlined and critiqued, as there is no consistent approach between types of natural hazards. Finally the role of the planner within the context of the legislation is outlined and discussed.

Appendix 2 provides an overview and discussion of managing uncertainty within land-use planning. Managing uncertainty is often seen as barrier to incorporating natural hazard risks into planning policy, and is therefore critical to any discussion on hazards, risks, and land-use planning.

2. Regulatory context

The radical planning reforms of the 1980's have set the scene for natural hazard management today, and have been reviewed and critiqued in detail by others (e.g. Buhrs, 1997; Ericksen, et al., 2003; Mamula-Seadon, 2006; May, et al., 1996). In summary, the purpose of these reforms was to devolve responsibilities from national to local government, encourage cooperation between the state, market and civil society, and provide market solutions to the management of natural and physical resources via effects-based[7] rather than activities-based planning (Ericksen, et al., 2003). However, the success of the reforms has been questioned, and has been the focus of extensive research by Ericksen et al. (2003) and others (listed above). It was found that while shortcomings in professional practice resulted in questionable plan quality, governance shortcomings were at the centre of the implementation problem. Key issues identified were mandate design, including the avoidance of integrated environmental protection and economic development; implementation efforts, including a lack of funding for MfE to assist councils; organisational capability of councils, including commitment and capacity; and institutional arrangements (Ericksen, et al., 2003).

In today's environment, there are four key pieces of legislation which have a primary influence on sustainable development and management in New Zealand, with particular regard to natural hazard management: the RMA, Building Act, CDEMA, and LGA. To a lesser degree, the Local Government Official Information and Meetings Act 1987 (LGOIMA) also contributes to hazard management by allowing hazard information to be available for all parcels of land, through a Land Information Memorandum (LIM). The four key statutes are intended to be integrated in their purposes, which all promote sustainability, as shown in Table 4.1. Other statutes also contribute to natural hazard management, although less so than those outlined in Table 4.1. These include the Local Government Official Information and Meetings Act 1987; Environment Act 1986; Conservation Act 1987; Soil Conservation and Rivers Control

[7] The term effect under the RMA includes any positive or adverse effect; any temporary or permanent effect; any past, present, or future effect; any cumulative effect which arises over time or in combination with other effects regardless of the scale, intensity, duration, or frequency of the effect, including any potential effect of high probability; and any potential effect of low probability which has a high potential impact.

Act 1941; Land Drainage Act 1908; Forest and Rural Fires Act 1977 (see Tonkin & Taylor, 2006, for further information).

Table 4.1 Purposes of key legislation for the management of natural hazards (emphasis added).

Statute	Purpose
Resource Management Act 1991 (Part 2, Section 5)	To promote the sustainable management of natural and physical resources. Sustainable management means managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural wellbeing and for their health and safety.
Building Act 2004 (Part 1, Section 3)	To provide for the regulation of building work, the establishment of a licensing regime for building practitioners, and the setting of performance standards for buildings, to ensure that— (a) people who use buildings can do so safely and without endangering their health; and (b) buildings have attributes that contribute appropriately to the health, physical independence, and well-being of the people who use them; and (c) people who use a building can escape from the building if it is on fire; and (d) buildings are designed, constructed, and able to be used in ways that promote sustainable development.
CDEM Act 2002 (Part 1, Section 3)	To improve and promote the sustainable management of hazards (as that term is defined in this Act) in a way that contributes to the social, economic, cultural, and environmental well-being and safety of the public and also to the protection of property
Local Government Act 2002 (Part 1, Section 3)	Provides for local authorities to play a broad role in promoting the social, economic, environmental, and cultural well-being of their communities, taking a sustainable development approach

This integrated approach to sustainability appears to reflect the 'strong' sustainability and triple bottom line approach (Paehlke, 2004), and the inherent limits and finite character of natural systems within which social, economic and cultural systems are embedded (e.g. Neumayer, 2003; Parliamentary Commissioner for the Environment, 2002). However, while the purposes of these statutes are consistent, in reality, practice does not reflect a strong sustainability approach. No balancing of the four well-beings is required; rather, economic considerations can take priority over social,

environmental and cultural well-beings. This priority reflects the political prerogative to encourage market solutions to the management of natural and physical resources (Ericksen, et al., 2003). A discussion of how sustainable management and development is interpreted under these statutes is therefore required to understand in more detail the inconsistencies highlighted above.

2.1 Interpretation of sustainable management and development

What is clear from Table 4.1 is the inconsistent terminology used between sustainable development (used in the Building Act and LGA) and sustainable management (used in the RMA and CDEMA). As discussed in Chapter 2, there is a lack of clarity when defining the concept, which can be beneficial in allowing a definition to fit the context. However, while definitions are available, the sustainable management philosophy has still proved difficult for councils to adopt (Ericksen, et al., 2003; May, et al., 1996). Although defined under the RMA, Grundy (2000) provides a comprehensive discussion and debate on interpreting Section 5 of the RMA, based on either a narrow or holistic interpretation. In relation to other statutes, according to the Brookers Online commentary the definition of sustainable management from the RMA could be used within the context of the Building Act. However, the commentary notes that for the LGA, the concept of sustainable development differs from that of sustainable management used in the Resource Management Act 1991, but no definition is provided. Under the CDEM Act, sustainable management is not defined within the Act, National Plan (or Guide), or the National CDEM Strategy.

The Building Act refers to sustainable development, but does not define it within the legislation or supporting documents. However, in a 2007 Building Code review discussion document, the Minister for Building and Construction (Hon Clayton Cosgrove) stated in the Forward (Department of Building & Housing, 2007, p2) that:

> Sustainability must be at the centre of what we do. It means that buildings in New Zealand must meet the needs of New Zealanders now and into the future. This is about continued social and economic wellbeing – ensuring people's health, safety, wellbeing and communities are enhanced, not diminished, by the buildings they use.

This view is supported by guidance available to councils on building sustainability, predominantly from Beacon Pathway Limited (e.g. Beacon Pathway Limited, 2010; Howell & Birchfield, 2010). At the current stage of the Building Act review, sustainable development is still not defined within the Act. Local authorities use the broader

understanding of the sustainable development concept for LGA activities, not the narrower definition of sustainable management used under the RMA (Clarke, 2010, pers. comm.). On a local government website (http://www.communityoutcomes.govt.nz/web/coutcomes.nsf/unid/TCAO-7GT26D?openDocument), the Brundtland Commission definition of sustainable development is provided. The website also provides guidance as to what local authorities need to take into account when taking a sustainable development approach.

To achieve sustainable, resilient communities to natural hazards, risks must be reduced within (but not limited to) the context of social, economic, environmental and cultural well-beings, as discussed below.

2.1.1 Social, economic, environmental, and cultural well-being

Chapter 2 outlined three key concepts of sustainable development, being the social, economic and environmental well-beings. As shown in Table 4.1, social, economic, environmental, and the additional cultural well-beings are common goals of legislation, particularly the RMA (while environmental is not specifically included as well-being, it is implicit within the purpose), CDEMA and LGA. Similar to 'sustainable management' and 'sustainable development', definitions of what these well-beings entail are not supplied. Rather, it is up to the individual councils to define what these mean for their region/district. For example, the following explanation is provided in Environment Canterbury's LTCCP (Environment Canterbury, 2009, p15):

> *Social well-being* – those factors that enable individuals, their families, hapu [i.e. Maori sub-tribe] and communities to set goals and achieve them – such as education, health, the strength of community networks, financial and personal security, rights and freedoms and levels of equity.
>
> *Economic well-being* – those factors relating to the capacity of the economy to generate the employment and wealth necessary to provide many of the prerequisites for social well-being, such as health services.
>
> *Environmental well-being* – those factors that relate ultimately to the capacity of the natural environment to support, in a sustainable way, the activities that constitute community life.
>
> *Cultural well-being* – those factors that encompass the shared beliefs, values, customs, behaviours and identities reflected through language, stories, experiences, visual and performing arts, ceremonies and heritage.

As mentioned in the previous section, a local government website does provide some guidance on what councils need to take account of. It is essential that these well-beings are defined, so that indicators can be used to measure progress against the well-beings and monitor the effectiveness of policies and plans in achieving these outcomes (Mileti, 1999). In this case, these well-beings can be related to the natural hazard risks communities are exposed to. This is discussed in more detail in Chapter 6 in terms of 'consequences'. In order to measure the risk of natural hazards against the well-beings, a definition of natural hazards is required. This is discussed in the following section.

2.2 Definitions of natural hazards

While the purposes of the four statutes are intended to be integrated and consistent, the definitions of a natural hazard vary. While the LGA does not define natural hazards, they are defined under the RMA, Building Act and CDEM Act, as shown in Table 4.2. While the Building Act is limited to certain phenomena, the RMA and CDEMA have unlimited definitions, both of which are consequence driven (i.e. may adversely affect human life, property; may cause or contribute to an emergency). This allows for consequences (and associated vulnerabilities, susceptibilities etc.) on these aspects to be assessed. This slight discrepancy between definitions is often not fully appreciated by land use planners, building officers, or emergency management officers, and can lead to inappropriate decisions being made. It is therefore important that the linkages between the statutes is understood and integrated between roles (i.e. planners, emergency management officers, building officers etc.). The following section outlines these linkages, roles and responsibilities.

Table 4.2 Legislative definitions of natural hazards

Statute	Definition of natural hazard	Comment
Resource Management Act 1991	Any atmospheric or earth or water related occurrence (including earthquake, tsunami, erosion, volcanic and geothermal activity, landslip, subsidence, sedimentation, wind, drought, fire, or flooding) the action of which adversely affects or may adversely affect human life, property, or other aspects of the environment.	Under Section 106, a consent authority may refuse to grant a subdivision consent, or may grant a subdivision consent with conditions, if it considers that the land, and any subsequent use of the land or any structure is or is likely to accelerate, worsen, or result in material damage to the land, other land, or structure by erosion, falling debris, subsidence, slippage, or inundation from any source. This section does not include consequences from active faults, tsunami, or geothermal activity, and is inconsistent with the definition of a natural hazard.
Building Act 2004	Erosion (including coastal erosion, bank erosion, and sheet erosion); falling debris (including soil, rock, snow, and ice); subsidence; inundation (including flooding, overland flow, storm surge, tidal effects, and ponding); and slippage.	Definition does not include active faults, liquefaction, lateral spreading, or tsunami.
CDEM Act 2002	Something that may cause, or contribute substantially to the cause of, an emergency.	Includes all natural and anthropogenic hazards.
Local Government Act 2002	No definition.	

2.3 Integrated roles and responsibilities

The integration of the practice of hazard management can be improved by understanding how the various roles and responsibilities of central government agencies, regional councils, territorial authorities, and non-statutory planning tools can work together to provide a holistic approach. Figure 4.1 shows these relationships, and areas for improvement.

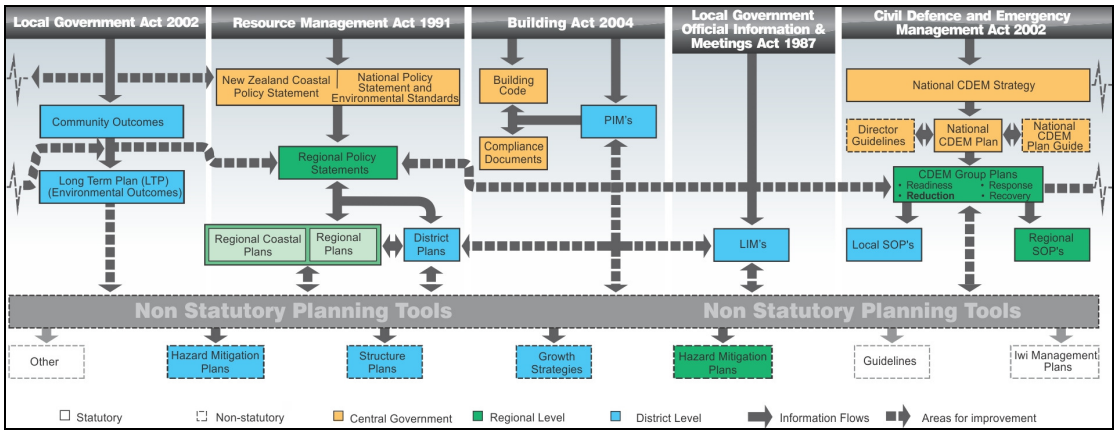

Figure 4.1 Legislative roles and responsibilities for hazard management in New Zealand (adapted from Saunders, Forsyth, Johnston, & Becker, 2007).

Figure 4.1 presents the five main statutes that govern natural hazards planning at different levels of government, namely central (orange), regional (green) and district/city (blue) levels. The hierarchy of plans established under each statute provides various regulatory and non-regulatory tools for natural hazards planning. The solid arrows show established relationships in the hierarchy of provisions. The dashed arrows highlight relationships between existing provisions where there is an opportunity for strengthening linkages. The relationships may be one- or two-way. These legislative provisions and the array of tools they provide constitute a robust 'toolkit' for natural hazards planning. However, many of these tools are not well known amongst either planners or emergency management officers, nor used to their full potential to reduce hazard risk and build community resilience (Glavovic, et al., 2010; Saunders, et al., 2007).

Under the Local Government Official Information and Meetings Act 1987, territorial authorities can issue a Land Information Memorandum (LIM) on request. The LIM provides information that the council holds on a parcel of land, including natural hazards. LIMs provide the applicant with the opportunity to become aware of any natural hazard on which the council holds information that may affect their property, and enables them to assess their willingness to accept or tolerate that risk. However, if hazard information is included in the district plan, it is not required to be included in the LIM. It is questionable whether applicants for LIMs are aware that the LIM may not include all information held by a council for a site, if that information is held in the district plan. Many LIM applicants assume that the LIM will contain *all* hazard information available.

Table 4.3 provides a summary of how these statutes contribute to the management of natural hazards in New Zealand. It can be seen from the table that primarily the reduction of risk lies with the RMA, whereas emergency management (readiness, response, recovery) lies with the CDEMA.

Table 4.3 Summary of ways in which statutes contribute to the management of natural hazards

Statute	Implication for natural hazard management
Resource Management Act 1991	• Health and safety issue must be addressed • Local authorities are required to avoid or mitigate the effects of natural hazards, not their occurrence (*Canterbury RC v Banks Peninsula DC, 1995).* • NZCPS includes specific coastal hazard policies • S106 (consent authority may refuse to grant subdivision consent) does not allow for the consideration of all natural hazards as defined.
Building Act 2004	• The Building Code does not include tsunami, as it cannot economically mitigate the risk for tsunami for all buildings (some exclusions may apply in the future for critical facilities).
CDEM Act 2002	• 4R philosophy – risk reduction is assumed to be managed under the RMA (MCDEM, 2008a; Saunders, et al., 2007) • Encourage and enable communities to achieve acceptable levels of risk • Readiness and response driven e.g. guidance for tsunami evacuation planning, mapping, and signage (MCDEM, 2008b, 2008c)
Local Government Act 2002	• Financial planning for risk reduction activities • Take into account the foreseeable needs of future generations
Local Government Official Information & Meetings Act 1987	• Provides for natural hazard information to be included in LIMs.

As this section has shown, although there is good integration of purposes across statutes, there are still inconsistencies in how natural hazards are managed. While there is limited non-regulatory guidance available to planners on hazards (e.g. Table 1.1, Chapter 1) with the exception of the National Coastal Policy Statement (NZCPS; refer Section 2.4 of this chapter), there is no statutory guidance available i.e. a specific national policy statement or national environment standard available for councils.

These tools are catered for under the RMA, but are yet to be realised. While these statutes provide a framework for managing natural hazards, when an event does occur, new legislation may be enacted to assist the response and recovery. This has implications for the existing processes within the legislation, as outlined below.

2.3.1 Canterbury Earthquake Response and Recovery Act

On Saturday 4 September 2010 at 4.35am, a magnitude 7.1 earthquake was centred 9.7 km south east of Darfield, 37 km west of Christchurch. While located at a depth of 10.9 km with a maximum intensity of MM9, there were no deaths directly related to the earthquake, and only two people were seriously injured (GeoNet, 2010). The earthquake caused extensive ground liquefaction in some areas of Canterbury and ground shaking resulted in damage to many commercial and residential buildings, which were unable to be reinstated.

The implication of the event from a legislative perspective was the enactment of the Canterbury Earthquake Response and Recovery Act 2010, which was passed under urgency on 14 September 2010. The legislation enabled the relaxation or suspension of statutory requirements, until 1 April 2012, that have the potential to divert resources away from the recovery efforts; may be unable to be complied with as a result of the earthquake; or could delay a prompt response to the emergency recovery. This exemption applied to all legislation that may be affected during the response and recovery, including the Building Act, CDEMA, RMA, LGA and LGOIMA. Many orders refer to removing liability for certain actions, extension of legislative timeframes, and the amount of information provided in LIMs (refer to Wynn Williams & Co, 2011 for further details of orders). The legislation also created the Earthquake Recovery Commission to provide advice and guidance, and holds no liability for decisions being made.

On 22 February 2011 a shallow, magnitude 6.3 aftershock was located under the Port Hills of Christchurch. This caused devastating damage to the CBD and the greater Christchurch area, with 172 confirmed deaths, nine bodies yet to be identified (New Zealand Police, 2011), and hundreds of injuries. The event resulted in the first national declaration of an emergency. The result of this second earthquake was further changes via Orders of Council under this Act, and the legislative establishment of the Canterbury Earthquake Recovery Authority (CERA) in April 2011. Changes under Orders of Council included the streamlining and fast-tracking of resource consents for land remediation works. It was considered that the normal process of public

notification, hearings and appeals would delay the rebuilding of suburbs, potentially for years. Under this Order, affected parties have two weeks to provide written submissions prior to councils making a decision (NZPI, 2011). It is too soon to understand or assess the process that CERA will implement. However, these new statutes show how the management of natural hazards is often reactive, in that the legislative environment can change in response to an event. Consideration of improving risk reduction via land-use planning provides a proactive, rather than reactive, response to natural hazards.

2.4 New Zealand Coastal Policy Statement

The 2010 NZCPS (Department of Conservation, 2010) is the only national regulatory policy document that provides guidance on the management of coastal hazards. A summary of this guidance is provided in Appendix 3. The NZCPS specifically includes natural hazards in Policies 24 (Identification of coastal hazards) and 25 (Subdivision, use and development in areas of coastal hazard risk). In particular, Policy 25 states that:

> … in areas potentially affected by coastal hazard over at least the next 100 years: (a) avoid increasing the risk of social, environmental and economic harm from coastal hazards; (b) avoid redevelopment, or change in land use, that would increase the risk of adverse effects from coastal hazards; (f) consider the potential effects of tsunami and how to avoid or mitigate them.

Policy 24 refers to “areas at high risk”, but this risk level is not defined i.e. what factors determine high or low risk. To assist in determining this level of risk, Chapter 6 discusses levels of risk, from acceptable through to intolerable, to assist in overcoming this gap.

Sustainable development is also promoted within the context for natural hazards. In particular, Policy 27(1) states:

> In areas of significant existing development likely to be affected by coastal hazards, the range of options for reducing coastal hazard risk that should be assessed includes:
> (a) promoting and identifying long-term sustainable risk reduction approaches including the relocation or removal of existing development or structures at risk; and
> (e) identifying and planning for transition mechanisms and timeframes for moving to more sustainable approaches;

Regional policy statements, regional plans and district plans must give effect to the NZCPS, however it is yet too soon to review the success of these policies.

2.5 Risk reduction and the CDEMA

Saunders et al. (2007) provide details on how risk reduction requirements under the CDEMA are assumed to be managed under the RMA, via RPS and district plans. In summary, it is essential that consistent policies between CDEM group plans and RMA plans are provided, to ensure that risk reduction is effective in achieving common risk reduction objectives and outcomes, particularly around land use recovery (Becker, et al., 2008). Risk reduction under the CDEMA is considered to be an RMA issue (MCDEM, 2008a; Saunders, et al., 2007). However, the term risk reduction is not included in the RMA, only the requirement to avoid or mitigate natural hazards (see next section). This requires emergency management officers and land use planners to work together with their communities to ascertain levels of risk (as required under the National CDEM Strategy (MCDEM, 2008a)), which are otherwise not defined. Planners are therefore primarily responsible for risk reduction (Saunders, et al., 2007) and land use decisions. In order to achieve sustainable risk reduction, it is imperative that these two professions work together. Under the RMA, the primary focus is on avoiding or mitigating the effects of natural hazards. This is the focus of the following section.

3. Reconciling avoidance, mitigation, and risk reduction under the RMA

Within the RMA, the definition of sustainable management includes avoiding, remedying, or mitigating any adverse effects of activities on the environment, with no preference given for each option, or any reference to risk. Contrary to international definitions of mitigation that include avoidance (Burby, 1998a; Godschalk, 2002; Mileti, 1999), in New Zealand the term mitigation is typically used to include measures other than avoidance, as that is a separate option. In the CDEMA, neither risk reduction nor mitigation is defined. In the National CDEM Strategy, risk reduction is a combination of avoidance and mitigation (MCDEM, 2008a).

The terms ‘avoid, remedy and mitigate’ are not defined within Section 2 of the RMA and there is limited case law to provide guidance on how these concepts can be applied to natural hazards. In practice, greater emphasis is given to avoiding and mitigating the risks associated with hazards than remedying the effects. This is

reinforced in Sections 30 and 31 (functions of regional councils and territorial authorities) where regional councils and territorial authorities are only required to avoid and mitigate natural hazards when controlling the use of the land and the effects of an activity. No preference is given for either avoidance or mitigation. The common meaning of 'remedy' is "a means of counteracting or eliminating something undesirable" (Oxford Dictionary). In the case of most natural hazards (e.g. landslides, tsunami, flood, earthquake), the hazard cannot necessarily be eliminated and therefore remedying it becomes impractical. Rather, avoidance or mitigation measures can lessen the risk to people and property and are therefore given greater emphasis (Burby, 1998a; Ericksen, 1986; Mileti, 1999; Saunders & Glassey, 2007).

However, there are subtle differences in outcomes of avoidance and mitigation under the RMA, and risk reduction under the CDEMA. Mitigation is not defined in the RMA, but it can be defined as element of risk reduction, involving an action taken to reduce or eliminate long-term risk to people and property from hazards and their effects (excluding avoidance)[8] (Godschalk, 2002). Under the National CDEM Strategy, risk reduction is defined as:

> Identifying and analysing long-term risks to human life and property from hazards; taking steps to eliminate these risks if practicable, and, if not, reducing the magnitude of their impact and the likelihood of their occurring (MCDEM, 2008a, p5).

It is assumed that this definition includes avoidance via 'taking steps to eliminate these risks' – of which avoidance is an option. While avoidance is an option separate from mitigation in the RMA, risk reduction under the CDEMA includes both mitigation and avoidance. Levels of risk are often cited when mitigation and risk reduction are discussed (e.g. NZCPS Policy 25(a); CDEMA s3(b)). However, there is little guidance available on what an acceptable level of risk is, to whom, and to what. This has implications for planning policy, when acceptable levels of risk are included in policy, but not defined (this is discussed further in Chapter 6).

[8] Note that this definition of mitigation is based within the US context, which includes avoidance. However, for the purposes of this research, and as no definition of mitigation is provided under the RMA, it can be applied to New Zealand acknowledging that avoidance is a separate option.

In the New Zealand context, avoidance achieves risk reduction by not putting people and property in harm's way. In contrast, mitigation provides measures that incorporate the risk, but may still place people and property at-risk (i.e. residual risks, which may require structural protective works), and therefore does not achieve risk reduction. Two Environment Court examples highlight the implications of this discrepancy: Kahikatea Estate in the Coromandel, and the Holt case in Dunedin – both of which focus on acceptable levels of risk and mitigation measures. Kahikatea Estate provides an example of the implications of mitigation, in that it does not require mitigation to be effective, only applied. This is discussed in the following section.

3.1 Kahikatea Estates, Coromandel

An example of how mitigation can be interpreted and implemented is the Kahikatea Estate subdivision application in the Thames-Coromandel District. The application provides one example where mitigation measures have been put in place, but risk to property (and personal safety, depending on the effectiveness of emergency management plans) is increased. This example also highlights how risk governance is dependent on institutional arrangements – in this case, the legal framework of the RMA.

Located on the Tairua River floodplain, the site is tidally influenced and had been flooded from the river five times during the previous 12 years. As such, the site is expected to flood on average every two to five years (Tonkin & Taylor, 2005). The site is deemed a high hazard site by the regional council (Waikato Regional Council), as the depth of flow in the main floodway is greater than one metre and/or speed of flow is greater than one metre per second. Rather than avoiding the risk altogether, this hazard was addressed by the applicants with mitigation options, their philosophy being to "recognise the risk of flooding that exists and to take measures to overcome the hazard risks, without endeavouring to impede the natural flow patterns of floodwater through the site" (Bhana, 2005, p7).

Original mitigation options proposed by the applicants included (Bhana, 2005, p7-8):

- A pontoon jet-drive rescue craft being permanently maintained on site. Carrying up to nine people, the craft would be used to evacuate people from their homes from designated loading and unloading areas. Several people in the area would be trained to operate the rescue craft on a first-response basis.

- Automated early warning systems to monitor river and rainfall levels, to provide adequate warning to evacuate if required. This system is also linked to the first response [emergency management] network.

- Safe areas will be provided above the flood levels where cars could be stationed in the event of rising water levels, with all-weather access to the main road. Alarms would give ample time for vehicles to be taken to the designated area. Community facilities would be above any flood levels, and would provide shelter for the residents if required as well as a command post for a first-response team.

Also identified in the consultant report (Tonkin & Taylor, 2005, p18) was that:

> Potential damage to buildings and building platforms will be mitigated by setting minimum floor levels to EW [Environment Waikato[9]] standards and constructing platform batters and building foundations to withstand flood velocities. In a similar way, the potential for loss of life and/or injury may be mitigated by proper planning and procedures.

The upstream corners of the building platforms were also to be reinforced (Arcus, 2006). It was summarised in the consultant report (Tonkin & Taylor, 2005, p20) that: "The risk of developing within the floodplain is accepted by the developer …". This raises issues of who is accepting the risks – the developer in the short term, but future purchasers in the long term. The Regional Council stated in their planner's report that:

> …the current location of the building platforms or sites for residential development proximity to the Tairua River based a [sic] precautionary approach to represent too great a risk to be suitable for residential development (cited in TCDC, 2006, p23).

The application was publicly notified, and subsequently an independent commissioner was appointed. In June 2006 the Commissioner approved the application, subject to conditions of consent being imposed (including the provision of a rescue boat). In his conclusion, the Commissioner stated that "Material damage to structures is unlikely because the structures are above a very conservative minimum floor level" and "Occupants are unlikely to be at risk because of the warning system. In the unlikely event that it fails there are other factors which would alert occupants to flood" (Arcus, 2006, p31).

[9] EW changed its name in April 2011 to Waikato Regional Council (WRC).

In May 2008 the Environment Court issued a consent notice which included the following conditions (Judge Dwyer, 2008, p3-4):

3. The consent holder shall provide a detailed Emergency / Hazard Management Plan 'E/HMP', detailing the provisions to be made to ensure the safety of occupants of the subdivided lots in the event of inundation of the site. This shall be submitted for the approval of the Thames-Coromandel District Council's Monitoring Officer. The E/HMP shall include but not be limited to the following measures:

    a) Ensuring the installation and ongoing maintenance of a new river level recorder.

    b) Ensuring an existing river gauge (Broken Hill) is upgraded to provide secure and ongoing river level data.

    c) The installation and ongoing maintenance of a 24 hour a day river level monitoring system shall be connected to all residential buildings and the Regional Council.

    d) Ensuring the provision of an evacuation plan. This is to be developed and maintained by the Residents Association of Kahikatea Estate, and will be developed around different responses corresponding to onsite water levels.

    e) Ensuring members of the residents association receive as minimum annual training in compliance with the provisions of the E/HMP.

    f) Ensuring the culverts under the internal driveway are regularly maintained including at least annually the

        I. Clearance of any accumulated debris, and
        II. Rectifying any visible signs of erosion.

    g) Ensuring any maintenance to the internal private way results in the RL of the private way being retained at the Hauraki Catchment BD Datum level of 14.5 metres with variance of 0.02 metres.

    h) Ensuring the ongoing maintenance of the building platforms for flood defence purposes for each of the residential lots.

    i) Ensuring the area defined as 'Restricted Planting Area' is managed so its primary purpose as a floodway is not compromised.

4. The consent holder shall provide to the Thames-Coromandel District Council a copy of the documentation establishing the Residents Association and setting out to the satisfaction of the Council's Monitoring Officer the responsibilities of the Association in terms of on-going

> site management. This includes arrangements to ensure compliance of the E/HMP; and providing Council with an annual report demonstrating on-going compliance. This is to be prepared by an independent certifier appointed by the Association and acceptable to the Council's Monitoring Officer.

The original jet boat response measure was not included in the final decision. This case provides an example of the wider implications for risk reduction, including the importance of qualifying and/or quantifying the levels of risk for natural hazards to ascertain and clarify what is acceptable, tolerable and intolerable; who accepts the short- and long-term risks i.e. the developer versus a future purchaser; and the paradoxical relationship between mitigation and risk reduction (i.e. mitigation does not necessarily result in a reduction of risk). In this case, risks to property are still potentially problematic for those dwelling in these properties. While the developer was willing to accept the risk, future owners/generations will have a legacy of flood risk to live with if they choose to (see also Handmer (2008)). The mitigation measures proposed lead to an increase in risk from the original land use, otherwise the consent conditions would not be required. To date, the development has not yet begun due to the 2009-10 economic recession.

The decision highlighted the inadequacy of the existing district plan provisions for managing flood risks. As a result of this decision, the Thames-Coromandel District Council undertook a plan change to the flooding section of the district plan's natural hazard chapter, which is yet to become operative. Ironically, the website for the development states that:

> Sites will have a high standard of amenities including a gravelled driveway to improve water dispersal … The development exceeds local body resource consent standards, preventing any possible risk of flooding to platforms or homes: so your house is safe as … well, houses (Kahikatea Estate).

This statement provides an example of the developer bearing the risk while properties are sold. Local body resource consent standards are exceeded due to the risk of flooding; it is still possible that platforms and homes can be flooded (hence the requirement for a warning system and evacuation plan).

When assessing mitigation measures, timeframes (i.e. likelihood, recurrence intervals, return periods, probabilities etc.) should be considered to assess whether mitigation measures are adequate for the risks and consequences involved. The following section outlines issues with planning timeframes for natural hazards.

4. Planning timeframes for natural hazards

While the NZCPS provides some guidance on timeframes for assessing coastal hazards (i.e. at least 100 years under policies 24, 25 and 27) (Department of Conservation, 2010), there is no national regulatory standard approach for deciding what timeframes should be used for other natural hazards. This has led to an inconsistent approach being adopted throughout the country, and has the potential to lead to an *increase* in risks if appropriate planning timeframes for natural hazards are not included in planning processes.

Choosing the appropriate timeframe as the basis for land-use planning is difficult for communities, planners, and politicians (who tend to focus on outcomes within political cycles, rather than long-term) alike (Deyle, et al., 1998; Ericksen, 2005). The decision of what return period[10] should be used often represents a value judgement that may be difficult to deal with in the political arena. At one end of the scale are hazards that produce modest levels of damage on a relatively frequent basis, generally with a recurrence interval of less than 20 years; at the other end are catastrophic events that recur less frequently, only once every 2,500 years or more, but produce devastating levels of damage and consequences (Deyle, et al., 1998; Ericksen, 2005). These high consequence, low-likelihood events are the most difficult hazards to manage (Slovic, Fischhoff, & Lichtenstein, 2000) due to a lack of understanding and awareness of the consequences of these events; and the 'it won't happen in my lifetime' view. It is essential that any decisions on these types of events are made with community and scientific input, to ensure support and understanding of risks and consequences.

In the Environment Court case *Save the Bay v Canterbury Regional Council* (C6/2001), the Court considered that there needed to be a greater recognition of catastrophic natural events, stating that 90% of damage to the environment caused by natural hazards occurs in 10% or fewer of events. The Court suggested that "authorities should recognise this inverse relationship in the preparation and wording of their plans". This case, and *Bay of Plenty Regional Council v Western Bay of Plenty District Council* [2002] A27/02 EnvC, and *Skinner v Tauranga District Council* [2002] A163/02

[10] For a discussion on terminology and definitions on the terms return period, annual exceedance probability (AEP), probability of occurrence and likelihood, see Saunders (2010).

all provide discussion regarding the appropriate risk period to plan for when preparing regional and district planning documents. These cases point to a 100-year planning horizon for hazards such as coastal erosion and coastal flooding, but should not be a benchmark for other natural hazards.

Flooding, coastal erosion, landslide hazards and tsunami risk are likely to be influenced by transient end points (Health & Safety Executive, 2001; Johnston & Paton, 1998), instigated by climate change, which may change their risk profile. For example, it is imperative that coastal erosion time frames of 100 years are adjusted with time to incorporate climate change – what was a '100 year event' in 1990 may be less than that in 2020. To ensure the 100 year return period remains at 100 years over time, the effects of climate change must be regularly monitored and incorporated into any planning timeframe. Tsunami risk is also impacted by climate change; whilst not the trigger of a tsunami, climate change has the potential to increase coastal erosion, which can erode previously stable beach dunes, allowing a tsunami to have a greater run-up and inundation (and impact) on land.

There is no consistent all-hazard return period/AEP for land use planners to use as a basis for planning for natural hazards events in New Zealand (see Saunders, 2010). While some perils 'share' return periods, not all are equal, in part due to forecasting and warning capabilities, as outlined in Table 4.4 and discussed below. For example, high rainfall events can be forecast, flood warnings can be given, and evacuation of communities at-risk is possible.

Table 4.4 Comparative land-use planning return periods for selected natural hazards in New Zealand

	Planning timeframe (years)	Case law	Forecast possible	Warnings available	Map extents	Affected by Climate change	Likelihood	Consequence
Flood	20-100	~	Yes	Yes	Yes	Yes	Almost certain	Minor/ Moderate
Coastal erosion	100	Yes	Yes	Yes	Yes	Yes	Likely	Minor/ Moderate
Active faults	</= 20,000	No ~	No	No	Yes	No	Rare	Moderate/ Major
Tsunami (local and distal)	</+ 2,500	Yes	Yes (distal only)	Yes (distal only, natural warning for local source)	Yes	Trigger not, but dune health is	Possible	Moderate/ Major
Landslide	</+ 2,500	No?	Yes (in some circumstances)	No	Yes	Yes	Possible	Moderate

For floods and coastal erosion, forecasts of impending weather are available via the Metservice. Through tsunami modelling, a forecast of wave height can be provided for distant-source tsunami, although only natural warnings are available for local-sourced tsunami events. For other hazards such as earthquakes and some landslides, warnings are not possible due to the sudden onset of such events. Floods, coastal erosion, and tsunami inundation have the potential to be affected by climate change, due to increased severity of rainfall events, sea level rise, and associated impacts (e.g. decreased dune health).

For effective risk reduction, hazardous areas should be avoided, as even with warning and evacuation, property is still affected (with subsequent social and economic

consequences). A balance needs to be reached between allowing a land use to proceed in an at-risk area; constructing buildings to withstand hazards; and having emergency management procedures in place when required. Once a land use has been permitted, and buildings have been constructed, the land use will carry on indefinitely beyond the 50 year default timeframe of buildings under the Building Act. Planning within a sustainability context, which implies planning for future generations, needs to extend beyond 50, and even 100, years. The influence of the Building Act is outlined in the following section.

4.1 The influence of the Building Act 2004 on timeframes under the RMA

Often there is reliance on timeframes under the Building Act for land-use planning, in particular the 50 year timeframe. Under the Building Act, buildings have a minimum intended lifetime of 50 years, and are constructed to withstand a 475 year return period earthquake (i.e. a 10% probability of occurrence in 50 years). Critical facilities are constructed to withstand a 2,500 year (2% chance of occurring in 50 years) earthquake event. Based on this approach, the timeframe of 50 years has become, in some districts, the default planning timeframe for flooding. However, if correctly used for flooding, the 475 year return period, with a 10% chance of occurring in 50 years, not a flat 50 year return period, should be used.

There is also a reliance on the Building Act to protect people's health and safety, rather than land use provisions. Within RMA case law from the Environment Court (*Petone Planning Action Group Incorporated v Hutt City Council, W020/2008)*, it is stated that:

> … the performance of the structure and the safety of people in earthquake events, is to be left to compliance with the Building Code and Standard … risks to safety from earthquake shaking, liquefaction and tsunami would be appropriately addressed and mitigated in the Building Code process and assessment in accordance with NZS1170.5:2004" (New Zealand Standard *Structural Design Actions Part 5: Earthquake Actions*).

The decision was summarised as follows:

> … we conclude that the consenting to the proposal on condition of compliance with the Building Code and NZS1170.5:2004 would enable people to provide for their safety against risks from earthquakes and other natural hazards.

However, NZS1170.5:2004 only considers earthquake, not other natural hazards such as tsunami, landslide, or flood, leading to the conclusion that the Environment Court

was questionable in its judgement that other natural hazards are provided for in this standard, and consequently peoples' health and safety is *not* provided for. Under the Building Act, only the *consideration* of other hazards is required. The implication of this is that planners should adhere to the purpose of s5 of the RMA and provide for people's health and safety. It is recommended that this includes planning beyond the default 50 year planning horizon of the Building Act.

In summary, reliance on the Building Act is too restrictive in its timeframes, and does not allow for consideration of consequences beyond a 50 year timeframe for buildings (excluding critical facilities). Chapter 6 seeks to address this issue. It is therefore essential that the planner knows and understands their role in reconciling issues discussed in this and previous sections. The role of the planner is outlined in the following section.

5. The role of the planner

The planner has a crucial role in natural hazard management. As outlined in Chapter 2, land use planning is a purposeful adjustment to the natural hazard risk, and can either reduce losses through avoidance or risk reduction; or through managing the location of the land use. One of the key tools available to planners to ensure risk reduction (as required under the CDEMA) takes place is the District Plan, one of the land-use planning mechanisms used in community governance in New Zealand. District plans include policies, rules, and assessment criteria, but land-use planning also extends beyond formal policies and plans. Other policy and planning provisions (e.g., structure plans, long term plans) are used in neighbourhood and community governance. While planning contributes to governance through the formal governmental processes, it is the planners who facilitate community engagement and participation in decision making, and interpret and administer responsibilities under the RMA for the market (which also includes private sector interests). Huxley (2000, p370) states that:

> Contemporary planning practices are inevitably related to the state – its powers, resources and regulations, whether or not they are carried out by private corporations, community organisations, or state planning departments.

Figure 4.2 represents the key participants and power relationships in environmental planning, and integrates insights from five models which reflect a sustainable

development approach (Berke, Godschalk, Kaiser, & Rodriguez, 2006; Campbell, 1996; Kaiser, et al., 1995; Paehlke, 2004; Randolph, 2004).

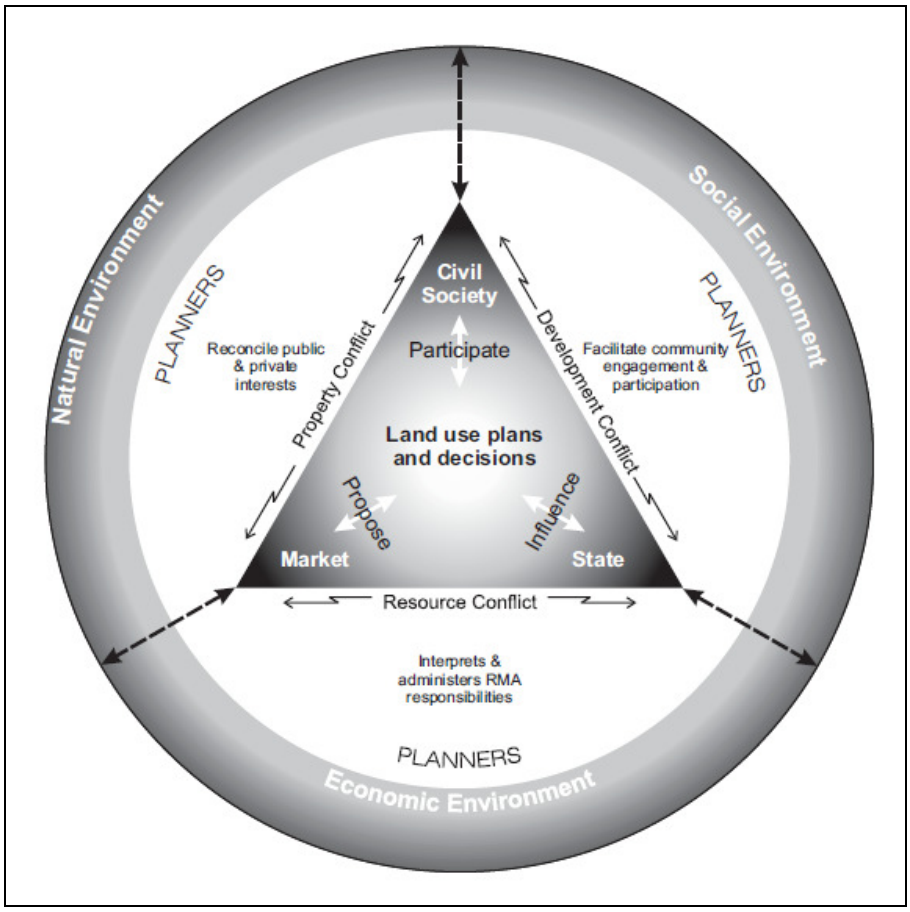

Figure 4.2 The role of the planner in New Zealand within a sustainable land-use planning framework (i.e. natural, social and economic environments)

Central to Figure 4.2 is a triangle with a corner for each of the market, state and civil society, with land use plans and decisions located between the three. For the purposes of this research, the term 'market' is defined as:

> … the activity, set of institutions, and processes for creating, communicating, delivering, and exchanging offerings that have value for customers, clients, partners, and society at large (AMA, 2010).

It includes private sector interests, industry, trade associations, land developers, designers, financial institutions, real estate, and market forces (Berke, et al., 2006; Kaiser, et al., 1995; Randolph, 2004).

The state (i.e. elected politicians, appointed officials, regulatory and support staff required to carry out regulatory responsibilities) at central, regional, and territorial (i.e.

districts and cities) levels plays an important role using the power vested in it to regulate private activity that affects the environment. For example, from a land-use planning perspective, the state authorises land-use plans to manage land use and physical development, e.g. growth strategies and structure plans aim to manage growth (Randolph, 2004). Land use plans can use regulatory tools, including zoning, subdivision regulations, and more innovative performance standards to control the location and impact of land development. Non-regulatory tools are also gaining increasing recognition, such as design guidelines, maps, and guidance notes.

Civil society is defined as:

> …the arena of uncoerced collective action around shared interests, purposes and values. In theory, its institutional forms are distinct from those of the state … and market, though in practice, the boundaries between state, civil society, … and market are often complex, blurred and negotiated (Centre for Civil Society, 2010).

Civil society includes non-governmental organisations, environmental and citizen groups, faith-based organisations, advocacy groups, trusts, property owners, and citizens with an interest in the activities of the market or the state (Berke, et al., 2006; Centre for Civil Society, 2010, 2010; Kaiser, et al., 1995; Randolph, 2004). Civil society actors can affect the activities of the market and the state in a number of ways: by participating in government planning and decision making; by pressuring or directly negotiating private development project proposals; or by actively preserving environmental resources through land trusts and conservation easements (Randolph, 2004). Civil society also plays direct and indirect roles in promoting societal goals such as social justice, economic opportunity, and income equality (Campbell, 1996).

Around this triangle are three conflicts that reflect divergent interests between the state, market and civil society, and are detailed further in Campbell (1996). The *property conflict* is between economic growth and equity within civil society. This conflict is grounded in competing claims on the uses of property, e.g. between building owners and tenants, long-time residents and ‘new’, more affluent professionals. Civil society and the market are interdependent, in that one not only needs the other for its own requirements (i.e. landowners need rent, tenants need space), but also resists the other (e.g. expensive upgrade demands from tenant, which may increase overall value of space), resulting in tension being generated as the market simultaneously resists and needs social intervention. The *resource conflict* is in response to society being in conflict about its priorities for natural resources (e.g. land, minerals, air, flora and

fauna). Business resists state regulation of its exploitation of nature for economic gain, but at the same time needs state regulation to ensure those resources remain sustainable for present and demands of future generations. The *development conflict* is between social equity within civil society and environmental preservation via state regulation. The challenge with this conflict is reconciling social equity within civil society and protecting the environment (which can be exploited for economic growth) via regulation (Campbell, 1996).

Figure 4.2 presents these central relationships with graduated shading, reflecting that the relationships are dynamic, in that one key sector may exert more influence than the other two, depending on the circumstances and stage of the planning and development process. Surrounding this triangle is a graduated shaded circle which represents the dynamic nature of the natural, social, and economic environments, which promotes a 'strong sustainability' and triple bottom line approach (Paehlke, 2004). The natural environment provides the boundary/limit within which social and economic needs are located. However, in a 'weak sustainability' approach, the priority may be given to economic needs rather than environmental and social needs.

In the land use context, developers (i.e. the market) change land use; local governments (the state) are responsible for managing land use; and community groups (civil society) seek to balance existing land use patterns (Berke, et al., 2006). In reality the power between the state, market and civil society may not be balanced, with potentially one holding more power than another at any one time. This also influences whether the environmental, social or economic factors are balanced, or whether one of these sustainability factors has more influence than another (hence the broken arrows). There are no boundaries within the shading, as the balance of power varies at different scales and changes over time.

Key to Figure 4.2 is the role of the planner, who seeks to facilitate and mediate conflicts between the market, state and civil society in pursuit of sustainable outcomes. Planners must manage and overcome conflict via participatory means, while promoting institutional solutions (which may require interpretation), and arriving at an outcome that meets the needs of all three key participants (Campbell, 1996). In Figure 3.2, the state interacts with the market, via growth management, regulation and enforcement, planning and design, and collaboration. The market is both constrained and enabled by the policies and rules that exist in plans, including those for natural hazard risk reduction. The state also interacts with civil society, and represents the interests of

civil society through policies and plans. However, civil society can also exert political pressure on the state via the consultation process to determine policy and decision making outcomes. The figure depicts an advocacy and participatory planning approach. It recognises that interested stakeholders do not speak with one voice, but are often separated from each other and fight for their special interests. The role of the planner is to mediate these often conflicting interests (Alexander, 1992; Fainstein, 2003; Randolph, 2004).

6. Summary and conclusions

This chapter meets the second objective of this research, to outline and critique the regulatory context for managing natural hazards in New Zealand. This was achieved by undertaking an institutional analysis of legislation and its implementation; a review of supporting literature on natural hazard management in New Zealand; and the role of the planner. The key finding of the chapter is that while legislation is integrated 'on paper', in reality the integration of hazard management practices between the statutes needs to be strengthened. In summary, the following opportunities exist to improve the current management of natural hazards via legislation:

- Clarification of purposes required, to ensure that policies and practices can be monitored against the purpose of a statute.
- Consistency between the definitions of 'natural hazard' to ensure consistency of management between statutes;
- Defining sustainable management under the CDEMA and sustainable development under the Building Act and LGA. This will allow for monitoring of policies to assess if sustainable management/development is being achieved;
- Risk reduction under the CDEMA is assumed to be managed under the RMA, therefore the tools available under the RMA need to incorporate the principles and terminology of risk reduction (e.g. risk, consequences);
- The terms 'mitigation' and 'avoidance' need to be clarified in relation to achieving positive environmental outcomes, in that sustainable risk reduction does not increase future risks and manages residual risk. This was highlighted in the discussion on the Kahikatea Estates development in the Thames-Coromandel district.

- To ensure mitigation measures do result in a decreased level of risk, levels of risk need to be quantified and/or qualified with communities, particularly as acceptable levels of risk within the NZCPS, CDEMA and RMA policies are not defined;

- Guidance on the nature of social, economic, environmental and cultural well-beings, and whether their definitions differ between the different statutes. Once these are defined, indicators can be used to measure effectiveness of policies and plans for hazard management.

- A general discussion on whether current timeframes for managing different natural hazards are adequate, given that timeframes range from 50 to 2,500+ years.

There is also the opportunity to improve hazard management by looking at the consequences of events via the four key community well-beings, rather than the current approach of focusing on timeframes. Chapter 6 explores this opportunity in further detail.

The context for the relationships between planner and representatives from the market, civil society and state was outlined. The planner has a key role to play in the management of natural hazards, and often requires multiple skills to reconcile resource, property and development conflicts between the state, market and civil society in a sustainable manner. This reflects the key principles for effective risk governance as outlined in Chapter 2 (Renn, 2008) – an effective legal framework, the role of sustainability and the tension between the economic and natural environments, and the role of the state, market and civil society.

The implication of the findings of this chapter is that changes to legislation may be required to ensure that the findings above can be implemented. Until these issues are addressed, planning for and building resilient and sustainable communities is likely to remain elusive. It is within the context of this legislative environment that Chapters 5 and 6 are based.

CHAPTER 5 Innovation and land-use planning: A perspective from Thames-Coromandel

1. Introduction

Increasingly the term 'innovation' is being used within a land-use planning context. However, there is limited guidance on what innovative land-use planning is, or its implications for planning practice, specifically when managing natural hazards. Traditionally the term 'innovation' is used widely within the business management and technology literature (Clausing & Fey, 2004; Daft, 2007; Davila, Epstein, & Shelton, 2006; 2003), with variations including 'social innovation' (Dasgupta, 2003; Fontan, Klein, & Tremblay, 2004; S. Goldsmith, Georges, & Glynn-Burke, 2010; Johnstone, 2005; Moulaert, Martinelli, Gonzalez, & Swyngedouw, 2007; Moulaert & Nussbaumer, 2005); community innovation (Kendra & Wachtendorf, 2006); sustainability innovation (Horbach, 2005); and innovative governance (Gonzalez & Healey, 2005; Healey, 2004; Swyngedouw, 2005).

Innovation can refer to the inventive process by which new things, ideas, and practices are created; it can mean the new thing, idea, or practice itself; or it can describe the "process whereby an existing innovation becomes a part of an adopter's cognitive state and behavioural repertoire" (Zaltman et al., 1973, p7-8, cited in Goldsmith & Foxall, 2003), thereby going beyond pure creativity. Moore (2005, p45) states that innovation should:

> … produce a desirable result; something really new; or if not entirely new, a significant departure from conventional practice in a field. The size of the effect it produced would be significant, not simply a marginal improvement.

The aim of this chapter is to meet Objective 4 of this research; that is, to describe what innovation is, and its relevance to land-use planning within the context of Thames-Coromandel district. This aim is achieved through the various methodologies outlined in Chapter 3. In particular, it has drawn on the literature review, and on the Thames-Coromandel case study, which includes interviews with key national, regional and district representatives from the state, market and civil society. First, a discussion of innovation is required in order to define its relevance to land-use planning, and in particular to natural hazard management. To achieve this, the chapter has two key components: 1) to outline the types of innovation within the context of business; communities; sustainability; risk governance; and land-use planning; and 2) to assess the level of hazard awareness amongst representatives from the state, market and civil society in the Thames-Coromandel; and gain an understanding of innovative land-use planning for risk reduction in the district, including any barriers and opportunities. The

aforementioned discussion will set the context of an innovative planning framework outlined in Chapter 6.

2. Types of innovation

Five types of innovation are relevant to this research: innovation in business; social and community innovation; environmental and sustainability innovation; innovation in risk governance; and innovation in land-use planning. Each of these types is discussed in detail in the following subsections.

2.1 Innovation in business

Davila et al. (2006) categorise innovation in business (i.e. the market) according to three generic categories:

1. *Incremental innovation* brings out as much value as possible from existing products or services without making significant changes or major investments. Incremental innovation represents constrained creativity, where only small changes are feasible at any one time; it often becomes the dominant form of innovation and crowds out other potentially more valuable changes.

2. *Semi-radical innovation* involves substantial change to either the business model or technology of an organisation – but not to both. Often change in one dimension is linked to change in the other, although the parallel change may not be as dramatic or disruptive.

3. *Radical innovation* is a significant change that simultaneously affects both the business model and the technology of a company. Radical innovations usually bring fundamental changes to the competitive environment in an industry.

While it is often thought that innovation is about making something new, these three types of innovation include a mixture of old and new. Sternberg et al. (2003) expand these three generic categories of innovation to eight distinctive types of innovation, reflecting variations in the nature of the creative contribution each represents (see Table 5.1). Innovation in the planning profession, within practice or theory, can be categorised as any one – or a combination of – these types depending on of the creative contribution that planning is making. An example is shown in Table 5.1, where these eight types of innovation are shown with an example of how they could be applied to land-use planning.

Table 5.1 Three categories of business innovation (Davila, et al., 2006) with eight types of innovation (based on Sternberg, et al., 2003) and examples of from land-use planning in New Zealand.

Category	Type	Examples from the planning profession
Incremental innovation	Replication – the field is where it should be	State of the Environment reporting – reporting on how well plans and policies are managing the impacts on the environment. Provides a baseline for environmental monitoring and reporting, but does not seek to improve policies beyond that.
	Redefinition – to redefine the field; a new point of view	Upgraded measurement techniques for monitoring e.g. water quality, air quality
Semi-radical innovation	Forward incrementation – moves the field in the direction it is heading, takes the field to a point with others	National Policy Statements – helps local government decide how competing national benefits and local costs should be balanced (MfE, 2011). Provides policy and guidance for councils on how to reach a common goal and assist decision making.
	Advance forward incrementation – moves the field in the direction it is heading, moving beyond where others are ready to head	Bay of Plenty Proposed Regional Policy Statement – defining levels of risk (refer Chapter 6). First council to take on development of risk-based approach.
Radical innovation	Redirection – moves the field toward a new and different direction	Introduction of the Resource Management Act 1991 and associated reforms of 2005 and 2009 – new focus / direction on sustainable management of natural and physical resources, with a move from activity-based planning to effects-based planning. The Act moved resource management into a new and different focus – sustainable management.
	Reconstruction / redirection – moves the field back to where it once was, so it can again move forward in a different direction	New urbanism – attempts to move urban planning back to the “traditional neighbourhood” design of the past, but with a new focus on sustainability e.g. reduced reliance on motor vehicles.

Category	Type	Examples from the planning profession
	Reinitiation – moves the field to a different and not yet reached starting point, and then moves in a new direction	Structure planning - a framework to guide the development or redevelopment of a particular area by defining the future development and land use patterns, areas of open space, the layout and nature of infrastructure, and other key features for managing the effects of development (MfE, 2010b).
	Integration – moves the field by combining past contributions that were distinct or opposed.	Integrating natural hazard risk reduction via the RMA, Building Act, and CDEM Acts, rather than working independently of each other within their traditional roles. Provides an opportunity to increase risk reduction initiatives by working together with consistent policies.

These terms are used in Chapter 6 to describe the type of innovations employed in the proposed risk-based framework.

2.2 Social and community innovation

An alternative to the business management definitions of innovation is the concept of 'social innovation' (Fairweather, 1967; S. Goldsmith, et al., 2010; Moulaert, et al., 2007). Moulaert, Martinelli et al., (2007, p196) state that:

> … social innovation has become an alternative view of urban development, focused on the satisfaction of human needs through innovation and the relations within neighbourhood and community governance.

Goldsmith (2010, p19) presents a framework for social innovation, which incorporates the market, civil society and state at local and national levels into a "vortex of social change". Social innovation within this context is transformative, with the purpose of closing the gap between social problems and solutions. It seeks to assist communities and the state in creating an environment that supports social change and associated innovation.

Interlinked with social innovation is community innovation; however, there is very limited literature that focuses explicitly on this type of innovation. What does exist tends to focus on how communities or regions attract or retain certain industries or become known for producing new goods and services (Kendra & Wachtendorf, 2006), rather than a community that innovates to bring about change (Velasquez, Yashiro, Yoshimura, & Ono, 2005). Community can be defined as "A social network of

interacting individuals, usually concentrated into a defined territory" (Johnston, Gregory, Pratt & Watts, 2000, p80). Similarly, Velasquez, Yashiro et al., (2005, p3-5), expand this definition, defining community as:

> …a group of people who are involved in collective action in a specific geographical location … our definition of communities does not always include all residents or only residents of particular area. What links them together is their sharing of common local environmental issues and collective action towards solving these issues … we use the term 'innovative community' to refer to a group of people who are able to bring about change and innovation in order to establish a sustainable society. They are willing to take unconventional approaches, often by making dramatic changes in people's attitudes, perceptions, mindsets, roles and behaviours, as well as developing new ethoses, cultures, institutions and governance structures.

In light of the discussion on community innovation, the literature acknowledges that it is the individuals, groups and organisations within a community that innovate (Goldsmith, et al., 2010). These might include government agencies, non-governmental organisations (NGOs), citizen groups, pressure groups, or other collectives. Therefore it is appropriate to look at community innovation from an organisational perspective, because communities are conglomerates of individuals and organisations, whether acting individually or working together (Kendra & Wachtendorf, 2006). Community innovation is therefore more than individuals, groups, or organisations – the benefits are from these different groups working together to achieve a common purpose (Goldsmith, et al., 2010). Innovation is not equal across geographical locations. What is innovative in one place or period may be common knowledge somewhere else. Some communities tend to develop innovations earlier than others and experience widespread diffusion of those innovations, whereas other areas may have barely begun to adopt them (Landry, 2005).

Velasquez et al. (2005) and Kendra & Wachtendorf (2006) highlight a number of essential features that characterise the innovative potential of communities, being:

- A shared community recognition of a relatively urgent sustainable development need or challenge is identified, communicated, and supported (e.g. risk reduction initiatives that promote social well-beings);

- Established, flexible local governance structures that can be adapted to accommodate and sustain various organisational requirements;

- The availability of relevant local culture, knowledge and indigenous practices that can combine with new and introduced ideas and technologies to generate innovation; and

- Strong local leadership and champions within different community groups and organisations.

These features are also transferable into a planning context — when a development need or challenge is recognised; governance structures in the form of planning policies and process should be flexible and adaptable (i.e. discretion is required); knowledge and information allow for new development designs; and strong leadership from a community and agencies responsible for implementing plans for these features to be supported.

Kendra & Wachtendorf (2006) identify two key barriers to community innovation. First, innovations do not always lead to positive changes for a community as a whole, or for certain individuals within a community. Uncertainties around whether or not a new approach or large-scale social changes will improve or worsen a community's quality of life can work to impede any innovation at all. Within the context of natural hazard planning, these uncertainties need to be managed. One method to assist in overcoming uncertainties of outcomes, is participation with communities in the decision making process to inform and gain an understanding of the innovation, and how it can contribute to the greater public good. Second, a barrier to innovation is the financial cost to a community, particularly in regard to hazard mitigation works. Costs are generally cited as a barrier to the adoption of new strategies for reducing hazards, in particular new approaches which may have uncertain outcomes (Kendra & Wachtendorf, 2006). Indeed, this issue is raised and discussed further in Section 4.3 of this chapter.

2.3 Environmental and sustainability innovation

Environmental and sustainability innovations represent subsets of innovation systems, including community innovation. Following a definition by Kemp, Arundel and Smith (2001, cited in Horbach, 2005), environmental innovation consists of new or modified processes, techniques, systems and products to avoid or reduce environmental damage. Sustainability innovations not only comprise the environmental dimension but also economic, social and institutional aspects (Horbach, 2005). These are integral elements of any innovative mitigation measures for natural hazards.

Sustainable development requires an innovative combination of both "redefinition" and "redirection", because changes are required in the way institutions, organisations and individuals operate. It cannot be "business as usual" alongside some minor environmental concessions. Some of the necessary innovations are about reassessing internal management approaches to achieve change; some are about new technologies; some relate to the nature of monitoring, regulation and enforcement through internationally agreed standards and reporting mechanisms. Central to all these necessary changes is the participation of stakeholders, especially local communities (Warburton & Yoshimura, 2005). To enable this participation, an inclusive risk governance framework must be in place which supports this participation (Renn, 2008). The role of risk governance in supporting innovation is discussed in the following section.

2.4 Innovation and risk governance

For innovation to occur in land-use planning, an adaptive governance structure that supports innovation must be in place. Landry (2005, p76) summarises the key features of a supportive environment as:

> … taking measured risks, widespread leadership, a sense of going somewhere, being determined but not deterministic, having the strength to go beyond the political cycle, and, crucially, being strategically principled and tactically flexible, as well as recognising the resources that come from a community's history, talents and products and services.

To make the most of innovations within this environment, changes in mindset, perception, ambition and will are required (Landry, 2005). As defined by Renn (2008, quoted and discussed in Chapter 2), risk governance fosters innovation within the market, civil society and state. Healey (2004, p100) also explores the role of innovation in governance, being:

> …modes of urban governance with the capacity to release creative energies, encourage innovative practices, move beyond narrow conceptions of 'development' and give space to multiple activities need to discover a complex balance between self-regulation and re-distribution, between being supportive in multiple ways and constraining where essential, between openness and transparency and accepting the likelihood of critique and protest, between producing and circulating knowledge and information and accepting that valuable knowledge resources are also to be found in the many nooks and crannies of urban life. Above all, a mode of urban governance which encourages creativity has to learn to experiment and therefore to learn from failure as well as success, and to recognise that

redundancy in resource use is as much a positive quality, spreading access to opportunity and support, as it is a negative inefficiency.

Moore and Hartley (2008) provide five interrelated characteristics of innovative governance, in that it:

1. Goes beyond organisational boundaries to create networked-based decision making, financing, decision making, and production systems;

2. Taps new pools of resources;

3. Exploits government's capacity to shape private rights and responsibilities;

4. Redistributes the right to define and judge value; and

5. Should be evaluated in terms of the degree to which it promotes justice and the development of society as well as its efficiency and effectiveness in achieving collectively established goals (i.e. risk objectives).

Innovative governance includes new political arrangements in local government, as well as organisational processes and systems for the planning and delivery of services (Hartley, 2005). Therefore within the context of this research, innovative risk governance may result in a new land-use planning processes to ensure that risk reduction is achieved (see Chapter 6).

Risk governance and its associated elements (refer Chapter 2) provide the basis for innovative land-use planning for risk reduction to occur within the market, state, and civil society; that is a) within the market, where innovative solutions, products and applications are produced. Opportunities for innovations within the market (including incentives and disincentives) must conform to the state governance frameworks (which are often influenced by market lobbying); b) As such, the state has two responsibilities: to have an internal governance framework that allows for innovation *within* government; and one that allows for innovation by external agents (the market and civil society) (Healey, 2004). Regulations set and enforced by the state should not be so restrictive as to stifle innovation within the market, but often allow a sector to be self-regulating (Swyngedouw, 2005); and c) Civil society provides the opportunity for community and socially-based innovations; and is a stimulus, consumer and beneficiary of market innovations. These relationships are shown in Figure 5.1.

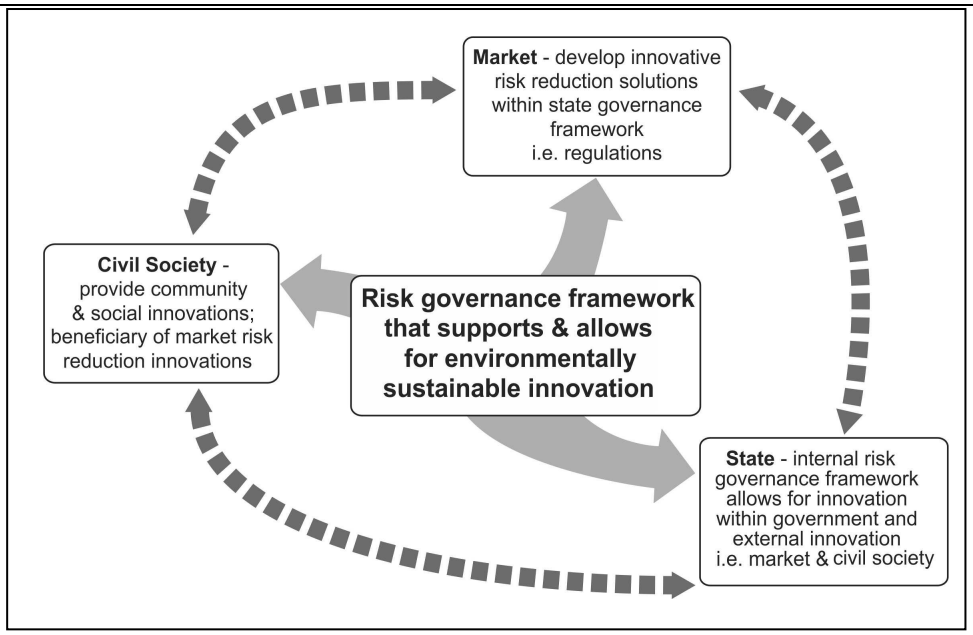

Figure 5.1 Role of the state, market and civil society in innovative risk governance and their dynamic relationships.

The outcome of Figure 5.1 is a risk governance framework that supports and allows for environmental sustainable innovation (e.g. risk reduction initiatives that are environmentally sustainable). This central element is based on the risk governance principles outlined in Chapter 2 (Section 3). Each stakeholder of innovation (i.e. market, civil society, state) is reliant on another to be successful. Innovation in land-use planning is regulated by the state, where internal and external policies allow for innovation, and from the market offering innovative solutions (including mitigation), from which civil society benefits (if successful). The nature, role and interactions of governance actors and institutions are profoundly complex and this overview is necessarily simplistic. It nonetheless highlights the pivotal but different roles played by the state, market and civil society in risk governance. Each bears different consequences for their roles in shaping the creation, bearing and sharing of risk (e.g. Kaihikatea Estates (Chapter 4) and Handmer, 2008). From this context the role of innovation in land-use planning can be explored.

3. Innovation and land-use planning

Chapter 2 discussed the role innovation and land use planning has in promoting sustainable development. In summary, the existing planning arrangements for natural risk reduction is not providing outcomes that adhere to the principles of sustainable development, in that new developments are still putting people and property at risk. Innovation is therefore required within the planning sector to see if being innovative (i.e.

doing things differently), can achieve a reduction in risks greater than what is currently occurring. In order to understand how these two concepts are linked to improve natural hazard management and risk reduction, a discussion must first take place on what innovative land-use planning is. Innovative land-use planning combines features from the definitions of business, technology, social, community, environmental and sustainable innovations, as well as the planning definition above. Friedmann (2003, p78) stated that:

> Innovative planning looks toward creative solutions to the social, physical, and environmental problems that rise to political consciousness in the public domain. Innovative planning is consequently focused rather than comprehensive in scope; present rather than future oriented; and concerned chiefly with institutional and procedural changes appropriate to the case at hand. Innovative planning is concerned more with resource mobilisation than with central allocation. It operates in real rather than imaginary time. And above all, it is entrepreneurial. As such, it is well adapted to a decentered planning system that involves a concentrating of the powers of many different actors. Therefore, innovative planning requires great skills in negotiation, mediation, and the art of compromise. It is a form of planning that, like entrepreneurship in the private sector, is prepared to take risks, even while remaining publicly accountable.

While Friedmann discusses innovation and planning, there are three points within his discourse that deserve further discussion. First, it can be argued that innovative planning can and should be comprehensive in scope and future oriented, in order to be sustainable for future generations. For example, structure planning and growth strategies (which are widely used in New Zealand) are often set with a development plan/vision of 20 year or longer time frames, and are incorporated into regulatory policies and plans. So planning *is* future oriented, and seeks to make procedural and institutional changes which ultimately aim to improve environmental, social, economic and cultural outcomes. Second, planning is community oriented given the participatory / consultative nature of contemporary planning, so planning is innovative when it is truly a community effort, engaging a wide range of stakeholders. Thirdly, planning in New Zealand is decentralised to a regional and district level, and as such should adapt well to innovative initiatives.

Land-use planning is linked to social and community innovation through the interconnected roles played by landowners, developers, and planners in bringing about change within a community through planning processes. Providing a coherent,

integrated, strategic, innovative, flexible and robust policy framework that is inclusive and outcome-focused is difficult, given the variety of interests and competing objectives that occur in the management and use of the land resource. The land-use planning system is therefore required to satisfy a diverse and complex array of different interests (Peel & Lloyd, 2007), of which innovative risk reduction measures is one. It has been noted that the planning policy process is highly incremental in nature, in that policy makers start with the policies they inherit, then look for ways of incrementally improving them (Shaw & Eichbaum, 2008).

In light of the limitations of the definition provided by Friedmann, a more refined definition of innovative land-use planning is required. From the review and analyses of the business, technology, social, community, environmental and sustainability innovation literature outlined above, innovative land-use planning can be defined as:

> *An opportunity to plan for positive social, economic, and environmental outcomes in a new way, based on old and new planning principles within planning theory and practice. It requires a vision, leadership, and belief that extend beyond political cycles; is comprehensive and integrated with policies and plans from different sectors; and involves the active and meaningful participation of the community. The outcome of innovative land-use planning is hazard-resilient, sustainable communities.*

The key elements of the analyses and subsequent definition above are that innovative land-use planning incorporates the community well-beings outlined in the legislation; acknowledges that innovation can be based on both old and new ideas (Moore, 2005); requires leadership and long term vision (Landry, 2005); is integrated (Chapter 4); and requires participation. The definition above is not just limited to planning theory and practice, but can be extended and integrated into other professional practices. For the purpose of this research, these other professions include those of emergency management and urban design. However, it must be realised that the outcomes and consequences of innovative planning choices made in the present, will not become apparent until sometime in the future. An appropriate risk governance framework is therefore required to ensure that decisions made in the present result in positive environmental outcomes in the future. Within the context of the definition provided for innovative land-use planning, the following section explores the issue of innovation and its role in risk reduction; and the practical realities of implementing innovative risk reduction measures within planning by the state, market and civil society.

4. Case study findings: hazard awareness and innovation in Thames-Coromandel

In May et al. (1996), the authors looked at innovation in planning in New Zealand, Australia and United States. For New Zealand, they found that one of the goals of the RMA, although not explicit, is to encourage local and regional councils to develop innovative approaches to resource management. Their findings included that the RMA signals an aspiration for local and regional councils to incorporate innovative policy instruments into their plans and policies, and provides the opportunity to undertake the planning process beyond the traditional way. However, little guidance is provided in the RMA about how regional and local councils are to achieve this (Ericksen, et al., 2003; May, et al., 1996). Ironically, May et al. found that central government officials were disappointed with the slow pace of innovation taking place, while local government planners were requiring guidance and more prescription about what was acceptable plan and regulatory provisions. Another key finding was that time is required for new ideas and innovation to occur (May, et al., 1996). This is supported by Healey (2004), who states that changes in governance, such as when the RMA was enacted allowing for innovation, take time – often a generation or more.

To find out how innovation is used and/or perceived in a district that has a history of natural hazard events, interviews were undertaken with various parties on innovation and land-use planning in the Thames-Coromandel district (refer Chapter 3 for the case study approach that was undertaken for this research, and the selection of Thames-Coromandel as the case study location). Section 4.1 (following) outlines the results from the questions asked of participants regarding their awareness of natural hazards in the district; Section 4.2 provides five examples of innovative measures relevant to hazard management; and Section 4.3 shows the participants' perceived barriers to, and opportunities for, innovative solutions. The results of this case study provided the context for the development of the innovative, risk-based approach to natural hazards planning (see Chapter 6).

4.1 Awareness of natural hazards in Thames-Coromandel

As discussed in Chapter 3, the Thames-Coromandel district has a record of historical natural hazard events. The purpose of the first question of the interview (are natural hazards a concern to you, given the many priority hazards that face the community?) was to gain an understanding of people's perceptions of natural hazards. The second

part of the questions (if so, what hazards?) was to assess their awareness of natural hazards in the district.

Of the 23 participants (refer Table 3.3, Chapter 3 for a list), 22 (96%) responded that natural hazards were a concern to them in the Thames-Coromandel district. The one participant who did not see natural hazards as a concern was a developer, who when asked to explain their position stated:

> Because I think depending on what you're doing you, you simply allow for possible hazards and that's not necessarily difficult.

This quote underscores Handmer's insights into creating, bearing and sharing risk (Handmer, 2008), where the market gains most of the benefit of risk creation for a short period of time. As well as asking the participants for their perceptions of natural hazards, a comparison of their responses to those natural hazards included in various planning documents was assessed. The planning documents which were assessed for their inclusion of specific natural hazards were the 2005 Waikato CDEM Group Plan – Thames Valley Emergency Operating Area; the WRC RPS; and the Thames-Coromandel District Plan. The specific natural hazards included in each plan are shown in Table 5.2, combined with responses to the question "if so, what hazards". The responses in Table 5.2 are based on 20 respondents; the reasons for this are discussed following Table 5.2.

Table 5.2 Specific natural hazards included in plans for Thames-Coromandel and responses as being a concern from participants (in percentages, n = 20)

Natural Hazard	CDEM Plan	EW RPS	TCDC DP	Responses
River/stream flooding	✓	✓	✓	75%
Tsunami	✓	✓		70%
Land instability[1]		✓	✓	65%
Storms[2]		✓	✓	50%
Coastal erosion			✓	35%
Wind			✓	35%
Earthquake	✓	✓	✓	25%
Storm surge	✓			25%
Fire		✓		15%
Drought		✓		10%
Volcanism		✓		10%
Climate change impacts				5%
Ashfall				5%
Geothermal		✓		0%
Mayor Island volcanic activity	✓			0%

[1] Includes avalanches, landslides, large scale rock/soil mass movements
[2] Also referred to as severe meteorological events e.g. 2002 weather bomb

It can be seen from Table 5.2 that there is not a consistent approach for including specific natural hazards in plans. While earthquake is included in the three plans, only 25% of respondents acknowledged this as a hazard. In comparison, the only other hazard included in all three plans is flooding, which was the most recognised by respondents, with 75% identifying flooding as a hazard in the district. This inconsistent approach has implications for prioritising funding for hazard management; ensuring land use decisions on natural hazard risk reduction are based on the best available information; and providing a consistent management and planning policy approach between the CDEM and land-use planning sectors (as discussed in Chapter 4). The lowest scoring hazards amongst respondents (i.e. 0%) was Mayor Island volcanic activity (only specified in the CDEM plan); climate change (not included in any plans); and geothermal hazards (included in EW RPS). Ashfall is not included specifically in any plans, but was mentioned by one respondent. However, this could be generally included under 'volcanism' in the EW RPS.

Three responses were not included in Table 5.2, therefore n = 20 rather than 23. This was due to the property developer stating that hazards were not a concern in the first part of the question, which then made the second part of the question redundant. The other two respondents based at the national level did not have knowledge of specific hazard that are a concern to the Thames-Coromandel, and therefore were not included in the analysis for Table 5.2. For example, nationally-based respondents replied to the question with the following statements:

> We tend to be more concerned for issues that impact on local government as a whole rather than a particular district, but the sorts of problems at Thames Coromandel is addressing are relevant in other areas as well.

> … Thames Coromandel contains almost all natural hazards for New Zealand apart from having active volcanoes, but their neighbours have those.

In one example, a national context was provided, due to the respondents' national responsibilities. The specific natural hazards listed below were not included in the analysis in Table 5.2, due to the national context:

> [Are natural hazards a concern to communities in New Zealand?]

> Well obviously yes and the ones occurred to me as being the obvious things to consider are earthquakes, sea level rise, floods and tsunami.

For many, personal experience of a natural hazard event may have had an effect on their awareness. In particular, the district has experienced flooding, with a response rate of 75%; tsunami 70% response (warnings were provided in 2010 prior to the interviews taking place, and recent community tsunami evacuation planning may of contributed to raising awareness), land instability 65% response, and severe weather 50% response (weather bomb 2002). The respondent who was able to list the most natural hazards to which the district is susceptible (10) was the Planner at the Thames-Coromandel District Council.

4.2 Innovation in Thames-Coromandel

Innovative risk reduction is occurring within the Thames-Coromandel District. From the interviews undertaken with key stakeholders (as outlined in Chapter 3), five examples of innovation in the Thames-Coromandel district were highlighted. Of these, three were market-led, one was state-led, and one was a combination of state and civil society (i.e. district council and individual landowners). The representative of Service Delivery from the district council stated that:

> …innovation if anything just comes from working together.

This opinion is backed up by the literature, in that the market, state and civil society should ideally be working together towards a common risk reduction goal. This is also reflected in Figure 5.1 of this chapter, where the market, state and civil society interaction is promoted via governance arrangements. However, in reality this 'togetherness' can be a challenge as each group has different perceptions, responsibilities, and benefits from risk (e.g. Handmer, 2008). On reflecting on innovation at a national level, one participant representing Local Government New Zealand suggested that:

> … saying no is an obvious innovation.

This quote indicates that avoidance is perhaps not used as a risk reduction option as often as it should. This could be due to issues of the economic benefits of a development, for the market (as developer), state (for increased population and associated rate revenue) and civil society (where perceived benefits can outweigh perceived risks), and due to issues outlined in Chapter 4. The following subsection outlines the five examples of innovation in the district.

4.2.1 Insurance

In New Zealand, the EQC is a state-managed compulsory residential insurance fund for natural disasters (i.e. damage from earthquake, natural landslip, volcanic eruption, hydrothermal activity, tsunami; in the case of residential land, a storm or flood; and fire caused by any of these). Dwellings are insured up to a maximum of $100,000 plus goods and services tax (GST) and personal effects are insured up to $20,000 + GST. EQC pays the value of damaged land at the time of the event, or the repair cost, whichever is lower (EQC, 2011). Private insurance companies provide 'top up' insurance over and beyond the cover provided the EQC. The implication of this is that insurance companies may be willing to take on increasingly at-risk insurance policies (i.e. sharing the risk with the property owner and EQC), due to the EQC taking responsibility for the first $120,000. This acceptance of risk sharing does not provide a disincentive for developing at-risk locations, or for innovative risk reduction measures to be employed.

However, in light of this two national insurance representatives and one national state representative highlighted the role of insurance in providing an innovative solution to flooding, after a weather bomb event in 2002. This was in regard to a national insurance company partnering with the district council to instigate flood mitigation measures while retaining insurance cover. This was considered innovative, as it was a first for an insurance company (market) and the local council (state) to work together to provide a reduction in risk to an acceptable level for both parties, and ultimately communities (i.e. civil society) within the district. This initiative sets the scene for the next example, the Peninsula Project.

4.2.2 Peninsula Project

The Peninsula Project was highlighted as innovative by two national insurance representatives, one national state representative; both the regional and district council; a consultant; the local newspaper editor; and the Coromandel Watchdog representative. The aim of the Peninsula Project is to improve the health of the environment and reduce flood risks on the Coromandel Peninsula. The project started in response to the 2002 weather bomb event, and addresses river and erosion issues from the mountains to the sea by integrating three key areas of work - flood protection, river and catchment management, and animal pest control. WRC, TCDC, the Department of Conservation and Hauraki Maori Trust Board are working in partnership to deliver a work programme that will meet the aim. It is considered innovative in that

the various agencies are working together, and it is taking a catchment-wide approach, realising the importance of pest management in retaining important forest canopy, which reduces runoff into streams and rivers. A summary of the project is provided by the Hauraki Herald representative:

> Again it's taking care of something before you, the ambulance at the bottom of the cliff. It's protecting those trees so that they don't die, so that the erosion doesn't happen. So that, you know it's that sort of flow on effect so, so yeah by attacking possums with this pest control to try and prevent some of [the issues] up the coast I guess that's pretty innovative.

The Peninsula Project is a state-led initiative, and is an example of semi-radical, forward incrementation innovation (i.e. moves the field in the direction it is heading; takes the field to a point with others). It provides a rare example of state partners at national, regional and district levels and civil society are working together to achieve a reduction in future flooding risks using a holistic approach. It could also be considered an example of reconstruction/redirection, as it is reminiscent of the catchment board functions that were in place prior to the RMA. Catchment boards took a holistic view of situations like this, focusing on aspects of pest management, forest canopy health, and options for reducing erosion. However, iwi and others would not have been involved in a similar way as today. The Peninsula Project approach benefits the communities in many ways, including ensuring that insurance (i.e. the market) cover continues in the district.

4.2.3 Kahikatea Estate

The third innovative example provided by participants was the Kahikatea Estate development (outlined in Chapter 4). This was highlighted as innovative by the representatives from the regional and district council, although some participants noted it was not necessarily providing adequate risk reduction to property. The developer involved in the development also cited Kahikatea Estate as an innovative solution to the flood hazard and risk. It was cited as innovative due to the conditions placed on the consent (as outlined in Chapter 4), which were considered a new approach in incorporating emergency management provisions into resource consent conditions. In particular, the original idea of having a jet boat on site for evacuation (which was subsequently removed from the application), the private warning system and emergency management plan were considered innovative (a new approach), although it was noted by one representative of the regional council that:

> [The] jet boat was innovation [sic] … I'm not saying it was effective or appropriate.

The emergency management officer from the district council had the following view:

> Every second soul to the lifeboat. That's pretty bloody innovative … That's not innovative. That's stupidity.

And from the District Planner:

> Some would argue that the developers and engineers are being innovative. Kahikatea Estates for example, some would say that that is innovative, but then again perhaps the consent and the conditions of consent are innovative.

The Kahikatea Estate development is considered innovative in that emergency management provisions have been incorporated into the consent conditions – an initiative that was not common practice at the time. However, this merging of emergency management with land-use planning does not necessarily result in effective risk reduction, in that while life safety may be assured via warnings and evacuation, the risk to property remains. In an extremely large flood event, this residual risk could lead to economic and social consequences not only for the land owners involved, but also to the wider community within the district and potentially regionally and nationally. An event of this nature could in turn adversely affect the social wellbeing of those living in the development, wider community and district. Whether this risk is tolerable or not is up to the individual property owners to first be aware of the risk, and second determine the level of risk they are willing to tolerate when purchasing properties in the development.

4.2.4 Whitianga Waterways

One single example raised by a developer was a development located on the east coast of the Coromandel Peninsula. The representative cited this as an innovative development, as described below:

> When we went into Whitianga the whole of what the area of Whitianga waterways was a flood plain, and that all development in Whitianga had a moratorium on it because of severe flooding, and we came along and showed that there was an alternative means of addressing that issue of flooding, intercepting and dealing with it. Now we were fortunate in that we had Pauanui that we could use as an example but it was still extremely difficult for us to get acceptance through the consent process that this was a viable alternative use of the land. It's almost a case of you're wrong until you prove

> yourself right … Well in ours, when we went in, it's probably not new but when we went into Whitianga with the canal development, council had undertaken a number of studies looking at what the options were to reduce flooding within the existing urban area. One of them was, I think it was a 20 metre wide basically concrete chute heading directly to the harbour which cut off the back of town, intercepted all the flood, straight through, which would have been bloody ugly. And we came up with a thing of building the canals, raising the surrounding ground level and creating a residential environment. That was relatively innovative as a means of addressing a pre-existing significant problem ... [the canals] become drainage channels for the flood waters … But to me it's not something which is all that innovative. It is practical, as I say it's a practical solution.

This development provides an example of how innovative thinking (i.e. redefinition via a new point of view), led by the market, provides a sustainable outcome economically, socially, and environmentally, while reducing the flood risk via the design of the canals. While the developer questioned its innovativeness, it does provide an innovative solution to an existing flood problem, in that it was a new and different way of thinking about how to mitigate the flood risk. The first stages of the development has been constructed (see http://www.whitiangawaterways.co.nz/), but the success of the design is still to be tested in a major event.

4.2.5 Backstop walls

The final example provided by both the regional and district council representatives was the use of backstop walls. Backstop walls require the construction of an engineered wall located inland from the coast (i.e. 20m). The wall is buried beneath the ground level, and is only exposed during extreme storm events. Beach sand in front of the wall provides a natural dune buffer to protect properties, which may be relocated behind the backstop wall (Beca Carter Hollings & Ferner Ltd, 2006). These walls have been constructed at Cooks Beach on the east coast of the Coromandel Peninsula. They are considered innovative as they are a mix of hard and soft engineering, are only exposed during extreme events, and are a new mitigation measure in the district. However, there was some question as to whether backstop walls are innovative or not. Views from a regional policy planner (plain text) and hazard analyst (italics) on backstop walls were as follows:

> What about back stop walls. Is that innovative? Is back stop walls innovation or not really?
> *Well I don't, I don't think it is ...*
> No, okay.

> *But, well I guess it is.*
> It's just another way of putting a seawall up ....
> *It's just dressing up a seawall yeah.*
> Yeah, bit of a smoke screen that one …

This in contrast to the District Planner, who stated:

> I suppose actually when you think about it the backstop wall in terms of beach erosion is innovative.

These two examples highlight the confusion around defining what innovation is. While the structures are technically sea walls, they have moved beyond the typical design and incorporated soft engineering into the construction. Therefore, backstop walls are considered to be type of semi-radical innovation, in that it is a 'new generation' of sea wall design. To assist with defining innovation, the definition provided in Section 3 of this chapter is recommended: *An opportunity to plan for positive social, economic, and environmental outcomes in a new way, based on old and new planning principles within planning theory and practice. It requires a vision, leadership, and belief that extends beyond political cycles; is comprehensive and integrated with policies and plans from different sectors; and involves the active and meaningful participation of the community. The outcome of innovative land-use planning is hazard-resilient, sustainable communities.*

In this example, the backstop wall is considered innovative and sustainable (for existing development), as it results in positive environmental changes by not impacting the recreational and aesthetic values of the coastal environment like a traditional structural sea wall defence (e.g. exposed rock wall).

4.3 Opportunities and barriers for innovation in Thames-Coromandel

While innovation for natural hazard risk reduction is occurring within the Thames-Coromandel district, interview participants perceived several common barriers to further innovation being undertaken. These barriers also represent opportunities, in that participants are aware of the barriers, therefore an opportunity exists to move forward and overcome these barriers. From analysing the interview responses, nine primary barriers/opportunities against innovative risk reduction ideas were highlighted, many of which overlap. Figure 5.2 summarises the key barriers and opportunities and their linkages as perceived within the Thames-Coromandel context. These key factors both constrain and provide opportunities for innovative land-use planning for effective

natural hazard risk reduction. 2GP refers to second generation plans, both within land-use planning and emergency management.

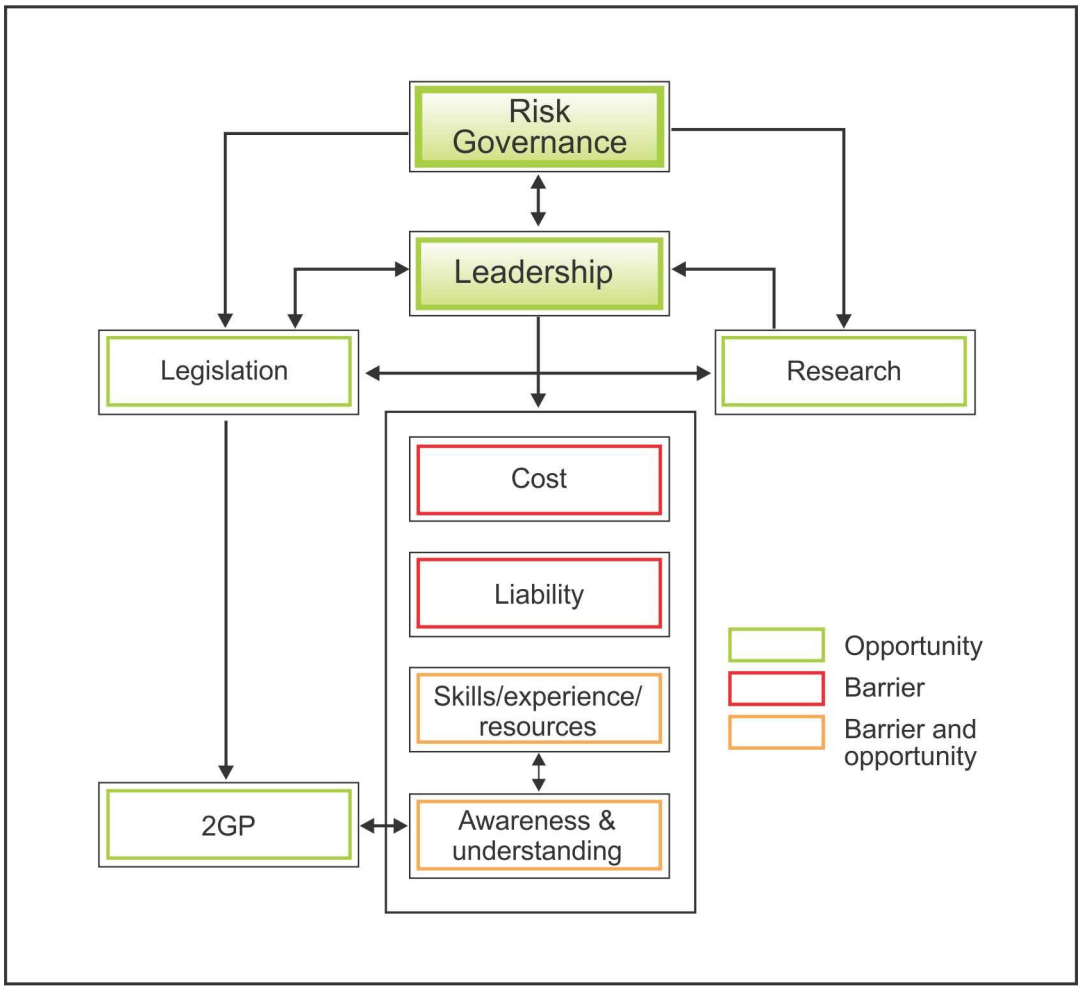

Figure 5.2 Key linkages between barriers and opportunities to innovative risk reduction within land-use planning.

Each of these elements is discussed below. Other barriers highlighted by the participants included people's lack of inventiveness; impact on the community; lack of political will; long return periods for events (e.g. it's never happened here!); and the political cycle (i.e. existing three year cycle is too short). Figure 5.2 presents those factors critical to sustainable development through risk governance arrangements, as shown in the hierarchy of governance arrangements in Chapter 2 (Figure 2.1). In order to have successful risk governance – and sustainable development – the barriers in Figure 5.2 must be overcome, and the opportunities promoted.

4.3.1 Governance

As Healey (2004) surmised, urban governance needs to encourage innovation, accept critique, and have the ability to learn from previous lessons. However, typically for elected officials, the benefits of supporting an innovative idea do not always outweigh the political cost of failure (Goldsmith, et al., 2010). This was highlighted from the representative from the local community interest group:

> Councils have all the sorts of pressures on them, particularly their elected representatives, quite often their staff think short term because of property values and vested interests. So they need something that actually forces them to take a more pro-active and long term thing because if, if elected representatives advocate for something like that, they're probably not going to get elected again. But if there was a mandatory requirement for councils to do this sort of thing and it had real teeth, so they couldn't dodge or fudge the issue, then it takes the pressures off the elected representatives. They no longer have to bear the wrath of the community because it's something that's been imposed on council and it becomes a requirement for them to develop a strategy or whatever to address these issue in a way that doesn't reflect back in any on the elected representatives.

This perspective points to a national policy or standard that could be relied on to provide direction to local government. Leadership is required for this to occur, as discussed in sub-section 4.3.2. A developer had the following insight:

> Well you know your by-laws or whatever it is, you have to have the ability for somebody to put forward mitigation or put forward alternatives rather than the blanket can't do this or can't do that. And that comes down to local bodies and also regional councils. There has to be within their book of rules the ability for people to put forward ideas providing they can justify the risks and what have you. And at the end of the day the problem is *how do you quantify what's an acceptable risk?* [emphasis added].

The emphasised last sentence reflects the elements required of risk governance provided by Renn (2008) in Chapter 2 (Figure 2.2) – being able to evaluate risks in terms of judging tolerability and acceptability. A risk governance framework is required that supports this approach, and reconciles the differences and risk responsibilities (e.g. Handmer, 2008) within and between key players – which comes down to the role of the planner to reconcile and facilitate (as discussed in Chapter 4, Section 5). This issue is discussed further in Chapter 6.

4.3.2 Leadership

Representatives from the state, market and civil society all pointed towards the lack of leadership as being a barrier but also an opportunity to improve risk reduction in the future. Observations from the Planner at the district council included:

> There needs to be the leadership and a comprehension that there actually is a problem … There needs to be an understanding of a sense of the problem, let's us adequately resource it. Let's try and address it. Let's build resilience.

The market response from a developer was similar:

> I think what is required is more leadership … I believe there is a need for centralised, some centralised entities to take responsibility because we, we have consent authorities which don't have the resources to be able to assess on perhaps a one in a hundred.

From the consultant who works for both the state and market, leadership was required at central government level:

> Central government does have an important role though in terms of providing a framework, I'm saying an enabling framework for local government to operate within, and I think at times that hasn't been particularly successful in hazard management and I think that's probably because a lot of it tends to be rather wishy-washy, you deal with it, and you end up with lots of councils having lots of approaches. I don't think that's that efficient.

A representative from the Environmental Defence Society (i.e. civil society) also pointed towards central government:

> I think the problem is we don't have a very kind of proactive central Government agency. MfE hasn't been very strong, and not strong on kind of driving these kind of issues and so we've kind had this vacuum at the centre ...

This quote confirms the findings of Ericksen, et al., (2003), in that central government leadership is lacking. Representatives appeared to consistently agree that central government leadership is key to encouraging innovative land-use planning, highlighted by representatives from the state, market and civil society. In the current political climate, this is not likely to change; however, it does provide the greatest opportunity for risk reduction, by taking leadership and responsibility in the area. This could include providing guidance via a national policy statement, a standard, or comprehensive guidance notes. Leadership was seen to be required from the top

down to ensure consistency, clear policy direction, and tools to assist councils and communities in implementing the new philosophies.

4.3.3 Legislation

Risk governance involves following due process as required by legislation, as outlined by Renn (2008) and discussed in Chapter 2 (refer Figure 2.2). As outlined in Chapter 4, the RMA is the key statute for managing natural hazards. Aspects of the RMA were highlighted as a barrier by district council and the market representatives. The District Council Planner had the following comments:

> … I think that is one of the criticisms of the Resource Management Act is that once, when it was passed in '91, there was this intention to put these National Policy Statements in place but the Ministry just, the Government just backed off and so councils were basically in the situation of having to go it alone.

This quote highlights the opportunity for a national policy statement on natural hazards to be prepared, providing clear guidance and direction on the management of natural hazards and risks. With no national policy, natural hazards are treated differently throughout the country. This is often frustrating for developers who work in different districts, and also leads to natural hazards being treated differently across the country e.g. different levels of protection to people and property are provided in different locations.

As a small council, the TCDC have struggled with balancing rates (with a small rating base on primarily minimal incomes) and projects. The Planner goes on to redirect the RMA barrier onto the institutional governance arrangements of the council:

> So we're prepared to be innovative but again, you know sometimes RMA processes, which, you know, it's not the fault of the RMA, just that council needs to be a bit smarter in a sense and I'm talking here in institutional sense, we've caught ourselves out by not sort of allowing for these sorts of works almost as a permitted activity.

The District Planner had the following view:

> … avoiding is quite hard, unfortunately.

The quote reflects the 'or' challenge of avoid or mitigate under the RMA, as discussed in Chapter 4 Section 3. With no preference for avoidance, mitigation is often the preferred option, regardless of whether it provides an adequate reduction in risk (e.g.

Kahikatea Estates). From the market perspective, one of the developers had the following view:

> The problem that we face is that at the moment the, the rules are very, very straight laced in that it is yes you can or basically no you can't for your own good. Whereas in fact there, what is happening is it's discouraging for want of a better word, innovation or alternative ideas, alternative options … With people like ourselves who are developers who are looking at then preparing a product and passing it on, I think there is definitely a need for us to be able to show that we recognise what the risks are and what we've done to try and mitigate.

And from the real estate agent:

> Well they shouldn't have the opportunity of their decisions to live in that environment taken away because you don't know how often, or when [a natural hazard event could occur], and if we keep on legislating for that once, or maybe situation, I mean we're just going to stifle entrepreneurial development and take away people's options. But I add to that very quickly, if they want to go into those environmental situations of risk, well then they've got to understand and they must provide maybe some of those safety factors required ...

From this market perspective, the policies and rules in plans are too restrictive, and do not easily encourage innovative ideas. Contrary to the views of the state and market above, a representative from the Ministry of the Environment defended perceived barriers such as the RMA:

> Sometimes there maybe barriers in place for very, very good reasons like legislative ones or within District Plans or whatever which may be a barrier to an innovative solution however there might be good justification for it or reason for it, in which case you know sometimes we need to be their protector, ourselves from ourselves.

Exposure can be limited by a stronger prescriptive planning system, rather than a performance-based system where there is always an engineering solution or trade-off available (Handmer, 2008). Any solution to this problem of balancing prescriptive rules and allowing and encouraging innovation needs to be flexible to allow for innovative ideas while still safeguarding the well-beings of a community in a sustainable context. A number of opportunities were raised in regards to the legislation, and in specific the RMA – and these could also be perceived as barriers. The iwi representative summarised one general opportunity as follows:

> The tools are there, but they're not being utilised for one reason or another.

This reflects a general feeling nationally about the utilisation of the RMA, however it was not a view supported by others. For example, this from a regional council representative:

> … quite often what we're missing is the tools …

The district council emergency management officer suggested the following:

> I would see that more robust laws, or more robust structure around what you can and cannot do subdivision wise I think would be helpful. I mean when central government says you can't or you can or maybe that you can't, local government leaps in and says, yes, yes, yes. That's what we've got to do. Maybe that's what's necessary so more robust, if that's the right word but what I mean by robust I mean very clear not negotiable guidelines. So that you don't have the subdivider with plenty of money being able to take on local councils and win … I think legislative requirements are more robust … but they need to be less bureaucratic too. More clear, more concise. You see we've tended to move away in recent years from prescriptive legislation into what we call enabling. We now write legislation that will enable you and me to reach our aspirations. That's crap. If you want a law and it's necessary sometimes it needs to be prescriptive doesn't it? You will not build on land that is below a certain level, relative to the sea level. Now what about if we do this, what about we do that. Never mind that. We just say you don't do it. So that land's out and it's out for all time.

The District Planner made a link to other legislation and inconsistencies with timeframes, as discussed in Chapter 4:

> I think there's some, some changes, the difference between the Building Act and the RMA I think needs to be aligned and obviously to the 100 year event not the 50 year event.

A local community interest group representative also had some insights about the RMA opportunities:

> Well I think the RMA was brought into effect when precautionary principle was in its infancy. And it really does look at remedying effects rather than actually taking a much more precautionary approach and I mean that's part of, you know when there's talk about you know that councils need to have a much stronger pressure to deliver, if there was the legislative framework that did that and I think the only time we're going to get a real change in RMA and not stuff that's just given, driven by vested interests which is what's happening at the moment, is, or when you bring in a whole new framework which the oceans policy some ways addresses that because it would force a look at the RMA

> in a much more holistic way that what it does now.

As mentioned in a number of quotes above, guidance was also an area highlighted as an opportunity to provide examples to councils on innovative ideas and how they were managed. This view was also supported by a developer:

> I think that there is a need for some performance standards so that this is the minimum outcome. You tell us how you're going to achieve it and show how it's going to work.

Legislative change for liability concerns was also raised by a national insurance representative as an opportunity to increase risk reduction initiatives:

> … that might be where some legislative work needs to be done to give local authorities a little more, perhaps under the Local Government Act or something, give them a little more immunity so that they can … come out from behind the barricades ... I think they should be made immune from any sort of especially second order results of what they might release so that they're somehow free to release information to be pro-active in the public interest.

The findings from this sub-section relate to those recommended changes to strengthen legislation for natural hazard management outlined in the summary and conclusion of Chapter 4. Any sort of change requires leadership and champions within organisations, as outlined by Velasquez et al. (2005) and Kendra & Wachtendorf (2006) in Section 2.2 of this chapter. Legislative change could provide more certainty for developers if more prescriptive, perhaps via performance measures based on community well-beings. But herein lies the conundrum, where too much prescription can constrain innovative risk reduction, but provide more certainty on requirements; whereas not enough prescription causes uncertainty around what innovations are considered appropriate.

4.3.4 Skills/expertise/resourcing

The determination of scientific and technical conventions are integral to the risk governance framework (Renn, 2008). However, the skills and/or expertise and resourcing of council staff required to assess innovative applications was perceived as a barrier by both the regional and district council representatives, the market (developer) and a representative of civil society. For example, the regional council representative in regards to engineered structures stated:

> … the building inspectors, they're not set up to handle it [innovation]. They don't

> actually know what standards they should be imposing so there's kind of, there are limits to how we cope with innovation.

In a similar manner, the developer makes the following insight:

> … we have consent authorities which don't have the resources to be able to assess on perhaps a one in a hundred [applications]. Someone will come up with something which is out of the norm, they don't have the sophistication, they don't have the skills to be able to assess it …

The Environmental Defence Society representative had the following statement:

> … some councils do do innovative things from time to time, particularly regional councils who have more resources and have scientists and I've seen much more innovation at a regional council level. District councils don't tend to have scientists and the time to think and they don't do their own research and they're much more kind of delivering services but you will get from time to time innovation coming out of councils but you can't rely on it, it just tends to kind of happen now and again and then gets knocked on the head when you get a new council elected that doesn't approve of what they're doing so you can't really rely on that.

From this statement, there is a perception that at a national level the regional councils are better resourced than district councils, and that a decision may come down to that of the elected councillors (who are representatives of their communities). The following statement from the district emergency management officer highlights the frustration of staff in regards to resourcing for promoting risk reduction initiatives and assessing consent applications by planners and emergency management officers:

> It's not happening and I suppose I'm possibly not helping the process from the point of view is that my work load is horrendous. I'm always going to be understaffed. Under-resourced, that's the right word. I'm always going to be under-resourced. And I mean I cover three councils.

Resourcing is therefore crucial to further integrating risk reduction initiatives under the CDEM Act into land-use planning under the RMA (as discussed in Chapter 4), and is currently a barrier to this integration in the Thames-Coromandel district.

4.3.5 Liability

Liability was highlighted by regional and district council representatives as a barrier to innovative ideas being taken up. For example, according to the regional council

representative:

> I think one of the problems is about liability. And if you're a council you maybe move to an outcomes based plan and you say if you can deliver these outcomes through your development, cool. But if you let someone be innovative and new and fresh and exciting, and it goes wrong, because they're not all going to go right, who's liable?

And from the district council Planner:

> … innovation tends to be stymied by the fact is that if you work for any council you are terrified of the consequences ... The fear of reprisal is actually preventing us from being innovative ... Because there's a fear of consequence. There is a fear of consequence but it's also, a lack of legislation or a fear of legislation.

From these perspectives, any approach to innovative risk reduction must address liability concerns, either via legal opinions or governance arrangements (refer Renn, 2008, Chapter 2). As shown in Figure 5.1, the state must have an internal governance framework that allows for innovation within council and externally (i.e. the market). This can only be effective if the liability issue is addressed within the internal governance framework, so that innovative ideas are encouraged.

4.3.6 Cost

Kendra and Wachtendorf (2006) highlight that costs are often a barrier to innovation. Indeed, cost was considered an issue in Thames-Coromandel, with representatives of the state (at national and district level), market and civil society all noting cost as a barrier to innovation. An example of this view from a developer:

> … if you are going to do something that's innovative and all of that, it's going to be more costly. So if the market is not buoyant or if the market's in, you know where it is at the moment, you know you probably struggle to do normal things never mind something that's a bit innovative.

From this statement, the cost issue is influenced by the market, and what the economic environment is like at the time. This is similar to the local community interest group representative:

> … any options they put forward are just not going to be adopted because they're seen as too expensive or they're going to have all those risk factors in terms of property values so it just doesn't happen.

This quote includes reference to a commonly perceived cost – cost to the property owner from perceived devaluation of property in regards to a mitigation measure. From a council perspective (i.e. instigating their own innovative solutions for a specific project), the following cost barrier is highlighted from the representative from Service Delivery:

> I think there is a need to continue to look for innovation and to do things differently. I think it just comes down to as much as anything, priorities at the time and where the effort goes and the fact that any one authority or agency can only ever afford to have so many projects underway at any one point in time ... and there's a limit to how much the community can afford.

A national state representative from MCDEM also highlighted the following funding barrier to exploring innovative risk reduction:

> To a degree I'm going to say it could be to do with lack of funding into this area for relevant research.

Cost is therefore an issue for state led initiatives, with the economic environment somewhat dictating what can be achieved in the market.

4.3.7 Awareness and understanding

According to Renn's elements of risk governance (2008, refer Chapter 1), mutual understanding is a key part of successful risk governance. However, the final barrier to innovation was awareness and understanding of risk and innovative solutions. This was predominantly highlighted by the state sector (at national, regional and district levels), and also by the market (two representatives commented). The Ministry of the Environment viewpoint from one participant was:

> Hard engineering has often been effective and can be seen to be effective and is simply understood. I mean it's a much simpler thing to understand how a seawall or a concrete barrier will stop something than other aspects, other things you might do ... So it's actually a much harder argument to, the softer solutions the more innovative solutions are harder to argue. Particularly if the innovative solution says get out of there, you can't be there.

From a regional state viewpoint, the following was noted:

> Because innovation means it's not tested. So there's [an] unknown and uncertainty about [it].

Two district council representatives had the following comments; first from the senior politician, second from the District Planner:

> Well, the flat earth society probably would be a big barrier. You know I think a lot of it is it often falls into the too hard basket ... I think there's perhaps a little bit of reluctance because it's like well we've never seen that done before so we're not so sure that it's going to work. But we've seen, we've seen groins, so we want to put a groin here because we've seen a groin build up sand on this side.

> I don't really know what innovative solutions are because you're dealing with people, quite often, and they're humans and they have very strong views and at the end of the day planners are people and you know there's no real certainty around a lot of the information so that's a real weakness. And I don't know that there'll ever be a hundred percent certainty about stuff ... There's firstly showing the flood risk. To be honest it's only a model so we're putting a lot of faith in the model and you know with any flood event things can happen and the water can go somewhere else and so potentially we're saying this is what will happen but it may not happen like that.

From a market perspective, the following two quotes are provided from an insurance representative and a developer:

> … because of the nature of local authorities, being democratic. They come up with great ideas. People don't understand them so they don't buy into them or they think they're too expensive up front and they don't realise that their long term returns will make sure that they've got themselves a thriving culture or thriving community. So they react to new ideas that they don't understand by saying we won't do that. That's why, it's the nature of democracy and democracy sometimes can be a very cumbersome process.

> … risk reduction and innovation is usually viewed as having been untested ... so there is that unknown.

Awareness and understanding of natural hazards and new ideas can be both a barrier and opportunity to up-skill staff and communities on options.

4.3.8 Second generation planning opportunities

In order to merge CDEM risk reduction policies into land use plans, second generation planning (2GP) for both sectors provides an opportunity to ensure policies are consistent. It also allows for more traditional land use plans to be updated to reflect

current thinking and changes in management options that allow for innovative risk reduction solutions. As a regional council representative stated:

> We don't give people the time or the ability and we fall on our traditional [ways] because that's what our policies say ... But existing development it gets pretty difficult. Or infill. When you've got infill. And that's the only thing that's going to stop is things like tightening district planning rules.

By following due process (as outlined by Renn, 2008), the second generation process provides an opportunity to improve risk reduction. However, any comprehensive review of plans takes resources, which may be limited at some smaller councils.

4.3.9 Research

Expert systems are a critical element of Renn's risk governance framework (refer Chapter 1 Figure 2.2). Connection with researchers was one area that was highlighted by a regional state representative. There is an opportunity for researchers to work closer with council staff by employing methodologies that encourage interactions between staff and researchers. One approach which has proved successful in this research and other research projects (e.g. Saunders, et al., 2011) is action research, which is outlined in Chapter 3. Research was also highlighted as an area of improvement from a national state representative, particularly following events which have impacted on communities. The participant from MCDEM noted reviews and recommendations are important, and that:

> … some of those recommendations might be more research but they might also be just a change in the current practice. They could be a recommendation that District Plan statements change.

However, a barrier to research is funding (as highlighted in Section 4.3.6 of this chapter), which is often limited and reactive to events.

5. Summary and conclusions

This chapter outlined two main contributions to this research. First, it provided an introduction to the concept of innovation and its role in risk governance and land-use planning. Second, it presented the findings from interviews on innovation in the Thames-Coromandel District, in particular the awareness of hazards in the district, innovative risk reduction which has been accomplished, and barriers and opportunities for risk reduction.

From the literature, there are five different types of innovation that are relevant in this research:

1. Innovation in business – contributes the 'language' of types of innovation;
2. Social and community innovation – requires leadership within the community that recognises and supports risk reduction needs and/or challenges;
3. Environmental and sustainable innovation – any innovative solution should be environmentally sustainable;
4. Innovation in risk governance – risk governance arrangements must both support and allow for innovation both internally (i.e. the state) and externally (i.e. the market, civil society); and
5. Innovation in land-use planning – results in sustainable, positive environmental change.

The significance of integrating these five types of innovation is that a definition is now available for planners to use to assess whether an approach is innovative or not. To bridge this gap, the following definition was presented: *An opportunity to plan for positive social, economic, and environmental outcomes in a new way, based on old and new planning principles within planning theory and practice. It requires a vision, leadership, and belief that extends beyond political cycles; is comprehensive and integrated with policies and plans from different sectors; and involves the active and meaningful participation of the community. The outcome of innovative land-use planning is hazard-resilient, sustainable communities.*

From the case study undertaken of the Thames-Coromandel district, awareness of natural hazards is mixed between participants. Specific hazards are listed inconsistently within the CDEM Group Plan, RPS, and district plan. However, innovation is occurring in the district, predominantly led by the market. Leadership was highlighted as a key element for innovative risk reduction, at all levels – national, regional, and district; and within the state, market and civil society. Incorporated into governance is leadership, which influences how the RMA and other legislation (i.e. CDEMA, BA, LGA) is administered, the amount of funding for research, and how key barriers and opportunities are managed. While cost and liability will often always be a barrier, skills/experience/resources and awareness and understanding can be overcome to become an opportunity for up-skilling and gaining knowledge.

The key issues in Figure 5.2 are consistent with those outlined by Renn (refer Chapter 2, Figure 2.2). In Figure 5.2, the opportunities and barriers of risk governance, legislation, skills/expertise/knowledge, liability, awareness and understanding, second generational planning and research all relate to aspects of Renn's elements of risk governance. In particular, elements of due process, legal statutes, determination of scientific conventions, liability, mutual understanding, and expert systems.

From the case study, it became apparent that an innovative risk governance approach is required that meets the shortfalls of the existing risk governance arrangements i.e. addresses the barriers and opportunities outlined above. As well as addressing these, improvements are also needed in the following areas:

- Consistency required between CDEM Group plans, RPSs and DPs. At the present time there is no consistent approach to including and ranking natural hazards (refer legislative linkages Figure 4.1, Chapter 4);
- Levels of risk need to be quantified and qualified to provide certainty to council staff and applicants on what level is appropriate;
- A move away from the current approach to mitigation in planning, which is not reducing risks to society (e.g. Kahikatea Estate and the Holt development, refer Chapter 4), towards a risk-based approach;
- The various tools available for in the RMA - such as policy statements and environmental standards – need to be implemented (e.g. Ericksen, et al., 2003) to provide clearer consistent national direction for dealing with risk. This approach could defuse the requirement for more prescriptive legislation.

If these areas can be addressed – which will take leadership at both central and local government - then we are a step closer to sustainable, resilient communities that manage their hazards without compromising their social, economic or economic requirements. This chapter has contributed to the aim of this research by investigating types of innovation relevant to land-use planning; ascertaining that innovation is taking place in the Thames-Coromandel district; and outlining key barriers and opportunities to implementation. This has allowed a further understanding of the issues, findings of which will be applied to the following chapter. Chapter 6 addresses the above suggested improvements by offering a risk-based governance framework that follows a three-step methodology for risk-based planning, based on consequences. This

approach allows for communities to quantify and qualify their levels of risk, and in doing so offers an innovative approach to assist in reducing risks to natural hazards.

CHAPTER 6 A risk-based framework for innovative land-use planning for natural hazard risk reduction

1. Introduction

The aim of this research is to develop a risk-based framework for innovative and-use planning which enables risks from natural hazards in New Zealand to be reduced. From observations and findings made in the previous chapters, this chapter will fulfil the aim of the research by outlining how the existing risk-based land-use planning framework can be improved to encourage better decision making for natural hazard risk reduction. This framework has been achieved by employing the PAR approach outlined in Chapter 3, which involved staff from eight councils (including regional, unitary and city/district councils). The framework is compatible with the current legislative context in New Zealand outlined and critiqued in Chapter 4; and was developed with insights gained from the case study presented in Chapter 5. The outcome is a framework that will allow both planning policy and developers to be innovative when managing risks to natural hazards. Within the context of sustainable development, this framework will allow any well-beings important to a community to be assessed against consequences of an event. For the purposes of this research, the underpinning sustainable development well-beings of health and safety, social, economic and environmental are assessed against consequences.

As Renn (2008) surmised, there are two major challenges facing risk governance: generating and collecting knowledge about the risk, and making decisions about how to handle or treat the risk. Indeed, as outlined in Chapters 4 and 5, in many cases the current approach to natural hazard planning and risk reduction is not reducing risks – rather, in some instances new development is increasing risks to people and property. In part, this has been due to focussing on the likelihood of an event occurring rather than the consequences of the event. Therefore a different approach is required to ensure that risk reduction and sustainability are being achieved.

There are two key purposes of this chapter: 1) to provide the context for risk governance and management in New Zealand; and 2) to present risk-based approach to land-use planning for natural hazards. The risk governance context is based within the Risk Management Standard (Standards Australia/New Zealand, 2009), which is consistent with the elements of risk governance provided by Renn in Chapter 2. Within this risk management context the three planning approaches to risk will be outlined: the risk-based, precautionary, and participatory approaches, as outlined in Chapter 2. This contextual setting provides the basis for the second aim of the chapter – to present a risk-based approach that allows for innovative land-use planning for natural

hazards. This approach consists of three key steps: assessing consequences of an event; determining the likelihood of an event of that magnitude occurring; then taking a risk-based approach to policy and resource consents. An example from Bay of Plenty Regional Council is provided presenting how the approach can be incorporated into a regional policy statement. The result is an approach that is appealing to the market, civil society and state, in that for individual parcels of land, planning policies and consents become more restrictive as risks increase, rather than the often-used practice of blanket zoning.

2. Risk governance and management

Chapter 2 provided a discussion of risk governance. Following on from that discussion, risk governance sets the institutional context for risk management (Standards Australia/New Zealand, 2009). The Risk Management Standard 31000:2009 recommends that three key stages are implemented to ensure successful governance of risk management, namely principles, a framework and process. These three stages are presented in Figure 6.1. The first stage outlines 11 key principles for risk management to be successful, and is effectively a best-practice check list for effective risk management. The second stage provides an adaptive management framework that provides the foundations and arrangements for all levels of an organisation. The key design features of the framework are that it: understands the organisation and context; establishes risk management policies; is accountable; is integrated into organisational processes; is resourced; and has internal and external reporting mechanisms (Standards Australia/New Zealand, 2009). The third stage is the risk management process.

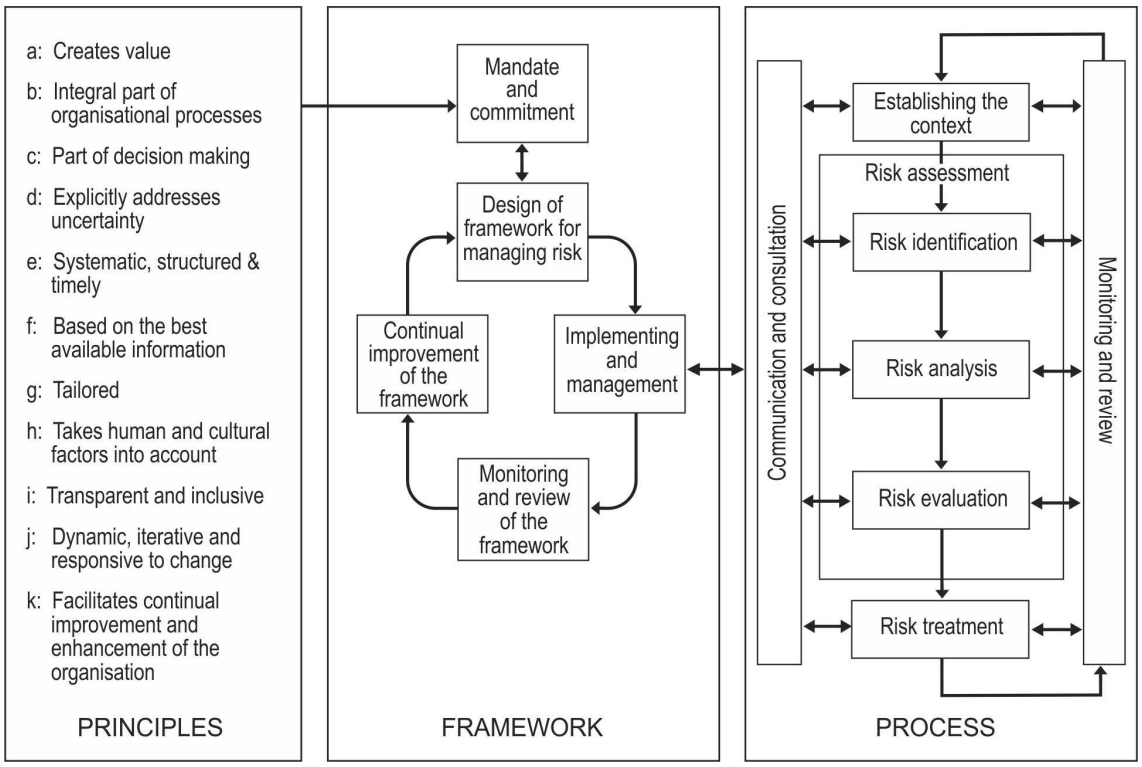

Figure 6.1 Three recommended stages for effective governance of risk management (Standards Australia/New Zealand, 2009, pvi).

The above approach is intended to be adaptable to different organisational contexts, and is therefore applicable to land-use planning for natural hazard risk reduction. It is noted that in the process section of Figure 6.1, 'Communication and consultation' is required, which is one aspect of the participatory planning approach outlined in Chapter 2. However, participation with key stakeholders (including communities) should not be limited to feedback on analysis, alternatives and/or decisions as outlined in the IAP2 public participation spectrum (Figure 2.3 Chapter 2); rather, opportunities for involvement and collaboration should be taken when and where appropriate. Within a land-use planning context, any natural hazard risk governance framework should primarily be a collaboration between planners and emergency management officers, with other key stakeholders (such as river engineers, developers, communities), and others involved in managing natural hazard risk also included. Within the context of this research the terminology 'risk treatment' is interchangeable with risk reduction measures through land-use planning. This chapter will outline a framework and process based on Figure 6.1 for incorporating natural hazard risks into land-use planning, which also meets the principles in Figure 6.1.

Within the context of risk governance discussed in Chapter 2, the framework presented in Figure 6.1 is consistent with the key elements proposed by Renn (2008), in that the approach is:

- based within a legal framework (as discussed in Chapter 4);
- process based;
- provides leadership via having mandate and commitment at the top level;
- takes into account cultural factors (i.e. political, economic, social);
- links to other networks via communication and consultation;
- forms part of the organisational process/institutional design;
- includes risk assessment, analysis, management and communication;
- the risk assessment includes social, economic and other influences; and
- builds upon and uses scientific knowledge.

When discussing risk governance and management, it must be acknowledged that risk perception and acceptability differ among individuals and other groups in our community (e.g. market, state, civil society) for cognitive, social, and cultural reasons (Durant & Boodphetcharat, 2004; Handmer, 2008; Johnston, et al., 2011; Slovic, Fischhoff, et al., 2000; Slovic, Kunreuther, & White, 2000). People's understanding of, and response to, risk are determined not only by scientific information, direct physical consequences or economic gain, but also by the interaction of psychological, social, cultural, institutional and political processes (Johnston, et al., 2011). This perceived risk can be amplified or attenuated via personal, social psychological and community factors (Renn, 2008). Effective risk management must therefore involve the consideration of the wide spectrum of social factors that determine levels of acceptable risk and influence human behaviour (Johnston, et al., 2011). These pluralistic[11] ideals have not been extensively considered in this thesis, but are integral to the framework

[11] According to van Asselt (2000), pluralism within a risk context means that different interpretations of uncertainty and different risk perceptions are legitimate.

presented and will form the basis of further research. The framework outlined in Section 4.2 of this chapter can be adapted to include a multitude of social factors via consequences. It is important that risk management be seen as a multi-disciplinary activity and that it works, accordingly, to develop models that reflect the dynamic and contingent nature of risk phenomena (Johnston, et al., 2011).

In order to understand the relationship between risk governance outlined in this section and its implications for land-use planning, the planning approaches to managing risk are outlined in the following section.

3. Planning approaches to risk

Chapter 2 outlined four approaches to planning: rational, rational-adaptive, incremental, and participatory. Within these approaches, planning for risk needs to be incorporated. Land-use planning forms an integral part of the risk management process by providing a tool for risk treatment options. As presented in Chapter 4, when discussing risk treatment options the role of the planner is three-fold: to facilitate community engagement and participation; to interpret and administer RMA responsibilities; and to reconcile public and private interests. Within the context of these roles, Klinke and Renn (2002) promote three approaches to managing risk which can be applied to land-use planning:

1. Risk-based approaches, including numerical thresholds (i.e. quantitative safety goals, exposure limits, standards, etc.);

2. Reduction activities derived from the application of the precautionary principle (e.g. ‘As Low As Reasonably Practical’ (ALARP)); and

3. Standards derived from a participatory process, including charettes, deliberative rule making, mediation, and focus groups.

These three approaches can be used in isolation, or as a combination, by the state, market and civil society. Each approach refers to levels of risk as defined in Chapter 2. Following is a brief summary of each approach; the risk-based approach is further detailed in Section 4 of this chapter.

3.1 Risk-based approach

The risk-based approach is based on the numerical assessment of probabilities and potential consequences (Klinke & Renn, 2002), and can provide important information

for policy (Stirling, 2010). The basis of the risk-based approach is determining levels of risk, which need to be defined with key stakeholders (e.g. state, market and civil society). Within the New Zealand planning context, generally the resource consent status becomes more restrictive as risks increase. Figure 6.2 presents the relationship between increasing risk and resource consent categories available to councils to use under the RMA.

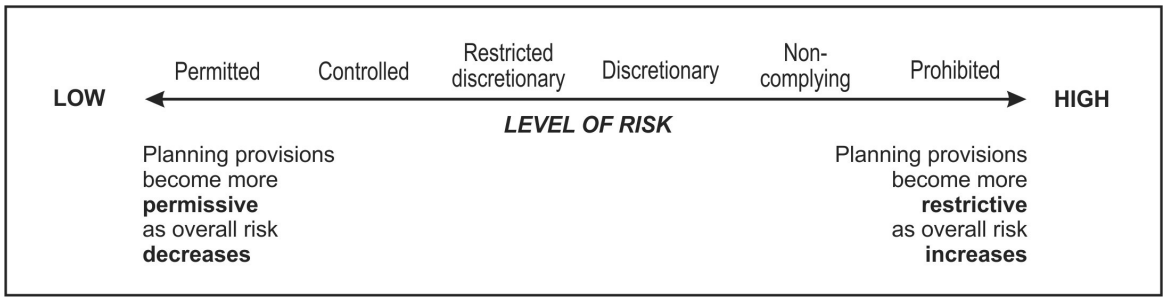

Figure 6.2 Relationship between increasing risk and resource consent status (adapted from Saunders & Glassey, 2007, p49).

Risk-based planning can make a substantial contribution to reducing risks to a tolerable level, by requiring more restrictive resource policy and consents as risk increases. However, to ensure that this approach is successful, risk assessment must become integrated into land-use planning policy (MIACC, 1995). For this to occur, substantial research may be required to ensure there is a reliable scientific basis for decision making (Vegter, Lowe, & Kasamas, 2003). However, even if there is good qualitative information available (e.g. for the risk-based approach) about a particular risk, the information can still be contested. When there is a certain level of uncertainty or a lack of knowledge, a precautionary approach is required, as discussed in the following section.

The risk-based approach forms the foundation of the innovative framework outlined in this chapter. If information required to employ a risk-based approach is not available, a precautionary approach may need to be considered, as discussed below.

3.2 Precautionary approach

The precautionary principle presumes that where there are serious threats of irreversible damage or loss of life, the lack of full scientific certainty should not be used as a reason for postponing measures to prevent risk reduction (Ersdal & Aven, 2008). It therefore provides an approach that incorporates uncertainty, as discussed in Appendix 2. One method of using the precautionary approach is to apply the ALARP

principle, an internationally accepted standard to judge the acceptability of risk and associated risk reduction measures. The principle recognises that above a certain level (threshold), risk will not be accepted by individuals or the community, despite any benefits associated with being exposed to that risk (Standards New Zealand, 2004). Figure 6.3 presents this principle.

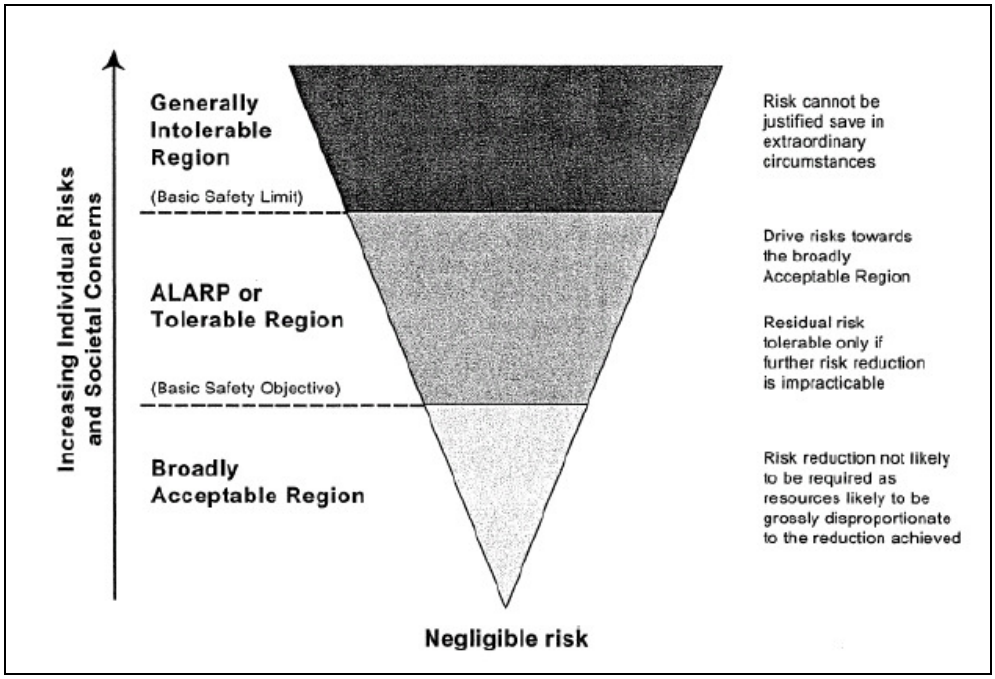

Figure 6.3 ALARP principle (DPMC, 2007; Health & Safety Executive, 2001; Standards Australia/New Zealand, 2004; Tonkin & Taylor, 2006).

In New Zealand, the Coastal Policy Statement (NZCPS) and case law provide guidance as to when the precautionary principle should be used. Policy 3 of the NZCPS states that a precautionary approach is to be adopted towards proposed activities whose effects on the coastal environment are uncertain, unknown, or little understood, but potentially significantly adverse (Ministry of Conservation, 2010). The policy also recommends that a precautionary approach is taken in relation to climate change effects. However, this wording is not as strong as that in the 1994 version of the NZCPS, which specifically refers to coastal hazards. In this version, Policy 3.3.1 emphasised that a precautionary approach should be adopted towards the identification of areas subject to coastal hazards, and towards proposed coastal hazard responses, particularly those whose effects are as yet unknown or little understood (Jacobson, 2004a; Ministry of Conservation, 1994).

A number of relevant points of law on the precautionary principle are provided in the Environment Court case *Sea-Tow Ltd v Auckland Regional Council* (Decision number A066/2006) including that a consent authority may use its discretionary judgement to grant or refuse resource consent to be influenced by the precautionary principle; and that a precautionary approach should only be applied where there is scientific uncertainty or ignorance about the nature or scope of environmental harm. The precautionary approach may include emergency management provisions (i.e. warnings, evacuation maps and plans, education and communication of risk), and provisions under the Building Act 2004, where a title can be 'tagged' when a building consent is applied for if certain hazards exist.

As Figure 6.3 shows, there is a low level of risk which will generally be accepted without resorting to specific mitigating measures – this is represented by the acceptance threshold. Between these two thresholds is a region where risks may be tolerated as long they are kept ALARP. Risks within this region are tolerated because of their risk / benefit ratio or because the costs of further treatment are not acceptable (Tonkin & Taylor, 2006). To verify ALARP, procedures mainly based on engineering judgments and codes are used, but also traditional cost benefit and cost effectiveness analyses (Ersdal & Aven, 2008). Further guidance is also provided by the Health & Safety Executive in the UK (see http://www.hse.gov.uk/risk/theory/alarp.htm).

Value judgements are required to assess ALARP. These depend on an individual's familiarity with the risk, their trust in the effectiveness of existing risk controls, and their perceptions of the risks and benefits of the activity. The same risk may seem negligible to one person, yet very high to another. A decision on risk therefore needs to take into account all those affected and subjected to the risk (Slovic, Kunreuther, et al., 2000; Standards New Zealand, 2004).

3.3 Participatory approach

The third approach encourages a participatory approach (as outlined in Chapter 2) to managing risk. Within the context of the New Zealand planning framework, various consultation requirements under the RMA provide the minimum level of participation required. However, this minimum level should be expanded through to collaborative goals for risk management, where the regulatory authority partners with the public / key stakeholders in each aspect of the decision, including the development of alternatives and the identification of a preferred solution, i.e. participatory decision making (refer Chapter 2).

Mileti (1999) outlines six objectives required to treat risks from natural hazards in a sustainable way. One of these objectives is to adopt local consensus building, as a sustainable community selects treatment strategies that evolve from full participation among all public and private stakeholders. Mileti goes on to state that "the participatory approach itself may be as important as the outcome" (Mileti, 1999, p6). Achieving this objective requires a participatory planning process to be in place. Burby et al., (1999) concluded that the promise of local planning lies in the possibility that zoning can reduce loss through appropriate location and design of development and that public participation in the planning process can create a knowledgeable citizenry supportive of hazard mitigation policies.

When confronted with risk, strategies should be in place to build up awareness of the risk. Decision makers (i.e. regulatory bodies) should have confidence in their abilities to make decisions, and take responsibility for their actions in response to the risk. Stakeholders including policy makers, communities, the market and scientists must trust these decisions. To achieve this, the involvement of all those affected should be incorporated into the process, so that they are able to integrate any remaining uncertainties and ambiguities into their own personal assessment of risk, benefits, and tradeoffs (Klinke & Renn, 2002). The participatory approach also provides the opportunity for a pluralistic approach towards a more equal partnership between social and 'natural' science advice in policy advice, which can lead to improved integration of quantitative and qualitative methods; articulating risk assessment and management concepts; resolving issues around uncertainty; and assisting in reconciling risk-based and precautionary methods (Stirling, 2010). The pluralistic participatory approach can also assist the complex problem of overcoming ambiguity when there is disagreement over risk contexts, treatment options, outcomes, and benefits or harms between key players e.g. the market, state, and civil society (Handmer, 2008; Stirling, 2010; van Asselt, 2000).

3.4 Which approach is most appropriate?

When a decision is required on what approach is most appropriate to use, policy makers need to evaluate what information they have, how complete it is, and what the level of uncertainty is. Table 6.1 summarises which approach should be used depending on the information available. A combination of approaches may also be used.

Table 6.1 Choice of approaches for managing risk (based on Klinke and Renn (2002) unless specified).

Information available	Recommended approach	Planning approach	Examples within land-use planning
Probability of occurrence and extent of damage are relatively well known; uncertainty is low	Risk-based	Rational-comprehensive (Randolph, 2004)	Risk-based approach to resource consents (refer Kerr, et al., 2003; Saunders & Glassey, 2007)
Greater levels of uncertainty, lack of knowledge	Precautionary	Rational-adaptive (Ericksen, et al., 2003)	ALARP, emergency management (i.e. warnings, evacuation), use of s72 of the Building Act (limits liability)
Mix of above	Participatory	Participatory (Arnstein, 1969; IAP2; Randolph, 2004)	Consultation, public participation in developing policy, conflict resolution

The approaches in Table 6.1 involve varying levels of research, analysis, consultation and participation. When the availability of quantitative risk information is low, a higher degree of public participation is required to debate and overcome the issues. When a higher degree of quantitative risk analysis is available, more reliance is placed on the information, and public participation to achieve acceptable outcomes is reduced as the effects are well known and accepted.

Regulatory planning approaches to risk potentially provide the most powerful means of risk reduction, as they reduce the number of people and properties in at-risk locations. They thereby provide for people's health and safety, ensure sustainable development, and increase the resilience of communities. However, they can be legally and politically problematic (Olshanksy & Kartez, 1998).

Legally, private property rights can increase risks to people and their property where existing uses cannot be regulated against. Therefore, Olshanksy & Kartez (1998, p187) recommend that:

> … hazard related land use regulations should clearly serve a legitimate public interest, be supported by scientific data demonstrating a connection between the regulation and the public interest, and should not render land valueless.

Politically, a transparent decision making process needs to be applied. Whichever approach is applied, any decision making should consider the issues shown in Table 6.2, as outlined in Standards New Zealand (2004, p82). This ensures that even for the most highly contested risk, decisions can be shown to be based on the consideration of various issues, although how much weighting is given to each (e.g. leverage versus effects on the environment) can be questioned.

Table 6.2 Decision making issues to be considered of planning options (adapted from Standards New Zealand, 2004, p82)

Acceptability	Is the risk reduction option likely to be accepted by relevant stakeholders?
Administrative efficiency	Is this risk reduction option easy to implement or will it be neglected because of difficulty of administration or lack of expertise?
Compatibility	How compatible is the risk reduction option with others that may be adopted?
Continuity of effects	Will the effects be continuous or only short term? Will the effects of this risk reduction option be sustainable? At what cost?
Cost effectiveness	Is it cost effective, could the same results be achieved at a lower cost by other means?
Economic and social effects	What will be the economic and social impacts of this risk reduction option?
Effects on the environment	What will be the environmental impacts of this risk reduction option?
Equity	Are risks and benefits distributed fairly e.g. do those responsible for creating the risk pay for its reduction?
Individual freedom	Does the risk reduction option deny any basic rights?
Jurisdictional authority	Does this level of organisation or government have the authority to apply this option? If not, can higher levels be encouraged to do so?
Leverage	Will the risk reduction option lead to additional benefits in other areas?
Objectives	Are organisational objectives advanced by this risk reduction option?
Regulatory	Does the risk reduction option (or lack of option) breach any regulatory requirements?
Political acceptability	Is it likely to be endorsed by the relevant government authority? Will it be acceptable to communities?
Risk creation	Will this risk reduction option introduce new risks?
Timing	Will the beneficial effects be realised quickly?

Whichever approach(es) are preferred, there needs to be an opportunity to integrate principles of risk (e.g. Renn, 2008; van Asselt, 2000), innovation, participatory planning (e.g. Healey, 2004), and hazards management (e.g. Burby, 1998b; Mileti, 1999), to ensure that the management of natural hazards does not continue along the 'business as usual' process, which is not creating sustainable communities. In order to achieve this, the contested nature of risk creation, sharing and bearing needs to be acknowledged and addressed (Burton, et al., 1993; Handmer, 2008). For example, Handmer (2008) highlights that institutional frameworks actually encourage developers to temporarily take on risk while physically developing a site, even though the burden will eventually fall on those who end up living in these locations, and the local authorities who are required to respond and assist in recovery after an event.

Within this context and focusing on the risk-based approach, the following section will outline an emerging, innovative risk-based approach to land-use planning for natural hazards in New Zealand which incorporates principles from Figure 6.1, Renn (2008) Mileti (1999), and Healey (2004) outlined in Chapter 2.

4. An innovative risk-based approach to land-use planning for natural hazards

Taking into account the 11 principles and the framework for developing a risk management process shown in Figure 6.1, and those outlined by Renn (2008), Mileti (1999), and Healey (2004), the following section presents an innovative process for the risk management of natural hazards via land-use planning. Together with the aforementioned principles and framework, it provides a comprehensive risk governance framework which can be tailored for differing internal and external contexts. The development of the framework was undertaken with council staff using the PAR methodology outlined in Chapter 3, and is based on risk management guidance provided by Standards New Zealand (Standards Australia/New Zealand, 2004).

While much work has been done internationally and in New Zealand on what level of individual risk is acceptable or tolerable for various perils such as dam failure (Australian National Committee on Large Dams Inc, 2003), hazardous facility failures (Health & Safety Executive, 2001), and tsunami (Webb, 2005), there is little guidance available to land use planners and politicians on what this level is. However, internationally, health and safety research has provided some guidance on what is

tolerable – and this could assist planners and politicians on the risk acceptability debate, as outlined in the following section.

4.1 The process

Figure 6.4 shows the risk governance process required to achieve the objectives of risk reduction. The Figure is consistent with the framework outlined by Renn (Chapter 2 Figure 2.2) and Figure 6.1 this chapter, in that it includes institutional mandate and commitment; fits within the context of the RMA and CDEM Act within councils; includes establishing risk management objectives (primarily through Regional Policy Statements and CDEM Group Plans, as outlined in Chapter 4); provides accountability via monitoring, review, and participation with stakeholders at each step; is integrated into the existing RMA and CDEM process; utilises knowledge and resources from both the planning and CDEM professions; and involves internal and external communication and reporting mechanisms via monitoring and reviewing at every stage. The implementation of the framework is via the risk treatment (i.e. risk reduction measures) step using the risk-based approach to land-use planning and associated risk management plan, which implements and regulates the risk-based approach presented. At every step there is a monitor and review phase, which should lead to a continual improvement of the framework and process as inconsistencies and so on become apparent.

New Zealand local government is primarily responsible for risk governance for natural hazards, which achieves risk reduction objectives through land-use planning regulations and emergency management planning (refer Chapter 4). The proposed risk-based process is transferable from national through to regional and local levels, and *vice-versa*. For example, there is the opportunity for national policies (such as the NZCPS, National CDEM Strategy) to use this approach; as too can regional and district policies via RPSs, regional/district plans and CDEM group plans. In Figure 6.4, both planners and emergency management officers have responsibilities to implement risk governance processes, rather than being part of the wider (and often 'siloed') governance structure within a council. As discussed in Chapter 4, this collaborative approach is necessary for risk governance in New Zealand, as emergency managers manage the '4 R's' – readiness, response, recovery, and to a lesser degree, risk reduction, which is also the domain of planners (Saunders, et al., 2007).

The planner's role is twofold – first, to collaborate with emergency managers to lead and implement the risk governance process; and secondly, to use their participation

skills and methodologies (in particular interpretation, facilitation and reconciliation) to instigate communication and participation with civil society, the market, politicians, and scientists at every step. The emergency management officer's role is to ensure that readiness, response and recovery planning needs are being met – from warning systems to evacuation requirements to rebuilding – and to participate with land use planners in ensuring consistent risk reduction objectives and policies.

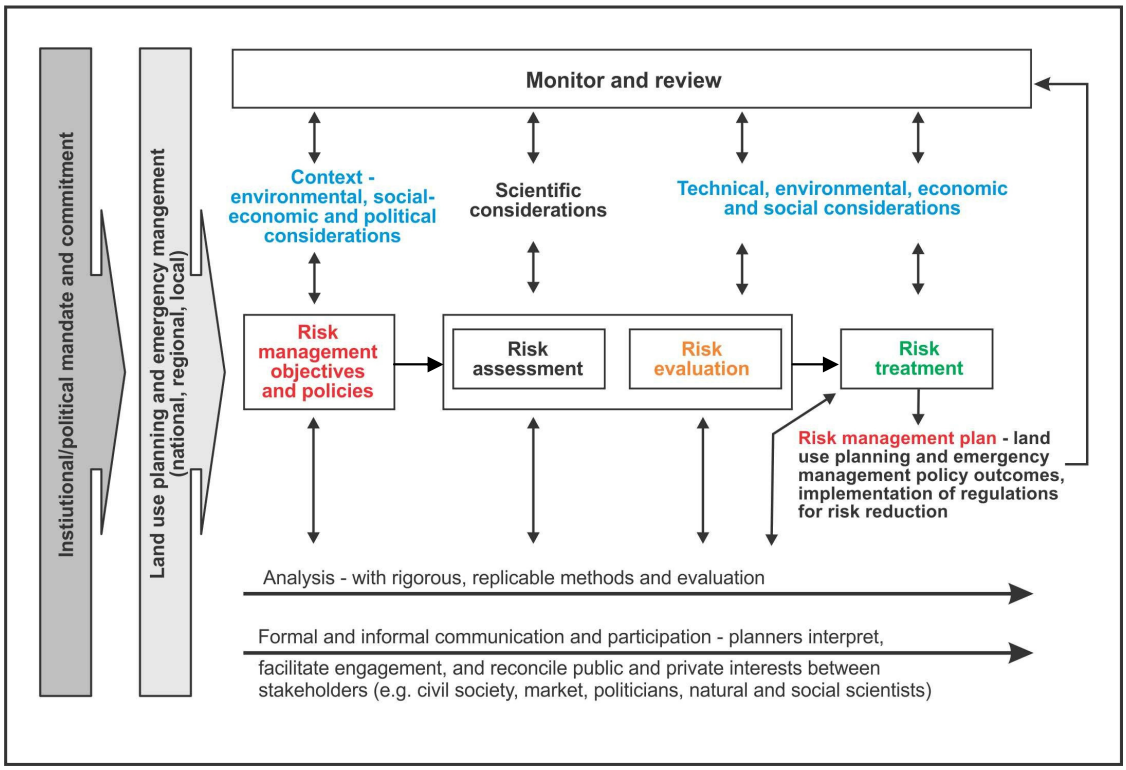

Figure 6.4 Risk governance model for land-use planning (based on ISO 3100 (based on Renn, 2008; Standards Australia/New Zealand, 2009; Stern & Fineberg, 1996).

Figure 6.4 is colour-coded to show which parts of this model are addressed in this research: the context, in blue (Chapter 4); risk management objectives and policies, in red (implementation of approach outlined in Section 5 of this chapter); risk evaluation, in orange (Section 6.2); risk treatment/risk reduction measures, in green (Section 6.2); and the risk management plan (i.e. land-use planning) in red (as links into risk management objectives and policies, Section 4.2).

The model is based on three frameworks: (1) the risk management process as outlined in ISO 31000 (Standards Australia/New Zealand, 2009); (2) the transparent (or inclusive) risk governance model by Renn (2008); and (3) the risk decision making process presented by Stern & Fineberg (1996). Instigating the risk governance process is the first stage, and requires mandate and commitment by central and local

government. This stage is included in the Risk Management Standard (Standards Australia/New Zealand, 2009), and was raised as a stage of critical importance in the workshops with council staff (refer Chapter 3). Once this step has been achieved, land use planners and emergency management officers must then work together towards a common goal of risk reduction (Saunders, et al., 2007). As required under legislation, the external contexts of the natural, social and economic environments (which are also consistent with community well beings as outlined in Chapter 4), are considered during the formulation of risk management objectives and policies, evaluation and treatment stages. Outcomes of the risk management objective and policy formulation should be consistent in both land use policies and plans and emergency management plans if effective risk reduction is to be achieved within the CDEMA and RMA policy frameworks.

Risk assessment is undertaken by scientists or specialists in the field, which at each stage is interpreted by planners for formal and informal deliberative participation with stakeholders. The information flow is two ways – from the planners to the stakeholders, and vice-versa, to ensure that outcomes from communication and participation are considered at each stage. The term 'participation' rather than 'consultation' (as in ISO 3100) is used, as consultation may be limited to informing stakeholders of information and obtaining feedback, whereas participation also includes involving, collaborating with, and empowering stakeholders (IAP2). Renn (2008) also refers to collaboration in his discussion of risk governance, which goes beyond consultation in the IAP2 spectrum of participation(IAP2).

Technical considerations include emergency management tools such as warning systems, and soft and hard engineering solutions. Planning-based technical considerations could include the role of urban design and construction. The final step of the process is risk treatment, which leads to a plan for risk management. This process includes policy outcomes (Adger & Jordan, 2009; Stirling, 2009), and the implementation of regulations (i.e. resource consent requirements) for risk reduction.

It is imperative that at each stage of the model, a monitor and review component is included. Monitoring and review involves the continual checking, supervising, and observing to determine the suitability, adequacy and effectiveness of actions to identify whether a change is required in order to achieve the stated objectives and policies (Standards Australia/New Zealand, 2009). This is an important step to ensure that any new policies and/or risk reduction methods are achieving the anticipated risk

management objectives, and to assess future progress of these objectives (Mileti, 1999). Monitoring is required under RMA and LGA as discussed in Chapter 4, however its implementation is limited.

When comparing Figure 6.4 with the risk governance definition from Renn (2008) in Chapter 2, the model for local government planners and emergency managers is consistent with the explanation of risk governance. It considers the legal, institutional, social and economic contexts which are evaluated through analysis at every stage; it involves key stakeholders; has a process for the collection, analysis and communication of risk information; requires collaboration and coordination between a number of stakeholders; and incorporates both internal and external contextual arrangements. The risk governance model in Figure 6.4 is also consistent with ISO 31000 (Standards Australia/New Zealand, 2009), in that it fulfils all the principles in Figure 6.1. The model encompasses the rational-adaptive planning themes of participatory and rational planning i.e. risk assessment, evaluation, and has controllable, measurable steps (Asimakou, 2009). Figure 6.4 also includes principles from Healey (2004), in that it allows for internal innovation within the governance framework (i.e. the state); which in turn allows for external innovation by the market and civil society; is based within a legal framework; incorporates economic and social influences; and is process-based.

Figure 6.4 is innovative within a risk governance, process, strategic and rhetorical context. It provides *redirection* for the existing structure of risk reduction within current governance structures; the *integration* of planning and emergency management into a risk governance framework by integrating the roles and responsibilities for natural hazard risk reduction of land use planners and emergency managers; places the responsibility for risk management with these two groups; outlines a process for planners and emergency management officers to follow to achieve their risk management objectives and policies; allows for innovation to take place at each level, be that either *incremental* or through *radical* change; and provides a new integrated model for risk reduction governance based on existing frameworks and processes within planning and emergency management. In order for this model to be incorporated under the general governance model within agencies of the state, institutional process changes may be required in either an incremental or radical way. To implement the risk treatment step in Figure 6.4, a 3-step risk-based approach process is outlined in the following section.

4.2 Implementation of risk treatment - a risk-based approach

For natural hazards and their associated risks to be seriously considered in land-use planning, the factual basis detailing the nature and severity of the hazard must be credible (Deyle, et al., 1998). The following risk-based approach provides a factual, rational basis for this to occur for all natural hazards. The aim of the approach outlined in the following section is to provide guidance on how to quantify and qualify tolerable levels of risk. This approach will allow decision makers to assess levels of risk for developments, particularly when their relevant regional, district, and/or CDEM group plan refers to an acceptable or tolerable level of risk. Based on this, the approach is considered innovative in that it is a departure from the current practice of not defining levels of risk. To assist with implementing this approach, a three-step process is proposed, which can also be combined with the precautionary and participatory approaches. The basis of the approach is that:

$$R = [C \times L] - T$$

where C = consequences (health and safety, social, economic, environmental);

L = likelihood; and

T = risk treatment, in this case via the planning process i.e. the resource consent process.

The three steps are listed below. Each step is outlined in the following subsections:

1. Ascertain what the land use is, then assess a level of acceptable, tolerable, and intolerable risk, based on the health and safety, social, economic, and environmental consequences (C);

2. Evaluate the likelihood (L) of an event occurring that produces the consequences ; and

3. Using a risk-based approach, determine the activity status of land use (i.e. activity status of resource consents) (T).

It is recognised and acknowledged that levels of risk can vary from community to community (MIACC, 1995). As such, this process has been developed as a guide only, and it is intended to be tailored for geographical, risk, and political contexts. It is intended that this would be undertaken collaboratively with a regional council, territorial

authority, the community, and key stakeholders in a participatory manner (MIACC, 1995). While not addressed in this research, a process for engaging communities in the approach outlined is the subject of further funding via the Envirolink Tools grants through the Ministry of Science and Innovation.

4.2.1 Step 1: Determine the consequences

As discussed in Chapter 4, focussing on timeframes when planning for natural hazards has not proved successful for achieving risk reduction. In order to provide an alternative to this approach, a consequence-driven framework is proposed (rather than likelihood-focused). A consequence approach is not new to risk management, and is outlined in detail in the Risk Management Guidelines (Standards New Zealand, 2004), and in recent guidance for flooding (MfE, 2010a). What is new is placing the focus on consequences, rather than on likelihood. While it is acknowledged that the 4360 Standard has been superseded by the Standard 31000:2009 (Standards Australia/New Zealand, 2009), as yet there is no comprehensive guideline associated with it. Therefore, the 4360 guidelines have been used for guidance in the development of the approach. Consequences are based on the well-beings associated with sustainable development, as discussed in Chapters 2 and 4.

Implicit in this step is ascertaining what the land use is. This can be achieved either by using a land use importance category (Saunders & Berryman, 2010), or by using land use types as included in district plans. For example, in the Thames-Coromandel District Plan (TCDC, 2010), 11 zones are included: coastal, rural, housing, town centre, industrial, industrial A, conservation, open space, iwi kainga, recreation active, and recreation passive. Associated with the zones are policy areas, which include airfield; future development, density (extra and low), beach amenity, heritage, service industrial, etc. When ascertaining land use (which may also be ground-truthed), these zones and policy areas can provide a guide for the type of land use in a particular area. This approach also ensures consistency between the land use categories and those used within the district plan context.

Once land use has been ascertained, three key elements are required: scale of impact, consequences, and severity of consequence, each of which are outlined below.

4.2.1.1 Scale of impact

The scale of impact is included to provide a qualitative description of the type of event. The definitions of this scale of impact are provided in Table 6.3. Workshops with

councils requested that a scale of impact be included to provide context to the final table.

Table 6.3 Scale of impact definitions (Standards New Zealand, 2004, p54)

Descriptive	Definition
Severe	Most objectives cannot be achieved
Major	Some important objectives cannot be achieved
Moderate	Some objectives affected
Minor	Minor effects that are easily remedied
Negligible	Negligible impact upon objectives

Within the context of this research, objectives relate to risk reduction objectives outlined in the CDEM Group Plan, Regional Policy Statement and district plans. The next input into the framework is the description of consequences.

4.2.1.2 Description of consequences

Four categories of consequences are provided in Figure 6.6 (health and safety, social, economic, environmental), however these are for guidance only, based on the 'well-beings' which underpin sustainable development (refer Chapter 2) and are required under legislation (refer Chapter 4). Due to limited guidance on defining well-beings under the LGA, one alternative option is to use recovery principles and priorities from the CDEM Act as a basis for consequences. This also allows the integration of consequences across the CDEM and RMA frameworks. The types of consequences considered using the CDEM recovery framework are shown in Figure 6.5.

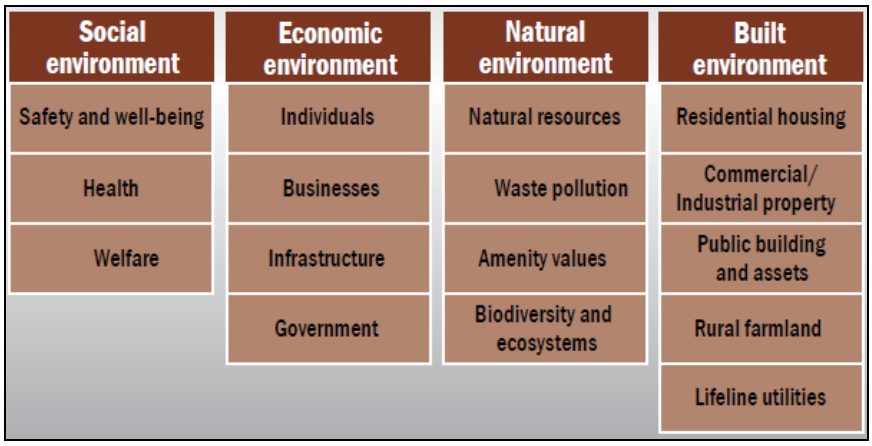

Figure 6.5 Recovery groups under the CDEM framework (adapted from MCDEM, 2006, s25 p3).

As previously mentioned, the framework can be tailored to a council/community's needs. For the purposes of this research, a simplified version of the well-beings is presented (i.e. health and safety, social, economic, environmental), to show how the framework can be applied. If using the more detailed approach presented in Figure 6.5, each subcategory would need to be quantified and/or qualified against a severity of consequence level. The social description in Figure 6.6 is adapted from guidance provided in both Standards New Zealand (2004) and Taig (cited in Berryman, 2005, p101). It is envisaged that this could be tailored to specific contexts by councils, stakeholders and communities.

Two options are provided for describing economic consequences. The first is a monetary amount, as suggested in Standards New Zealand (2004). However, this approach does not take into account the context of place. For example, if using this framework over a regional area, populations and communities are diverse. What may be economically tolerable for a large town to bear, may become intolerable for a smaller town. Therefore a second option is also provided – using a percentage of assets. Again, this percentage could be adapted to the local context, and could be a percentage of some other measure, such as the GDP of an area.

Environmental consequences are based on guidance provided in Standards New Zealand (2004), but can be tailored for specific environmental contexts.

4.2.1.3 Severity of consequences

The final element is the severity of consequences, numbered from I to VI, as suggested in Standards New Zealand (2004). This provides a summary of consequences, and is incorporated in the second step of the three-step framework (see Figure 6.6). The severity of consequences is shown in roman numerals to avoid possible confusion between consequences and likelihood in Step 3.

Scale of impact	Description of consequences				Severity of Consequence
	Health & safety	Social	Economic	Environmental	
Severe	Multiple fatalities, or significant irreversible effects to >50 persons.	On-going serious social issues. Significant damage to structures and items of cultural significance	Severe i.e. over $10 million -or- more than 50 % of assets	Severe, long-term environmental impairment of ecosystem functions	VI
Major	Single fatalities and / or severe permanent disability (>30%) to one or more people.	On-going serious social issues. Significant damage to structures and items of cultural significance	Major i.e. between $1 million and $10 million -or- 10-50 % assets	Very serious, long-term environmental impairment of ecosystem functions	V
Moderate	Moderate irreversible disability or impairment (<30%) to one or more persons.	On-going social issues, permanent damage to buildings and items of cultural significance	Moderate i.e. between $100,000 and $1million -or- 10 % of assets	Moderate, short term effects by not affecting ecosystem functions	IV
Minor	Reversible injury possibly requiring hospitalisation.	On-going social issues, temporary damage to buildings and items of cultural significance	Minor i.e. between $10,000 and $100,000 -or- 1 % of assets	Minor effects on physical environment	III
		Medium-term social issues, minor damage to dwellings	Minor i.e. between $10,000 and $100,000 -or- 0.1% of assets		II
Negligible	Minor first aid or no medical treatment required.	Negligible short -term social impacts on local population, mostly repairable	Small i.e. less than $10,000 -or- 0.01% of assets	Insignificant effects on physical environment	I

Figure 6.6 Scale of impact, consequences, and severity of consequence

The severity of consequences can also be qualitatively described, using guidance from AS/NZS 1170.0:2002 (Standards Australia/New Zealand, 2002) as shown in Table 6.4.

Table 6.4 Qualitative description of severity of consequences (adapted from Standards Australia/New Zealand, 2002)

Severity of consequence	Qualitative consequence	Description
I, II, III	Low	Low consequence for loss of human life, or small or moderate economic, social or environmental consequences
IV	Ordinary	Medium consequence for loss of human life, or considerable economic, social or environmental consequences
V	High	High consequence for loss of human life, or very great economic, social or environmental consequences
VI	Exceptional	Circumstances where reliability must be set on a case by case basis

Individual and multiple life safety can also be used in the 'health and safety' consequence column in Figure 6.6, however this attribute does contain the likelihood within it (rather than being the next step). If life safety risk were included, it could be as follows for an individual (based on the discussion in Chapter 2):

Intolerable	above ~ 10^{-2} / year
Generally tolerable with consent	~ 10^{-3} to 10^{-4} / year
Tolerable	~ 10^{-5} to 10^{-6} / year
Acceptable	~ 10^{-6} to 10^{-7} / year

The description of consequences should be completed by the council with participation from the community, to reflect the local hazardscape (including societal/individual perceptions) and social, economic and environmental contexts. Once consequences have been determined, there is an option to rank their importance, as outlined in the following section.

4.2.1.4 Ranking of consequences

Within the sustainable development literature, there is little guidance available on how to rank the well-beings which underpin sustainable development within the context of natural hazard management and land-use planning. Guidance is therefore required when ranking consequences for this framework. For a natural hazard event which impacts on a community, more than likely the consequences across the four categories provided will not be equal. For example, following the September 2010 Darfield earthquake in Canterbury, the health and safety criteria could be assessed as 'tolerable', as no deaths were reported, and only two serious injuries required hospitalisation. For the population of Christchurch, this meets the 'tolerable' criteria. However, the social impacts for some suburbs could be defined as 'intolerable', with significant damage to homes and items of cultural significance (e.g., churches). The full economic consequences have yet to be quantified, but for the purposes of this example are considered to be generally tolerable (based on initial economic loss vs long term gain from recovery). Moderate environmental impacts were observed from liquefaction (i.e. short term effects), however these areas were known and information was provided in LIMs on this risk. The environmental consequences could therefore be assessed as generally tolerable with consent. This example has four levels of risk – tolerable, generally tolerable, generally tolerable with consent, and intolerable. To assist in reconciling these differences between consequences and to allow a summary 'severity of consequences' label to be given, two options are available for ranking consequences: (1) 'first past the post', where the most severe consequence provides the severity of consequence across all consequences; and (2) using the 'SMG' model by MCDEM for determining hazard priorities (MCDEM, 2009).

Under the SMG model, S = seriousness, M = manageability, and G = growth. For this risk-based framework, the focus is on the 'seriousness' ranking. MCDEM (2009, p17) recommend the social (which includes health and safety), built, economic and natural environments are weighted as follows:

- Social – 50% of the total value, due to the high priority of protection of human life and safety, and community readiness, response, and recovery in CDEM;
- Built – 25% of the total value, due to the importance of protecting lifelines and other critical infrastructure in relation to social concerns;
- Economic – 15% of the total value, reflecting a secondary priority, and that the built environment will normally account for most of the economic damage; and

- Natural – 10% of the total value, reflecting the relatively low level of concern with the environment within the CDEM sector.

This approach takes into account that different types of consequences will have larger impacts on society than others. Again, it would be up to the council, stakeholders and communities to decide which approach is most appropriate for their context, e.g. the percentages could be adapted to the local context. Once a severity of consequence label has been determined, the likelihood of an event occurring which could produce the consequences requires consideration.

4.2.2 Step 2: Evaluate the likelihood of an event

Once the land use and consequences have been determined, only then should the likelihood be evaluated. This overcomes the planning timeframe issues outlined in Chapter 4 Section 4 (e.g. using 50 years for flood risk). By focusing on consequences first, it is envisaged that the current approach of putting people and property in harm's way, based on small timeframes, is overcome. Table 6.5 provides a likelihood scale that can be used as a guide - for some hazards, e.g. active faults, the annual exceedance probability (AEP) can be extended to 20,000+ years. This scale should be adapted to each regional/district/ community hazard context.

Table 6.5 Likelihood scale (adapted from Standards New Zealand, 2004)

Level	Descriptor	Description	Indicative Frequency (expected to occur)	AEP
7	Almost certain	The event will occur on an annual basis	Once a year or more frequently	1
6	Likely	The event has occurred several times or more in your career	Once every three years	0.3
5	Possible	The event might occur once in your career	Once every ten years	0.1
4	Unlikely	The event does occur somewhere from time to time	Once every thirty years	0.03
3	Rare	Heard of something like this occurring elsewhere	Once every 100 years	0.01
2	Very rare	Have never heard of this happening	One in 1000 years	0.001
1	Almost incredible	Theoretically possible but not expected to occur	One in 10,000 years	0.0001

Based on the formula R = [C x L] - T, once the consequences (step 1) and likelihood (step 2) have been determined, then the treatment option, in this case risk-based land-use planning, can be assessed. The methodology of this final stage of the process is outlined in the following section.

4.2.3 Step 3: Taking a risk-based approach to land-use planning

To meet the requirements of R = [C x L] – T, the consequences (which include an assessment of the land use, as outlined in Step 1) and likelihood must be multiplied. To achieve this, the roman numerals for the severity consequence are replaced with arabic numbers 1 to 6 (see Figure 6.7) to allow calculation of C x L. This adaptation of the scales allows for the risk (i.e. consequence x likelihood) to be quantified. Likelihood and consequences are ordered according to the recommendations in Standards New Zealand (2004).

	Consequences					
Likelihood	**1**	**2**	**3**	**4**	**5**	**6**
7						
6						
5						
4						
3						
2						
1						

Figure 6.7 Framework for quantifying risk

The matrix is then populated with a quantitative risk level, expressed as a function of consequences x likelihood (Figure 6.8). This risk ranges from 1 (extremely low) to 42 (extremely high). Ordinal numbers are used, as the scale is descriptive and relative, rather than a measure of absolute magnitude of risk. The numerical value does not relate to any specific value or quantity, but is merely a number to categorise a level of risk, as shown in Figure 6.8 (Standards New Zealand, 2004).

	Consequences					
Likelihood	**1**	**2**	**3**	**4**	**5**	**6**
7	7	14	21	28	35	42
6	6	12	18	24	30	36
5	5	10	15	20	25	30
4	4	8	12	16	20	24
3	3	6	9	12	15	18
2	2	4	6	8	10	12
1	1	2	3	4	5	6

Figure 6.8 Quantification of risk

Once the matrix has been populated, the risk levels then need to be determined. Figure 6.9 shows how the risk levels are determined from Figure 6.8. This was done in a subjective manner for the purposes of this research, however in practice participation and associated debate would be required within council and with the community to determine these levels.

Risk	**Level of risk**
1-6	Acceptable
7-16	Tolerable
17-26	Tolerable with consent
27-42	Intolerable

Figure 6.9 Levels of risk based on Figure 6.8

Once levels of risk are determined, the matrix is then colour coded, based on the levels of risk shown in Figure 6.9. The use of colours allows a faster assessment of the level of risks involved (Figure 6.10). The colours of green (acceptable), yellow (tolerable), orange (tolerable with consent) and red (intolerable) are used, as they are considered standard colours for this approach (Standards New Zealand, 2004).

	Consequences					
Likelihood	**1**	**2**	**3**	**4**	**5**	**6**
7	7	14	21	28	35	42
6	6	12	18	24	30	36
5	5	10	15	20	25	30
4	4	8	12	16	20	24
3	3	6	9	12	15	18
2	2	4	6	8	10	12
1	1	2	3	4	5	6

Figure 6.10 Colour-coded risk table

Consequence numbers are then relabelled to roman numerals to avoid confusion with the likelihood scale. The levels of risk quantifiers (i.e. numbers) have been removed, and the colours, based on the levels of risk, are used to determine the consent status (i.e. treatment) of the activity (Figure 6.11).

Level of risk	**Consent status**
Acceptable	Permitted
Tolerable	Controlled
Tolerable with consent	Discretionary, restricted discretionary
Intolerable	Non complying, prohibited

Figure 6.11 Qualitative levels of risk based on Figure 6.10

This provides the final framework (shown in Figure 6.12), which includes all elements of the formula R = [C x L] – T. Risk now equates to consent status.

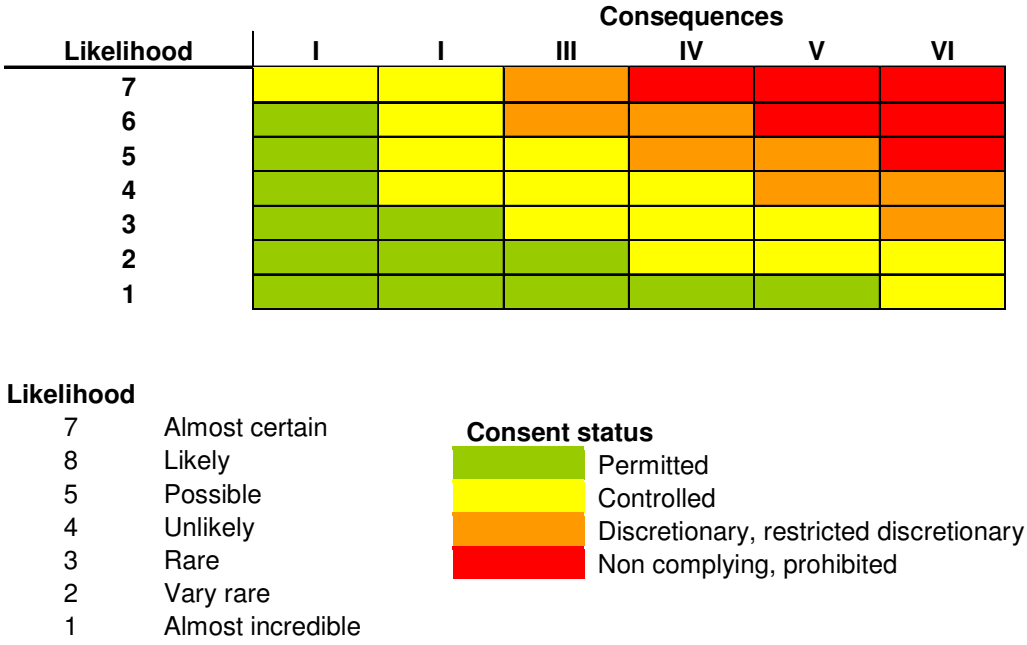

Figure 6.12 Risk-based approach to land-use planning for natural hazard risk reduction.

Non-complying and prohibited activities are merged together, but it is acknowledged that the former allows for development, while the later prohibits development. For the purposes of this example, the two are merged to allow high consequence activities to take place in high risk areas, which may not be able to be avoided. For example, a port has to be located on the coast, but its location may also be susceptible to tsunami. Discretionary and restricted-discretionary are also merged together, as both represent a discretionary consent status. As per Figure 6.2, consent categories – and therefore land use - becomes more restrictive as the risk increases.

As previously discussed, Figure 6.12 is to be used as a guide only to what can be achieved – community engagement and pluralistic participation are required to determine the levels of consequences and subsequent likelihood of those consequences occurring. Consent categories and the evaluation of levels of risk in Figure 6.10 may change depending on the outcome of reconciling the risk context and often-contested risk appetite between key stakeholders i.e. market and civil society (e.g. Handmer, 2008). Other options may also be available to reduce losses that are acceptable or tolerable for communities. For example, sharing the risk of potential losses via insurance, or accepting/tolerating the risks involved (refer choice tree of adjustments, Figure 2.3 Chapter 2).

This approach builds on the current risk-based approach outlined in Kerr et al. (2003), Saunders & Glassey (2007) and Ministry for the Environment (2010a). The contribution to existing guidance is that consequences (based on the legislative well-beings) become the focus ahead of the likelihood of an event occurring; it provides a rational approach to quantifying and qualifying acceptable levels of risk for land use; and it is adaptable to different communities and the risks they face. This also provides guidance for levels of risk stipulated in the New Zealand Coastal Policy Statement (as discussed in Chapter 4 Section 2.4). The approach meets the principles shown in Figure 6.1 in that it creates value above the existing approach; can be part of the organisational processes that govern planning; addresses uncertainty by using in conjunction with mapping (see Appendix 2); is systematic and structured; is based on the best available information; can be tailored to different locations; takes human and cultural factors into considerations via the assessment of consequences; is transparent and inclusive when used with a pluralist participatory approach; is dynamic, iterative and responsive to change; and will facilitate improvement in the current planning practice. While the risk-based approach is not new, the approach outlined moves the existing practice into a new era (e.g. advanced forward incrementation), with consequences being considered before likelihood; tolerable levels of risk (the product of consequences and likelihood) being quantified and qualified consistent with planning terminology; and it is very adaptive to local conditions. While the approach outlined focuses on the resource consent process, it also provides guidance for policy formulation on levels of risk. Based on the Kahikatea Estate example provided in Chapter 4, this is an essential element of the planning process, and provides the basis for setting criteria for resource consents. An example of how this can be achieved is provided in Section 5. Limitations and opportunities for implementing the approach are outlined in Section 6.

5. Implementation of approach – Bay of Plenty Regional Council

Considering that a governance transformation such as that proposed is usually takes a generation or more (Healey, 2004), it is encouraging that the BOPRC supported the concepts and included parts of the process into their Proposed Regional Policy Statement (RPS) (BOPRC, 2010), even before this approach was fully developed. The inclusion was based on a preliminary research paper on quantifying and qualifying risk

for land-use planning (Saunders & Berryman, 2010), and continual discussion with the policy planners during the course of the research and development of the draft RPS.

This section will outline why change was required to the BOP RPS, how aspects of the approach outlined in this chapter were incorporated, and any issues/barriers the council has come across in implementing the approach.

5.1 Why change was required

The existing BOP RPS became operative in 1999, and after over 10 years of operation improvements were required to the natural hazard sections (and others) to make them more effective. In particular, the RPS did not clearly allocate roles between the regional council and territorial authorities; it relied on the identification of natural hazards of regional significance which never occurred; and there was an unstated motivator of avoiding liability (Regional Planner, 16 February 2011). In the RPS monitoring and evaluation report (required under s35(2A) of the RMA), it was noted that:

> [the natural hazard] … policy framework was not sufficiently directive to avoid or mitigate the effects of natural hazards (particularly at the level of land use and subdivision consents) (BOPRC, 2008, p150).

Recommendations for the second generation RPS included risk indicators for monitoring purposes; and more precise and directive policies and methods to reinforce regional and district plan policies and rules (BOPRC, 2008). It was acknowledged by the policy team that avoidance and mitigation needed to be put into a risk management framework, where hazards were addressed based on risk. Previously, natural hazards (and in particular flooding) were addressed on the basis of one element of risk – the likelihood of an event occurring via return periods. This approach did not allow for the consideration of consequences, and councils were reluctant to consider events with a probability of less than 1% occurring in any year (refer Chapter 4 Section 4). Whereas previously the focus was on flooding and some coastal hazards, by taking a risk-based approach, other hazards could also be considered, such as tsunami, volcanic and seismic hazards (Regional Planner, 16 February 2011). The approach also strengthened linkages for risk reduction between the RMA and CDEMA, as discussed in Chapter 4.

It is anticipated that this new approach to the RPS will overcome the existing problems of hazards being assessed with inconsistent timeframes; inadequate attention being

given to low probability/high consequence events; poor integration with the CDEM framework; and unclear roles between the regional council and territorial authorities (Regional Planner, 16 February 2011). With this acknowledgement of a need for change, the following subsection outlines the revised approach in the Proposed RPS, which incorporates aspects of the risk-based approach presented in this chapter.

5.2 Implementation within the Proposed Regional Policy Statement

The approach outlined in this chapter provided a framework for the council where risks could be measured, and mitigation applied as required and/or appropriate. By quantifying and qualifying levels of risk, a policy framework within the RPS could be developed to provide direction for avoidance or mitigation of natural hazard risks, particularly around resource consents. In the Issues and Objectives - Natural Hazards (Section 2.8) of the proposed RPS, a risk-based approach is outlined (BOPRC, 2010, p63):

Natural hazards

Avoidance or mitigation of natural hazards is based on risk (the likelihood and consequences of a hazard). Rare events with potentially catastrophic outcomes may have the same level of risk as frequent but low-impact events. Ideally, the risk of both extremes should be managed so as not to exceed an acceptable level. In some situations, a higher level of risk may be tolerated but will need to be managed through specific monitoring and response procedures to be as low as reasonably practicable. For example, the consequences of some natural hazard events may be reduced by evacuating people out of harm's way, reducing the risk accordingly. In no case should intolerable risk be accepted. This approach is based on three risk categories:

Intolerable: risk cannot be justified and risk reduction is essential whatever the cost.
Tolerable: opportunities (for example, to lower the background level of risk) balance against potential adverse consequences; risk should be reduced to as low as reasonably practicable until the cost of reducing the risk is grossly disproportionate to the benefits gained.
Acceptable: risk is negligible and the cost of further reducing risk is grossly disproportionate to the benefits gained.

The issues and objectives for natural hazards outlined above show a new, innovative point of view in that they move from 'traditional' natural hazards policy to a redefinition of planning policy. The language is innovative, in the use of levels of risk and consequences. It provides a qualitative framework of levels of risk, which forms the basis of quantitative and qualitative policies further on in the document. Following on from the Issues and Objectives, policies also support the risk-based approach (BOPRC, 2010, p112-113):

Policy NH 1B: Using criteria for assessing natural hazard risk

Assess risk in three categories – acceptable, tolerable, and intolerable – according to the following criteria:

a) An acceptable level of risk can be considered to be exceeded if the risk of death exceeds 1 in 1 million per annum (1 x10^{-6} per year).
b) A risk can be considered to be intolerable:
   1. For members of the public who have a risk imposed on them if the risk of death exceeds 1 in 10,000 per annum (1 x 10^{-4} per year); or
   2. For any substantial category of residents or workers for any large part of a working life if the risk of death exceeds 1 in 1000 per annum (1 x 10^{-3} per year); or
   3. If the frequency of an event causing the death of 50 people or more is estimated to be more than 1 in 5000 per annum (1 x 10^{-2} per year); or
   4. For any equivalent criterion interpolated or extrapolated to other numbers of casualties and frequencies.
c) Tolerable risk exceeds the acceptable level but does not meet the criteria for intolerable risk.

Include an assessment of risk (in addition to the risk of death), in accordance with relevant New Zealand Standards, social, economic, cultural and natural environment consequences.

An assessment should:

a) Be in such detail as corresponds with the scale and significance of the risk having regard to the purpose of regionally significant infrastructure and land use importance categories;
b) Include evaluation of the likelihood and consequences of maximum credible events;
c) Facilitate review; and
d) Inform and take account of community response.

In summary, the policy has quantified levels of health and safety risk in the following way:

Acceptable	1 x 10^{-6}
Tolerable	1 x 10^{-5}
Intolerable	1 x 10^{-4} to 10^{-2}

These risk levels are consistent with those health and safety levels offered in section 4.3.2, with the explanations being adapted for the BOP community. For example, the levels of risk for intolerable risk are more detailed than that provided in Figure 5.5, with societal risk being specifically included. The policy provides an example of how the risk-based approach outlined previously in this chapter can be adapted and incorporated into RPS policy. It is consistent with the approach outlined in that it:

- quantifies health and safety levels of risk based on international best practice;
- includes reference to social, economic, cultural and environmental consequences (although these are not quantified or qualified);

- requires the assessment of risk in regards to land use importance (based on Saunders & Berryman (2010)), although not defined;
- the language is consistent with the risk-based approach outlined, i.e. likelihood, consequences, maximum credible events;
- includes review/monitor requirement; and
- provides for consultation with the community.

The highlight of the proposed policy is that the council used the methodology provided, and adapted it for their use – which is exactly how the framework is to be implemented. This is innovative as no other council in New Zealand has used this approach before.

The policy is followed by an explanation, as follows (BOPRC, 2010, p113):

> **Explanation**
>
> Although there may be uncertainty in the factors that are included in a risk assessment, it should try to present an objective view. The needs of all those affected, including the people actually subject to the risk, should be taken into account through community consultation. An open exchange of information contributes to the establishment of relationships based on trust. This is particularly important in the management of low likelihood and high consequence natural hazards. Where uncertainties are high, people's beliefs and values are very important.
>
> Where greater levels of uncertainty exist because of lack of knowledge, a precautionary approach is called for. Because some outcomes are so bad, even though they may be very unlikely, precautionary action is justified.
>
> When the availability of quantitative risk information is low, a higher degree of public participation is required.
>
> Determination of what constitutes acceptable, tolerable and intolerable risk will involve using current methods of analysis and taking into account society's current level of tolerance. In the end, judgement is required to be exercised by or under the authority of elected representatives.

There are three key points in the explanation. First, it refers to community consultation. As shown in Figure 6.4, this is a key part of the risk-based governance framework, and ideally any consultation should be participatory in nature. If used within the participatory planning framework, ideally the policy should extend beyond consultation (which is all that is required under the RMA), to involving, collaborative, or empowering forms of participation (IAP2, refer Chapter 2). Second, it refers to the precautionary approach, as discussed in Section 3.2. The explanation provides a good example of how, if the information for the risk-based approach is not available, then the precautionary approach should be applied. Third, it acknowledges the variation in risk

perceptions, and that judgement is required. It is hoped that with a framework such as this, these decisions will be made with rational, risk-based information.

Finally, the objectives, anticipated environmental results and monitoring indicators (Section 4.2) for natural hazards are provided below (BOPRC, 2010, p153):

Objectives	**Anticipated environmental results**	**Monitoring indicators**
Natural hazards **Objective 23** Communities achieve acceptable levels of risk from natural hazards	Any residual natural hazard risk in new development is within acceptable levels.	District plan provisions and resource consent conditions are assessed to determine whether risk from natural hazards exceeds acceptable levels.
	The natural hazard risk to existing land use or development is acceptable or as low as reasonably practicable.	Wherever the risk from natural hazards exceeds an acceptable level, conditions of resource consent for 1. the re-establishment of any use, or 2. the reconstruction or alteration of, or extension to, any existing building, require mitigation of risk to be as low as reasonably practicable.
		The coastal hazard risk indicators defined in Confirmed Coastal Hazard Risk Indicators (Environment Bay of Plenty Environmental Publication 2006/05 April 2006) show a trend of decreasing risk.
	Intolerable risk from natural hazards is avoided.	Intolerable risks are reduced to tolerable or acceptable levels.
	People and communities are enabled by access to risk information to provide for their social, economic and cultural well-being and their health and safety.	Survey results show that the public understands natural hazard risk. Reviews of hazards and risk show a reducing trend in the level of risk from natural hazards.

Again, the language e.g. levels of risk and well-beings, is consistent with the recommended approach. One concern with the monitoring indicators is the feasibility of measuring how intolerable risks are reduced to tolerable/acceptable levels.

The implications of these innovative objectives, issues, policies and anticipated results are that district plans must give effect to the RPS (s73, RMA). Therefore, if these policies are successful in becoming operative, changes of policy may be required at district levels. These changes will result in a more comprehensive and consistent risk-based approach being applied throughout the region. The challenge will be for districts to implement the next step – a risk-based approach to resource consents (Figure 5.12).

The result of the revised Proposed RPS is improved integration between regional councils and territorial authorities; and between RMA and CDEMA (Regional Planner, 16 February 2011). However, in applying the risk-based approach outlined above, the Regional Planner did acknowledge some limitations of changing approaches. These are outlined in Section 6, below.

5.3 Current status of the proposed RPS

Submissions had been received by the regional council in February 2011 on the Proposed RPS, and the summary of submissions was released in April 2011 for further consideration. At the time of completing this research, the issues that submitters have on this approach were being assessed, and a further submission was being drafted for consideration (to be finalised after submission of this thesis). The key issue raised by submitters, on the approach outlined in the proposed RPS, was how it can be implemented (no guidance for implementation was included). However, Section 4.2 provides an option for the implementation of the approach. To date the territorial authorities appear to be generally supportive of this approach, in particular that the regional council will take responsibility for risky existing use situations. However, there is some apprehension that applying a new approach such as this may be overly cautious. Because the new approach is risk-based (i.e. planning restrictions increase as risk increases), the resulting restrictions should be focused only on land at-risk, rather than blanket zoning. This should produce more certainty for resource consent applicants.

Hearings for submissions are proposed to be undertaken in July 2011, and the process of making the natural hazard sections of the proposed RPS operative will be the focus of continued research.

6. Limitations and opportunities of approach

The emerging research and the output of the risk-based approach presented in this chapter builds on existing risk-based land-use planning concepts (e.g. Kerr, et al., 2003; MfE, 2008b; Saunders & Glassey, 2007). However, the approach outlined is still somewhat conceptual in nature, is only in early stage of development, and therefore has specific limitations at this time, as outlined below.

Figure 6.4 of this chapter presented a risk governance model for land-use planning; however, the research undertaken has only looked at specific parts of the model – the context, risk management objectives and policies via RPSs, risk treatment/mitigation, and risk management plans (or district plan options). This risk governance model and risk-based approach needs to be fully explored and tested.

As outlined in Section 4.2.1, the description of consequences can be further detailed according to the MCDEM recovery framework (Figure 6.5), rather than based on the simplified four well-beings provided in Figure 6.6. Future research and development will provide further details of the approach. In particular, further guidance on quantifying and qualifying levels of risk will be explored; as well as how to engage with communities on discussing a risk approach such as this. This community engagement issue was also raised by the Regional Planner at the Bay of Plenty Regional Council as an issue that needs to be explored. In particular, bringing the community into the process will inform and equip people to make their own risk management decisions. However, the requirement to involve the community in establishing the criteria makes some technical staff nervous that they may lose control of the decision making (Regional Planner, 16 February 2011). Developing the description of consequences and pluralist community engagement is currently the subject of a project funded via the Ministry of Science and Innovation's "Envirolink Tools" grant program, with support from various councils around New Zealand.

The framework provided is currently limited to assessing consequences for single-hazard events. There is a need to reconcile multiple hazards into the framework i.e. ground shaking causing liquefaction, landslides, tsunami, and increased flood risk (as flood defences weakened). Further research is required to ascertain how one event with multiple hazard outcomes can be incorporated. The framework is also focused on the resource consent process; however the approach can be incorporated into planning policy, as the implementation example of the Bay of Plenty Proposed RPS highlighted.

Integral to the health and safety consequence column in Figure 6.6 is the life safety issue. Further research needs to be undertaken within a New Zealand context to compare multiple fatality events in order to assess an acceptable and intolerable level of risk (individual deaths are generally deemed to be tolerable at a certain likelihood). Such an assessment should include both natural and anthropogenic events. For example, fatalities from the 1931 Napier earthquake; 1953 Tangiwai rail disaster, 1968 Wahine ferry disaster, 1979 Erebus air accident disaster, 2010 Pyke River mine disaster, 2011 Christchurch earthquake, annual drownings, and the annual road toll could be assessed and compared. Assessments could also consider whether measures were put in place after the event to ensure that the consequences did not happen again.

Estimates of risk in the framework are based on objective analyses of the consequences, and then the likelihood of a hazard event in a specific location. However, there are considerable differences between expert assessments of risk and the way in which risk is interpreted and acted on by individuals and other groups in our community (e.g. market, state, civil society). It is therefore acknowledged that people's understanding of, and response to, risk are determined not only by scientific information or direct physical consequences, but also by the interaction of psychological, social, cultural, institutional and political processes (Johnston, et al., 2011). This perceived risk can be amplified or attenuated via personal, social, psychological and community factors. Effective risk management must therefore involve the consideration of the wide spectrum of social factors that determine levels of acceptable risk and influence human behaviour. These factors have not been considered in this thesis, but form the basis of further research. It is important that risk management be seen as a multi-disciplinary activity and that it works, accordingly, to develop models that reflect the dynamic and contingent nature of risk phenomena (Johnston, et al., 2011). The framework presented does allow this multidisciplinary approach by being adaptive – councils can take the framework and adapt it to include any consequences they would like. For example, the 'social' consequence category can include social, psychological and community factors.

Despite these limitations, there are opportunities available to further explore the concepts in the framework, and to implement the general principles. As mentioned, funding has been applied for to further explore the description of consequences and community engagement. Like the Bay of Plenty Regional Council, many councils around the country have expressed an interest in implementing some of the concepts

outlined in this chapter (e.g. TCDC, Gisborne District Council, Hawke's Bay Regional Council), particularly during plan changes and review process. For example, feedback from one council on the approach stated:

> I found these sections [on the risk-based approach] very useful/interesting (and clear) and it would be great for some council … to run with them in their next DP [district plan] review! …the report's approach would be a welcomed as a method of implementation.

The Bay of Plenty Regional Council adoption of this approach in the Proposed RPS process provides an opportunity to test the appetite for change to a risk-based framework such as this, by highlighting through the submission process any issues that may arise and need to be addressed.

7. Summary

As outlined in Chapter 1, the overall aim of this research is to develop a risk-based framework for innovative land-use planning which enables risks from natural hazards in New Zealand to be reduced. Based on findings from the previous chapters, this chapter has achieved this aim by presenting an innovative three-step risk-based approach to land-use planning for natural hazards. The three steps involved 1) quantifying and qualifying levels of consequence; 2) determining the likelihood of an event occurring based on consequences; and 3) taking a risk-based approach to resource consents. The framework is intended as a guide only, that councils use to develop their own risk-based framework within the context of their hazards and communities. It has been developed using sustainable development principles, particularly the use of the four well-beings of health and safety, social, economic, and environmental when determining consequences of an event (as outlined in Chapter 2). The methodology was primarily based on the PAR approach outlined in Chapter 3, with a focus on case study findings, workshops and interviews. The framework is compatible with the current RMA and CDEMA requirements outlined in Chapter 4, and as such can be incorporated into the planning process using existing tools available under the RMA. The approach presented is set within a risk governance approach, based on principles outlined in Figure 6.1, and a model risk governance framework presented in Figure 6.4, resulting in the three-step process-based approach outlined in Section 4.2. The risk governance rationale behind the outcome of this chapter is consistent with that of Renn as discussed in Chapter 2. While this innovative approach is focused on risk-based planning, it is envisaged that the framework can be used in

conjunction with precautionary planning approaches, although it is acknowledged that participation is an integral part of the risk governance framework shown in Figure 6.4.

From the definition of innovative land-use planning provided in Chapter 5 Section 3, the approach meets the criteria for being innovative in that it provides an opportunity to plan for positive social, economic, and environmental outcomes in a new way. It is based on existing risk-based planning principles, and provides integration between CDEMA risk reduction requirements and the RMA. It provides the opportunity for active and meaningful participation with the community to decide levels of risk. The outcome of the research is land-use planning that leads to sustainable management and development, while not increasing risks from natural hazards. The approach can be categorised as either semi-radical or radical innovation, depending on the existing planning measures in place within regional and district plans (which vary throughout the country).

In conclusion, based on feedback from the PAR methodology on the framework and the implementation already being pursued by Bay of Plenty Regional Council, this type of approach is of interest and practical use for councils when reviewing their policies on risk reduction. A change is required from the current approach of set timeframes for planning for hazards (e.g. 50 years for flooding) to a consequence driven approach, where the likelihood of an event with *x* consequences is determined at the last step of the framework, rather than at the current practice of using a set likelihood at the outset. This approach has the potential to change how risks are managed through land-use planning in New Zealand, with the potential to achieve risk reduction for communities based on levels of risk/consequences, rather than blanket zoning.

The following and final chapter will provide a summary of the key findings of this research, their significance for land-use planning in New Zealand, a summary of the limitations of the research, and key conclusions.

CHAPTER 7 Summary and conclusions

1. Introduction

New Zealand is subject to a number of natural hazards, with many communities susceptible to the impacts of a severe natural event. Within the context of sustainable development, the current approach to land-use planning for natural hazards is not producing a reduction in risk. Rather, despite the stated legislative intent to manage hazard risk, developments are continuing to be approved in high risk locations. While there is a variety of guidance to councils to assist in managing their risks, there is no guidance that explicitly provides details on how to quantify or qualify risks for land-use planning. To assist in bridging this gap, an innovative risk-based planning approach is required to ensure sustainable risk reduction is achieved in the future.

The aim of this research was to *develop an innovative framework for land-use planning that enables risks from natural hazards in New Zealand to be reduced*. In order to meet this aim, the overarching question of this thesis was *"How can the existing risk-based land-use planning framework be improved to encourage better decision making for natural hazard risk reduction?*

To achieve this aim and answer the subsequent research question, the objectives of the research were to:

1. Provide the context to the rationale for the study, based on an international literature review around sustainable development, risk governance, natural hazards, land use planning, risk, and innovation (Chapter 2);

2. Undertake ethical research based on reliable research methods (Chapter 3);

3. Outline and critique the regulatory context for managing natural hazards in New Zealand (Chapter 4);

4. Describe what innovation is, and its relevance to land-use planning within the context of the Thames-Coromandel district (Chapter 5);

5. Outline approaches to risk governance within land-use planning and present an innovative risk governance framework for managing natural hazards via risk-based land-use planning (Chapter 6); and

6. Summarise key findings of research and their implications for decision making and future research (Chapter 7).

In order to achieve the aim and objectives of the research, six key research methods were applied: PAR; review of literature; case studies; interviews; content analysis of interview transcriptions; and workshops. The basis for the research was PAR, where the research was undertaken both *for* and *with* institutions (Cameron, 2007). As part of this approach, a case study based on the Thames-Coromandel district was undertaken, with associated interviews, content analysis and findings (Chapter 5).

The purpose of this final chapter is fourfold. First, it will provide a summary of the key findings of the research; second, it will summarise the limitations of the research; third it will provide a summary of the opportunities for future research, and fourth, will provide the overall conclusions of the research.

2. Summary of research findings

There are four key themes on which the research findings are based: 1) sustainable development; 2) the legislative context; 3) innovation and land-use planning for natural hazard risk reduction; and 4) an adaptive, risk-based approach to land-use planning. The findings of each of these themes are discussed in the following sections.

2.1 Sustainable development

This research has been based within the overarching context of sustainable development, which is integral to reducing risks to natural hazards. If communities are located in at-risk locations, the likelihood of adverse consequences occurring are increased; and the resulting economic, environmental and social costs prevents the goal of sustainable development and community resilience being achieved. Within the New Zealand legislative context, both sustainable management and sustainable development terminology is used with various statutes, but only sustainable management is defined.

To assist in achieving sustainable development outcomes, the hierarchy of arrangements for risk reduction is required. This begins with overarching governance arrangements, followed by risk governance (based on Renn, 2008), natural hazard management, and finishes with land use planning as one option for achieving risk reduction. Land use planning has a key role to play in sustainable development and reducing risks to natural hazard events, through the control of land use. This can be achieved by two primary processes: 1) by avoiding development in high-risk locations; and 2) by modifying the design and construction requirements of communities, so that

consequences are reduced. However, this existing approach does not always provide satisfactory outcomes, and innovation is required within planning policy and when planning for developments, to improve risk reduction and consequences. By allowing for and practicing innovative planning, planning policy can be improved, resulting in better decision making for at-risk areas, which will lead to increased community resilience and sustainable development.

2.2 Legislative context for natural hazard management in New Zealand

The regulatory context of the management of natural hazards focuses on four key statutes: the RMA; Building Act; CDEMA; and LGA. While the purposes of the statutes are integrated 'on paper', in reality the integration of hazard management practices between the statutes needs to be strengthened. In summary, the research found that the following opportunities exist to improve the current management of natural hazards via legislation:

- Clarification of purposes is required, to ensure that policies and practices can be monitored against the purpose of a statute.
- Consistency between the definitions of 'natural hazard' is needed to ensure consistency of management between statutes.
- There is a need to define sustainable management under the CDEMA and sustainable development under the Building Act and LGA. This will allow for monitoring of policies to assess whether sustainable management/development is being achieved.
- Clarity is needed about whether a strong or weak sustainability model is a legislative priority for development. Currently there is tension between economic priorities versus the more holistic environmental-social-economic approach. This has been shown to lead to mitigation initiatives that increase future risks to people and property.
- Risk reduction under the CDEMA is assumed to be managed under the RMA, therefore the tools available under the RMA need to incorporate the principles of risk reduction.
- The terms 'mitigation' and 'avoidance' need to be clarified in relation to achieving positive environmental outcomes, in that sustainable risk reduction does not

increase future risks and manages residual risk. This was highlighted in the discussion on the Kahikatea Estates development in the Thames-Coromandel district.

- To ensure that mitigation measures do result in a decreased level of risk, levels of risk need to be quantified and/or qualified with communities, particularly as acceptable levels of risk are not defined within the NZCPS, CDEMA and RMA policies.

- Guidance is needed about what comprises social, economic, environmental and cultural well-beings, and consistency of definitions is required between the different statutes. Once these are defined, indicators can be used to measure effectiveness of policies and plans for hazard management.

- A task force (or similar) could be established to provide guidance on various natural hazards and appropriate likelihoods, e.g. whether current timeframes for managing different natural hazards are adequate, given that timeframes range from 50 to 2,500+ years.

There is also the opportunity to improve hazard management by looking at the consequences of events via the four key community well-beings, rather than the current approach of focusing on timeframes. These findings have the potential to contribute to any review of the legislation that may be undertaken. Within the legislative context for managing natural hazards, the concept of innovation was explored and informed by a case study of the Thames-Coromandel district, as summarised in the following section.

2.3 Innovation and land-use planning for natural hazard risk reduction: a perspective from Thames-Coromandel

From undertaking a literature review it became apparent that while innovation is well defined from a number of perspectives (i.e. business, social and community, environmental and sustainability, and governance), there is limited literature on innovation in land-use planning. Two authors of note have contributed to the discussion of innovation in land-use planning – Healey (Gonzalez & Healey, 2005; Healey, 2004) and Friedmann (2003). However, there are limitations to the definitions provided, in particular by Friedmann (2003). To bridge this gap, the following definition was presented to a) contribute to the body knowledge on innovation and land-use

planning, and b) provide a definition so that innovation within land-use planning can be monitored against key elements: *An opportunity to plan for positive social, economic, and environmental outcomes in a new way, based on old and new planning principles within planning theory and practice. It requires a vision, leadership, and belief that extends beyond political cycles; is comprehensive and integrated with policies and plans from different sectors; and involves the active and meaningful participation of the community. The outcome of innovative land-use planning is hazard-resilient, sustainable communities.*

From the case study based within the Thames-Coromandel district, it became apparent that an innovative risk governance approach is required that meets the shortfalls of the existing risk governance arrangements. The state, market and civil society are key to an integrated risk governance approach, however as outlined by Handmer (2008), risk creation, bearing and sharing may not be equal between these players, and economics often override social and environmental issues. Barriers and opportunities to innovations for risk reduction included governance, leadership, legislation, research, second generation plans, cost, liability, skills/experience/ resources, awareness and understanding. Improvements are also needed in the following areas:

- Consistency is required between CDEM Group plans, RPS and DPs. At the present time there is no consistent approach to including and ranking natural hazards (refer legislative linkages Figure 4.1 Chapter 4);
- Levels of risk need to be quantified and qualified to provide certainty to council staff and applicants on what level is appropriate;
- There is a compelling need to move towards risk reduction and away from the current approach of hazard management in planning, which is not reducing risks to society (e.g. Kahikatea Estate and the Holt development, refer Chapter 4); and
- Legislative changes are needed to provide more certainty for local authorities, communities and developers based on more prescriptive performance-based measures of community well-being.

Incorporating the findings in Thames-Coromandel and based within the regulatory context, a risk-based approach to natural hazard risk reduction was then developed, as summarised in the following section.

2.4 A risk-based approach to natural hazards and land-use planning

An innovative, adaptable, three-step, risk-based approach to land-use planning for natural hazards was developed to provide an alternative option for managing natural hazards through the planning process. This approach was predominantly based on risk governance elements provided by Renn (2008) and Risk Management Standard (Standards Australia/New Zealand, 2009). The three steps involved 1) quantifying and qualifying levels of risk based on consequences; 2) determining the likelihood of an event occurring based on consequences; and 3) taking a risk-based approach to resource consents. The approach is considered innovative in that rather than addressing the likelihood of an event occurring first (e.g. 50 or 100 years), first the consequences are quantified and/or qualified, then the likelihood is assessed based on the consequences provided. The framework is presented as a guide, and councils need to adapt it to develop their own risk-based framework within the context of their hazards and communities. The risk governance rationale behind the framework is consistent with that of Renn, in that it involves risk appraisal. This includes the determination of consequences involving social and economic aspects; vulnerability assessment and hazard identification and estimation; judges the tolerability and acceptability of risk; risk reduction options can be based on risk via the resource consent process; and communications/participation occur with the community during the development of the framework. The framework involves input from the economic, political, and expert systems and civil society. While this innovative approach is focused on risk-based planning, it is envisaged the framework can be used in conjunction with precautionary planning approaches, although it is acknowledged that participation is an integral part of the risk governance framework.

The result of the innovative, adaptive approach is twofold: 1) levels of risk are able to be quantified and/or qualified, which allows for ‘acceptable levels of risk’, often referred to in plans, to be defined. This contributes to planning practice by ensuring that unacceptable risks are not taken on by individuals which are not acceptable to the greater community. It also allows risk levels and risk reduction initiatives to be monitored. As Mileti (1999) explained, monitoring is important to ensure that any risk reduction policies and initiatives achieve their desired outcomes (i.e. a reduction in risk); and 2) provides a risk-based approach based on consequences first, rather than likelihood. This provides an opportunity to manage hazards differently from current planning practice (and is therefore innovative).

This approach provides an opportunity to contribute to planning practice in New Zealand by providing an adaptable framework that can be applied to individual communities, based on their risk profile. The approach is already being implemented in the Bay Of Plenty, and is being considered by other councils around New Zealand. While the findings of the research are based on accepted and structured social science methodologies, there are limitations to the research presented, as outlined in the following section.

3. Limitations of research

While acknowledging the importance of other aspects of hazard research, in particular the holistic nature and requirement of undertaking and linking into multidisciplinary hazard fields, this research is focused on one aspect of the natural hazard field of enquiry – land-use planning. Although consultation is explicit within the land-use planning context in New Zealand, issues around community engagement and participation have not been a primary focus.

Chapter 6 presented a risk governance model for land-use planning, but the research undertaken has only looked at specific parts of the model – the context, risk management objectives and policies via RPSs, risk treatment/mitigation, and risk management plans (or district plan options). This risk governance model and risk-based approach needs to be fully explored and tested. In regard to the description of consequences within the risk-based approach (outlined in Chapter 6), the consequence categories can be further defined according to the more detailed MCDEM recovery framework, rather than being based on the simplified four well-beings provided (health and safety, social, economic and environmental). Perceptions of risk are not addressed.

The framework provided is currently limited to assessing consequences for single hazard events. There is a need to reconcile multiple hazards into the framework e.g., ground shaking causing liquefaction, landslides, tsunami, and increased flood risk (as flood defences are weakened). The framework is also focused on the resource consent process; however the approach can be incorporated into planning policy, as shown by the Bay of Plenty Proposed RPS.

4. Opportunities for future research

Integral to the health and safety consequence column in Step 1 of the risk-based approach is the life safety issue. Further research needs to be undertaken within a New Zealand context to compare multiple fatality events in order to assess acceptable and intolerable levels of risk (individual deaths are generally deemed to be tolerable). Such an assessment should include both natural and anthropogenic events.

Future research and development will provide further details of the risk-based approach, in particular on quantifying and qualifying levels of risk, and exploring how to engage with communities on discussing a risk approach such as this. Developing the description of consequences and community engagement is currently the subject of a project funded by the Ministry of Science and Innovation's "Envirolink Tools" grant program, with support from various councils around New Zealand. Further research is required to ascertain how one event with multiple hazard outcomes can be incorporated. Longitudinal research on the BOP RPS implementation will also be undertaken.

5. Conclusions

Planning has a key role to play in reducing risks from natural hazards and in-turn contributing to sustainable development; however, a new approach is required to ensure that planning decisions do not result in an increase in risk to people and property. This thesis has developed an innovative framework for land-use planning that provides an alternative to the current planning approach to managing risk in planning. The framework focuses on levels of acceptability of consequences, before the consideration of the likelihood of an event, as part of hazard management practice. Based on risk management principles and processes, the framework will enable the risks from natural hazards in New Zealand to be reduced via risk-based land-use planning, and thereby contributes to planning practice. In order to provide the legislative environment which supports risk reduction through land-use planning, legislative change is required to better integrate legislation and provide effective monitoring of risk reduction policies and outcomes. The risk-based framework provides an opportunity to qualify and quantify levels of risk, based on assessing consequences first, rather than likelihood. This is a new approach and a significant departure from most current planning practice. It is important to define levels of risk, to ensure that an

acceptable level of risk for risk reduction can be effectively implemented and monitored.

APPENDICES

Appendix 1 Massey University Human Ethics Committee approvals

School of People, Environment & Planning, Massey University, Palmerston North, New Zealand
GNS Science, PO Box 30368, Avalon, Lower Hutt, New Zealand

Innovative land use planning for natural hazard risk reduction – a case study

INFORMATION SHEET

Introduction

This study focuses on the role of innovative land use planning in reducing risks to natural hazards to tolerable level. The aim of this research is to improve planning practice and encourage risk reduction initiatives within land use planning for natural hazards. By undertaking such research, a better understanding can be gained about how natural hazard risk reduction can be better incorporated into land use planning processes. The locational focus of this case study is the Thames-Coromandel district.

To carry out this research, it is proposed that a number of interviews will be undertaken with individuals in communities (e.g. Council staff, developers, iwi), central government agencies (e.g. Ministry of Civil Defence Emergency Management, Ministry for the Environment, Local Government New Zealand), and national agencies (e.g. Insurance Council of New Zealand, EQC). The purpose of the interviews is to gauge perceptions and build understanding about the role that land-use planning can play in reducing disaster risk. In particular, who is responsible for risk reduction; what constitutes and who instigates innovative risk reduction practices; the role of land-use planning in disaster risk reduction; and what are the obstacles and opportunities for improving risk governance (i.e. how governance is perceived amongst a range of stakeholders).

For the purpose of this research, the following definitions are applied:

Risk is the likelihood of an event and its social, economic and environmental consequences
Risk reduction is identifying and analysing the long-term risk to human life and property; taking steps to eliminate those risks if practicable, and if not, reducing the magnitude of their impact and the likelihood of their occurring.
Governance refers to the processes through which the collective affairs of a society or community are managed.
Innovation is doing something new, or something differently, than how it has been done before.

The project forms part of a student PhD research project by Wendy Saunders through the School of People, Environment & Planning, Massey University. Research funding has been provided by the Foundation for Research Science and Technology through GNS Science, of which the student is also an employee; and via the Zonta/BRANZ research award. Supervision of the student is provided by Assoc. Prof. Bruce Glavovic and Assoc. Prof. David Johnston at Massey University (Palmerston North and Wellington).

Project Procedures
Interviews will be undertaken in person. Before an interview is conducted, all interviewees will be informed about the nature of the research being undertaken, their rights as participants, and will be asked to sign a consent form.

Interviews may be taped and transcribed. Following transcription, all individuals will be sent their transcripts to check and confirm that what is represented in the transcripts is correct. Themes will be extracted from the interview transcriptions and general findings reported on only. Project results will be accessible by contacting Wendy Saunders, and may be in various report formats.

All data will be collected, utilised and stored by methods that comply with the Massey University Code of Ethical Conduct.

Participant involvement
Interviews will be approximately one hour in length.

Participant's Rights
You are under no obligation to accept this invitation. If you decide to participate, you have the right to:

- decline to answer any particular question;
- withdraw from the study at any time before the results are sent for publication;
- ask any questions about the study at any time during participation;
- provide information on the understanding that your name will not be used unless you give permission to the researcher;
- ask for the audio tape to be turned off at any time during the interview;
- be given access to a summary of the project findings when it is concluded.

Project Contacts
For further information about the project, please contact:

Wendy Saunders, Massey University / GNS Science, P.O. Box 30386, Avalon, Lower Hutt

Ph: 04 570 4802, w.saunders@gns.cri.nz

Assoc. Prof. Bruce Glavovic, School of People, Environment & Planning, Massey University, Palmerston North, Ph: 06 356 9099 ext 2036, b.glavovic@massey.ac.nz.

Assoc. Prof. David Johnston, Disaster Research Centre, School of Psychology, Massey University, Tasman Street, Newtown, Wellington, Ph: 04 801 5799 ext. 62168, david.johnston@gns.cri.nz

Project Evaluation
This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named above are responsible for the ethical conduct of this research.
If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Professor Sylvia Rumball, Assistant to the Vice-Chancellor (Ethics & Equity), telephone 06 350 5249, email humanethics@massey.ac.nz.

School of People, Environment & Planning, Massey University, Palmerston North, New Zealand
GNS Science, PO Box 30368, Avalon, Lower Hutt, New Zealand

Innovative land use planning for natural hazard risk reduction

PARTICIPANT CONSENT FORM

This consent form will be held for a period of five (5) years

I have read the Information Sheet and have had the details of the study outlined to me. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I agree/do not agree to participate in an interview (circle one).

I agree/do not agree to the interview being audio taped (circle one).

I wish/do not wish to have data placed in an official archive (circle one).

I agree to participate in this study under the conditions set out in the Information Sheet.

Signature: ..... **Date:** .....

Full Name - printed .....

School of People, Environment and Planning, Massey University, Palmerston North
GNS Science, PO Box 30368, Avalon, Lower Hutt

1 May 2010

Interviews on land use planning and natural hazards – Transcription Check

I would like to thank you very much for participating in an interview for my research on innovative land use planning and natural hazard risk reduction.

I attach a copy of the transcript of the interview. Please read through and check that you are happy with the transcript. Do not worry about the grammar too much, as it has been typed up in the format of our conversation. If you are happy with the transcript, please confirm this via email.

If you want to make any changes, please make them, and return the transcript to me. You can make alterations in two ways:-

- If you prefer to amend a paper copy, write any changes on the paper copy, and send back to me at the following address: Wendy Saunders, GNS Science, PO Box 30368, Avalon, Lower Hutt; or
- If you prefer to amend an electronic version, you can make direct changes to the electronic document, and email it back to me. Please indicate where you have made changes by highlighting the parts changed, or using the "Track Changes" function.

It would be appreciated if you can either confirm you are happy with the transcript, or return the transcript, within 10 days of receiving this.

By confirming you are happy with the transcript, or by sending back edited versions of the transcripts, you agree that the edited transcript, and extracts from this, may be used by the researcher, Wendy Saunders, in reports and publications arising from the research.

As a reminder, all interviews are anonymous, and information is not linked back to individual participants. Where names have been mentioned, these will be deleted from the transcript. You are also entitled to withdraw from the study at any time before the results are sent for publication, and can do this by contacting me directly.

Kind regards

Wendy Saunders
Massey University / GNS Science

For further information, please contact Wendy Saunders at:
Phone: 04-570 4802 or Email: w.saunders@gns.cri.nz

Massey University

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7 July 2008

Wendy Saunders
2B Kelso Grove
Kelson
LOWER HUTT

Dear Wendy

Re: Innovative Land Use Planning for Natural Hazard Risk Reduction

Thank you for your Low Risk Notification which was received on 4 July 2008.

Your project has been recorded on the Low Risk Database which is reported in the Annual Report of the Massey University Human Ethics Committees.

The low risk notification for this project is valid for a maximum of three years.

Please notify me if situations subsequently occur which cause you to reconsider your initial ethical analysis that it is safe to proceed without approval by one of the University's Human Ethics Committees.

Please note that travel undertaken by students must be approved by the supervisor and the relevant Pro Vice-Chancellor and be in accordance with the Policy and Procedures for Course-Related Student Travel Overseas. In addition, the supervisor must advise the University's Insurance Officer.

A reminder to include the following statement on all public documents:

> *"This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named above are responsible for the ethical conduct of this research.*
>
> *If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Professor Sylvia Rumball, Assistant to the Vice-Chancellor (Research Ethics), telephone 06 350 5249, e-mail humanethics@massey.ac.nz".*

Please note that if a sponsoring organisation, funding authority or a journal in which you wish to publish requires evidence of committee approval (with an approval number), you will have to provide a full application to one of the University's Human Ethics Committees. You should also note that such an approval can only be provided prior to the commencement of the research.

Yours sincerely

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Appendix 2 Managing uncertainty in land-use planning

Uncertainty is the state of the information, understanding or knowledge of an event, its consequences, or likelihood (ISO., 2009), where the likelihood of any adverse effects (or the effects themselves) cannot be precisely described, although the factors influencing the issue are identified (Health & Safety Executive, 2001). Some risks can be anticipated, and hence planned for, which reduces uncertainty. Yet uncertainty will always exist, whatever data gathering and analysis exercises can be accomplished (Dovers & Handmer, 1992; Grunwald, 2008).

To assist with understanding uncertainty, Klinke and Renn (2002) suggest the following categories of uncertainty, which are often interlinked:

- Variability of observed or predicted individual responses to an identical situation;
- Systematic and random measurement errors, such as problems of drawing conclusions from small statistical samples, and uncertainties of modelling. These types of uncertainty are usually expressed through statistical confidence levels;
- Indeterminacy results from a genuine stochastic relationship between cause and effect(s), apparently noncausal or noncyclical random events, or badly understood nonlinear, chaotic relationships; and
- Lack of knowledge resulting from ignorance, or from the deliberate definition of system boundaries and associated exclusion from external influences, measurement impossibilities, and others.

These categories are also shown in Figure A2.1 by van Asselt, which shows the explicit uncertainties between hazard modellers (e.g. tsunami, flood, earthquake, volcanic, landslide, coastal and climate change modellers) and decision makers.

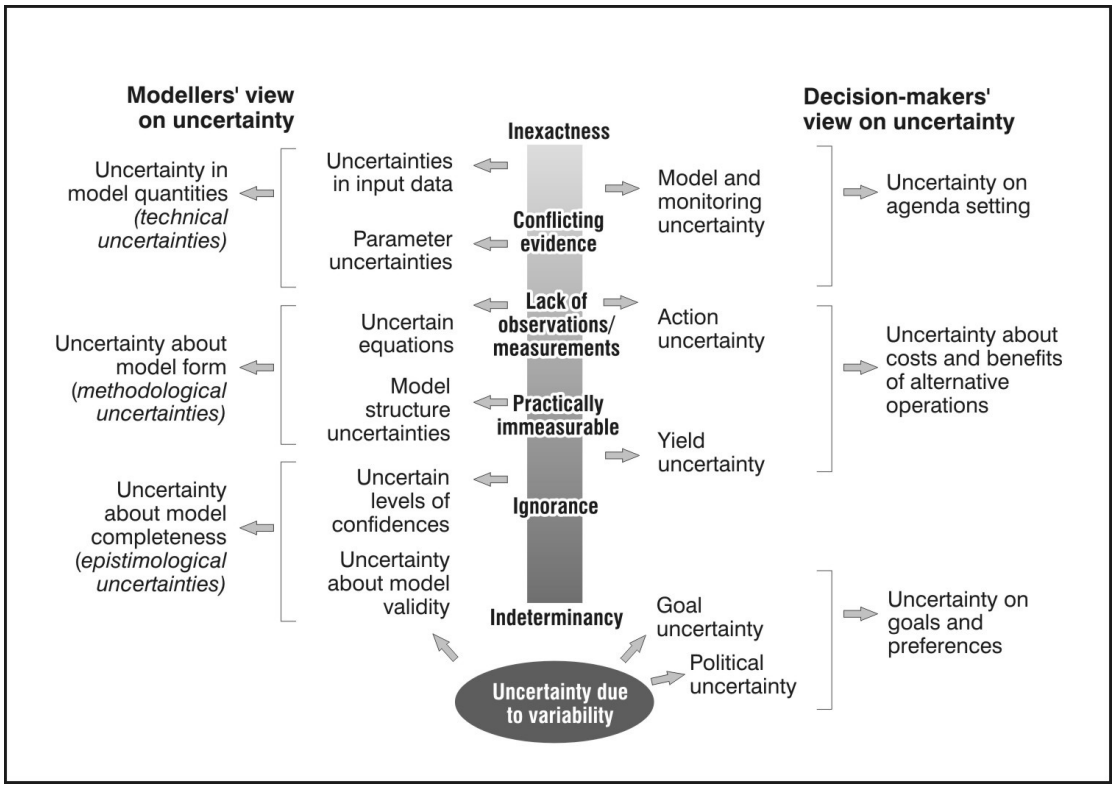

Figure A2.1 Modellers' and decision-makers' view on uncertainty (van Asselt, 2000, p91)

To manage any residual uncertainty, a good understanding of the uncertainty and its implications should be acknowledged, with strategies developed to reduce the impacts of uncertainty and change. Similar to natural systems, human systems need to be flexible enough to cope with uncertainty and unanticipated shocks (Dovers & Handmer, 1992; Grunwald, 2008). One option is to construct credible scenarios about how hazards could be realised, thereby making assumptions about consequences and likelihood. The credible scenarios can range from 'most likely' consequences to 'worst case possible' depending on the degree of uncertainty (Health & Safety Executive, 2001).

It is important to recognise, acknowledge and incorporate uncertainties into the planning process. In New Zealand, this is already being successfully achieved for active faults and landslides, and a similar approach is being recommended for tsunami (Saunders, et al., 2011). Examples of mapping uncertainty include using 'constrained' and 'distributed' mapping of active faults (Kerr, et al., 2003, see Figure A4.2); landslide 'core' and 'fringe' areas (Saunders & Glassey, 2007, see Figure A4.3); and tsunami hazard zones (Saunders, et al., 2011). Each of these maps has associated policy restrictions and additional assessment criteria.

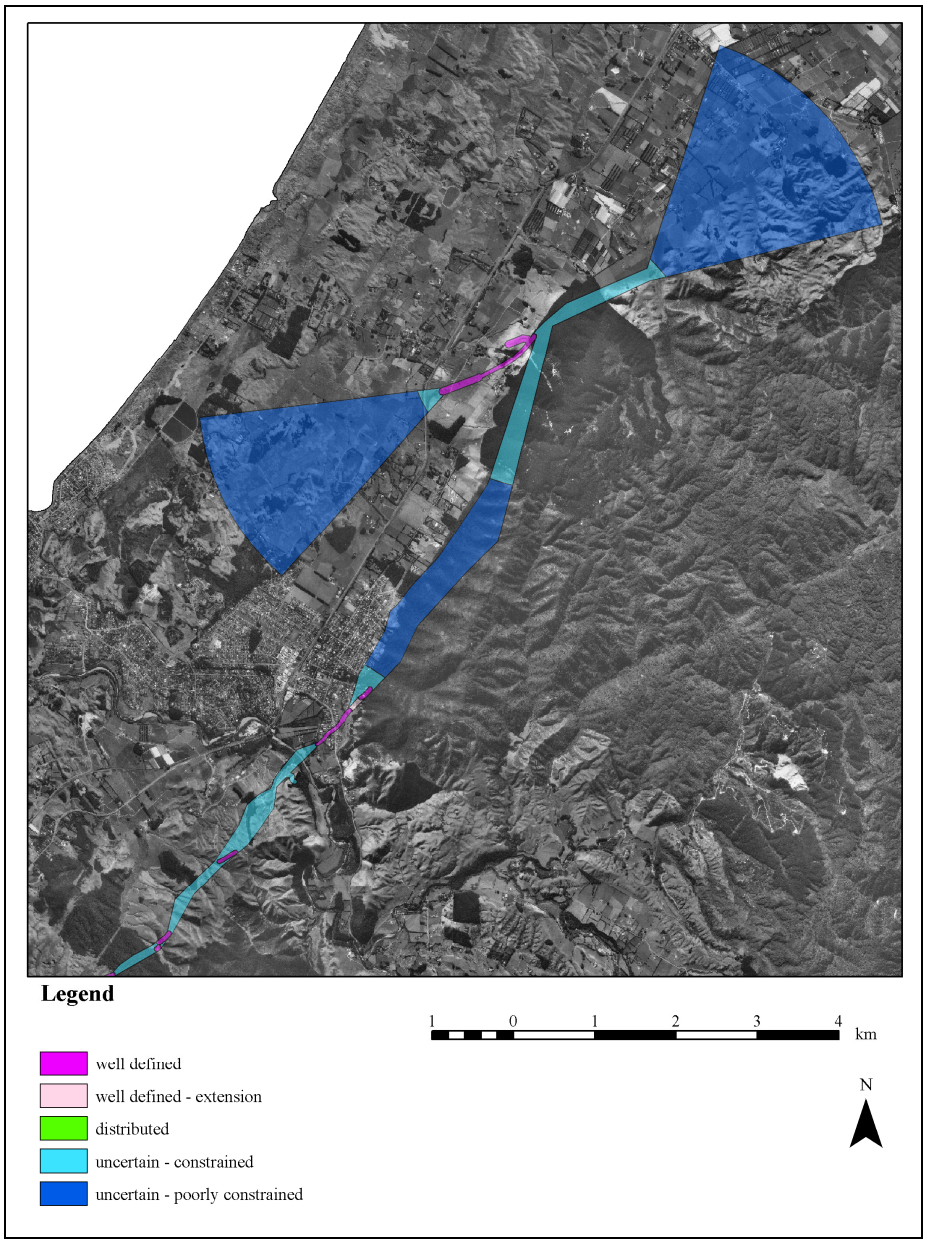

Figure A2.2 Example of uncertainty cones in active fault mapping, with colours depicting type of fault and level of uncertainties (Kerr, et al., 2003).

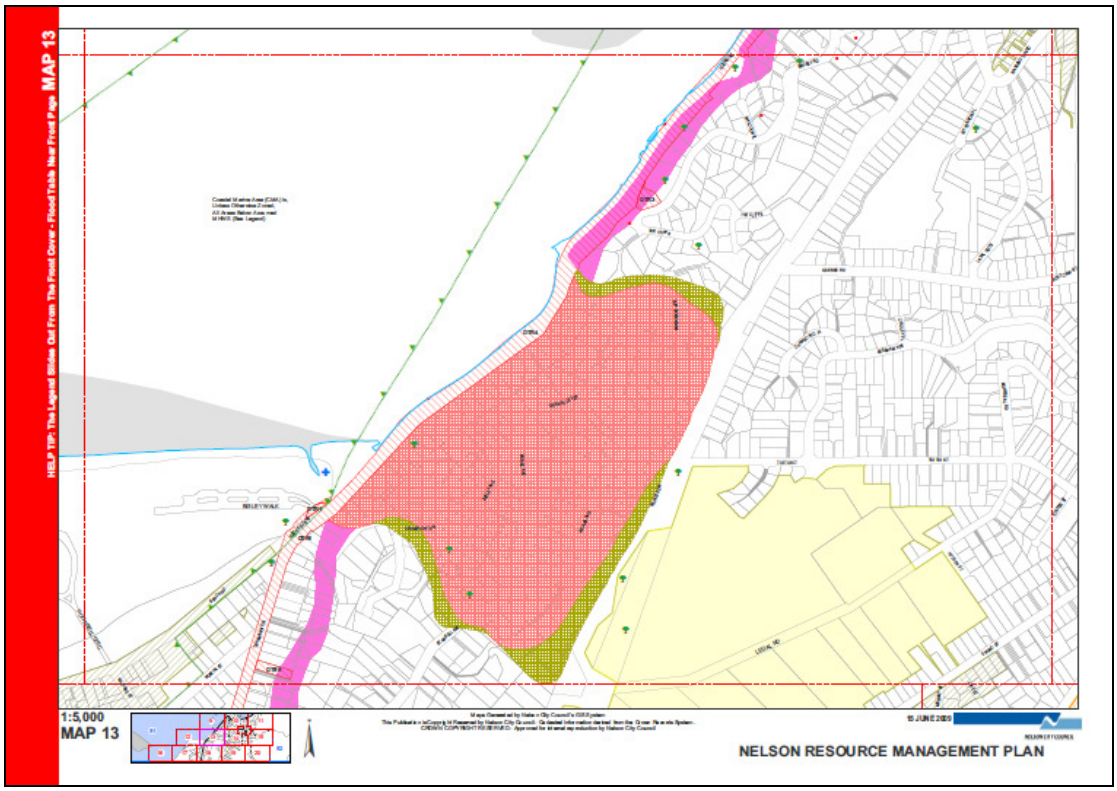

Figure A2.3 The Tahunanui Slope Risk Area, commonly known as the Tahunanui Slump, is defined on the Planning Maps within the Nelson Resource Management Plan.

Figure A2.3 consists of a core landslide area where the hazard is known (red), surrounded by a fringe area where the edge of the active slump has not been able to be accurately defined (green) (Nelson City Council). Rules stipulate that new residential units within the core are non-complying; within the fringe area they are discretionary (Rule REr.77.3).

Although it has negative connotations of not possessing certain knowledge for planning and decision making processes, uncertainty can be seen as an opportunity for the future. For example, uncertainty can influence and shape activities which can and will have an impact on the further course of development. It allows for learning processes, for working according to self-defined goals, for deliberating about how to shape the future, and for proactively thinking about future society. Therefore, uncertainty not only comprises risks for directing activities, but simultaneously provides the opportunity for reflection, learning, and open deliberation (Grunwald, 2008).

Appendix 3 Relevant provisions in the New Zealand Coastal Policy Statement

The following table provides a summary of relevant provisions in the NZCPS for managing coastal hazards. Regional policy statements, regional plans and district plans must give effect to the NZCPS.

Objective / Policy
Objective 5 To ensure that coastal hazard risks taking account of climate change, are managed by: • locating new development away from areas prone to such risks; • considering responses, including managed retreat, for existing development in this situation; and • protecting or restoring natural defences to coastal hazards.
Policy 3 Precautionary approach (1) Adopt a precautionary approach towards proposed activities whose effects on the coastal environment are uncertain, unknown, or little understood, but potentially significantly adverse. (2) In particular, adopt a precautionary approach to use and management of coastal resources potentially vulnerable to effects from climate change, so that: (i) avoidable social and economic loss and harm to communities does not occur; (ii) natural adjustments for coastal processes, natural defences, ecosystems, habitat and species are allowed to occur; and (iii) the natural character, public access, amenity and other values of the coastal environment meet the needs of future generations.
Policy 7 Strategic planning (2) Identify in regional policy statements, and plans, coastal processes, resources or values that are under threat or at significant risk from adverse cumulative effects. Include provisions in plans to manage these effects. Where practicable, in plans, set thresholds (including zones, standards or targets), or specify acceptable limits to change, to assist in determining when activities causing adverse cumulative effects are to be avoided.
Policy 24 Identification of coastal hazards (1) Identify areas in the coastal environment that are potentially affected by coastal hazards (including tsunami), giving priority to the identification of areas at high risk of being affected. Hazard risks, over at least 100 years, are to be assessed having regard to: (a) physical drivers and processes that cause coastal change including sea level rise; (b) short term and long term natural dynamic fluctuations of erosion and accretion; (c) geomorphological character; (d) the potential for inundation of the coastal environment, taking into account potential sources, inundation pathways and overland extent; (e) cumulative effects of sea level rise, storm surge and wave height under storm conditions; (f) influences that humans have had or are having on the coast; (g) the extent and permanence of built development; and (h) the effects of climate change on: (i) matters (a) to (g) above; (ii) storm frequency, intensity and surges; and (iii) coastal sediment dynamics; taking into account national guidance and the best available information on the likely effects of climate change on the region or district.
Policy 25 Subdivision, use and development in areas of coastal hazard risk In areas potentially affected by coastal hazards over at least the next 100 years: (a) avoid increasing the risk of social, environmental and economic harm from coastal hazards; (b) avoid redevelopment, or change in land use, that would increase the risk of adverse effects from coastal hazards; (c) encourage redevelopment, or change in land use, where that would reduce the risk of adverse effects from coastal hazards, including managed retreat by relocation or removal of existing structures or their abandonment in extreme circumstances, and designing for relocatability or recoverability from hazard events; (d) encourage the location of infrastructure away from areas of hazard risk where practicable; (e) discourage hard protection structures and promote the use of alternatives to them, including

Objective / Policy
natural defences; and (f) consider the potential effects of tsunami and how to avoid or mitigate them.
Policy 26 Natural defences against coastal hazards (1) Provide where appropriate for the protection, restoration or enhancement of natural defences that protect coastal land uses, or sites of significant biodiversity, cultural or historic heritage or geological value, from coastal hazards. (2) Recognise that such natural defences include beaches, estuaries, wetlands, intertidal areas, coastal vegetation, dunes and barrier islands.
Policy 27 Strategies for protecting significant existing development from coastal hazard risk (1) In areas of significant existing development likely to be affected by coastal hazards, the range of options for reducing coastal hazard risk that should be assessed includes: (a) promoting and identifying long-term sustainable risk reduction approaches including the relocation or removal of existing development or structures at risk; (b) identifying the consequences of potential strategic options relative to the option of 'do-nothing'; (c) recognising that hard protection structures may be the only practical means to protect existing infrastructure of national or regional importance, to sustain the potential of built physical resources to meet the reasonably foreseeable needs of future generations; (d) recognising and considering the environmental and social costs of permitting hard protection structures to protect private property; and (e) identifying and planning for transition mechanisms and timeframes for moving to more sustainable approaches; (2) In evaluating options under (1): (a) focus on approaches to risk management that reduce the need for hard protection structures and similar engineering interventions; (b) take into account the nature of the coastal hazard risk and how it might change over at least a 100 year timeframe, including the expected effects of climate change; and (c) evaluate the likely costs and benefits of any proposed coastal hazard risk reduction options. (3) Where hard protection structures are considered to be necessary, ensure that the form and location of any structures are designed to minimise adverse effects on the coastal environment. (4) Hard protection structures, where considered necessary to protect private assets, should not be located on public land if there is no significant public or environmental benefit in doing so.

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