Using land administration for land risk management

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Submitted in total fulfilment of the requirements of the degree

Doctor of Philosophy

October 2013

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I dedicate this thesis to my best friend who has always helped me and believed that I could do it

∞
Abstract

The impact of risk and disaster events on land and property within the developed world in the last decades has highlighted a significant problem in the ability of citizens and governments to address and respond to these threats. A breakdown in the process of identifying, analysing, evaluating and treating these risks has occurred, leaving communities exposed and vulnerable to a range of very real risk possibilities.

The integration of land administration information and risk management processes is considered essential for achieving effective land risk management practices and community resilience for risk events. However, in most countries, land administration and risk management are usually disparate disciplines. This research addresses this problem with the overall aim of facilitating improved risk management of land and property for all stakeholders.

This research investigates how land administration could support the process of managing risk to land and property for a range of stakeholders. Its primary objective is to develop a land risk management model which illustrates how these two elements, land administration and risk management, could be integrated to enable the implementation of effective land risk management practices by all stakeholders and to facilitate the development of a resilient community.

A mixed methods research design was utilised which included the use of a case study approach focusing on developed countries with established land administration systems. The research developed: an understanding of the issues which impact upon the ability of land administration agencies to contribute to land risk management as well as the factors which motivate them to participate; an understanding of the stakeholder roles and responsibilities in the process of land risk management; and finally, a land risk management model which illustrates a ‘to be’ situation for how land administration could support land risk management if the issues and factors identified were addressed. The model is realised as a prototype system which demonstrates how land administration information can facilitate the effective implementation of land risk management processes and strategies.

This research goes beyond the disaster risk reduction and disaster risk management strategies which have emerged from the integration of traditional disaster management models with the process of risk management. In these new models, only specific elements of the risk management process are incorporated and the focus remains largely on the response and
recovery elements. This research focuses more heavily on the entire risk management process and all of the elements within the model and is applied specifically to the problem of risk affecting land and property and how this risk can be managed. Applying more attention to the risk management process enables the development of a more resilient community through thorough identification, acknowledgement, assessment and treatment of risks affecting land and property. The integration of land administration facilitates the process enabling stakeholders to better understand the risks which affect their land and property through a user centred view.

The study concludes that the current land risk management processes are not sufficient and that improvements are required to achieve community resilience to risk events. The findings reveal that land administration systems have the potential to support land risk management practices and have significant motivational factors however changes to policy, legal, institutional and technical arrangements are first required.

It is expected that land risk management initiatives will continue to be high profile issues as climate change brings more frequent and severe weather events. The success of future community resilience will therefore rely heavily on improved management processes for managing risk to land and property through the utilisation of land administration information and engagement of all stakeholders.
Declaration

This is to certify that:

i. the thesis comprises only my original work towards the degree of Doctor of Philosophy;

ii. due acknowledgement has been made in the text to all other material used;

iii. parts of this work have been published in refereed journals or refereed conference proceedings as listed in Appendix 1;

iv. the thesis is less than 100,000 words in length, exclusive of tables, maps, bibliographies and appendices.

_______________________

Katie Elizabeth Potts

Melbourne, October 2013
Acknowledgements

To describe this as a journey is an understatement. It has been hard work, incredibly difficult at times, but extremely rewarding, and I am surprised and amazed to have made it to this point. I have a number of people to thank for their support in getting this far on this doctoral journey.

First and foremost I would like to thank my supervisor Professor Abbas Rajabifard. Without his support, encouragement, and guidance this thesis would have remained a dream. The opportunities extended to me, and the experiences I have had through being a part of the Centre for SDIs and Land Administration, which he has helped to build and grow, have made my time as a PhD student a highly enjoyable period of my life which I will always appreciate.

I would also like to acknowledge and thank Dr. Rohan Bennett for his role in this journey. I will be forever grateful for his time and dedication, and for his willingness to go above and beyond all expectations to guide me through this experience. To Professor Ian Williamson, thank you for challenging me along the way and providing the motivation to continue on when it was needed. I would also like to express my gratitude to Jude Wallace, for her encouraging words and her unwavering support for my research.

To the other members of the NIMLI team, Brian Marwick, Mohsen Kalantari, Muyiwa Agunbiade and Nilofer Christensen, I would like to thank you for your ideas and guidance, and for the opportunity to work with a wonderful group of people. Particularly, I would like to thank my fellow students Muyiwa and Nilofer. I would like to thank Muyiwa for his time, the knowledge he shared with me, and his problem solving skills which enabled me to find a way forward. To Nilofer, I am sincerely grateful for her constant support, reassurances, and most of all, her friendship.

I would also like to thank my colleagues within the Centre: Hamed Olfat, Ali Aien, Davood Shojaei, Heri Sutanta, Sam Amirebrahimi, Farhad Laylavi, Hosna Tashakkori, and James Hung for their friendship and support throughout my time as a student. To Serene Ho especially, my close comrade for the final nine months, thank you for encouragement and wise words when needed.

To the professional staff, Rose Macey, Pauline Woolcock and Felicity Clissold thank you for your assistance and help with the administrative hurdles and organisational challenges.
Finally, to my family and friends, enough cannot be said. My thanks to my housemates Matthew Kehoe and Melinda Hall for their willingness to always listen and offer advice. To my parents, David and Di, for providing support, understanding and the opportunity to pursue postgraduate study. To my sister Sherryn, and brothers Mitchell and Bradley, for their friendship and ability to make life fun. And to Hugh, for believing in me always.
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<tr>
<td>ACT</td>
<td>Australian Capital Territory</td>
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<tr>
<td>ANZLIC</td>
<td>The Spatial Information Council (formerly the Australian and New Zealand Land Information Council)</td>
</tr>
<tr>
<td>AS/NZS</td>
<td>Standards Australia and Standards New Zealand</td>
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<tr>
<td>AUD</td>
<td>Australian Dollar</td>
</tr>
<tr>
<td>BOM</td>
<td>Bureau of Meteorology</td>
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<tr>
<td>CBD</td>
<td>Central Business District</td>
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<tr>
<td>CEO</td>
<td>Chief Executive Officer</td>
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<tr>
<td>CERA</td>
<td>Community Emergency Risk Assessment</td>
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<td>CFA</td>
<td>Country Fire Authority</td>
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<tr>
<td>CSIRO</td>
<td>Commonwealth Scientific and Industrial Research Organisation</td>
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<tr>
<td>DSE</td>
<td>Department of Sustainability and Environment</td>
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<tr>
<td>DSS</td>
<td>Decision Support System</td>
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<tr>
<td>DTS</td>
<td>Decision Technology System</td>
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<tr>
<td>FAQ</td>
<td>Frequently Asked Question</td>
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<tr>
<td>FIG</td>
<td>International Federation of Surveyors</td>
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<td>GIS</td>
<td>Geographic Information System</td>
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<tr>
<td>HR</td>
<td>Human Resources</td>
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<tr>
<td>ICSM</td>
<td>Intergovernmental Committee on Surveying and Mapping</td>
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<tr>
<td>ICT</td>
<td>Information and Communications Technology</td>
</tr>
<tr>
<td>ID</td>
<td>Identification</td>
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<tr>
<td>ISO</td>
<td>International Organisation for Standardisation</td>
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<td>LA</td>
<td>Land Administration</td>
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<td>LAS</td>
<td>Land Administration Systems</td>
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<td>LGA</td>
<td>Local Government Authority</td>
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<tr>
<td>LiDAR</td>
<td>Light Detection And Ranging</td>
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<td>LMP</td>
<td>Land Management Paradigm</td>
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<td>LPI</td>
<td>Land and Property Information division</td>
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<td>LPMA</td>
<td>Land and Property Information Authority</td>
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<td>MFB</td>
<td>Melbourne Fire Brigade</td>
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<td>MOU</td>
<td>Memorandum of Understanding</td>
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<td>NSW</td>
<td>New South Wales</td>
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<td>NT</td>
<td>Northern Territory</td>
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<td>OECD</td>
<td>Organisation for Economic Co-operation and Development</td>
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<td>PSMA</td>
<td>Public Sector Mapping Agency</td>
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<td>QLD</td>
<td>Queensland</td>
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<td>QUAL</td>
<td>Qualitative</td>
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<td>QUAN</td>
<td>Quantitative</td>
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<tr>
<td>RFS</td>
<td>Rural Fire Service</td>
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<td>RRR</td>
<td>Rights, Restrictions and Responsibilities</td>
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<td>SA</td>
<td>South Australia</td>
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<td>SDI</td>
<td>Spatial Data Infrastructure</td>
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<tr>
<td>Abbreviation</td>
<td>Full Form</td>
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<td>SES</td>
<td>State Emergency Service</td>
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<td>TAS</td>
<td>Tasmania</td>
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<tr>
<td>UN</td>
<td>United Nations</td>
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<tr>
<td>UN-ECE</td>
<td>United Nations Economic Commission for Europe</td>
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<tr>
<td>US</td>
<td>United States</td>
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<td>VGI</td>
<td>Volunteered Geographic Information</td>
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<td>VIC</td>
<td>Victoria</td>
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<td>WA</td>
<td>Western Australia</td>
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Glossary of terms

The following definitions are adopted for the purpose of this research:

**Authoritative information**  
Information sourced from government agencies or bodies, which is the best of its kind and can be trusted as being assured, accurate and reliable. In countries with well established land administration systems, the government land administration agencies can be considered the most legitimate and hence most authoritative source of land transaction information (Williamson et al. 2012)

**Cadastre**  
A cadastre is a parcel based and up-to-date land information system containing a record of interests in land (i.e. rights, restrictions and responsibilities) (FIG 1995)

**Collaboration**  
The willingness of two or more organisations to, constructively, explore (synergy) differences in their functions and processes and search for strategies to achieve better outcomes beyond their own limited vision of what is possible. This relationship includes a commitment to mutual relationships or goals, a jointly developed structure and shared responsibility; mutual authority and accountability for success; and sharing of resources and rewards. It involves a high degree of formality, high resource commitment and inter-agency control Mattessich and Monsey (1992) sited in Townsend and Shelley (2008)

**Common sense**  
The basic ability to perceive, understand, and judge things which are considered ‘common to’ nearly all people, and can be reasonably expected of almost all people without any need for debate.

**Coordination**  
The harmonious interaction of functions or processes between two or more organisations. It involves minimal rules, limited resources, some interdependency and clear agency goals.

**Developed country**  
A sovereign state that has a highly developed economy, advanced industrialisation and technological infrastructure
Developing country
A nation which is underdeveloped in terms of economy, standard of living, industrialisation and technological advancement.

Disaster
A serious disruption of the functioning of community or a society causing widespread human, material, economic or environmental losses which exceed the ability of the affected community or society to cope using its own resources.

Disaster risk management
Defined by the UNISDR (2009) as “the systematic process of using administrative directives, organisations, and operational skills and capacities to implement strategies, policies and improved coping capacities in order to lessen the adverse impacts of hazards and the possibility of disaster”.

Disaster risk reduction
Defined by the UNISDR (2009) as “the concept and practice of reducing disaster risks through systematic efforts to analyse and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events.

Emergency management
The organisation and management of resources and responsibilities for addressing all aspects of emergencies, in particular preparedness, response and initial recovery steps.

Hazard
A potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation.

Land administration
‘The processes run by government using public or private sector agencies related to land tenure, land value, land use and land development’ (Williamson et al. 2010).

Land administration functions
These include, land tenure, land value, land use and land development (Williamson et al. 2010)

Land administration information
Information relating to tenure, value, use and development of land that is collected by authoritative, government land
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<td>Land management</td>
<td>Land management is the process of managing the use and development (in both urban and suburban settings) of land resources in a sustainable way. It is the process by which resources of land are put into good use.</td>
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<td>Land management paradigm</td>
<td>The land management paradigm outlines land management activities within a country context, all in support of sustainable development. The paradigm has three components which relate to the land management activities: land policies, land information, and land administration infrastructures (Enemark 2005c).</td>
</tr>
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<td>Land rights</td>
<td>The absolute ability of individuals and groups of individuals to obtain, possess and use land at their discretion, with the exception of activities that violate the absolute human rights of others (Adi, 2009).</td>
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<td>Land tenure</td>
<td>A recognised relationship between people and land. As outlined by Williamson et al (2010), tenure is also defined as “the manner of holding rights in and occupying land”.</td>
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<td>Land value</td>
<td>“The worth of a property, determined by one of a variety of ways, each of which can give rise to a specific estimate” (Williamson et al, 2010).</td>
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<td>Mitigation</td>
<td>The lessening or limitation of the adverse impacts of hazards and related disasters.</td>
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<td>Nation</td>
<td>Smith (1991) defines a nation as “a named human population sharing an historic territory, common myths and historical memories, a mass, public culture, a common economy and common legal rights and duties for all members.”</td>
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<td>Natural disaster</td>
<td>A natural disaster is a major adverse event resulting from natural processes of the Earth; examples include floods, volcanic eruptions, earthquakes, tsunamis, and other geologic processes. A natural disaster can cause loss of life or property damage, and typically leaves some economic damage in its wake, the severity of which depends on the affected population's resilience, or ability to recover (Bankoff et al. 2004).</td>
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Natural hazards
A hazard type of either geological (earthquake, tsunamis, volcanic activity), hydro-meteorological (floods, tropical storms, drought) or biological (epidemic diseases) origin. It is a natural process or phenomenon that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

Policy
A policy is a statement of objectives that provides a framework for actions which are consistent with the priorities of the organisation or government implementing it (Dalrymple 2005; Merriam-Webster 2011)

Preparedness
The knowledge and capacities developed by governments, professional response and recovery organisations, communities and individuals to effectively anticipate, respond to, and recover from, the impacts of likely, imminent or current hazard events or conditions.

Prevention
The outright avoidance of adverse impacts of hazards and related disasters.

Private sector
The private sector is that part of the economy, sometimes referred to as the citizen sector, which is run by private individuals or groups, usually as a means of enterprise for profit and is not controlled by government.

Public safety
Involves the prevention of and protection from events that could endanger the safety of the general public from significant danger, injury, harm or damage, such as crimes, natural disasters or man-made disasters.

Recovery
Recovery is regarded as the reconstruction of communities after a disaster has occurred. It involves the restoration and improvement where appropriate, of facilities, livelihoods and living conditions of disaster-affected communities, including efforts to reduce disaster risk factors (Smith and Wenger 2007).

Resilience
The capacity of a system, community or society potentially exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of functioning and structure. This is determined by the degree
to which the social system is capable of organising itself to increase its capacity for learning from past disasters for better future protection and to improve risk reduction measures

**Response**

Response phase relates to the activities immediately before, during, and directly after an event (McLoughlin 1985).

**Risk**

The probability of harmful consequences, or expected losses (deaths, injuries, property, livelihoods, economic activity disrupted or environment damaged) resulting from interactions between natural or human-induced hazards and vulnerable conditions

**Risk management**

The identification, assessment, and prioritisation of risks followed by coordinated and economical application of resources to minimise, monitor, and control the probability and/or impact of unfortunate events or to maximise the realisation of opportunities.

**Sustainable development**

Meeting the needs of the present without compromising the ability of future generations to meet their own needs (World Commission on Environment and Development, 1987)

**Vulnerability**

The conditions determined by physical, social, economic and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards
Part 1: Introduction
1.1 Background to research

Disaster events such as earthquakes, floods, droughts, hurricanes and tsunamis around the world are increasing in frequency and severity (IPCC 2007; Westlund et al. 2007; United Nations Department of Public Information 2012). This is a direct result of climate change, agricultural production systems, population growth, and increasing pressure and over-exploitation of natural resources (Baas et al. 2008). This has increased impetus in many countries to address these events which are having devastating impacts on the land and property of stakeholders such as citizens, governments and the private sector. The affect of risk on land and property in developed countries with established land administration systems is a particular focus in this thesis.

As a result of these events: the world is responding. A number of initiatives, reports, and strategies have been developed to address the overall problem of risk affecting land and property (across both developed and developing countries). These include the UN International Strategy for Disaster Reduction (ISDR), which reflects a major shift from the traditional emphasis on disaster response to disaster reduction and aims to promote a culture of prevention; the Hyogo Framework for Action 2005-2015 (2005), which developed priorities to be addressed for improved disaster risk reduction; the Centre for Research on the Epidemiology of Disasters (CRED) which demonstrates the increasing relevance of disaster and risk reduction as well as the need to focus on the beforehand aspects facilitated by the risk management process for potential disaster events; the UN International Decade for Natural Disaster Reduction (IDNDR) initiative; and the Yokohama Strategy and Plan of Action for a Safer World, both of which promote further disaster risk reduction strategies.

The integration of disaster management, emergency management and risk management was the result of research indicating a gap in event preparation – traditionally the phases of mitigation and preparedness, which showed that people were typically unaware of the risks they faced (Mileti 1999). Human vulnerability is exacerbated by the lack of prevention and preparedness measures, which leads to human, structure and financial losses (UN-HABITAT 2010). The lack of understanding and support for implementing these phases lead to the introduction of the risk identification and assessment stages from the risk management process to enhance the current methods. This lead to the development of the disaster risk management (DRM) model which uses administrative decisions, organisation, operational skills and capacities to implement policies, strategies and coping capacities of the society and communities to lessen the impacts of natural hazards and related environmental and technological disasters (UN/ISDR 2004). The incorporation of risk management processes with disaster management enables the focus to shift from disaster response to preparing for, assessing, treating and managing as a whole, these risks. Preplanning for risk events can save
lives and injuries, limit the damage to land and property, minimise disruptions which promotes community resilience for when an event does occur (Mileti 1999).

Five land related characteristics of disaster vulnerability include: unsustainable land use; poor urban planning; landlessness; weak land administration; and land related discrimination (UN-HABITAT 2010). All of these characteristics highlight the important connection between land and disaster and risk events. As the relevant discipline, land administration has a very important and relevant role to play in the management of disaster and risk – specifically risk which affects land and property. Risk and disaster events happen somewhere; information about the land can support the management of these events. This was identified in the UN/FIG Bathurst meeting held in 1999. The outcomes of the meeting made clear that better land information is needed to support sustainable development. Sound information about land promotes better land policy, better land administration and management and better land use. This in turn contributes to improved disaster resilience and risk management. With growing populations around the world, more people are living in areas where they are exposed to the dangers of natural events. Access to better land information at all levels of government and throughout society should be facilitated.

This thesis aims to continue the challenge to improve the management of risk to land and property through sustainable land administration. It will explore aspects related to land information access for risk management purposes within the context of developed countries with established land administration systems.

1.2 Research Formulation

1.2.1 Defining the research problem

Several major disaster events in developed countries around the world during the late 2000s, for example: severe weather, riverine flooding, bushfires, and cyclone events within the country of Australia; hurricane, tornado and wildfire events across the country of the United States; flooding and extreme temperature incidents across Europe; and earthquakes and a tsunami in Japan, and have drawn attention to risk management practices within communities. The outcomes of the disaster events have shown that effective risk management is not as prevalent across communities in these countries as believed. A limited understanding of the risks faced by the general public, a lack of awareness of risk management strategies for dealing with these threats, limited knowledge regarding land and property information, and barriers preventing easy access to information have been highlighted as some key reasons why effective risk management is absent in present society (Armitage 2012; Fanning 2012;
Han 2012; van den Hoenert and McAneney 2012; Scolobig et al. 2012; Hwacha 2005; Pearce 2003). Research has shown that the use of land and property information for disaster and emergency management can improve operations (Mansourian et al. 2004; Asante et al. 2007), and as demonstrated by recent amendments to disaster and emergency management models around the world to incorporate risk management processes (c.f. Ellis et al. 2004; UK Resilience 2010; Rogers 2011; UN/ISDR 2004), this improvement can be translated to risk management. For some stakeholders, the value inherent to land and property information for identifying, analysing, evaluating, and selecting treatments for risks has been realised and documented (c.f. Insurance Council of Australia 2006; FIG 2006; Ravan 2010; Productivity Commission of Australia 2012; Zevenbergen et al. 2013), however for the majority of stakeholders the use of land administration data is limited to its historical uses: fraud and tax enforcement (Kain and Baigent 1992; Ting and Williamson 1999). Land administration agencies are often the primary custodians of land and property information within a country, therefore the role of creating, maintaining and publishing this information is assigned to them. Facilitating more effective dissemination would contribute to improved risk management practices for society. However, the task of providing information for risks other than fraud management and tax enforcement has not been extensively explored.

In response to these issues, the following problem statement has been developed:

As disasters and risk events become more prevalent, improved risk management practices are required for stakeholders to better manage land and property. Land administration systems have the potential to facilitate the management of multiple risks; however, current legal, policy, institutional and technical arrangements limit this advancement.

Where:

‘land administration systems’ are infrastructures used to implement land policies and land management strategies in support of sustainable development, and includes institutional arrangements, legal frameworks, land information, and technical components.

‘risk management’ includes the application of policies, procedures and tools in the attempt to identify, evaluate, and minimise the risk.

‘risk’ includes all perils and hazards that may occur resulting in a loss.
1.2.2 The research aim and objectives

The articulation of the research problem then leads to the research aim, which is:

*To develop a model which demonstrates how land administration could support the process of land risk management*

Based on the research aim and the identified research problem, a number of research objectives were formulated to achieve the research aim:

- Examine existing theory on risk management and land administration. Specifically, review the current relationship between the concepts of risk management and land administration to create a new body of knowledge.
- Assess the role and function of land administration systems and identify how they could support land risk management through legal, policy, technical and institutional changes.
- Identify the factors which motivate land administration agencies to support land risk management activities.
- Determine the issues which prevent stakeholders from implementing effective land risk management strategies.
- Design and evaluate the model and assess its implementation as a real world application for stakeholders.

1.2.3 The research questions

In considering the research problem, aim and objectives outlined above, the primary research question that this research addresses is:

**How can land administration activities be redesigned to support societal risk management?**

Breaking this overarching question down into smaller investigative pieces, a number of smaller, more detailed research questions emerge:

1. Are land administration agencies motivated by the notion of land risk management? If yes how? And how might they be motivated in the future?
2. How do land right holders perceive their role in land risk management?
3. What should be the relationship between land right holders, risk, and government? Or what are the various options?
4. How can land administration systems support land risk management – given a specific country context?
Using land administration for land risk management

Where:

‘societal risk management’ refers to a community or a large group engaging in effective risk management activities. The risk management activities are undertaken by members of society, or for the benefit of members within a society. Other terms are as previously defined.

The first research question posed aims to understand the priorities of land administration systems and determine their focus, whether it be risk management or otherwise. The second question is focused on how land right holders understand risk management, and what risk management is believed to be. This question also examines the roles of risk management and who different stakeholders within a society view as the person or organisations responsible for that role. The third research question relates to the different roles of risk management, and which stakeholder should be responsible for what role. The final research question addresses legal, organisational, and technical characteristics of land administration agencies that contribute to risk management processes in some way to determine a framework to support risk management.

The relationship between the research activities, which respond to the research questions, and the research objectives are shown in table 1.1 below. The methodology detailing the research activities conducted is explained in more depth in section 1.4 and chapter 4.

**Table 1.1 The relationship between the research objectives and the research activities**

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Research Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>To examine existing theory on risk management and land administration.</td>
<td>Literature review and evaluation of current risk management theory and disaster risk management initiatives within the field. Examine current land administration literature and initiatives where land administration has been applied to other disciplines.</td>
</tr>
<tr>
<td>Review the current relationship between the concepts of risk management and land administration</td>
<td>Design and conduct questionnaires for distribution to jurisdictions within the case study country of Australia. Analyse data and identify legal, policy, technical and institutional factors which should be addressed to enable the support of land risk management.</td>
</tr>
<tr>
<td>To assess the role and function of land administration systems and identify how they could support land risk management through legal, policy, technical and institutional changes</td>
<td>Literature review and questionnaire surveys and analysis on land administration systems within the case study country of Australia.</td>
</tr>
<tr>
<td>To identify the factors which motivate land administration agencies to support land risk management activities</td>
<td>Semi structured interviews and questionnaire surveys to land risk management stakeholders within the case study country of Australia. Analyse data and identify common issues hindering the process of land risk management.</td>
</tr>
<tr>
<td>To discover the issues which prevent stakeholders from implementing effective land risk management strategies</td>
<td>Prototype development and application.</td>
</tr>
<tr>
<td>To evaluate the model and assess its implementation as a real world application for stakeholders</td>
<td></td>
</tr>
</tbody>
</table>
1.3 Justification for research

This research addresses an issue that is of national importance for developed countries around the world: the safety, wellbeing and resilience of the community at large with respect to disasters and risk events. Improved land risk management is required to ensure that within a community there is an ability to recover from large scale risk events affecting the land and property of stakeholders. Land and property information has been shown to assist in land risk management practices by allowing stakeholders to understand and visualise different risks which present a threat to their land and property.

Land administration has much to offer the discipline of risk management however the role land administration agencies can play needs to be investigated. Land administration systems are an example of available resources which exist within developed countries which could assist in enhancing the current risk management practices of stakeholders if they were recognised, utilised or coordinated in a way where they could be easily accessed by stakeholders. Direction in this area is required however, to educate stakeholders on how to utilise these resources for risk management purposes, and importantly, how land administration agencies can contribute to this process and what their role should be.

This research looks at the world from a risk management perspective to understand how land administration systems and agencies could contribute to the management of risks affecting land and property. The investigation process involves assessing land right holders and their risk management activities, and examining the existing land administration systems and agencies to determine how they are arranged and operate. This enables an understanding of what information is required by stakeholders wanting to manage their land and property to be discovered. Additionally, the information which is available from land administration systems, and whether this information can meet the needs of stakeholders and fulfil the purpose intended when applied to land risk management can be assessed. The results of the two enquiries inform the changes required in order for land administration systems to support current risk management activities related to land and property. Case box one below highlights the problem.

Case Box 1

In a number of developed countries around the world a lack of understanding of the role and responsibilities of stakeholders in the process of land risk management has been observed. Additionally, a general understanding of the risks which are faced, or the reality of these threats were not realised. A number of events in countries across the developed world provide examples of this; one such example is flooding in the country of Australia:

In Queensland in 2010/2011 over 200,000 people were displaced and AUD$2.38 billion worth of damage was caused because of a flood event. The majority of the properties flooded were built on known flood plains and had flood information linked to the properties indicating that those parcels were at risk of a 1 in 100 year flood. Despite this available information hundreds of people were surprised...
when they were affected and shocked that it had occurred. Other floods across the country of Australia result in the same shock, with citizens claiming that they were not aware of the risk or that they were not aware of the meaning behind the information warning them about the threat: “They were told the suburb could experience a flood only once every 100 years” (Han 2012). This is a common problem that exists within the Australian community. The interpretation of risk information is causing problems with misconceptions about the meaning of the warnings. One example is the flood overlay on a parcel which can list, for example, a one-in-100-year flood. The true meaning of the information is that there is a one-percent change of flooding in any year (Fanning 2012). Interpretations such as above are common however, leading to an unprepared community. To further worsen the situation, a large number of people were not aware that their insurance policy did not cover the case of riverine flooding, and that only flash flooding or water from storm damage were included (Kavanagh 2011; Ooi 2011; Fanning 2012). The issue of roles within this situation further highlights the problem, with the expectations of some citizens falling to local councils: “the council should actively inform and warn residents rather than leaving them to source information” (Han 2012), and others to the insurance companies or federal governments.

This factor has not received attention, and ways to address this issue have also not been widely promoted. This research looks at these issues using a land administration lens to understand and identify how land administration information could contribute to risk management practices of stakeholders.

This research will enable improved risk management practices to take place by creating a greater awareness of risk management and how it can be implemented to better manage land and property. A more informed understanding of risk management processes will improve community resilience and enable land and property to be better protected against disaster and risk events which will achieve safer and more sustainable communities. The promotion of this available land administration information will also enable these developed resources to be taken advantage of and utilised for a range of activities, resulting in time and cost savings.

1.4 Research approach

This thesis follows a mixed methods approach which integrates the quantitative investigation of land administration systems, and the qualitative investigation of the risk management processes carried out by stakeholders to develop a comprehensive land risk management model. The research questions identified to address the research problem varied in nature and required both quantitative and qualitative approaches to provide effective answers. Mixed methods theory was investigated and a multi strand mixed methods approach was identified as appropriate to meet the needs of the study.

The research approach consists of four stage processes leading to the development of a model which demonstrates how land administration could support societal risk management. Figure 1.1 illustrates the research approach. Stage one is the process of formulating the research. Most importantly, this stage involves identifying the overarching research question which dictates the research direction, and from this, the selection of an appropriate research
approach. It also includes a review of all relevant background information such as land administration theory and risk management theory.

Stage 2 of the research approach relates to the quantitative aspect of the research. Within this stage a quantitative questionnaire is developed and sent to land administration agencies at the state jurisdictional level within Australia. The purpose of the questionnaire is to examine the capacities and needs of each state and territory land administration system. The questionnaire is framed around the RRRs toolbox (Bennett 2007) and the elements of the toolbox are used as the framework for assessment.

The third stage of the research approach is a case study focused on the risk management perspective. For this stage the two jurisdictions of New South Wales and Victoria are focused on at the citizen, local government, and state government level. The investigation involved the distribution of qualitative questionnaires to citizens and local governments within the case study jurisdictions, and additional interviews of local government organisations. The questionnaires and semi-structured interviews were both developed and framed around the ISO Risk Management Standards for Australia and New Zealand (Standards Australia/Standards New Zealand 2009).
Within the final stage of the research approach the results of the quantitative questionnaire to land administration agencies and the results of the risk management stakeholder’s case study are integrated to reach a meta-inference to address the overarching research question. The issues and factors gleaned from this process which can be translated to a wider context are identified. Based on these results, the model to demonstrate how land administration can support land risk management is developed. The model is then evaluated and its wider application and contribution to societal risk management is discussed. An in-depth discussion which details each aspect of the methodology and expands on the description above is carried out in chapter 4.

1.5 Structure of the thesis

This research is composed of four main parts: introduction; background; design analysis and results; and synthesis. Figure 1.2 illustrates the structure of the thesis and how each chapter contributes to the overall thesis.

Part one, the introduction includes the statement of the research problem, the research aims, objectives, as well as the research questions. Justification for the research is explained and reasoned. In addition, the research structure and scope are detailed, and the research approach is briefly described. Notably, a research hypothesis is not included in this section. This is due to scientific understanding which considers the development of a hypothesis possible only once a thorough understanding of the problem is achieved.

Part two, the background includes chapters 2 and 3. Chapter 2 provides an overview of risk management theory, including basic definitions of risk, how the idea of risk developed in society, and relevant elements of the risk management standards. The relationship between risk management and disaster management is also discussed. How risk management is implemented within different country contexts concludes chapter 2. Chapter 3 focuses on the discipline of land administration. Historical background is first given followed by a discussion of land administration within the context of developed countries. The topics of land information and risk, land and sustainability and spatially enabling land information are also explored.
Part 3, the research comprises of chapters 4, 5, and 6. Chapter 4 details the research design and approach taken to address the research questions outlined in chapter 1. Discussions of the most appropriate method and advantages and disadvantages of each are presented. The selected approach is detailed and justified, and the implemented of this approach is explained. Chapter 5 presents the results of the jurisdictional land administration agencies questionnaire. Chapter 6 presents the results of the risk management stakeholder’s case study. The key issues and factors from each are extracted to enable the development of the model which can be applied to a range of different country contexts.

Part 4, the synthesis, draws together the quantitative land administration agencies questionnaire results and the risk management stakeholder’s case study results in chapter 7 to develop the land risk management model. Chapter 8 implements the model as a prototype to assess the model design in the context of a real world application, and Chapter 9, the concluding chapter presents the research findings, achievements and conclusions. The hypothesis is addressed to determine its accuracy, and recommendations for further research are provided.

1.6 Scope of the research

This research is focused on developed countries with established land administration systems. The country of Australia is used as a case study within the research. The two different disciplines of land administration and risk management are the focus within the investigation to determine how land administration activities can contribute to improved societal risk management.
The model developed is designed primarily for use within countries which have the established land administration agencies and information resources discussed throughout the research; however elements of the model could be applied to other developed countries which have available land and property information which require improvements within the area of land risk management.

During this research, within the case study component which uses the country of Australia as its focus, the risk management processes and the role of government within the risk management area has continued to change. The availability of land administration data has also evolved. This is due to the increased disasters which Australia has faced during this time and the attention that the management of risk has received. The descriptions and documentation is therefore valid at the time of data collection only, where not explicitly noted, and it should be recognised that changes may have taken place since this time.

1.7 Chapter summary

This chapter introduced the research problem, aim and objectives. The overarching research question and the individual research questions branching from the overarching question were also presented. Additionally, the research approach was briefly described and justified, and the thesis structure outlined and the scope discussed.

The next section, part 2 - the background, provides a deeper understanding of the problem by expanding on the two disciplines of risk management and land administration and issues relevant to the management of risks to land and property in the context of developed countries.
Part 2: Background
Chapter 2 – Land administration systems: a new century, a new role
2.1 Introduction

Land and property management is a relevant issue worldwide. Appropriate management actions are becoming increasingly important with the rise in risk and disaster events threatening land (Yodmani 2001; Smith 2013). For this reason, strategies which promote the effective administration of land are of great importance. The discipline of land administration is dedicated to improving current practices and supporting countries in finding ways to effectively deal with land. This chapter provides a brief overview of land administration including land administration systems and the encompassing elements such as the cadastre and land administration functions. Following this, key developments are discussed, and the development of land administration in a case country is explored. Finally, a global issue which impacts on the successful management of land – risk is viewed from a land administration lens to identify how an understanding of land administration can contribute to an improved approach to the management of land affected by risk.

Guide for background chapters

During this thesis, and principally in this chapter and the following, the two broad areas of land administration and risk management are explored. Particular emphasis is put on where these two areas overlap and how they are connected. To illustrate the area of emphasis within each section, the following diagram is utilised.

![Figure 2.1 Broad areas explored in thesis](image)

Figure 2.1 will be used as a guide to indicate whether the focus of the section is land administration related, risk management related, or a combination of both areas where they are found to overlap.
2.2 Land administration

In the last two decades, the discipline of land administration has undergone a major evolution. The role land administration plays within society has become more defined and understood and the link between appropriate land administration and sustainable development has been established, largely through continued efforts from the International Federation of Surveyors (FIG) (Enemark 2005a). One element which is now aligned with land administration is disaster risk management (FIG 2006). The specific role of land administration within this area has not been extensively explored, particularly in the area of integrating land administration systems in a country context with land risk management practices. Within the discipline of land administration a range of different tools and concepts exist which help to explain the field of land administration, and to assist in the development and application of effective land administration to a range of activities, including land risk management. A number of these tools and concepts are discussed below.

2.2.1 Land administration systems

Land administration systems are the foundation for conceptualising rights, restrictions and responsibilities related to people, policies and places and focus on managing the relationships between these elements in support of sustainability (UN-ECE 1996; Enemark 2009). They provide the mechanisms that support the management of property (Dale and McLaughlin 1999; Wallace and Williamson 2004). The UNECE Land Administration Guidelines (1996) state that a good land system should create security of tenure and guarantee ownership, develop and monitor land markets, facilitate land reform, improve urban planning and infrastructure development and support environmental management.

At the core of any land administration system is the cadastre which provides the infrastructure and support for implementation of land policies, land management strategies, land markets, effective land use management, and now, effective land risk management practices (Williamson 2002; Nasruddin and Rahman 2006). It describes the nature of the interests, the ownership and control of the parcel and the interests, and aids in the registration of rights in land, supports the valuation and taxation of land and property, and assists in managing present and possible future use of land (Larsson 1991; Henssen 1995). Additionally, it provides information about geographical objects and their attributes, which is becoming more integral as members of the general public are becoming more interested in land information, and a number of commercial applications are making use of cadastral information within their systems. While the English influenced parts of the world did not

Une autre composante des systèmes de gestion des terres est la souscription légitime – l'organisation qui fournit et maintient le record des ventes ainsi que des modifications et création d'intérêts sur les terrains. Concernant le contexte légal, une distinction doit être faite entre le cadastre et la souscription sur les titres. Larsson (1991) définit la souscription sur les titres comme un registre public de titres et de droits concernant la propriété immobilière, qui peut être soit un registre de titres soit un registre de titres. En théorie, la distinction entre la souscription de titres et la souscription de titres est parfaitement claire, mais en pratique il est souvent dépendant de la caractéristique du système de titres, et des relations qui existent entre le registre et le notaire (Zevenbergen 2002; Ploeger et van Loenen 2004). Fondamentalement, la souscription sur les titres, en tant qu'organisation gouvernementale dans la plupart des pays, maintient l'information sur la propriété. Le rôle du cadastre et de la souscription sur les titres dans les systèmes de gestion des terrains sera discuté plus loin dans une section ultérieure.

Contenu dans un système de gestion des terrains est l'information spatiale qui inclut l'information sur les parcelles de terrains, les droits de propriété, les restrictions et les responsabilités, ainsi que d'autres informations obtenues à travers des relations avec d'autres infrastructures d'information enregistrées comme l'information topographique, l'information de construction, l'information administrative, l'information hydrologique, etc. (van Oosterom et al 2009). Toutes ces informations sont pertinentes dans le contexte de la gestion des risques sur les terrains et les propriétés. Comme mentionné, le gestion des droits de propriété, restrictions et responsabilités sont une priorité dans les systèmes de gestion des terrains. Les droits de propriété sont normalement concernés avec la propriété et la tenure. La sécurité que les droits de propriété apporte un marché immobilier efficace qui en retour permet l'amélioration des investissements et la protection des actifs en prenant des mesures de gestion des risques. Une autre avantage qui sort des droits de propriété est l'amélioration de la société tels que des routes pavées, des feux de rue et des systèmes de collecte d'eaux usées qui résulteront de l'augmentation des revenus d'impôt sur les terrains, qui en retour augmenteront la valeur globale de la propriété (Palmer 1998). Les restrictions de propriété contrôlent l'utilisation du terrains et les activités qui se déroulent sur le terrains. Ces restrictions sont de plus en plus devenus importants pour promouvoir le développement durable et l'amélioration de la gestion des ressources, des infrastructures et des services (Ting et Williamson 1999; Enemark 2009). Les responsabilités de propriété sont concernés avec une société sociale, une approche éthique ou environnementale et la gestion efficace des ressources et de services et sont culturellement centrées. Comment les systèmes de gestion des terrains et leurs fonctions alimentent le terrains.
management paradigm, a tool for developing and implementing effective land administration is outlined in the discussion of the paradigm below.

### 2.2.2 Land management paradigm

The land management paradigm guides the selection of tools for managing common processes of land administration. It assists in the delivery of sustainable development by outlining the process for putting resources of land into good effect (UN-ECE 1996). The paradigm illustrates the role of the land administration functions (land tenure, land value, land use, and land development) and how land administration institutions relate to the local institutional context of a country and its policy decisions (figure 2.2).

![Figure 2.2 The land management paradigm (Enemark et al. 2005b)](image)

The central component of the land management paradigm is the land administration functions which are focused on the management of land rights, restrictions, responsibilities, and increasingly risks as well as the use and overall management of land and its resources (Enemark et al 2005b). These land administration functions are supported by land information infrastructures and a land policy framework. Each element of the land management paradigm will now be discussed in more detail.

#### Land administration functions

The land tenure element of the land administration functions is focused on securing and transferring rights in land and natural resources and represents a recognised relationship between land and people. This is an important element within the context of land risk management as the management of a particular risk often falls as the responsibility of the person with the relationship to the land. The second element of the land value component
Using land administration for land risk management

deals with the valuation and taxation of land and properties, and can be influenced by potential future use of land as determined through zoning as well as land use planning regulations and the granting of permits (Enemark 2005a). The value of land can be directly linked to the level of threat presented by certain risks, and can therefore reflect the adaptation of a land market to eliminate vulnerabilities. The element of land use relates to the planning and control of the use of land and natural resources. Within the context of managing risks which affect land and property, the land use element has a large role. Land use planning is central to reducing risks associated with natural hazards, and can be considered as a strategy for significantly reducing the impact of hazards (March and Henry 2007). A number of hazards have a particular relevance to land use planning, such as flood, bushfire, erosion, sea level rise, cyclone etc., and can be managed through appropriate land use decisions. The challenge for land use is to ensure that all planning which is carried out contributes towards the most advantageous outcomes for all stakeholders (Steiner 1979). The final element of the land administration functions is land development which is focused on implementing utilities, infrastructure, construction planning, and schemes for renewal and change of existing land use. Within this element, consideration of risk and disaster events is becoming implicit.

Ensuring that adequate systems are designed in the areas of land tenure and land value should lead to the creation of an efficient land market, and planning satisfactory systems in the areas of land use control and land development should lead to an effective land use administration. The arrangement of an efficient land market and an effective land use administration within society should then support a sustainable approach to all aspects of sustainability – economic, social and environmental – which in turn should promote effective land risk management practices (Williamson et al 2010).

**Land policy**

The land policy component determines the values, objectives and the legal regulatory framework for the management of land in a society. It acts in promoting objectives such as economic development, social justice and equity and political stability. Between countries land policies vary, however in most countries they include poverty reduction, sustainable agriculture, sustainable settlement, economic development, and equity among various groups within society. These policies should be now expanded to include disaster resilience policies and effective land use management agendas for all contexts.

**Land information infrastructure**

Land data engines and spatial data infrastructure are two elements within the land information infrastructure. The spatial data infrastructure component (SDI) provides access to and interoperability of cadastral information and other land information, while the land data
engines organise the cadastral information (Rajabifard et al. 1999; Rajabifard et al. 2000; Enemark 2009). In order for effective land management to take place the land information should be organised to combine the cadastral and topographic information to enable the linking of the built environment (including legal land rights) with the natural environment (including management of natural resources and environmental issues) (Enemark et al 2005b). This arrangement is important to support the adoption of land risk management practices across different contexts as well as to support overall land management. Organisation of the land information using the spatial data infrastructure at a range of levels such as national, state/regional, and local levels allows for incorporation of relevant policies, data sharing, access to data and standards implementation (Feeney et al. 2001; Rajabifard and Williamson 2001).

Country context
The country context component of the paradigm refers to the institutional arrangements and the structure of the land management system in the country. This is a critical element as land is managed vastly different between countries. Within different countries a land parcel reflects the way that people use land in their day to day lives and provides the link between the system and the people (Enemark 2009). Understanding the culture, value and perception of land is a defining feature when implementing or learning about a land administration system. This is also an important element to be considered for land risk management. As risks and hazards differ between countries, as does geographical locations and environmental conditions, adaption of the paradigm to the country context is paramount to the successful application of risk management practices to land and property.

Sustainable development
The sustainable development component of the paradigm is achieved when all of the other components are working together harmoniously. Without an effective land administration system, sustainable development cannot be achieved. In the case of this model, sustainable development includes economic, environmental and social sustainability.

From the land management paradigm and the elements described above, the requirement for reliable information about the existing land and its resources in order to carry out effective land management was discussed. Land management aims to deliver efficient land markets and effective management of land for all aspects of sustainability in order to address the triple bottom line of economic, social and environmental sustainability (Kaufmann 2002). One important aspect of land management and land administration, which was touched on in the above discussion was the cadastre. The land management paradigm makes a national cadastre the engine of the entire land administration system which supports a country’s ability to
Using land administration for land risk management

achieve sustainable development. As a central component, the cadastral layer cannot be
replaced by a different spatial layer derived from a geographic information system (GIS)
(Enemark 2009). Figure 2.3 below illustrates the butterfly diagram which highlights the
important role of cadastral systems within land management, and how sustainable
development, spatially enabled government, and the land management paradigm are all
dependent on cadastral data.

Figure 2.3 The butterfly diagram (Williamson et al 2010)

Sustainable development requires comprehensive information on environmental conditions in
combination with other land and property related data. Cadastral data can support this
information. Economic development, environmental management and social stability can all
be improved through cadastral data (Dale and McLaughlin 1999). Referring specifically to
land risk management, the arrangement depicted by the butterfly diagram further illustrates
the importance of the cadastral information within this activity. As the underlying layer or
engine, the cadastral information supports the application of other information, such as data
specific to risks, which can support the risk management practices of stakeholders, leading to
sustainable development through overall improved land management.

The risk example above, as well as other adaptations reveals that cadastres are evolving into
broader land administration systems which can address a range of issues and support not only
land ownership and land markets, but all aspects of sustainable development (Steudler et al
2004). They should be viewed as a core component of a more comprehensive land
administration system. As a foundation for effective land administration systems, the value of
cadastral systems should not be underestimated.
2.2.3 The land administration toolbox and the RRRs toolbox

As additional tools for the management of land administration systems, the land administration toolbox and the RRRs toolbox offer strategies and principles to guide best practice. The land administration toolbox, offers tools to address the evolving and dynamic nature of humankind to land relationships (Williams on 2002). The tools include: land policy options, legal options, land tenure options, land administration and cadastral options, institutional options, spatial data infrastructure options, technical options, and capacity building options.

The second toolbox, the RRRs toolbox is framework which outlines a set of principles for best practice for the management of rights, restrictions and responsibilities (RRR). The toolbox was developed by Bennett (2007) in response to global issues related to the management of RRRs and the need for a framework to classify and manage these RRRs. This toolbox focuses solely on land interests and their appropriate management. The RRRs toolbox is an expansion on the original Land Administration Toolbox developed by Williamson (2001) which provided an example of a holistic approach to managing land interests. The original Land Administration Toolbox was focused on the management of ownership rights and did not necessarily cover all new interests, restrictions and responsibilities which had been placed on land. Therefore a complementary toolbox or framework which could address these issues was required.

The RRRs toolbox presents eight different principles to guide effective management of RRRs (Bennett 2007): land policy principles – new tools for better integrating RRRs into whole-of-government and sustainability policies; legal principles – new tools for ensuring RRRs are legislated in fair and sensible ways; tenure principles – new tools for understanding the different tenures RRRs may create; cadastral and registration principles – new tools for utilising existing cadastral and registration systems to administer RRRs; institutional principles – new tools for better organising institutions to administer RRRs; spatial and technology principles – new tools for mapping, integrating, administering and distributing information about RRRs; human resources and capacity building principles – new tools for educating and improving understanding about all RRRs; and emerging principles – utilising ontological design, uncertainty theory and economic theory to better manage all RRRs. As information about risk has emerged, the management of this information has been incorporated into land administration systems alongside RRR information (Potts et al. 2012). The RRR toolbox can assist in identifying best practices for managing risk information. Each of the eight components of the RRRs toolbox should be addressed and acted upon if a jurisdiction wishes to coherently manage all of its land rights, restrictions and responsibilities. While the RRRs toolbox does not offer a complete solution to managing RRR and risk
Using land administration for land risk management

information, it offers a starting position for understanding and redesigning existing land administrative systems so that they are more able to address the demands of sustainable development (Bennett et al. 2008). In order to understand how land administration theory has been adapted and applied to new initiatives, key developments within the discipline will now be discussed.

2.3 Key developments in land administration

Land administration literature, particularly documents focused on best practice such as UNECE guidelines, the World Bank Indicators and Williamson (2001) discuss the ideal role of land administration information. The findings of these discussions support customer focused land information systems for the benefit of the user rather than information producer (UNECE 1996; UN-FIG 1999; Burns 2007). This finding is supported by computerisation of land information systems. The advantages of computerisation within land administration are recognised by the best practice documents in addition to Cadastre 2014 (Kauffman and Steudler 1998) which allow for greater functionality to occur across jurisdictions: a useful ability to enable and enhance applications such as land risk management, and to address customer needs. To further attend to the best practice guidelines, access to land information for the public at a cost-effective price is identified as important for informed public decision making. As land administration systems have been proven by Bennett et al. (2013) to be a critical public good infrastructure, the resulting information from these systems should exhibit low excludability and rivalry of use (cost effective, easily accessible).

In addition to the best practice literature mentioned above, and building on the concepts of multipurpose cadastres which originated in the 1980s (NRC 1980) and Cadastre 2014 (Kauffman and Steudler 1998), Bennett et al (2010) presents six design elements for future cadastres: survey accuracy; property objects instead of parcels; the inclusion of height and time information; real time maintenance and information access, regional and global access for cross border trading; and the modelling of organic land resource information. Stoter and Salzmann (2003) and Aien et al (2012) both discuss the needs and technological capabilities of developing a 3D cadastre, which is supported by the arguments of Kalantari et al (2008) and Bennett et al (2008) which suggest that two dimensional information is often not sufficient for modelling all interests related to land.

Following the above developments in the field of land administration, the creation and standardisation of the Land Administration Domain Model (LADM) by the International
Organisation for Standardisations (ISO 2012) provides the discipline with a recognised, efficient and standard approach for enabling cadastral systems to align. The LADM standard is aimed at generating a foundation for the creation and improvement of land administration systems through a shared vocabulary and improved sharing capabilities (ISO 2008). Building on the LADM, the Social Tenure Domain Model (STDM) has been developed as a specialisation to accommodate social tenures in particular. It proposes a more flexible system tailored to issues in developing countries for identifying the various kinds of land tenures that exist in informal settlements or in customary areas (FIG et al. 2010). The model aims to assist in providing security of tenure in developing countries to support formal land rights. In the situation of a significant disaster or risk event, formal or recognised land rights can prevent land grabbing and can assist in the response and recovery phase by enabling common ground to set up temporary shelter for victims to be identified.

Added to the discussion on new developments in land administration are the new roles which are emerging for land administration systems. Both the World Bank through their Land Governance Assessment Framework (LGAF) and the FAO through their Voluntary Guidelines on the Responsible Governance of Tenure identify new roles for land administration in terms of land governance. The LGAF aims to address land governance through the identification of indicators and overarching areas for policy intervention such as: legal and institutional framework; land use planning, mitigation, and taxation; management of public land; public provision of land information; and dispute resolution and conflict management (Deininger et al. 2011), and the responsible governance of tenure guidelines complement this through their goals to achieve food security for all through addressing land development through the promotion of secure tenure rights and fair access to land (FAO 2012). Future land administration designs will have to take into account these initiatives.

This research aims to identify a new role for land administration in the application area of risk management. Other research focused on applying land administration to areas outside of the tradition scope has also been carried out. One such example is the application of land administration to macroeconomic management. In this research Christensen (2013) addresses the need for better, more reliable information for improved economic management of land and its resources, using carbon and water markets as examples. The findings establish an operational link between government land administration and macroeconomic policy agencies. A second example is the application of land administration to housing production. This application investigates the inter-relationship across the land administration functions and between different levels of government in the management and delivery of land for housing production (Agunbiade 2012). The findings showed that the optimal levels of inter-agency integration varied from one organisation to the other. In order to further investigate
how the role of land administration can be adapted for another purpose, the specific case country of Australian will be explored in the next section to identify opportunities for land administration.

2.4 Land administration: The Australian perspective

Australia, as a federation of states organises the management of the country between the three governmental layers of federal government, state government and local government. Each different tier of government has a range of activities for which they are responsible. The federal government has powers over defence, foreign affairs, health, trade and commerce, taxation, customs and excise duties, pensions, immigration and postal services, while the state and territory government manage education, transport networks, and land administration. The remaining tier, local government manages community services and assets such as roads and garbage collection as well as town planning and building control (Dalrymple et al 2003; Enemark et al 2005b). As a role of the states and territories, centralised land administration offices exist within each state and territory jurisdiction. Each state and territory manages their land administration independently and as a result, there is no common organisational structure, however the objective of each system is the same; to underpin effective land transfer and land registration (Williamson 1985).

Within the land administration department in each jurisdiction are the state or territories digital cadastral map, land registry and titles office, Crown lands management office, Surveyors board, and business units for land information and resources (Dalrymple et al 2003). While the datasets held within each land administration office vary between states and territories, the core layers available in most jurisdictions include: the cadastre, topographic, imagery, elevation, transport network, geodetic network, administrative boundaries, properties addressing, and geographic names. The cadastre, within the Australian context, is a digitised layer available at the national level through a seamless cadastral database called ‘Cadastral Lite’ created by the Public Sector Mapping Agency Ltd which integrates and coordinates the cadastral data from each jurisdiction. The availability of this information at the national level and in a digital form enables wider land management and environmental planning to take place as well as improved economic, environmental and social decision making (Enemark et al 2005b). As an underlying layer, custodians have the ability to create and provide data which can feed into the system and be supported by the cadastral data.

Spatial data infrastructures play a fundamental role in facilitating the integration of other core data sets with the cadastre, and enabling the implementation of broader land administration activities. Within most jurisdictions a dedicated Spatial Data Infrastructure unit for managing
the collection and maintenance of spatial data has been established to respond to the demands from both the public and private sectors for spatial data. The fundamental layer within the SDI model is the cadastral layer as it provides an authoritative and unambiguous visualisation of the land which other layers can be overlaid upon and is easily understood by a range of stakeholders, including stakeholders which are not experts within the land management area. Increasingly, emphasis on the development of core spatial data sets that will enable the use of spatial information in a broader range of areas such as risk management and disaster management has become a focus (Dalrymple et al 2003). Currently, activities such as electronic conveyancing, online vendor statement certificates, town planning, and emergency response are supported, however with the changing environment and needs of society, an ability to expand and assist in a range of areas and activities has become a priority. The SDI technology offers a valuable way for efficiently and effectively disseminating spatial information for these purposes. Changes are still needed however to enable land administration systems to adequately support wider economic, environmental and social issues such as risk management (Williamson 2001; Enemark et al 2005b). How land administration systems can adapt and support these wider issues, specifically risk management, and how the two areas of land administration and risk management are inherently linked is discussed in the following section.

2.5 Land administration and risk management: the overlap

Land administration exists fundamentally as a process to manage at least two land related risks. Today they focus on creating, maintaining and publishing land information which combines cadastral information about individual parcels and properties and information about attributes of land such as owners, interests, land cover, boundaries, area, tenure, land use, topography, and so on (Wallace et al 2006). A large part of this task involves administering the complex rights, restrictions and responsibilities (RRRs) related to land and its use (Williamson et al 2010). Over time, as information describing risks has emerged within each jurisdiction, the management of this information has sometimes been incorporated into land administration systems, alongside RRRs information – although, often it remains disparately managed by different public or private institutions (examples include asbestos and toxic soil). This information, which describes the nature and location of a particular threat, could improve community resilience and assist stakeholders in implementing effective risk management practices if it were made available and easily accessible. As most risks have a relationship to land, this information is important for facilitating an understanding of where and how a risk
could potentially impact upon a stakeholder. With this knowledge, informed risk management decisions could be initiated by stakeholders (Muggenhuber and Mansberger 2004).

As was demonstrated in the above case example of a country context, current land administration arrangements can limit the ability of land administration systems to contribute to the area of risk management through legal, policy, institutional and technical barriers. A nation’s ability to respond effectively to emerging national issues such as risk events are greatly impeded by a lack of response to these issues, and through disregard and overlooking of relevant resources such as the land and property information available in land administration systems. Policies need to be addressed to enable the sharing of information across and between levels of government to facilitate the management of risk affecting land and property, as is recommended in the best practice literature. Case studies carried out by Bennett et al (2012) of the federal and state governments within the context of Australia provide a number of examples where land administration infrastructure would assist disaster relief and management on a national scale and facilitate emergency response. Research into natural hazards has also found that inadequate availability of data limits effective reduction of natural hazard impacts (Middlemann 2007). These examples all come together to demonstrate that land administration systems play a key role in the management, prevention and mitigation of risks (Enemark 2009). Understanding more about the environment through land administration information can enable improved planning, better risk management, and better resource use through an understanding of where things happen and what people and assets exist in that location (Communities and Local Government 2008).

2.6 Chapter summary

This chapter examined the discipline of land administration and a number of the tools and concepts which exist to explain how land administration can be implemented and understood in a range of contexts. How land administration is applied within the context of Australia and how it currently contributes to the changing environment and needs of society – specifically risk management was also explored. It was found that the foundations of land administration are based on risk management principles and focused on decreasing risk through secure tenure. The literature reviewed the role of land administration systems and highlighted their importance in creating and maintaining critical data sets such as the cadastre. The potential for land administration systems to play a role in improved societal risk management through the provision of land and property information relevant to risk management was demonstrated. The benefits which can result from this information were illustrated through examples within the literature. The value of land administration information in risk
management activities was highlighted, but research gaps exist in describing how land administration systems and information can be incorporated into the risk management process.

The next chapter will examine the area of risk management and how it is applied within the Australian context. The relevance of land administration information in the processes of risk management and the support land administration systems can provide for a range of stakeholders in the overall process of managing risks which affect land and property is discussed.
Chapter 3 – The world of risk
3.1 Introduction

Risk management is not a modern development. The concept has existed for centuries. A mere 350 years is all that separates the risk assessment and hedging techniques used in today’s society from decisions guided by superstition, blind faith, and instinct (Bernstein 1996). While precursors of contemporary risk analysis can be traced as far back as early Mesopotamia, it was not until the time of the Renaissance in the 17th century when the human imagination broke loose from the constraints of the past and the theory of probability emerged, leading to the availability of intellectual tools for quantitative risk analysis (Covello and Mumpower 1985). The long held fundamental beliefs used for risk management purposes in the past – the stars, the snake dances, and the human sacrifices were rendered obsolete in one human breakthrough (Bernstein 1996). To this end, this chapter investigates the idea of risk and risk management of land within current society, and considers how it aligns with similar forms of management such as disaster management and emergency management. How risk management of land is performed within developed countries, and then specifically within the case study country of Australia is also explored in depth, including the role of different stakeholders within the risk management process. Finally, policy issues for risk management, and the connection between land administration and risk management are discussed.

3.2 The concept of risk

The term risk is often used within day to day language and can mean a myriad of things. Within the context of this research the term risk is used to represent the chance of something happening that will have a negative impact (Vaughan and Vaughan 1996; Teale 2008). It is inherently associated with the conscious recognition and assessment of the likelihood and impacts of a particular hazard (Aharoni 1981). When a vulnerability to a particular hazard – a product of the likelihood or frequency and the consequence or severity, is combined with exposure to that hazard, the result is the eventuation of risk (Hodgson and Cutter 2001).

Traditionally, risk was managed through religious beliefs and spiritual means before a move towards science and mathematical approaches founded on probability occurred during the renaissance period (Vesper 2006). From these advancements, the thinking around risk developed, driven largely by money and financial interests resulting in the creation of the insurance industry. Over time, other forms of risk management offering an alternative approach to market insurance became available. The 1950s was the height of this change when the perception of market insurance shifted and it was viewed as a costly and incomplete
protection measure against pure risk (Dionne 2013). Following these changes in the needs of the public, the study of modern risk management began. This occurred around the time of 1955 to 1965 after the Second World War (Crockford 1982; Williams and Heins 1995; Harrington and Neihaus 2003). As a result, contingent planning activities developed, risk prevention and self protection activities advanced and strategies for reducing the effect of known risks were explored for a range of different applications, most notably, the financial industry. During the 1970s the concept of risk management within this sector was revolutionised as protecting against various price fluctuations and other risks related to interest rates, stock market returns, exchange rates and commodity pricing became a priority for many companies (Dionne 2013). This attention towards risk management and the important role that it demonstrated for financial security, alongside the rise in requirements for protection against litigation and enterprise risk, provided the impetus for the creation of well defined and broadly accepted risk management standards.

Several standards for risk management have been developed, including the Practice Standard for Project Risk Management (Project Management Institute 2009) and the Risk Management Guide for Information Technology Systems: Recommendations of the National Institute of Standards and Technology (Stoneburner et al. 2002); however the widely accepted standards used today, which can be applied to a range of applications, and endorsed as a worldwide standard are the AS/NZS ISO 31000:2009 Risk Management Standards. These standards are expected to address the entire management systems that support the design, implementation, maintenance and improvement of risk management processes and provide a process by which the management of risk could be undertaken. These standards build on the previous standard AS/NZS 4360:2004 Risk Management Standards.

The risk management process, a component of the overall standards, is organised into a number of stages (see figure 3.1). The stages outlined in the standards include establishing the context, identifying, analysing, evaluating, and treating risks as well as the continuous stages of monitoring and communication. Within the risk management process, each stage has individual aims and focuses on a different aspect of management. The first stage, communication and consultation incorporates stakeholder interests, views and perspectives, while the second stage of establishing the context focuses on becoming familiar with the environment and becoming familiar with the environments and identifying any specific inclusions and exclusions for the overall risk management process. Activities such as SWOT analyses to determine the strengths, weaknesses, opportunities and threats which affect the land and property can assist in the implementation of this stage (Hillson 2002).
The third stage of risk identification guides the process of finding, recognising and recording different risks which apply to the situation including elements such as the cause and source of potential risks. The following two stages of the process focus on the analysis and evaluation of risks and involve consideration of the consequences and likelihood of each risk occurring as well as the significance and priority for treatment. The final stages of the process involve applying an appropriate treatment to the risk, such as avoiding, mitigating, transferring or accepting the risk, and implementing a routine for monitoring and review the risk to ensure that the treatment will remain effective (Hillson 1999). All of these stages come together to provide a comprehensive strategy for managing risks, and if executed effectively the risk management process provides decision-makers with an improved understanding of risk and treatment options to address this risk (Mok et al. 1997).

The risk management standards and the subsequent stages within the risk management process were originally designed as a risk management framework for various organisational typologies such as government, private, non-government etc. Due to the generic nature of the standards however, they can be applied to any scope or context and can be used by any public, private or community enterprise, association, group or individual. As a result, risk management has been widely used in diverse areas including project management, megaprojects, information technology, petroleum and natural gas techniques, as well as application to the pharmaceutical sector and in enterprise risk management.

Over time the standards have also been applied to the management of risks affecting land and property – land risk management. Specific applications include disaster management, emergency management and disaster risk management. Within this context, as the risk is a function of a natural hazard and vulnerability and exposure, the potential hazards can have
different origins such as natural (biological, climatological, geophysical, hydrological, meteorological) and are characterised by location, intensity, frequency and probability (UN/ISDR 2004). The land and property which can be affected in a negative way by a hazard reflects the exposure factor, and the extent to which the land and property are exposed to the hazard depicts the vulnerability which together combines to form the overall risk (Schneider et al 2009).

The incorporation of the risk management standards into existing management plans and strategies such as traditional disaster management and emergency management have resulted in more integrated models which enhance strategic awareness (Cronstedt 2002). The models such as the 5R’s model (Ellis et al. 2004), which modifies the PPRR (Prevention, Preparedness, Response, Recovery) disaster management model (National Governors’ Association 1979; Emergency Management Australia 1998) for specific application to bushfire and incorporates elements of the risk management process which are found to improve the ability to address that specific risk event; the adaption of the PPRR model by Rogers (2011) to include additional stages of anticipation and assessment which refer to the identification, analysis and evaluation stages of the risk management process; the later adaption by Emergency Management Australia to redefine the PPRR model to reframe the PPRR phases as a part of the risk treatment stage within the overall risk management process (Emergency Management Australia 2004); and the disaster risk management model which again incorporates risk identification and risk assessment into the traditional PPRR disaster management model (UN/ISDR 2004) all demonstrate the shift towards a risk management way of thinking to provide a comprehensive approach to managing risks affecting land and property (Usamah 2012). This approach, defined as land risk management above goes beyond the management of specific events, hazard types, or large scale which the disaster management, disaster risk management, and emergency management models are focused on. The land risk management approach is inclusive of all elements of the risk management process and applies to all variables which can result in risk affecting land and property, not just natural disasters as a type, or disasters or emergencies as an event. The focus of the land risk management process is on the preservation and protection of land and property and is centred on the stakeholder to promote a bottom up approach for managing all risks affecting land and property. How this translates in the developed world will now be explored.

3.3 Managing risk to land in developed countries
Within developed countries around the world, significant problems still exist in the task of managing risks which affect land and property – known as land risk management. Despite a large range of information and resources existing related to implementing land risk
management practices, significant problems are faced during events. A number of examples within developed countries demonstrate this.

Example 1: The United States

Hurricane Katrina 2005
A series of different events resulting in damage to land and property within the country of the United States of America has drawn attention to their land risk management practices. The 2005 disaster of Hurricane Katrina demonstrated a number of failures and breakdowns in the overall management of this event from both a risk management and disaster management point of view. The findings from the Senate Committee on Homeland Security and Governmental Affairs (2006) highlight a few points:

- There was a failure of government at all levels to plan, prepare for and respond aggressively to the storm
- There were conspicuous failures in governments’ emergency preparedness and response
- FEMA was unprepared for a catastrophic event of the scale of Katrina

These conclusions emphasise a need for change in current management practices. Utilisation of land information which could indicate areas at risk, low lying areas, and possible evacuation routes could have assisted in management of the disaster.

Hurricane Irene 2011
Following the hurricane event which affected the city of New York and the surrounding state of New Jersey, response to the hurricane in the form of adaptive and preventative measures for subsequent events was noted as lacking by critics. Potential flooding which could result from another hurricane event could paralyse transportation (such as underground subway routes), cripple low-lying financial districts and cause evacuation of a number of residents within the city was identified as a problem. A storm surge research group from Stony Brook University found a lack of urgency relating to this issue, and Navarro (2012) identified a failure of new construction to adapt to future flood risks. Land related information could have been utilised in this situation to warn residents and occupants in low lying areas of the significance of flooding after hurricane events, additionally, the land information and accompanying planning information could have been applied to ensure that future development was resilient to hurricane events.

Hurricane Sandy 2012
Following the hurricane Irene in 2011, and the inadequate reaction to implement preventative measures, severe damage was caused when hurricane Sandy reached ground in 2012. A large number of citizens were hugely unprepared as a result of not experiencing any damage the year before: "We had a false sense of security, when we didn't suffer any water into the home from Irene, that the storm [Sandy] would not be any worse" (Parry 2012). The city of New York also was caught unprepared and suffered substantial damage since little was done to protect the City from the threat that was known to ultimately materialise (Steinberg 2012). Had land information been utilised, citizens could have been more prepared and more aware of the risk through viewing the vulnerabilities and exposure of their property on a map.

Wildfires
Despite continual warnings, cautions, and recommendations to prepare and plan for various natural or man-made disasters, such as wildfires, residents in the at-risk state of California continue to voice the belief that they are immune from such disasters (EFG-BN 2013). Further contributing to this problem in the US is the increasing numbers of people living in fire-prone areas. Some 250,000 new residents have settled in the wildfire prone area of Colorado, known as the “red zone” over the past two decades (Plumer 2013). Land information at the parcel level identifying parcels which have a wildfire overlay, or at risk zoning could improve community acceptance of the risk.

Tornados
Within areas that frequently experience between one to nine tornados a year, preparedness issues remain even as warning systems and the dissemination of information improves (Khalamayzer 2013). The area of Oklahoma County, a region which lies in the higher risk zones has just 6,489 such shelters out of approximately 260,000 residential properties, meaning that less than 2.5% of properties can refuge the inhabitants (Wisniewski and Bailey 2013). Again, the use of land information to indicate the risk at the parcel level could contribute to community understanding and assist in building community resilience to these risks.
Countries with strong economies, established land administration systems, and a good and functioning government are struggling to respond to climate change and natural disasters, and are failing in attempts to implement effective strategies to address these problems. Results from online databases such as EM-DAT, NatCatSERVICE (Munich Re), and Sigma (Swiss Re) show the statistics which highlight this problem. One example, shown in table 3.1 below taken from the EM-DAT database, displays the impacts of natural disasters on developed countries around the world (as defined by the Australian Minister for Foreign Affairs at August 2013). The results show that between the years 2000-2013 over 60% of deaths caused by natural disasters were related to climatological disaster types.

<table>
<thead>
<tr>
<th>Disaster sub-group</th>
<th>Occurrence</th>
<th>Deaths</th>
<th>Injured</th>
<th>Affected</th>
<th>Homeless</th>
<th>Total affected</th>
<th>Total damage (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological</td>
<td>12</td>
<td>38</td>
<td>0</td>
<td>7750</td>
<td>0</td>
<td>7750</td>
<td>240000</td>
</tr>
<tr>
<td>Climatological</td>
<td>31</td>
<td>1106</td>
<td>5348</td>
<td>33748</td>
<td>762</td>
<td>39858</td>
<td>9862000</td>
</tr>
<tr>
<td>Geophysical</td>
<td>6</td>
<td>364</td>
<td>3094</td>
<td>1200000</td>
<td>600</td>
<td>1203694</td>
<td>49000000</td>
</tr>
<tr>
<td>Hydrological</td>
<td>72</td>
<td>154</td>
<td>62</td>
<td>488854</td>
<td>800</td>
<td>489716</td>
<td>25022000</td>
</tr>
<tr>
<td>Meteorological</td>
<td>98</td>
<td>164</td>
<td>666</td>
<td>145518</td>
<td>30408</td>
<td>176592</td>
<td>19717108</td>
</tr>
</tbody>
</table>

**Table 3.1 Extract from EM-DAT database online.**

The remaining types contributed to the following: biological (epidemic, insect infestation) 2.1%; climatological (drought, extreme temperature, wildfire) 60.6%; geophysical (earthquake, mass movement (dry), volcano) 19.9%; hydrological (flood, mass movement (wet)) 8.4%; and meteorological (storm) 9%. These statistics raise concern as with the onset of climate change some regions are expected to experience more extreme events, such as heatwaves and cold waves, high levels of precipitation, extreme floods, droughts, tropical cyclones and storms (IPCC, 2001). In response to this, both the climate change adaptation and disaster risk reduction communities have developed a large range of analytical tools and methodologies based on risk management approaches to assess risk and vulnerability and to identify opportunities for action (Thomalla et al 2006; Sperling and Szekely 2005; Task Force on Climate Change Vulnerable Communities and Adaptation 2003; World Bank et al. 2003; IATF Working Group on Climate Change and Disaster Reduction 2004). These approaches are much needed as the following examples demonstrate. Land risk management solutions are required to promote suitable solutions and address all aspects of the problem, which range from information access and awareness to the roles and responsibilities of all the stakeholders involved.
Example 2: Land risk management problems in developed countries

a) Flooding in Canada
Within Canada, there is an information gap resulting in a limited understanding by citizens regarding the risks they face. Research by Hwacha (2005) found that unless a concerted effort is made to inform citizens about the risks they face and how they may be resolved, misconceptions and resistance to disaster mitigation would persist. These problems were made apparent in the June 2013 flood in Calgary and South Alberta, the 2011 flood in Manitoba, the 2009 Red River flood, the 2005 floods in Ontario, Alberta, Newfoundland and Labrador, and a number of floods in preceding years. Availability of land information showing the risk of flood at parcel level could assist in raising awareness of this risk.

b) Bushfires in Australia
In February 2009 a severe bushfire occurred in the state of Victoria, Australia. As a result of the extreme nature of the event, resulting in 173 deaths, a Royal Commission was held to review the disaster and identify issues to be addressed. As a result a number of recommendations were given as an outcome. Two of these outcomes relate specifically to land risk management:

- Recommendation 7: that the Commonwealth lead an initiative through the Ministerial Council for Police and Emergency Management, facilitated by EMA, to develop a national bushfire awareness campaign (Teague et al. 2010)
- Recommendation 53: that the State amends s.32 of the Sale of Land Act 1962 to require that a vendor’s statement include whether the land is in a designated Bushfire-prone Area (Teague et al. 2010)

A need for improved awareness and understanding of risk was identified, and the use of land information indicated as an effective way to convey the understanding of risk.

c) Flooding in Europe
As a result of climate change, European cities may have to erect flood barriers as impacted weather patterns brings storms, floods, heavy rainfall and higher sea levels. Advice from the European Environment Agency suggests that adaptation for risks and hazards, and uncertainty will require Europeans to invest in the long-term transformations required to sustain well-being in the face of climate change (UPI.com 2013). Utilisation of land information showing predicted flooding can assist in raising awareness and supporting mitigation actions in the future.

d) Flooding in Australia
Flood events in Australia in 2010 and 2011 impacted heavily on citizens. Many were severely unprepared, and in many cases, people were unaware that they were at risk of flood (van den Honert and McAneney 2011). Misinterpretation of information lead people to believe that the correct interpretation of a ‘1 in 100 year flood’ was that the suburb could experience a flood only once every 100 years (Han 2012). Using the available land information as a resource to help identify parcels at risk can assist in highlighting the problem at a local level. Further information regarding how to interpret land information is also required in this instance to ensure that the correct message is conveyed.

As the examples of disaster events in developed countries have illustrated, a holistic approach to the management of risk affecting land is required in order to enhance resilience and reduce the vulnerability of stakeholders to disasters and risk events (FIG 2006). To better understand the myriad of issues and problems faced within a country context so that an appropriate approach to addressing the problem can be developed, the case example of Australia is examined to determine core issues preventing effective land risk management processed from being implemented by stakeholders.
3.4 Risk in context: an Australian case study

3.4.1 Overview

The country of Australia acts as an appropriate case as several major disaster events during the late 2000s have drawn attention to the current risk management practices for managing land and property within Australia. The outcomes of the events have shown that effective risk management to address threats to land and property has not been implemented. A limited understanding of risk management by the general public, a lack of awareness of land and property information which can assist in the risk management process, and barriers preventing easy access to information have been highlighted in the literature as key factors for the breach of effective land risk management application (Armitage 2012; Fanning 2012; Han 2012; van den Hoenert and McAneney 2012). A gap in information required for analysis was also identified as a contributing factor (Middelmann 2007). The outcome of these events caused enormous economic costs for all stakeholders, including government at all levels, citizens and the private sector as well as an additional social cost on the community (Middelmann 2007). In response to these events, a number of policy and strategic documents aimed at addressing factors which contributed to these events were released by the Australian federal government. These strategies and policies are summarised below focusing on elements relevant to the effective implementation of land risk management processes by stakeholders.

3.4.2 Current risk management strategies within Australia

The different policies and strategies introduced by the federal government can be better understood when viewed alongside major events which have impacted upon land and property of stakeholders. The occurrence of an event can highlight any deficiencies in the ability of stakeholders to respond to and manage the risk and can motivate action such as new awareness campaigns, policies, or strategic documents. Figure 3.2 illustrates events affecting land and property at a large scale within Australia since the year 2000 and the corresponding government documents that were released.
Figure 3.2 Major events affecting land and property and the associated government responses

The figure shows that there are a number of serious events experienced within Australia, and that there is a significant response by the federal government. The figure also identifies a possible shortcoming in the application of the report findings as a number of events, such as bushfire and flooding are repeatedly experienced with significant damage resulting and inquiries into the event being ordered. Each event and report will now be discussed to highlight land risk management issues which arose out of the event and the aim of each report.

**Year: 2002**

In the year 2002 the Council of Australian Governments (COAG) commissioned a report to review Australia’s approach to natural disaster relief, recovery and mitigation against disasters. The aim was to determine whether current practices by stakeholders were adequate for addressing the real threats that existed. The review found that improvements were required in the risk identification, analysis and evaluation stages of the overall risk management process and that increased information collection and sharing, promotion of risk reduction techniques, and education and awareness programs would enhance current practices (COAG 2004).
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**Year: 2003**
In January 2003 two serious bushfire events occurred: the first in the Alpine region of Victoria which burnt for over 59 days, covered 31,000 square kilometres, destroyed 41 homes and killed over 9000 livestock; the second, a suburban fire on the outskirts of the city of Canberra in the Australian Capital Territory which started in the forest and eventually moved into residential areas causing several deaths, multiple injuries and the destruction of more than 500 homes. These events highlighted a need to review the land risk management practices of stakeholders.

**Year: 2004**
The review of these fires – a national enquiry, was released in 2004. The review focused on risk factors, bushfire mitigation strategies, impacts and consequences of bushfire events, response issues and resource issues (Ellis et al 2004). A major outcome of the report indicated that a lack of risk management elements had been addressed, and that the current disaster management practices should be adapted to include these important elements – resulting a new model called ‘the 5 Rs approach’, a hybrid of the disaster management PPRR model and the existing AS/NZS 4360:1999 standards for risk management. These changes to incorporate risk management stages into planning for event affecting land and property support the recommendations from the earlier report commissioned in 2002 by COAG.

Later in 2004 a second document was released aligning with the current recommendation to incorporate elements of risk management into current disaster and risk management practices. The document was an emergency risk management applications guide aimed at the community level to educate on emergency preparation. The management of land and property was minimal in this document and the focus was on the preparedness and response phases of an emergency. A further document was released this year from the same group which addressed critical infrastructure. The focus of the report was on preserving and protecting the land and property that was deemed critical. The new report also incorporated the risk management stages required for effective land risk management practices as was recently recommended.

**Year: 2006**
During the year 2006 a severe tropical cyclone (Larry) made ground in Far North Queensland damaging land and property. The cyclone was recorded as a category 4, had wind gusts reaching 240 kilometres per hour, and resulted in one fatality. The majority of the buildings that suffered damage were buildings constructed prior to the introduction of higher cyclone rating standards. This reflects the effectiveness of risk management measures for land and
property which can be easily implemented when land information indicating the parcels of land at risk is utilised.

**Year: 2007**

A storm of serious proportions took place in 2007, again in the capital city of Canberra. There was large hail which damaged building and caused rooves to collapse, flash flooding, and mud and debris damaging infrastructure. Later in the year a category 4 cyclone caused significant damage to the area of Port Headland in the state of Western Australia.

In response to these events, and the events of previous years a report titled ‘Natural Hazards in Australia: identifying risk analysis requirements’ was released by the Federal Government. The aim of the document was to address the challenges of natural disasters and to improve the protection of property and infrastructure. A thorough overview of the different hazards which could evolve into risk events was given, and emphasis was placed on identifying risk analysis requirements for these hazards with a particular focus on likelihoods and consequences (Middelmann 2007). The area of implementing treatments to address these risks affecting land and property was noticed in the report however.

**Year: 2008**

The main outcome of 2008 was report aimed at the citizen level released by Emergency Management Australia. The report provided a high level overview of how Australia addresses the risk and impacts of hazards through a collaborative approach; however the link towards risk management, and specifically managing risk to land and property was not strong. The focus of the report was on the principles, structures, and procedures that support a national all-hazard coordination of emergency management in Australia.

**Year: 2009**

Early in 2009 substantial flooding as a result of a cyclone occurred in Northern Queensland affecting over 3000 homes. In the following weeks, further heavy rain caused additional flooding to areas already impacted and other areas. At the same time as these events, in the southern state of Victoria a severe bushfire event affecting over 3900 kilometres squared was taking place. This bushfire was unprecedented in the extent of the damage resulting in 173 deaths and the destruction of 2000 homes (Potts et al 2013).

Subsequent to these events the government report ‘National strategy for disaster resilience: building our nation’s resilience to disasters’ was released. The document aimed to respond directly to the ambiguity surrounding the role of government and citizens in a disaster situation. A severe lack of preparedness was identified as a major factor in the severity of the event, so strategies to build resilience were focused upon in the document.
The bushfire event as well as the events preceding the fire highlighted the need for a fundamental shift in the current culture to enable the community to become engaged in land risk management processes to better prepare themselves for disasters (Templeman & Bergin 2009). The report aimed to promote resilience within communities to better prepare them for future events (Insurance Council of Australia 2008). Underpinning the strategies outlined in the report were requirements for information to be made available to promote local disaster risks education (National Emergency Management Committee 2011).

An additional document emerged in 2009 called ‘managing our coastal zones in a changing climate: the time to act is now’. This report addressed the need for national leadership in managing coastal zones in the context of climate change. From the report 47 recommendations were put forward based around the issues of: existing policies and programs related to coastal zone management; the environmental impacts of coastal population growth; climate change adaptation for coastal areas; sustainable strategies; and governance and institutional arrangements for the coastal zone (Standing Committee on Climate Change Water Environment and the Arts 2009). A large focus of the report related to managing the risk to land and property affected by climate change.

A final document which should be noted was the Australian Government Emergency Management Policy Statement. This document focused on the roles and responsibilities of different stakeholders in the implementation of effective land risk management – focusing largely on state and federal governments.

**Year: 2011**

A series of floods hit the state of Queensland in 2011 affecting the state capital Brisbane, causing evacuations which affected over 200,000 people, and left three-quarters of the state a declared disaster zone (Carbone and Hanson 2013). Additionally, 38 fatalities were recorded along with 6 missing persons presumed deceased. Concurrent to this event, flooding was also occurring in the state of Victoria resulting in similar stories of mass evacuations, the flooding of 1730 properties and two fatalities. Parallel to these two serious flooding events was a cyclone event in Far North Queensland which made landfall causing significant damage to the towns in its path. Despite the land information identifying this risk, effective disaster mitigation and preparedness and risk management processes were not in place for a significant number of parcels.

Later in 2011 a bushfire event took place in the state of Western Australia which destroyed around 20 square kilometres of land and ten homes, and, in Melbourne, a flash flooding event in the city which caused major damage to houses and vehicles. Again, effective land risk management practices were not implemented.
**Year: 2012**

In 2012 a report titled ‘Barriers to effective climate change adaptation’ was released which focused on mitigation action for households, government and organisations to respond to climate change to better manage these risks which affect land and property. More extreme weather and events such as cyclones and severe storms were highlighted within the report as predicted to occur emphasising the need for appropriate land risk management strategies to be implemented.

**Year: 2013**

In January 2013 a cyclone passed over the state of Queensland causing widespread impact including severe storms, flash flooding, storm surge, and riverine flooding. As the fourth significant event related to flooding and cyclone related effects the land risk management practices of residents within Queensland have been highlighted as a considerable problem.

As the different government documents discussed above demonstrate, the management and response to these events have adapted over time. As different risk events took place, the traditional emergency management disaster management approaches were modified to enable elements of the risk management process to be incorporated to enhance the overall management of risks affecting the land and property of stakeholders. The change reflects a move towards a prepared and resilient community as a priority for government. As clearly stated by McLoughlin (1985), the time to think about emergencies is before they happen. By modifying current disaster management and emergency management practices to include the risk management process, a comprehensive approach to addressing risk for all stakeholders can be achieved. Australia requires a proactive approach to risk events which has a large focus on firstly identification of risks – to enable stakeholder to acknowledge and then respond to these risks, and secondly mitigation of the events – to ensure that measures to reduce the impact of the risk have been implemented rather than waiting for post-event relief from external agencies (Tate et al 2010). A resilient community based method where the management of risk follows a bottom up approach is required, however, in order for these strategies, which integrate risk management and disaster management methods for improved community resilience to risks, to be effective quality information is required for effective decisions to be made. Without good information about risks, good risk management decisions cannot be made. The ability to correctly recognise emerging issues or problems – such as increased likelihood of risk events from climate change effects, is essential to reducing the overall risk to land and property and to improving land risk management practices of stakeholders (Middelmann 2007). This is supported by the recommendation by the Council of Australian Governments (COAG) to make all information on risk publicly available to support and encourage the community to participate and become part of the solution to
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reducing risk and reducing the detrimental effects of risk (COAG 2004). The issues of information availability to support the implementation of land risk management processed by stakeholders and the roles and responsibilities of stakeholders in managing risk to land and property will be explored further in a following section.

3.4.3 Managing risk to land and property in Australia: a stakeholder lens

Governments, citizens, and the private sector all have a role to play in the effective management of risk affecting land and property. As societal impacts from hazards are escalating, there is a need for management of risks to be addressed from the local level up (Tate et al 2010). Communities need to be aware of the responsibility they have in the management of risk events, and how manage their exposure and vulnerability to decrease the overall risk (Department of Industry, Tourism & Resources Australia 2007). This is even more significant with the predictions that the intensities and frequencies of hazards are to increase in the coming decades (The World Bank and the United Nations 2010). These predicted events such as intense storms and bushfires all have the potential to create significant loss and damage to land and property given the required circumstances (Emergency Management Australia 2005). As such, the land risk management process of stakeholders should be addressed.

Managing risks, disasters and emergencies is not simply a matter for governments. The responsibility falls to individuals, families and the community as a whole to ensure that adequate plans are in place and resilience to these events exists within the community (Emergency Management Australia 2008). Within the stakeholder group of citizens, there is considerable empirical evidence documenting a lack of interest to adopt protective measures despite living within a hazard prone area (Kunreuther and Miller 1985). This creates a large problem within society as the responsibility for safeguarding property and assets against risks lies principally with the citizen (Emergency Management Australia 2008). The responsibility of having a basic awareness of risks which pose a threat to land and property and to minimise vulnerabilities to these risks also stops with the citizen (Middelmann 2007). Addressing this issue is essential for governments. The overall actions or inactions of a community or individual citizens can influence to a large degree the severity of a risk event (Emergency Management Australia 2008). Therefore the awareness and understanding of the importance of each citizen’s involvement in risk mitigation and resilience is critical (SMEC 2006). The stakeholder group of business, specifically insurers can assist in community awareness and mitigation through the process of property insurance. Through hazard identification, risk assessment and mitigation efforts, the insurance industry can play a vital role in the
management of risk and the assistance of community resilience. As advocates of risk mapping and mitigation, the insurance industry has much to offer in the area of managing disaster and emergency events (Emergency Management Australia 2008). Currently the insurance industry are aligned with government strategies and are focusing on increasing community resilience in order to prepare for and respond to the extreme weather events Australia is currently experiencing (Insurance Council of Australia 2008).

In the management of risk in Australia, governments have a range of different roles and responsibilities. As risk events never respect administrative or national boundaries, the nature of risk management within government has become dynamic and requires cooperation from local, state and federal levels (Emergency Management Australia 2008). Within each individual jurisdiction governments (federal, state, and local) have a responsibility for planning, preparing and mitigating against disasters and risk events which will impact upon government assets. A responsibility for protecting the community at large also exists, however at the individual level the responsibility shifts to the citizen. At the local government level, increasing awareness of risks and promoting preparedness for such risks events is an important role of local governments (Middelmann 2007). The strong relationship with the community and local networks, and the local knowledge of the area enables local governments to influence the management strategies of their municipality. At state and territory level the role is scaled back to the management of events, and broader risk management strategies and planning. The development of appropriate policies, warning systems, awareness and education, and support is assigned to the state and territory governments (Middelmann 2007). Now that the roles and responsibilities of different stakeholders have been explored, the broader context of risk in Australia will be summarised.

3.4.4 Summary of risk in context: an Australian case study

This section has looked closely at the country of Australia and the different risk events which have occurred as well as the government responses to these events. The evolution of emergency and disaster management processes which lead to the eventual incorporation of risk management processes was demonstrated. The changing nature of events within Australia demonstrated the need for governments to adapt and move from a response focused strategy to a preparedness and prevention focused stance. The integration of the risk management process was shown to be integral in this move. Additionally, the role and responsibilities of stakeholders for managing risk affecting land and property within the Australian context has been explored which exposed some gaps within the overall understanding and management of land risk. Policy implications will now be explored to identify shed further light on these issues.
3.5 Policy implications for the management of risk

The management of risk, specifically risk which affects the land and property of a range of stakeholders is an issue for the community at large. Adequate management of this risk is required to ensure vulnerability is kept minimal. For effective management to take place however good policies and good information regarding risks, disasters and emergencies are required. Recommendations from The World Bank (2010) advise governments to make information more easily available as people are guided in their risk management activities by such information, and obtaining this information should not be difficult. Suggestions to share information on risk are also given, with the justification that sharing information on hazards generally involves little expense as some government agencies already collect and analyse data on risk. The result would be, if this suggestion was taken upon by governments, a small expense to them and a huge gain for others.

Access to information regarding risk is a crucial issue to community member who currently own a property or who are considering the purchase of a property. The ability to make decisions with the best known risk data will place individuals and communities in the best position possible to address any present risks. Alternatively, not having access to such information could greatly influence an individual’s choice when selecting a property which could result in significant vulnerability to an unknown risk. What should also be considered, however, is the education of stakeholders and decision makers in the overall process of risk management. The delivery of risk information to individual decision makers is irrelevant if those decision makers do not incorporate the information into their risk assessment (Insurance Council of Australia 2008). Further, as risk is not easily understood, the interpretation of the risk information is an issue that should be addressed to ensure that an adequate response takes place, such as addressing the risk through a treatment of avoiding, reducing, transferring or retaining (Prater 2008). This was an issue which was highlighted in the flooding events in Queensland, discussed above in the Australian case example, where either the risk of flooding was unknown due to a lack of available information, or the information given was misinterpreted – for example, confusion surrounding the reference of a 1 in 100 year flood was interpreted as ‘it will flood only once in every 100 years’ as opposed to the correct interpretation that ‘every year there is a 1 percent chance that it will flood’ (Han 2012; Fanning 2012). A move by the Australian government to assist in the education of decision makers will broaden social understanding of risk which will in turn promote political will to address risks and implement reduction and mitigation strategies (Prater 2008). It would also enable governments to address risks from both a top down and bottom up approach. The implementation of top down solutions is effective when the community
understands the problem or the severity of the problem (Prater 2008), and the implementation
of a bottom up approach can be successful if community resilience is present. Land
administration information is key to successfully implementing these approaches and
achieving a resilient and risk prepared community. How land administration is relevant in the
context of risk management is discussed below.

3.6 Risk management backed by land
administration

Land administration information is fundamental in
improving risk management practices for decision
makers. It is relevant to stakeholders at both federal government level, local government
level, citizen level and everything in between. Research has shown that the use of land and
property information for disaster and emergency management can improve operations
(Mansourian et al. 2004; Asante et al. 2007), and as demonstrated by recent amendments
around the world to disaster and emergency management models to enable the inclusion of
risk management processes (c.f. Ellis et al. 2004; UK Resilience 2010; Rogers 2011), this
improvement can be translated to the broader application of land risk management. This has
been recognised by some stakeholders and the value inherent to land and property
information for identifying, analysing, evaluating, and selecting treatments for risks has been
realised and documented (c.f. Productivity Commission 2012; Insurance Council of Australia
2006). For the majority of stakeholders however, these two disciplines are considered
separate.

The argument which supports the use of land administration information in the process of risk
management is not complicated. The combination of risk information with relevant
information on land tenure, land value, and land use enables the necessary risk prevention
and mitigation measures to be identified and assessed in relation to legal, economic, physical
and social consequences (Enemark 2009). The information presentation is easy to understand
for decision makers as they are familiar with maps from the surge in online mapping
providers, and the interpretation of the visual information is straightforward (Tate et al.
2010). The value in using these two disciplines in a harmonious way is that as a combined
resource, the nature and extent of risks can be visualised, which can enable the impacts of the
risks to be understood, which can then inform further risk management strategies (National
Emergency Management Committee 2011; Tate et al. 2011).

The land administration information is a key component in this scenario. Combined land and
risk information has been identified as a critical element in the mitigation of new
developments (Emergency Management Australia 2008). Risk information presented using land administration information as a foundation can assist in making decision makers more aware of risks and more motivated to implement appropriate risk management strategies (The World Bank 2010). As some risks are relevant to specific areas, the land administration information can reveal vulnerabilities and exposure to certain hazards. The land administration information regarding topography is particularly useful in its ability to reflect tsunami, storm tide, tropical cyclone, bushfire, and landslide risk (Middelmann 2007). The incorporation of risk management into land administration systems will allow for a holistic approach that underpins risk and disaster awareness and an ability to manage risk events for all decision makers (Enemark 2009).

As an ideal outcome, risk management should be integrated as a component of overall land management to allow for the inclusion of a range of issues and measures relevant to risk management within sustainable land administration systems (Enemark 2009). The current theory shows that within the country of Australia as an example, the awareness of risk is not at a sufficient level within the community. Further, details of risk processes such as risk mitigation within local government levels being constrained by the lack of adequate hazard information available are emerging (SMEC 2006). Sharing at all levels of government within a country context would benefit a range of stakeholders, including the government itself and would increase the capacity of decision makers. Additionally, the incorporation of land administration information within the risk management process would improve implementation of mitigation and other risk management actions. The better the knowledge base of information that is available for assessment of the risks, the more informed the decision regarding management is likely to be (Schneider et al 2009). Therefore, land administration should be incorporated. Governments need to address any inadequacies in information supply for the management of risks, including in the area of land administration and the knowledge gap in this area needs to be addressed.

### 3.7 Chapter summary

This chapter has reviewed the overall concept and origins of risk and the risk management process, and looked at the development of these ideas over time to understand the important role that risk management plays within society today. The focus of the research was to examine the role of land administration in the process of managing different risks which can impact on land and property. The specific application of risk management to land and property was observed, with several examples from developed countries around the world discussed to demonstrate the need for improved land risk management practices. Current risk management practices within a case country were explored using examples of events that had
taken place which had affected land and property, and then the government response which demonstrated a move towards risk management practices were examined. A movement from disaster and emergency only based management systems towards the incorporation of the risk management process was observed and a need for improved risk management practices and education to promote community resilience to risks affecting land and property was discussed.

The overarching literature review broadened to look at the convergence of risk management and land administration and found that the intersection between these two disciplines in increasingly becoming more common. The benefits of utilising land administration information within the risk management process were discussed and areas with limited information were identified as gaps. In order to address the research questions presented in chapter one and respond to the issues discussed in this chapter and the previous chapter, chapter four will present the research methodology and explain the research design which was developed to respond to the research questions and to achieve the research objectives.
Part 3: Research
Chapter 4 – Research design and methods
4.1 Introduction

This chapter discusses the overall study design and the data collection and data analysis activities used within each aspect of the study to gather information required to answer the research questions. The conceptual design framework is investigated first and from this possible research methods are explored. Quantitative research methods, qualitative research methods, and mixed research methods are all examined. To best address the goals of the study, a multi-strand mixed methods approach was chosen and developed to support the exploratory and descriptive nature of the research. Specifically, a quantitative study of land administration systems was conducted from one strand of the research; and a qualitative study of the current risk management practices carried out by land right holders was conducted from the second strand. Justification of the selected approach is provided and the final research design is presented. Methodological issues, and ethical considerations encountered by the researcher are also highlighted within this chapter.

4.2 Conceptual design framework

In chapters 2 and 3, theory from the two major disciplines - risk management and land administration, and the overlapping theory of these two disciplines were reviewed. The current risk management practices in Australia were also investigated as an insight into the selected case study country. The review of risk management and land administration theory revealed a number of gaps in research, including an understanding of how to interpret the risk management standards, as well as an understanding of how to access critical land and property information or how to overcome institutional or administrative barriers.

The combined theory provided an improved awareness of how information about risk could be better conveyed to stakeholders and how this information could be used to impact stakeholder understanding of such situations. The understanding of how to identify, assess and treat risk at the citizen level, and the need for a strategy for governments to convey the message of risk management and resilience to their jurisdiction/s, as well as an understanding of the current land information environment within each country context were factors considered in the conceptual design framework and incorporated into the research design.

4.2.1 Research questions

As stated in chapter 1, the research questions developed to address the research problem and the overarching research question are as follows:

How can land administration activities be redesigned to support societal risk management?
- Are land administration agencies motivated by the notion of land risk management? If yes how? And how might they be motivated in the future?

- How do land right holders perceive their role in land risk management?

- What should be the relationship between land right holders, risk, and government? Or what are the various options?

- How can land administration systems support land risk management – given a specific country context?

In Figure 4.1 the conceptual design framework illustrates the two concepts brought together in this research and the relationships that these concepts have with the key factors which exist around the research problem.

![Conceptual Design Framework](image)

**Figure 4.1 Conceptual design framework**

To address the overarching research question the results from both the *quantitative* and *qualitative* approaches are required in order to guide the development of the model and prototype to assist in understanding how land administration can contribute to improved risk management of land for society.
4.2.2 Hypothesis

As a result of the background research into risk management of land and property and land administration systems, the following hypothesis has evolved:

That the management of risk to land and property will be improved if:

1. Land administration systems are used as a foundation;
2. Land and property information is aggregated at a national scale;
3. Emerging spatial technologies and concepts are utilised;
4. Existing risk information is spatially enabled.

Where:

‘land administration systems’ include land policy frameworks, land administration functions, and land information infrastructures.

‘spatially enabled’ refers to making information about a risk to land or property available through location based searches.

‘emerging spatial technologies’ refers to instruments such as digital globes, web mapping services, wireless sensor networks, location based services, volunteered geographic information (VGI), and other web 2.0 applications used for spatial purposes.

4.3 Selection of research approach

4.3.1 Overview

This section presents both qualitative and quantitative methods and examines them within the context of this research to determine which research strategies are most fitting to address the research problem and aim. During the investigation of possible research methods it became apparent that both quantitative and qualitative research methods should be considered. The research strategy needed to support the objectives developed and also to result in data sufficient to answer the four research questions posed to the study. A discussion on the methods considered for this research follows.

4.3.2 Qualitative methods

Qualitative research methods aim to understand the meaning given to a particular phenomenon and focus on ‘how’, ‘what’ and ‘why’ questions. Meanings, concepts, definitions, characteristics, metaphors, symbols, and descriptions of things all refer to qualitative research (Dabbs 1982, p. 32). Through this method, answers are sought by
examining various social settings, and the individuals who inhabit these settings (Berg 2004, p. 7). Many strategies exist for gathering qualitative data. Burns (2000) proposes five different data collection strategies: ethnography, unstructured interviewing, action research, case study, and historiography. Qualitative research focuses on meaning in context and requires an instrument sensitive to underlying meaning when gathering and interpreting data (Merriam 2009, p. 2). Consequently, often it is the researcher who collects data first hand.

Qualitative research differs from quantitative research in that the data it produces is descriptive and relates to people or activities being studied. A strength of qualitative research is that the product of qualitative enquiry is richly descriptive and from this a greater depth of understanding on a subject can be achieved (Merriam 2009). A qualitative research strategy usually involves a small number of respondents and cannot always be statistically analysed or graphed as quantitative data can be. Qualitative methods therefore produce outcomes which are more suggestive than conclusive. As a result qualitative methods are sometimes criticised for being non-scientific and thus, invalid (Berg 2004, p. 2). Some authors have described the qualitative method as being merely a tool for individual descriptions of phenomena and as introductory research to the legitimate research of hypotheses and statistic testing (Benbasat 1984). Frameworks now exist however which provide both a rigorous and scientific approach to qualitative research, and when used properly, authors argue that qualitative research has similar standards of credibility as a quantitative research approach (Lee 1989; Krefting 1991; Yin 1994).

In the context of this research, a qualitative research strategy was deemed the most appropriate method for investigating the relationship between land right holders, risk, and government, and for understanding how land right holders perceive their role in the process of risk management. The use of this method and the variety of strategies that exist for collecting data enables greater understanding regarding individual choices and perspectives to be accomplished through the descriptive nature of a qualitative research strategy. Within this research key aspects to be understood are: what risks land right holders feel threaten their land and property; how they identified these risks; why they feel these risks are a threat; what level of threat these risks present; and what risk management methods they have implemented. Qualitative research methods offer the flexibility and depth required to facilitate this. To collect this data, a case study strategy was conducted. Details of the case study and justification for this choice are specified below.

**Justification for case study approach**

The case study strategy focuses on understanding the dynamics present within a single setting (Bryman and Burgess 1999). It provides a mode of inquiry for an in-depth examination of a
phenomenon and is useful when the opportunity to learn is of primary importance (Stake 1995). Creswell describes the case study approach as:

“a qualitative approach in which the investigator explores a bounded system (a case) or multiple cases (cases) over time, through detailed, in-depth data collection involving multiple sources of information (e.g., observations, interviews, audiovisual material, and documents and reports), and reports a case description and case-based themes” (Creswell 2007, p. 73)

The use of a case study is suitable in the broad field of land administration as the field is characterized by constant change and situation specific issues such as economic, political and social forces. The case study approach has been used by many PhD students in the land administration discipline in recent years (Bennett 2007, McDougall 2007, Dalrymple 2005, Warnest 2005, and Steudler 2004) as a strategy for gaining descriptive and in-depth information linking human issues with the existing knowledge base. Yin (2003) advocates the use of cases to help address contextual issues and not just the overarching phenomenon of the study. Thus, the case study approach, informed by an understanding of the contextual conditions is the only way to understand the extensive field of land administration (Bennett 2007).

Within the case study approach, Yin (1994) identifies four different types of design: single-case holistic design, single-case embedded design, multiple-case holistic design, and multiple-case embedded design. The distinction between holistic and embedded design is: that while a holistic case study focuses on one single unit of analysis with a global approach, the embedded case study involves – within the same case, multiple units of analysis (Yin, 1994). The single-case design is appropriate when aiming to confirm, challenge or extend current theory, when the case is unique, or when the study is of a revelatory case. In contrast, a multiple case design is selected when there is possibility for a literal replication or theoretical replication of results through the study and investigation of several cases. While multiple-case designs are often considered more robust and the results more compelling, they can have distinct disadvantages such as requiring extensive resources and time – often beyond the means of an independent research investigator (Yin, 1984).

This study utilises the single-case embedded design. In this sense, the study is focused on addressing the research problem using Australia as a case study. The embedded units within the study are the different stakeholders represented by: federal government, state government, local government, national businesses and citizens. Yin (1989, p. 48) argues that the use of a single case is appropriate or warranted when the case is revelatory. A revelatory case is one in which there is an assumption that the issues revealed in a particular case are common to other cases as well.
The study into current risk management practices by land right holders can serve as a revelatory case as the issues identified and described within the study may be common to other cases focused on risk management practices by land right holders in other jurisdictions within Australia or other countries. In addition, the aim of the case study was to extend the theory and understanding of the current Australian context which aligns with a single-case design. Further, as Hamel et al (1993) points out:

“a case study typically examines the interactions between all variables in order to provide a comprehensive understanding of an event or situation”

Thus, the single case embedded design is an appropriate selection as an inclusive understanding of the situation in Australia was required and theory on the topic required extending.

The use of case study as a method is relevant in this research as it enables the ‘when’, ‘how’ and ‘why’ questions to be answered and facilitates the study of a small number of subjects in depth in order to gauge an understanding of how different land right holders and jurisdictions deal with risk related to land and property. Detailed knowledge of how land right holders perceive the process of risk management for land and property purposes was essential as well as an understanding of how risk management processes are interpreted and implemented. The case study framework supported this focus. The use of this method alone however is not enough. Not all of the research questions are effectively addressed using the case study approach. The use of quantitative methods should also be considered.

### 4.3.3 Quantitative methods

Quantitative methods differ from qualitative in that the intent of quantitative methods is to test a theory deductively to support or refute it, whereas the intent of qualitative methods is to understand meaning individuals give to a phenomenon inductively (Creswell 2007). Quantitative methods have a focus on “measurements and amounts (more or less, larger or smaller, often or seldom, similar or different) of the characteristics displayed by people and events that the researcher studies” (Thomas 2003, p.1). Traditionally, quantitative research is structured and follows a linear sequence which includes the elements of defining a research problem, formulating the hypothesis, designing the study, selecting samples and instruments, gathering the data, statistically analysing the data, drawing conclusions, and reporting on the results.

Quantitative research may make use of a variety of approaches including the conduct of surveys or experiments. Quantitative methods are focused on asking closed-ended questions and testing specific variables that form hypotheses or questions. Unlike qualitative research,
where the researcher is involved first hand in collecting the data, in quantitative research the role of the researcher remains in the background (Creswell 2007).

The strength of quantitative strategies stem from an ability to efficiently include a large number of participants through instruments such as surveys, and then an ability to analyse those variables comprehensively and swiftly using computing methods (McDougall 2007). It also provides the potential to aid in the discovery of key factors, correlations and possible trends.

4.3.4 Mixed methods

The field of mixed methods research developed as a pragmatic approach to utilise the strengths of both methods (McDougall 2007). This new approach was evolving near the end of the 1970s when scholars began to agree that since no one methodology could answer all questions and provide insights on all issues both quantitative and qualitative approaches were needed (Burns 1997). As a result researchers have begun to re-examine previously isolated qualitative and quantitative approaches and develop designs which incorporate multi or mixed method techniques (Creswell 2003).

A number of reasons, including: the ability to answer research questions which other methodologies cannot; the ability to provide better (stronger) inferences; and the opportunity for presenting a greater diversity of divergent views, identify why a mixed methods approach may be superior to a single method approach (Tashakkori and Teddlie 2003a). As with all research methods however, problems still exist and care must be taken in the integration and interpretation phases of research (Bryman, 1992). Still, when carefully combined the mixed methods approach is powerful.

These reasons listed above, although general in context, provide the basis for how the use of a mixed method approach in this thesis can be justified. Firstly, the mixed method approach not only enabled an investigation into the two independent disciplines of risk management and land administration, but also facilitated the study of how they impact upon each other and how they could adapt to support each other within a defined context. To answer the research questions an understanding of both disciplines individually, as well as an overall understanding of both disciplines combined was required. As a requirement for a truly mixed design, Teddlie and Tashakkori (2008 pg.142) state that “two or more clearly identifiable (sets of) inferences, each gleaned from the findings of a strand of the study, followed by a deliberate attempt to integrate these inferences” should be present. This understanding and use of mixed methods is aligned with the aim of this research – to obtain results from both
stands of study (the risk management strand, and the land administration strand) and to integrate these inferences to achieve an overall understanding of the situation.

Secondly, through the use of multiple methods the weaknesses of a single method are minimised when combined correctly. The qualitative case study allowed for an in-depth study of how risks are managed by stakeholders and what land and property information is utilised in this process, while the quantitative questionnaire provided the opportunity to investigate what information existed, and who was it available to and for what use.

Finally, the chance to examine and offer a greater diversity of views was deemed central to validating the research findings. This was important because it led to the re-examination of the conceptual framework and underlying assumptions of each of the two methods (Tashakkori and Teddlie 2003a).

This led to further investigation into which mixed methods typology was appropriate for this research.

**Deciding upon a mixed methods approach**

Since the time that mixed methods emerged as a field in its own right, typologies aimed at documenting the design characteristics and functions have developed through work of many well known authors (e.g., Creswell et al 2003; Tashakkori and Teddlie 2003a; Greene and Caracelli 1997; Greene et al 1989; Johnson and Onwuegbuzie 2004; Morgan 1998; Morse 1991, 2003). The advantages defined typologies present are a variety of paths or ideal design types to model research on in order to achieve specific goals. When selecting a typology the criteria which define the design types can assist in determining whether the typology will fit the goals of the research. The typology developed by Teddlie and Tashakkori (2006) outlines four criteria (methodological approach, number of strands, implementation type, and integration approach) used to develop the Methods-Strands Matrix (see Table 4.1). By making a decision regarding each criterion the most appropriate cell (and design type) will be revealed within the matrix.
### Table 4.1 The Methods-Strands Matrix (Tashakkori and Teddlie 2003a)

<table>
<thead>
<tr>
<th>Design Type</th>
<th>Monostrand Designs</th>
<th>Multistrand Designs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monomethod designs</td>
<td>Cell 1 Monomethod monostrand designs</td>
<td>Cell 2 Monomethod multistrand designs</td>
</tr>
<tr>
<td></td>
<td>Traditional QUAN designs</td>
<td>Parallel monomethod QUAN + QUAN</td>
</tr>
<tr>
<td></td>
<td>Traditional QUAL designs</td>
<td>QUAL + QUAL</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sequential monomethod QUAN → QUAN</td>
</tr>
<tr>
<td></td>
<td></td>
<td>QUAL → QUAL</td>
</tr>
<tr>
<td>Mixed method designs</td>
<td>Cell 3 Quasi-mixed monostrand designs</td>
<td>Cell 4 Mixed methods multistrand designs</td>
</tr>
<tr>
<td></td>
<td>Monostrand conversion design</td>
<td>Parallel mixed designs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sequential mixed designs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Conversion mixed designs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Multilevel mixed designs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fully integrated mixed designs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Quasi-mixed multistrand designs</td>
</tr>
</tbody>
</table>

The first dimension in the matrix, the number of methodological approaches, refers to the decision to include a qualitative approach (QUAL), a quantitative approach (QUAN), or both (QUAL + QUAN) within the research design. If the research includes only QUAL or QUAN it is defined as a monomethod design. If both QUAL and QUAN approaches are used the research is defined as a mixed methods design. The second dimension in the matrix refers to whether the research study has one strand or more than one strand. One strand or monostrand designs have only a single phase that encompasses all of the research stages, while multistrand designs have multiple phases – each encompassing all of the research stages. The third dimension in the matrix refers to the implementation process involving the mixing of qualitative and quantitative approaches which can occur as a parallel, sequential, conversion, multilevel or fully integrated approach. The final dimension in the matrix is the stage of integration of approaches and refers to whether the qualitative and quantitative approaches will be integrated at the last stage during the analyses and inferences, whether the qualitative and quantitative approaches will be integrated during the experiential stages, or whether they will be integrated during all stages. By making a decision regarding these four basic methodological criteria the most appropriate design approach can be discovered.

This research followed a design from Cell 4 (highlighted) of the Methods-Strands Matrix (Table 4.1). To meet the criteria for this cell the research must have utilised both qualitative and quantitative methods and have multiple research strands. Within this cell, the parallel mixed designs typology was selected (Figure 4.2).
Parallel mixed designs are defined as “designs with at least two parallel and relatively independent strands: one with QUAN questions, data collection, and analysis techniques and the other with QUAL questions, data collection, and analysis techniques” (Teddlie and Tashakkori 2009). Each strand is planned and implemented to answer different aspects of the research questions and to contribute to answering the overarching research question. In terms of the design types outlined in the typology proposed by Tashakkori and Teddlie (2003a), the parallel mixed design is the closest fit.

4.3.5 The convergence model: making valid inferences

When conducting a mixed methods design attention must be given to the convergence of the results of each strand to reach the overall meta-inference. A condition of the research design chosen, a parallel mixed methods multi-strand design, requires the inferences reached from the two strands to be triangulated to create a meta-inference.

The term triangulation refers to the study of a problem using two different methods to gain a more complete picture (O’Cathain et al 2010). An advantage of this approach is that it enables an overall view of the phenomenon to be obtained. The full picture is more meaningful than each of the components, therefore studying each of the components separately, and bringing the results of each study together allows for an overall understanding of the phenomenon to be obtained. The process involves developing inferences based on the results from each strand, and integrating these findings to form meta-inferences at the end of the study (Teddlie and Tashakkori, 2009 pg.152). The meta-inference created provides an
overall conclusion, explanation or understanding of the phenomenon under study (Tashakkori and Teddlie 2008).

In order to reach this conclusion and the meta-inference, integration or triangulation, of the two inferences reached from the analysis of the qualitative and quantitative strands much first take place. This method of triangulation to merge the results of a mixed methods design has been utilised by many PhD theses in the field of land administration in the past (see Bennett 2007; McDougall 2007; Christensen 2013). The process of triangulating the findings from the different strands of research takes place at the meta-inferential stage of a study when both sets of results have been analysed separately (O’Cathain et al 2010). As such, care must be taken during the integration and interpretation stages of the research (Bryman 1992).

![Figure 4.3 Triangulation of results: the convergence of the QUAN and QUAL inferences](image)

In order to ensure that effective integration and interpretation of the results during the triangulation stage takes place, and that the results and meta-inferences developed are valid, an integrative framework to determine the quality of inferences, developed by Tashakkori and Teddlie (2003b), is adopted. As part of this model, Tashakkori and Teddlie (2003b) propose two broad criteria for evaluating the quality of inferences: design quality and interpretive rigor.

Design quality refers to “the degree to which the investigators have utilised the most appropriate procedures for answering the research question(s), and implemented them effectively” (Tashakkori and Teddlie 2008). Four research criterions to determine the design quality are outlined below:

- Design suitability: Was the method of study appropriate for answering the research question(s)?
- Design adequacy/fidelity: Were the components of the design implemented adequately?
- Within design consistency: Did the components of the design fit together in a seamless and cohesive manner?
Chapter 4: Research design and methods

- Analytic adequacy: Are the data analysis techniques appropriate and adequate for answering the research questions?

Interpretive rigor is the degree to which credible interpretations have been made on the basis of obtained results (Lincoln and Guba, 2000; Tashakkori and Teddlie 2003b). In order to assess such rigor, and improve the quality of inferences, five research criterions have been identified:

- Interpretive consistency: Does each conclusion closely follow the findings?
- Theoretical consistency: Is each inference consistent with current theories in the academic field and/or with empirical finding of other studies?
- Interpretive agreement: Would other scholars reach the same conclusions on the basis of the results from the study?
- Interpretive distinctiveness: Is each conclusion distinctively different from other plausible conclusions regarding the same results?
- Integrative efficacy (mixed and multiple methods): This applies to meta-inferences only. It addresses the degree to which a mixed methods researcher adequately integrates the findings, conclusions, and policy recommendations gleaned from each of the two strands.

The framework presented above provides a general set of standards for which the validity of the research can be assessed against to determine the quality of the mixed methods approach.

4.4 Research Design

This research looks at the world from a risk management perspective to understand how land administration systems and agencies need to adapt to contribute to the management of risks affecting land and property. The investigation process involved assessing, within the case study country of Australia, land right holders and their risk management activities, and the existing land administration systems and agencies to determine how they are arranged and operate. The results of the two enquiries inform the changes required in order for land administration systems to support current risk management activities related to land and property. Figure 4.4 illustrates this process. The design consisted of four phases which concluded in a model for land administration driven risk management.
The design detailed above follows a generalised design framework for mixed methods proposed by Tashakkori and Teddlie (2003a). The chosen design framework is one of many mixed method design frameworks which have emerged in recent times (Creswell et al 2003; Johnson and Onwuegbuzie 2004; Tashakkori and Teddlie 1998). The design in figure 4.4 is defined by criteria such as implementation, priority, and integration to guide selection and determine an appropriate design, a detail common to all recent mixed methods design frameworks.

The decision to select the mixed methods design framework proposed by Tashakkori and Teddlie (2003a) over other frameworks proposed by authors was made due to a small design feature not found in the other models. The framework proposed by Tashakkori and Teddlie (2003a) supports a parallel multi-strand design where each strand (the qualitative strand and the quantitative strand) remains relatively independent. Both strands are investigated and studied independently, and analysed separately to reach a conclusion independent of the other strand. As a final process a meta-inference stage occurs where the results from both the

**Figure 4.4 Research design**
qualitative stand and the quantitative strand are brought together to reach a final understanding.

A design incorporating this feature was necessary in this research as the focus is on two separate disciplines: risk management and land administration. The implementation of this design supported the structure of the research questions allowing for the first strand to address the quantitative questions within the land administration component, and for the second strand to address the qualitative questions within the risk management component. A large number of data attributes were required from the government land administration agencies, and the quantitative approach facilitated the collection of this data. An in-depth understanding at the community and local government level was also required, which was supported through a qualitative approach. A strength of this design is that it permits the combination of the results from two independent strands within the meta-inference stage to address the overarching research question.

The following sections of this chapter will detail the research methods used throughout this research.

4.5 Research methods

Based on research design framework, the research method is broken down into four phases: review of theory and framework development; stage government land administration questionnaire; risk management stakeholders study; and integration, model development and validation. The four phases relate to the case study country of Australia, in which all the primary investigation is carried out. The selection of the country of Australia as the case to focus on is based on the criteria developed for case selection which is founded on the research scope. The first criterion was that the case study country should be a developed country with an OECD economy. This is to address the research gap identified in the literature for research focused on managing risk to land and property outside of developing countries. The second criterion was that the country for selection should have an established land administration system. This is critical as a large focus of the research is on the potential use and application of land administration to the area of land risk management. Based on the two initial criteria, the country of Australia was selected as it offers insight into a range of risk events which impact upon land and property, it has a diverse landscape to again provide insight into factors which might impact upon land risk management processes, and the structure of the federated government provides an opportunity to examine a range of roles related to managing risk to land and property, and examine issues which are created when land administration is not managed in separate jurisdictions within the one country.
4.5.1 Phase 1 – Review of theory and framework development

The initial phase of the research provided the basis for development of a suitable conceptual framework. The framework incorporates both the land administration focus and the risk management focus of the research and highlights the overlapping areas of these two disciplines to be explored.

The primary intentions of this research was to understand, within the case study country of Australia, the current arrangements of land administration systems and agencies, the current risk management practices of a range of stakeholders, and how land administration agencies could adapt to assist in the implementation of effective risk management practices. Therefore, the conceptual framework for the data collection was guided by land administration theory and rights, restrictions and responsibilities theory for the state level land administration agencies questionnaire, and risk management and disaster management theory for the stakeholder case study.

4.5.2 Phase 2 – State government land administration system questionnaire

In order to examine and understand the capacities and needs of each state and territory land administration system, a quantitative questionnaire was developed and tailored to the expert respondents who were invited to participate. The questionnaire was targeted at land registries and other agencies which create and manage land information vital to Australia’s economy.

The design of the questionnaire was constructed around the ‘RRR toolbox’ (Bennett 2007). The RRR Toolbox is a framework for managing rights restrictions and responsibilities (RRRs) that are understandable and applicable to individuals, institutions and the wider society (Bennett and Rajabifard, 2009). The eight components of the toolbox: Land policy principles, legal principles, tenure principles, spatial and technology principles, emerging principles, HR and Capacity Building principles, cadastral and registration principles, and institutional principles, guided the development of the questionnaire.

The overall questionnaire distributed to each jurisdiction in Australia was designed as a combined effort within a larger project. Questions which were specific to this project, developed with the aims of the research in mind were embedded within the questionnaire in the relevant sections.

The questionnaire was based around the seven sections described below:
Section 1: Your jurisdiction’s RRR policies and legislation
This section explored the support for RRRs through legislation, the future of RRRs publication and the protocols for recording RRR information.

Section 2: Your organisation
This section examined the internal and external relationships of the organisation. It queried the business model utilised, the role of the agency, and the progress of the agency regarding the publication of RRRs.

Section 3: Managing your RRRs
This part of the questionnaire investigated what RRRs are on title, how are they defined, how are they classified. How the RRRs are described and recorded and who the custodians of the RRR information are was also included in this section.

Section 4: Sharing and providing access to RRRs
This section investigated public accessibility, access controls, pricing allocation, inquiry charges, and key stakeholders and users of the data.

Section 5: Your platforms and systems
This section explored the technical systems used to manage RRRs and focused on the architecture of the systems, key features of the systems, and the ability of the systems to integrate with other agencies.

Section 6: Spatially enabling RRRs
This section explored aspects around whether the information is geocoded in some way, whether the information is recorded in a standard way and what the relationship between components of the agency such as the cadastre and the registry is.

Section 7: Miscellaneous
This final section examined problems and issues of management, policy changes required, and the existing formal arrangements around creation and sharing.

For the majority of questions, a response of either yes or no, or a rating measured on a five point Likert scale was required. In some case a numeric response was required, or a short textual response which was quantified in the analysis. Although predominantly close ended questions were employed – numeric or Likert responses, a small number of open ended questions were included to support the quantitative content and provide additional context. A copy of the questionnaire is given in Appendix 2.
**Questionnaire distribution**

The questionnaire aimed to gain a perspective from all state and territory land administration agencies. Within Australia only eight different jurisdictions exist, therefore it was decided that all state and territories would be approached to participate in the questionnaire.

The questionnaire was distributed by the spatial information council ANZLIC as a part of the larger project underway. The questionnaire formed part of ANZLIC’s on-going analysis of land information needs and capacities coordinated by the land title Registrars and their staff, land information agencies and national bodies; in particular PSMA Australia Ltd. As a smaller component of this work, this research was able to take advantage of the activities planned for the overarching research, and contribute to the questionnaire and benefit from the distribution coordinated by ANZLIC.

The questionnaire was conducted between June 2011 and October 2011. A total of 9 responses were received, including a response from New Zealand which was disregarded as it was not included within the scope of this specific research. As such, a 100% response rate was recorded as all states and territories within Australia responded. The relevant questions to this study were extracted from each returned survey and compiled into one document where the responses from each state and territory were input into tables for each question for easy analysis. Full details of the analysis and results are presented in chapter 5.

**4.5.3 Phase 3 – Risk management stakeholders case study**

The key purpose of this qualitative study was to examine risk management stakeholders, namely, citizens and local governments, in order to describe and classify the information utilised in the risk management process and to gain a better understanding of the risk management activities undertaken by each stakeholder group.

**Case study selection**

To meet the aims of the study a comprehensive investigation was undertaken to understand how risk management activities are interpreted and implemented by a range of stakeholders. The two Australian states of New South Wales and Victoria were selected for this research study (see Figure 4.5).
The two states were selected for a number of reasons: firstly, within recent years both states have faced severe disaster events which caused considerable damage across the state (2009 Black Saturday Bushfire in Victoria, 2010/2011 Floods which affected NSW and VIC, drought); both states have similar populations; and combined, these two states account for more than half of Australia’s total population.

### Jurisdictional environments

#### New South Wales

The state of New South Wales is located in the east of Australia bordered by Queensland, South Australia and Victoria (see figure 6.1). It is the fifth largest jurisdiction by area, at 809444 kilometres squared, and has the largest population of all the jurisdictions with 7,272,800 citizens. In terms of population versus size, New South Wales has the third highest population density of all jurisdictions. The climate of a location can impact largely on the types of risks which can be expected. Within New South Wales, the climate ranges from a temperate climate with higher rainfall in the eastern areas to alpine climate in the south east regions. The mean temperature of New South Wales is moderate; however extreme heat and cold temperatures can occur.

As climate can impact on aspects of risk management, the population of a location can also determine the impact which a risk event can have. The eastern coastline of New South Wales is highly populated, while the northern area is sparse in population and is a rural agricultural area. Towards the south of the state the population increases and the area is used for agricultural purposes as well. Running through the state is the Great Dividing Range – a mountain range surrounded by national park bushland. Surrounded completely by the state of New South Wales is the jurisdiction of the Australian Capital Territory. This is a separate jurisdiction, excluded from the data collection and analysis.

#### Victoria

The state of Victoria is located in the south-east of Australia bordered by New South Wales and South Australia (see figure 6.2). Geographically it is the smallest mainland state with an area of 237,629 kilometres squared; however it has the second largest population of all the jurisdictions with 5,603,100
citizens. In terms of population versus size, Victoria has the second highest population density of all jurisdictions.

The climate of Victoria varies from a semi arid and hot in the north-west to temperate and cool along the coastal regions. A cooler alpine climate exists around the areas of the Great Dividing Range which runs through the centre of the state.

In terms of population, the southern and eastern coastline of Victoria is highly populated. The western area of the state is sparse in population and is a rural agricultural area. Towards the north of the state the population increases and the area has many regional centres as well as a large agricultural purpose.

Within the case study, both local governments and citizens were investigated in each state (Figure 4.6). The selection of these two stakeholders for the investigation was justified by their role in the overall risk management process. Firstly, local governments have an important connection between the community and state and federal levels of government. They are the ‘on the ground’ manager of local assets and first responders in risk events. They also, as a government organisation have a strong relationship with the state and federal tiers of government and assist in enacting policy related to risk management. Finally, as there are numerous local governments within each state under study, comparisons between local governments were possible. The second stakeholder selection of citizen was based on relevance. Citizens as members of the community face direct risk to their land and property, and as a result require effective risk management. The stakeholder of citizen adds further depth to the investigation also as there are a number of different relationships to land that can exist at the citizen level such as ownership and leasing, and different types of properties that exist such as farms, apartments, detached house. The aim was to gain an understanding of how risk management was applied and perceived, and to understand how these different stakeholders interact.

Figure 4.6 Stakeholders investigated in the risk management case study
**Methods of data collection**

Underpinning this research was an understanding of current risk management practices and the perception of risk management by stakeholders. To achieve this understanding the study utilised two different data collection techniques which offered complementary perspectives on the understanding of how risk is perceived by stakeholders, and how risk management activities are carried out by stakeholders. To obtain this information, targeted studies of citizens who either owner or leased a property in the chosen case study states of New South Wales or Victoria were undertaken. Additionally, local governments within these two states were also invited to participate in the study.

The data collection focused on two primary forms of evidence: in-depth questionnaires and semi-structured interviews. The questionnaires were distributed to both the citizen stakeholder group and the local government stakeholder group, while the semi-structured interviews were conducted only with local governments. A copy of the pre-survey letter requesting participation in the study from local governments is shown in Appendix 3.

The questionnaires used within the study were designed specifically for land right holders at the citizen level and for local governments. Each questionnaire was similar in the questions asked, however the first section of each questionnaire differed slightly. The questionnaire used for citizens directed the questions to the individual land right holders, whereas the questionnaire developed for local governments directed the question at the organisation in general. The questionnaires were designed and structured around the ISO risk management standards framework (Standards Australia/Standards New Zealand 2009). The questionnaires were broken down into the following six sections: risk management plan; risk identification; risk analysis; risk information; risk treatment; and, monitoring and review.

The first section, the risk management plan, aimed to understand the context of the land and property being surveyed and the approach taken towards risk management for the specific land and property. The second section aimed to understand the different risks posing a threat to land and property. The third section aimed to understand how each identified risk was analysed. Section four focused on the information used to execute risk management decisions and the origins of this information, and section five and six were directed at risk treatments implemented based on risk management objectives identified and the available information, as well as the monitoring and review of such decisions. A copy of the citizen and local government questionnaires are given in Appendix 4 and 5 respectively.

The positive response rate from each of the questionnaires distributed is shown in Table 4.2. A response of at least 15 citizens within both categories of owners and lessee’s per state, and a response of at least five local governments from each state was the aim. The categories of
owners and lessees were selected using the tenure classification system described in the Australian Bureau of Statistics 2011 Census data results. The classification system used within the census identified the five tenure categories of: owned outright, owned with a mortgage, rented, other tenure type, and tenure not stated. As the results of this research were not dependent on whether a property was owned outright, or whether a mortgage still existed, these two categories were combined and considered as one category of ‘owner’. Three tenure categories still remained: rented, other tenure type, and tenure not stated. As other tenure type and tenure not stated were not descriptive categories and would not offer much insight into how specific tenures influenced the management of risks to land they were disregarded. The category of rented (lessee) was included within the research as a second primary tenure type.

<table>
<thead>
<tr>
<th>Stakeholders</th>
<th>New South Wales</th>
<th>Victoria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Citizen</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>37</td>
<td>45</td>
</tr>
<tr>
<td>Owner</td>
<td>20</td>
<td>22</td>
</tr>
<tr>
<td>Lessee</td>
<td>17</td>
<td>23</td>
</tr>
<tr>
<td>Local Government</td>
<td>7</td>
<td>10</td>
</tr>
</tbody>
</table>

The second data collection technique utilised was a semi-structured interview. This technique was utilised to collect data from staff within local government agencies from both New South Wales and Victoria who had a role within the area of risk management, emergency management or disaster management. The interviews were structured around the broad topics of information planning, obtaining the information, storing and sharing the information, maintaining the information, applying the information, and disposing of the information. These topics were based on the information lifecycle (Bernard 2007). Overall, eight local governments participated in the interview component. A list of the general questions used within the interviews is contained in Appendix 6, and a summary of the interviews is given in Appendix 7.

The results of both the citizens and local governments questionnaire, and the interviews carried out with local government were brought together to create an overall view of the risk management environment within Australia. Data collected from each group was analysed and applied back to the risk management model as illustrated in the research design. The results reflect the findings from the two different stakeholders of citizens and local governments. The case study reporting and analysis is presented in detail in Chapter 6.

4.5.4 Phase 4 – Integration, model development and validation

After the completion of the state government land administration agency questionnaire and the risk management stakeholders case study the results from each component were brought
together to reach the meta-inference using the convergence model as a framework for integrating data. This process requires the two theories – land administration theory and risk management theory and the two theoretical models used throughout the study - the RRR toolbox and the ISO risk management framework to be merged. Details of this method were discussed in the previous section 4.3.5. Based on these results the land risk management model which describes how land administration systems can be integrated into the risk management process to support societal risk management was developed.

The results from the land administration questionnaire enabled an understanding of the capacities, motivations, information availability and role of each state operated land administration agency, while the risk stakeholder’s case study allowed for an overall understanding of the goals, current processes, and perceived and real roles, requirements and attitudes towards managing risk which affects land and property from the perspective of both citizens and local governments. The overall meta-inference which emerged from these two understandings facilitated a comprehension of all factors relevant to the problem and supported the development of the model for land administration supported risk management.

The convergence of the two results as described in section 4.3.5 and illustrated in figure 4.7 below merges the results of the two investigations to inform the development of the final model. The advantage of this mixed methods approach is that the results of one investigation can be used to validate the data from the alternate investigation – a self testing process.

![Figure 4.7 Internal and external validity of the mixed methods approach](image)

Through the comparison of both investigations, differences and similarities were able to be identified. The convergence of the two results enhances the external validity of the research outcomes. The final stage of the validation process was to assess the land risk management model developed. To carry out this assessment the model was implemented as a prototype...
system which reflects a real world application of the developed model. The prototype was
designed from elements of the model and demonstrates how the conceptual model can be
realised as a tool for risk management stakeholders. The assessment focused on positive
contribution of this prototype, and thus the model - which acts as a framework for the
prototype.

4.6 Ethical considerations
The research was undertaken in both an organisational and individual context, however views
expressed by interviewees and participants of either the land administration or risk
questionnaire were in many cases personal options or perspectives. Appropriate ethical
approval to conduct the human research was gained through the University Ethics Committee
and the individual government agencies were contacted at an early stage to seek their support
and approval. The information from the case study and questionnaires remained confidential
and was utilised for research purposes only.

Before the questionnaire to the land administration agencies took place, consent and
agreement from the ANZLIC - the spatial information body who has a representative from
each state or territory was granted. An explanation of the project, the process and what was
expected of the respondents was given.

In the case of the risk management component where questionnaires were given to
individuals to fill out and interviews took place, plain language statements were given to each
questionnaire respondent and interviewee beforehand, and a consent form was given and
returned signed before anything further took place. In cases where online questionnaires were
used the information was provided online and participants were required to agree to
participate before being allowed to access the questionnaire.

Collected data was held in a secure environment during and after the collection period.
Participants were informed of this process and consented to this action. Where individual
comments were recorded in the data collection, they have not been directly attributed to any
individuals to ensure privacy.

4.7 Chapter summary
This chapter presented the methodological framework for this research and outlines and
justifies each component. The research context provided by chapters 2 and 3 has been
reviewed and the research questions clarified. Both quantitative and qualitative approaches
were examined in order to answer the identified research questions and hypothesis. A mixed
methods multi-strand design was adopted and justified as being an appropriate strategy for the research on Australian land administration agencies, and the risk management characteristics of different stakeholders within Australia.

The quantitative analysis of land administration agencies within Australian jurisdictions enabled an understanding of common practices and issues present within the sector. The case study of New South Wales and Victoria provided an in depth understanding of how each different stakeholder implemented risk management processes for managing land and property and issues which arose during this activity. The results of both investigations are reported in detail in chapters 5 and 6. The development of the land risk management model through the integration of both the quantitative and qualitative data sources is later described in chapter 7.
Chapter 5 – An investigation into Australian land administration systems
5.1 Introduction

The results of the Australia case study are presented over two chapters. This chapter presents the results of the quantitative study into the land administration systems in each jurisdiction in Australia, while Chapter 6 details the findings of the qualitative case study element which focuses on risk management activities by stakeholders at the citizen and local government levels.

The overall objective of this thesis is to understand how the risk management processes of stakeholders such as governments, the private sector, and citizens could be improved by better incorporating land administration systems. This chapter addresses the current processes used to manage information about land by investigating each land administration agency within Australia in depth. An understanding of these organisations through the application of the RRRs toolbox which outlines a range of principles identifying best practice for the management or RRRs is used to determine the ability of each agency to contribute to the processes of societal risk management. From these findings, the legal, policy, institutional and technical characteristics of land administration agencies which are managing RRRs well are determined. These findings are then used to address the research question – are land administration agencies motivated by the notion of risk management.

The primary form of data collection used was a quantitative questionnaire. The questionnaire was distributed online to all jurisdictions where the most appropriate people or person from the organisation participated in the questionnaire. Of the eight jurisdictions within Australia that the questionnaire was sent to, all jurisdictions responded with a completed questionnaire.

This chapter is structured in three parts and presents the results of the analysis of the quantitative questionnaire to state land administration agencies. In the first part of the chapter the findings from key questions in the questionnaire are presented with the results and discussed. Principles from the RRRs toolbox are also applied in this section. The second part of the chapter examines the results of the application of the RRRs toolbox to determine characteristics of jurisdictions which are managing RRRs well. The final section of the chapter looks at the four settings of policy, legal, institutional and technical from the perspective of risk within the overarching RRRs viewpoint to address the research questions.

5.2 Results of the Australian LAS study

5.2.1 Background

The questionnaire developed for state government land administration systems was conducted within each Australian and New Zealand jurisdiction. As the questionnaire was
administered as a component of an overarching Australian and New Zealand Land Information Council (ANZLIC) project the country of New Zealand was included in the data collection, however for the analysis within this thesis the data from New Zealand was excluded as it was outside of the scope of the project. The questionnaire (see appendix 2) was arranged into seven sections and included questions on each jurisdictions organisation. Table 5.1 summarises the structure of the land administration systems questionnaire.

<table>
<thead>
<tr>
<th>LAS questionnaire component</th>
<th>Topics covered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section 1: Your jurisdictions RRR policies and legislation</td>
<td>Legislation support for RRRs, RRRs publication, recording protocols</td>
</tr>
<tr>
<td>Section 2: Your organisation</td>
<td>Internal and external relationships, business models, agency roles, progress in publication</td>
</tr>
<tr>
<td>Section 3: Managing your RRRs</td>
<td>RRRs on title, definitions, classifications, descriptions, recording protocol, custodians</td>
</tr>
<tr>
<td>Section 4: Sharing and providing access to RRRs</td>
<td>Public accessibility, access controls, pricing allocation, inquiry charges, key stakeholders, users</td>
</tr>
<tr>
<td>Section 5: Your platforms and systems</td>
<td>Technical systems, system features, integration opportunities</td>
</tr>
<tr>
<td>Section 6: Spatially enabling RRRs</td>
<td>Geocoding, standardisation, agency relationships</td>
</tr>
<tr>
<td>Section 7: Miscellaneous</td>
<td>Management issues and problems, policy changes, formal arrangements</td>
</tr>
</tbody>
</table>

The results in this chapter are structured around these seven sections, and the RRRs toolbox (Bennett 2007) is used as the framework for assessment for the results of the questionnaire. The components of the RRR toolbox which relate to specific questions within the questionnaire will be identified and discussed throughout the results section, and summarised at the end. Based on the findings from the assessment, how aligned each jurisdiction is with principles from the RRRs toolbox will be revealed. This will enable the characteristics of jurisdictions most successful at managing RRRs to be determined to assist in formulating traits required for successful management of risks - an extended component of the RRRs concept. A response to the questionnaire was received from each jurisdiction giving an overall response rate of 100%, although responses to each question varied. The results from the analysis are provided below.

5.2.2 Section 1: RRRs policies and legislation

Section 1 of the questionnaire examined the policies and legislation relating to RRRs within each jurisdiction including legislation which supports RRRs, the publication of RRRs, and recording protocols for RRRs. The findings from this section of the questionnaire can offer significant insight into the motivations for agencies to be involved in risk management. The
results are further broken down into the four sub sections of supportive framework, legislation, information availability, and recording process.

**Supportive Framework**

The recording of RRR information varies from jurisdiction to jurisdiction. Each jurisdiction has a process for recording the management of RRRs which developed over time and independently of the other states and territories. Of the eight jurisdictions, only three jurisdictions have in place an overarching framework for recording the management of RRRs: ACT, NSW and SA. Policy principle four of the RRRs toolbox conveys the importance of having an overarching policy framework in place. The principle advocates government collaboration across and between jurisdictions and states that land policies must reflect the whole-of-government nature of land administration.

Of the jurisdictions which have implemented a guiding policy or framework, the states of SA and NSW have overarching policies in place to upgrade their systems, and the state of VIC has an overarching vision to implement a framework. Within their visions to upgrade their systems or to develop a policy to implement a framework, the states of VIC and NSW have included local governments as a component to be considered and factored into the vision. This inclusion is essential, as described in policy principle five of the RRRs toolbox, as local governments have a presence at the local ‘on ground’ level and can play a monitoring role in the implementation of RRR policy.

**Information availability**

The availability of information is an issue which has received attention in all jurisdictions in Australia. Who can access the information, what information they can access, and whether there is a fee involved are all topics gaining interest. To determine the current status of this, the presence of legislation demanding that RRRs information be made publicly available in each jurisdiction was explored. From this study it was found that three of the jurisdictions have requirements embedded in legislation demanding RRRs information to be made publicly available, while the remaining five jurisdictions have no formal arrangements.
Legal principle three from the toolbox is focused directly on this issue. It discusses the role of government in the creation of legislation for RRRs and states that government accountability must be embedded into legislation. Additionally, this principle advocates the implementation of legislation by government to allow for these RRRs to be publicly discoverable.

**Recording process**

When RRRs are created in legislation, how the RRR is to be recorded is not always detailed. As outlined in legal principle four of the RRRs toolbox, the inclusion of specific details such as spatial extent, duration and people impacted is important for the organisation and integration of information which has a number of benefits within the jurisdiction and also between jurisdictions. Requirements for attributes such as a RRRs spatial extent, duration, and people to be defined within legislation are present within the Australian Capital Territory only. None of the other seven jurisdictions have such a requirement within their legislation. The result is that the possibility for integration of information across jurisdictions is not currently easily achievable.

Another problem inherently associated with recording RRR information is the amount of legislation that exists. To assist in the management of RRR and legislation creation the RRRs toolbox presents a number of approaches. Firstly, legal principle seven suggests that trouble cases must not be used to develop reactionary legislation. RRRs created through legislation in response to publicised problems are often band-aid solutions that are not intended for long term implementation. Different approaches to dealing with these problems are required. Secondly, legal principle eight states that education should be used over legislation – namely that the option of education should be tried before legislation is created. The principle affirms that legislation is not always the most effective way to communicate information to people who have a relationship with the land; often education is an effective means.

**Figure 5.1 Jurisdictions with legislation for RRR information availability**

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACT</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>NSW</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>NT</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>QLD</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>SA</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>TAS</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>VIC</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>WA</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>
5.2.3 Section 2: The organisation

Section 2 of the questionnaire examined the internal and external relationships of the organisation. It queried the business model utilised, the role of the agency, and the progress of the agency regarding the publication of RRRs.

Internal and external relationships

To get a comprehensive understanding of the nature of each organisation the internal and external relationships of each jurisdiction were examined. Firstly, the relationship between the organisation and the Valuer General, Surveyor General and Registrar General was looked at to determine whether the relationship exists, and if it does is it an internal or external relationship. Table 5.2 shows each land administration agency and the type of relationship which exists between the Valuer General, Surveyor General, and the Registrar General.

<table>
<thead>
<tr>
<th>Jurisdictional LA agency</th>
<th>Relationship with Valuer General (or equivalent)</th>
<th>Relationship with Surveyor General (or equivalent)</th>
<th>Relationship with Registrar General (or equivalent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACT</td>
<td>N/A</td>
<td>Yes - external</td>
<td>Yes - internal</td>
</tr>
<tr>
<td>NSW</td>
<td>Yes – internal</td>
<td>Yes - internal</td>
<td>Yes - internal</td>
</tr>
<tr>
<td>NT</td>
<td>Yes – internal</td>
<td>Yes - internal</td>
<td>Yes - external</td>
</tr>
<tr>
<td>QLD</td>
<td>Yes - internal</td>
<td>N/A</td>
<td>Yes - internal</td>
</tr>
<tr>
<td>SA</td>
<td>Yes - internal</td>
<td>Yes - internal</td>
<td>Yes - internal</td>
</tr>
<tr>
<td>TAS</td>
<td>Yes - internal</td>
<td>Yes - internal</td>
<td>Yes - internal</td>
</tr>
<tr>
<td>VIC</td>
<td>Yes - internal</td>
<td>Yes - internal</td>
<td>Yes - internal</td>
</tr>
<tr>
<td>WA</td>
<td>Yes - internal</td>
<td>Yes - internal</td>
<td>Yes - internal</td>
</tr>
</tbody>
</table>

The table reveals that the majority of jurisdictions have an internal relationship with the Valuer General, Surveyor General and the Registrar General. Within the jurisdiction of ACT there are two main variations from the other jurisdictions displayed. Firstly, the role of the Valuer General is not present within this jurisdiction, and secondly, the role of the Surveyor General is within an external department. The other two variations of the table occur within the jurisdictions of Northern Territory, where the Registrar General is located in another department (Department of Justice), and in Queensland – which does not have a Surveyor General role within government. Institutional principle four of the RRRs toolbox addresses these differences stating that the organisation of government should be determined based on the land activities themselves, and not the institutions. The principle highlights that the organisation of institutions being based around the core land activities of citizens, and not around a jurisdictions own administrative needs is important.
Secondly, to get an understanding of the nature of each organisation and reveal some motivations behind the organisational arrangements the primary business model of each agency and their funding arrangements were examined. The results are summarised in table 5.3.

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>Business model</th>
<th>Funded by</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACT</td>
<td>Government department</td>
<td>Internally funded (Budget)</td>
</tr>
<tr>
<td>NSW</td>
<td>Government business enterprise</td>
<td>Internally funded (Budget)</td>
</tr>
<tr>
<td>NT</td>
<td>Government department</td>
<td>Internally funded (Budget)</td>
</tr>
<tr>
<td>QLD</td>
<td>Government department</td>
<td>Treasury</td>
</tr>
<tr>
<td>SA</td>
<td>Government department</td>
<td>-</td>
</tr>
<tr>
<td>TAS</td>
<td>Government department</td>
<td>Consolidated funding</td>
</tr>
<tr>
<td>VIC</td>
<td>Government department</td>
<td>Revenue retention</td>
</tr>
<tr>
<td>WA</td>
<td>Statutory authority</td>
<td>Revenue and consolidated funding</td>
</tr>
</tbody>
</table>

The table reveals the different arrangements of each jurisdiction. While the majority of jurisdictions follow the government department business model – with the exceptions of WA and NSW, a range of different funding arrangements exist within the jurisdictions. The three jurisdictions of ACT, NSW, and NT receive funding based on budget assignment, while QLD follows a treasury funded model. TAS receives consolidated funding, and VIC has a revenue retention model, while WA is funded on a combination of both revenue and consolidated funding.

**RRRs integration and management**

The integration of RRRs is a task which requires an agency to take the lead and manage the overall process. Within the jurisdictions, the ability to be the lead agency in this role will vary depending on a range of factors such as staff numbers and capabilities, funding opportunities, and technology and equipment capacity. A contrast between responses received from jurisdictions regarding the question of whether they would be the lead agency was observed. The jurisdictions of NSW, SA, TAS, VIC and WA all responded that their agency would act as the lead agency who would (or currently is) coordinating the integration of publication of RRRs information. The jurisdiction of NT responded that their agency would not be the lead agency, and that there was currently no one appointed to lead the coordination. The jurisdictions of ACT and QLD responded that the lead agency was unknown. These differing responses reflect the different progress levels within each jurisdiction, as some jurisdictions are well into the journey of integration of publication of RRRs information, while some jurisdictions have not begun yet, and may not begin for some time. Institutional principle one provides some guidance, suggesting that in order for a successful outcome in this area,
leadership in the form of a single information coordination body is required. This principle supports jurisdictions which have already, or plan to move towards, appointing a lead agency to manage the task of integrating RRR information.

Subsequent to this topic, another issue within this area is the decision regarding whether a land administration agency should or should not aggregate the management of existing RRRs information within a single department or agency. Within Australia currently, the jurisdictions of ACT, NSW, QLD and SA all have plans to carry out aggregation, while the jurisdictions of NT, TAS, VIC and WA have indicated that this is not a priority or a task to be undertaken in the near future. A recommendation from the institutional principle two of the toolbox sheds some light on this issue. This principle advocates a decentralised but collaborative environment. The toolbox advises that aggregation of this information into a single department or agency would create a range of problems, and best practice is to create partnerships and utilise technology to bring together the information.

5.2.4 Section 3: The management of RRRs

Section 3 of the questionnaire investigated what RRRs are on title, how and if the information is shared, and the pricing of the information. How the RRRs are described and recorded and who the custodians of the RRR information are was also included in this section. The issues regarding the management of these land interests, such as pricing, can identify a range of factors which contribute to an agencies motivation to become involved in risk management.

Information ownership and sharing

Within a government, a range of departments are involved in the management of land and land interests. Primarily it is a land department maintaining the information on title; however for non title information a range of different departments can be responsible. As the agency responsible for maintaining the registry and cadastre, land administration agencies hold the tools which could assist in the publication of non title information. Whether land administration agencies are actively seeking to use these tools to publish other RRRs information (non-title) information was queried. It was found that there was an even split between jurisdictions, with four of the jurisdictions moving in this direction – seeking to use the registry and cadastre to publish this non title information, while the remaining four jurisdictions indicated that they were not yet at this stage. Figure 5.2 shows which jurisdictions are active in this area, and the jurisdictions which are not (yet) going down this path.
Custodianship

The land tenure component and cadastral and registration component of the RRRs toolbox explores this issue. Firstly, land tenure principle three discusses flexible administration for flexible tenure models. The principle states that not all interests need to be included in the land registry. If security of the RRR is required then it should be included in the register, however if security is not required then inclusion in the registry is not necessary. Cadastral and registration principle two of the RRRs toolbox expands on this issue. It explains how cadastral and registration systems should focus on traditional RRRs, which require security. RRRs which do not require the security of a guaranteed do not need to be included in the land registry.

Custodianship

Within the Australian jurisdictions, non title land information has a range of custodians. As non title information can originate from a range of different activities, the information is kept within the department which created and uses the information. This is the policy followed by all jurisdictions. The identification of custodians in this situation is through legislation. Institutional principle three of the RRRs toolbox outlines the approach taken by all jurisdictions in relation to the decentralised management of RRRs information as best practice. As proposed by the RRRs toolbox, departments who create the information and use the information within their business processes should be assigned as the custodians of that information.

Consistency within jurisdictions

Intra-jurisdictional consistency aims to create uniformity. For RRRs this means agreeing upon a language to describe each RRR. From the study conducted it was found that two of the jurisdictions have arrangements in place to achieve intra-jurisdictional consistency of basic RRR terms and descriptions for example, location, people, time, activity. For NSW
these arrangements are based on legislation, and for QLD the consistency is based on mechanisms within departments which encourage the improvement of consistency. The remaining jurisdictions – ACT, NT, SA, TAS, VIC and WA currently do not have any arrangements in place. Spatial and ICT principle seven of the RRRs toolbox discusses the need for standards for spatial identifiers, units and access. It states that standards are required in the form of uniform spatial identifiers to allow for integration and efficiency between jurisdictions for applications such as addressing, and descriptions such as location, people, time and activity.

**Pricing**

Pricing is an important business aspect for land administration agencies. Depending on the arrangements within an organisation, an interest inquiry fee can serve as a major source of income for the organisation or simply as a service recovery aspect. For that reason, the pricing between jurisdictions is expected to vary based on their funding and business arrangements. Table 5.4 displays the fee charged in each jurisdiction for an interest inquiry.

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>ACT</th>
<th>NSW</th>
<th>NT</th>
<th>QLD</th>
<th>SA</th>
<th>TAS</th>
<th>VIC</th>
<th>WA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fee</td>
<td>$21</td>
<td>Varies</td>
<td>$15</td>
<td>Varies</td>
<td>$250</td>
<td>Free</td>
<td>$2.50</td>
<td>$24</td>
</tr>
</tbody>
</table>

The table reveals that all jurisdictions except TAS charge a fee for interest inquiries. Of the jurisdictions which have appointed a fee, the price for an inquiry ranges from $2.50 to $250. The value charged by SA is much greater than any fee charged in the other jurisdictions. The price of a property interest report in SA is based on a regulated price and acts as a major source for revenue, creating over $12 million dollars for the government per year.

**Intra-jurisdictional influences**

A range of issues have been identified which can influence the management of RRRs within a jurisdiction. These issues vary from the sharing and currency of data to the importance of consumer protection and social inclusion. In order to understand these influences, each jurisdiction was asked to rate the current impact of a range of different issues within their jurisdiction. A score of 1 refers to a low influence, while a score of high equals a high influence. The results are displayed in figure 5.3, figure 5.4 and figure 5.5.
Figure 5.3 Influences on intra-jurisdictional management of RRRs

Figure 5.4 Influences on intra-jurisdictional management of RRRs

Figure 5.5 Influences on intra-jurisdictional management of RRRs
From the three figures presented above, the top three influential factors for the management of RRRs can be identified:

1. **Currency of data.** This factor was rated the highest from all of the jurisdictions. All jurisdictions indicated that the influence of this factor was high, except for NT which indicated a low influence within their jurisdiction.

2. **Emergency services need for accuracy.** This factor received a score of four or five (indicating high influences for the management of RRRs) from all jurisdictions except for SA, which rated the influence as low.

3. **Sharing of data.** This factor was rated as highly influential for all jurisdictions except SA and VIC, who indicated that within their jurisdiction the influence is low.

The three factors which were rated by the jurisdictions as least influential can also be identified:

1. **Social inclusion.** ACT and NSW indicated a moderate influence, while SA indicated no influence at all. The remaining jurisdictions rated the factor as having very low influence.

2. **Privatisation of processes.** Overall, this factor was deemed a low influence by the jurisdictions. The majority indicated a low influence: ACT, NT, TAS, VIC, WA, however, NSW responded that this was a moderate influence and SA indicated a high influence from this factor.

3. **COAG harmonisation process.** Jurisdictions were divided on this factor, with three jurisdictions (ACT, NSW, WA) indicating a high or medium influence, and the remaining jurisdictions (NT, SA, TAS, VIC) indicating no influence or a very low influence.

Overall, the influence of each different factor on the management of RRRs from the perspective of each jurisdiction differed quite substantially. The population size, business model and political priorities of each jurisdiction are relevant factors.

The jurisdictions were next asked to rate on a scale of 1 to 5 (1=low, 5=high) the level of influence they believe registration policy and practice will have on each listed factor in the next decade. Table 5.5 displays the results.
### Table 5.5 Initiatives and their influence on registration policy and practice

<table>
<thead>
<tr>
<th>Estimate of impact</th>
<th>ACT</th>
<th>NSW</th>
<th>NT</th>
<th>SA</th>
<th>TAS</th>
<th>VIC</th>
<th>WA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growth of national land information data set, eg under climate control and emissions legislation</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Increased use of GIS</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Increased accuracy in GIS</td>
<td>1</td>
<td>5</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Spatial enablement</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Innovation in the web environment: crowdsourcing, the cloud</td>
<td>3</td>
<td>5</td>
<td>2</td>
<td>5</td>
<td>1</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Increased demand for accurate land information for public safety, emergency management and disaster prediction and response</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Increased demand for accurate transaction information</td>
<td>5</td>
<td>5</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Location intelligence policies</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Tax equity (eg GST on commercial land, CGT on non residential land, agricultural tax concessions)</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Private sector services in GIS and land IT services</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Land information agencies’ need for timely and accurate information about parcels and owners</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>National electronic Conveyancing</td>
<td>3</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>5</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Information streams and data generated from national electronic conveyancing</td>
<td>3</td>
<td>5</td>
<td>1</td>
<td>4</td>
<td>5</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Visualisation of land and buildings</td>
<td>2</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Development of a 3D cadastre</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Increasing penetration of registration services in marine areas</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Identification of building footprints in survey information accompanying applications for survey registration</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Survey accurate cadastre</td>
<td>2</td>
<td>5</td>
<td>2</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Electronic lodgement of survey plans</td>
<td>1</td>
<td>5</td>
<td>2</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Development of extensive national datasets of land and building information</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Non-parcel inquiries (eg noise limitations)</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Assistance for management of owners corporations</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>5</td>
</tr>
</tbody>
</table>

The results reveal the four most influential and four least influential factors on registration and policy. The four most influential include:

1. Increased demand for accurate land information for public safety, emergency management and disaster prediction and responses.
2. Land information agencies’ need for timely and accurate information about parcels and owners
3. Spatial enablement
4. Survey accurate cadastre

The four factors which were rated as having the least impact are:

1. Tax equity (e.g. GST on commercial land, CGT on non-residential land, agricultural tax concessions)
2. Private sector services in GIS and land IT services
3. Non-parcel inquiries (for example, noise limitations)

What the results also reflect is the degree to which jurisdictions feel influenced by these factors overall. The jurisdiction of NSW returned results which showed that they were influenced in a moderate to high degree by all factors, assigning ratings of 3, 4 and 5 to all factors, while the jurisdiction of VIC showed little influence by all factors assigning ratings between 1 and 3 for all factors (with the exception of one rating of 4, which they assigned to national e-conveyancing). All other jurisdictions assigned ratings ranging from the low value of 1 to the high value of 5. These factors help to address the research question and identify how land administration agencies are motivated by risk management. The jurisdiction of QLD was excluded in the results as no response was received. The next section of the results looks into the sharing and access of RRRs within each jurisdiction.

5.2.5 Section 4: RRR sharing and access

Section 4 of the questionnaire investigated public accessibility, access controls, pricing allocation, inquiry charges, and key stakeholders and users of the data.

Access rights

How stakeholders and the general public in particular access RRRs information from the land registries within each jurisdiction is an important aspect to address. The spatial and ICT principle four of the RRRs toolbox below outlines best practice for management of RRRs. It indicates that information provided online for stakeholder access is what organisations should be striving for. It states that land interest information and transactions should be online and affordable, to enable availability of information for citizens. HR and capacity building principle one further adds to this topic, encouraging land administration agencies to design tools around citizen needs in order to improve accessibility.

To further explore this issue, whether there are any datasets subject to access controls within that specific jurisdiction was queried (table 5.6). The presence of access controls, the data
which the controls apply to, how the control is implemented, and why the control is put in place is described.

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>Access controls</th>
<th>Data Description</th>
<th>How</th>
<th>Why</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACT</td>
<td>Yes</td>
<td>Properties with a name suppression lodged against it</td>
<td>Search function removed and access restricted to approved users</td>
<td>Protection of individuals</td>
</tr>
<tr>
<td>NSW</td>
<td>Yes</td>
<td>Central Register of Restriction (CRR) data</td>
<td>Access restricted to approved users</td>
<td>Security reasons</td>
</tr>
<tr>
<td>NT</td>
<td>Yes</td>
<td>All data</td>
<td>By custodian agency's business processes</td>
<td>To control access to approved users</td>
</tr>
<tr>
<td>QLD</td>
<td>Yes</td>
<td>Datasets with RRRs Licence agreement</td>
<td>Licence agreement</td>
<td>To control access to approved users</td>
</tr>
<tr>
<td>SA</td>
<td>No</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>TAS</td>
<td>Yes</td>
<td>Threatened species datasets</td>
<td>Displayed as a polygon</td>
<td>To avoid potential misuse</td>
</tr>
<tr>
<td>VIC</td>
<td>Yes</td>
<td>Name index to title register, and; Property sales value</td>
<td>Must sign deed of use to access; data restricted to valuers and real estate agents</td>
<td>Privacy act; land tax act</td>
</tr>
<tr>
<td>WA</td>
<td>Yes</td>
<td>Interest Enquiry</td>
<td>Restricted to Landgate account holders</td>
<td>To control access to approved users; to meet agreement terms made with custodian agencies</td>
</tr>
</tbody>
</table>

The table shows that all jurisdictions except for SA have a control in place to restrict access to some or all data. The majority of the jurisdictions make use of login or account holder details to restrict certain users. Other jurisdictions such as ACT restrict users by removing the ability to search for certain data, or by altering the data so that the general public cannot view certain details within the data, such as TAS. Reasons for creating the restrictions are to control access, protect individuals and to avoid potential misuse. Another restriction method, not mentioned here by the jurisdictions is pricing. The cost associated with accessing this information can limit the ability of stakeholder to view the data. The cost of accessing this information and how the prices are set are addressed in the following discussion – access fees.

**Access fees**

Each jurisdiction approaches the topic of pricing data using their own method. The culture of the organisation, as well as the custodial arrangements can impact on data pricing. Within
ACT the price for data is set by the Registrar General. This contrasts with the methods used within NT, QLD, TAS and WA. These jurisdictions have a regulated fee which determines the prices they apply to their data. The jurisdiction of SA follows historical pricing to determine fees for the data, while NSW allows the custodians of the data to determine the most appropriate fee for each data, and VIC follow a cost recovery strategy. Figure 5.6 summarises the pricing methods used within each jurisdiction.

![Jurisdictional Pricing Determinants](image)

**Figure 5.6 Jurisdictional pricing methods**

As the methods for determining fees vary, so do the fees associated with accessing data in each jurisdiction. To understand the pricing differences within each jurisdiction the highest and lowest fees charged for data were sought out and graphed. Figure 5.7 displays the results.

![Lowest and Highest RRR search fees](image)

**Figure 5.7 Search fees for RRRs**
The divergence in pricing between jurisdictions is highlighted in the graph. The lowest value fee charged for searching RRRs data within a jurisdiction are all similarly priced – ranging from free for access to $15. A difference is noted within the highest fee charged where the fees range from $15 to $250 between jurisdictions. The highest fees set by SA, VIC, and NSW for $250, $150, and $100 respectively all follow non regulated pricing methods. SA uses historical data to determine fee pricing, VIC sets fees for cost recovery and NSW allows for custodians to determine prices. The methods for determining a fee, and users and stakeholders of the data are factors which can influence pricing decisions.

**User experience**

In order to understand the needs of the users and the experience of users in terms of accessing and using the data, key user groups must be identified. Nine key stakeholders groups have been recognised by the jurisdictional land administration agencies as users of RRR data. The list includes:

- Federal Government
- State/Territory Governments (and Departments within)
- Local Governments
- General public
- Financial sector
- Legal sector, including conveyancers
- Surveyors
- Real estate agents
- Community groups

How each jurisdiction manages the expectations and requirements of these stakeholders in terms of accessing and using the data was of interest. To investigate this, the six features of RRR access, search type, report generation, report type, report format, and generalisation of interests were characterised by each jurisdiction based on the user experience in relation to accessing RRRs from their organisation. Table 5.7 summarises the results.
Table 5.7 The user experience within each jurisdiction

<table>
<thead>
<tr>
<th>RRR access</th>
<th>ACT</th>
<th>NSW</th>
<th>NT</th>
<th>QLD</th>
<th>SA</th>
<th>TAS</th>
<th>VIC</th>
<th>WA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onsite</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Online</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Search type</th>
<th>ACT</th>
<th>NSW</th>
<th>NT</th>
<th>QLD</th>
<th>SA</th>
<th>TAS</th>
<th>VIC</th>
<th>WA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Map or spatial based</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td>No response</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Text</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Report generation</th>
<th>ACT</th>
<th>NSW</th>
<th>NT</th>
<th>QLD</th>
<th>SA</th>
<th>TAS</th>
<th>VIC</th>
<th>WA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Delayed or posted</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Report type</th>
<th>ACT</th>
<th>NSW</th>
<th>NT</th>
<th>QLD</th>
<th>SA</th>
<th>TAS</th>
<th>VIC</th>
<th>WA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authoritative</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Flagging</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Report format</th>
<th>ACT</th>
<th>NSW</th>
<th>NT</th>
<th>QLD</th>
<th>SA</th>
<th>TAS</th>
<th>VIC</th>
<th>WA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardcopy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PDF</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Online webpage</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Representation of interests</th>
<th>ACT</th>
<th>NSW</th>
<th>NT</th>
<th>QLD</th>
<th>SA</th>
<th>TAS</th>
<th>VIC</th>
<th>WA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spatial</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Textual</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

Based on the results, it can be observed that all of the jurisdictions (excluding SA) offer access to RRR data online. This is an important aspect to examine as it widens the audience which can access the information. The geographic location of the person seeking information is not a factor affecting the access of this information. Providing access to this information online is also outlined in the RRRs toolbox under spatial and ICT tools; principle four, which states that access to RRR information should be online.

For the majority of jurisdictions both map and spatial based searching and text searching are options, excluding NSW which has only a text based search. Once the data sought is identified and selected, a user can request a report of the information. An immediate report is available from NSW, NT and SA, while TAS and WA offer delayed or posted reports. The jurisdictions of QLD and VIC offer the option of either an immediate report or a delayed or posted report as a choice for the user. The report type requested can be either authoritative or flagging or both depending on what jurisdiction the request is made from. The jurisdictions of NSW, NT, QLD, VIC and WA offer either an authoritative or flagging report, while TAS offers a flagging report type only.

The report format offered ranges from jurisdiction to and is generally one of three options: hardcopy format, PDF format, or online webpage format. The jurisdictions of ACT, NSW, NT, QLD and VIC all offer the format of an online webpage. QLD, SA, VIC and WA offer a PDF format, and QLD and TAS offer a hardcopy version. QLD is the only jurisdiction which offers all formats, and VIC the only other jurisdiction which has more than one option.
From the data accessed, the jurisdictions have two options for representing the interests; either spatially or textually. NSW, NT and VIC offer a textual representation, WA offers spatial representation, and ACT, QLD, and TAS offer both textual and spatial representations.

Overall, each jurisdiction offers a range of different options which enable a stakeholder, from any group, to access information regarding RRRs. The jurisdiction of QLD is the most flexible, offering all information features.

**Search capabilities**

The issue of how a user searches the RRRs data was touched on in the previous section where the jurisdictions indicated whether the system was capable of a map or spatial based search or a text based search. This topic is now investigated in more depth. Table 5.8 shows the attributes that can be searched on within each jurisdiction.

<table>
<thead>
<tr>
<th></th>
<th>ACT</th>
<th>NSW</th>
<th>NT</th>
<th>QLD</th>
<th>SA</th>
<th>TAS</th>
<th>VIC</th>
<th>WA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parcel IDs</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Address</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Spatial Location</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>RRR Type</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Person</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Time</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Theme</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combinations of above</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

The majority of jurisdictions have the capability to search using the attribute of parcel IDs. The jurisdiction of ACT did not specifically identify this attribute, but it is likely that a search could be conducted using parcel ID as a parcel ID is a traditional identifier assigned to the majority of RRRs, specifically parcel based, above the line RRRs. As all jurisdictions have RRRs which fit this description within their registry it is no surprise that this is the most common attribute to be searched. The next available attribute to conduct a search with is address – NT, QLD, TAS, VIC and WA systems are all capable of find data based on this input. Other attributes supported include spatial location in the jurisdictions of TAS and WA, RRR type in the jurisdictions of NSW and VIC, and by person in VIC. Within the investigation conducted, it was found that no jurisdiction had the capability to search based on time or theme. Based on the recommendation of the RRRs Toolbox spatial and ICT principle two, jurisdictions should move towards recording the location, time and place
attributes of an RRR to enable improved RRRs management. Currently, the search functionality within some jurisdictions is limited due to the restricted attributes available for searching. The technical systems of each jurisdiction will now be explored as section 5 of the questionnaire is examined.

5.2.6 Section 5: Organisational technical systems

Section 5 of the questionnaire explored the technical systems used to manage RRRs and focused on the architecture of the systems, key features of the systems, and the ability of the systems to integrate with other agencies.

System technology

To understand the systems used in each jurisdiction the underlying technologies which were used to develop each system were investigated. Table 5.9 summarises the findings.

<table>
<thead>
<tr>
<th>State</th>
<th>Database</th>
<th>Web Delivery</th>
<th>Other technologies used</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACT</td>
<td>Oracle</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>NSW</td>
<td>Oracle, Informix</td>
<td>Java, XML</td>
<td>Mapserver, Google Earth Enterprise, ESRI, ERDAS, MapInfo, Bentley</td>
</tr>
<tr>
<td>NT</td>
<td>Oracle</td>
<td>Java, XML</td>
<td>Mapserver, Google Earth Enterprise, ESRI, ERDAS, MapInfo, Bentley</td>
</tr>
<tr>
<td>QLD</td>
<td>Ingres</td>
<td>Weblogic</td>
<td>VB, OCR engines</td>
</tr>
<tr>
<td>SA</td>
<td>Oracle</td>
<td>Java</td>
<td></td>
</tr>
<tr>
<td>TAS</td>
<td>Oracle, ArcSDE</td>
<td>ArcIMS, Java, Tomcat</td>
<td>ArcGIS, ArcObjects</td>
</tr>
<tr>
<td>WA</td>
<td>Oracle</td>
<td>Java Swing</td>
<td>Delphi, ESRI, MapObjects</td>
</tr>
</tbody>
</table>

The table shows that the database technology of Oracle was used within all jurisdictions except QLD, which used the technology of Ingres. The jurisdiction of VIC was excluded as no response regarding the underlying technology of their system was received. For web delivery, the use of Java was recorded within the jurisdictions of NT, SA, TAS and WA. Other technologies used were a range of different products from ESRI (ArcIMS, ArcGIS, ArcObjects, ArcSDE), and products from other larger companies in the spatial sector such as, Bentley, Pitney Bowes, and Google.

System integration

The systems described above, were then further investigated to determine whether these systems were integrated with other enterprise-wide systems. Specifically, whether these systems were integrated with federal agency systems, systems in other jurisdictions, or local government systems was of interest. Table 5.10 displays the results.
Table 5.10 Integration of RRRs system with systems from other agencies

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>Enterprise</th>
<th>Federal Govt.</th>
<th>Inter-jurisdictional</th>
<th>Local Govt.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACT</td>
<td>Yes</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>NSW</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>NT</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>QLD</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>SA</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>TAS</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>VIC</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Some</td>
</tr>
<tr>
<td>WA</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

The table reveals that systems within five jurisdictions integrate with other enterprise-wide systems. Only one jurisdiction – WA, has integration of their system at any other level. WA has system integration with a federal agency, and with local government.

**System upgrading and expansion**

To gain an understanding of the maintenance routine for each organisation, each jurisdiction was asked to indicate when the previous significant upgrade of their system took place. The jurisdictions of NSW and VIC did not respond, therefore are excluded from the findings. Figure 5.8 illustrates the results.

The figure shows that a significant upgrade has occurred in each jurisdiction within the last ten years. Most recently, NT has upgraded their system (2011). ACT had a last upgrade in 2004, while the remaining jurisdictions, which participated in this question, QLD, TAS, WA, and SA, all upgraded their systems between 2007 and 2009.
Plans for system expansions within the jurisdictions were also queried during the questionnaire process. The jurisdiction of ACT is planning to upgrade their system to Oracle version 11, while NSW plans general ongoing expansion of the system with no specific aims at the moment. NT will base any improvements on custodian requirements, but does not have any overall plans for expansion at this time. The jurisdiction of VIC is also not planning any expansion, and would only adopt plans based on a business case justification. The state of QLD is planning to replace the VB6 system and to adopt the NECS initiatives. In addition, the state of WA is also planning to adopt the NECS initiatives, and to redevelop the current lodgement process within the jurisdiction. SA has plans to implement a web enabled front end for client access to improve the system, and TAS is also planning some significant expansion with plans to develop a numeric cadastre based on ESRI parcel editor. Based on these responses, there are significant expansions and improvements taking place in some jurisdictions, while others, possibly related to progress already achieved, do not have plans to develop the current system.

**Relevant technological initiatives**

Within Australia there are a range of different initiatives taking place in the area of RRR management and management of land information in general. Some of these initiatives are occurring at a federal or national level, and some are occurring at the state level within a specific jurisdiction. To determine which initiatives are useful to jurisdictional land administration agencies, each jurisdiction was asked to rate the usefulness and applicability of each initiative. A score of 1 indicated that the initiative was not applicable to the jurisdiction, and a score of 5 indicated that the initiative was very useful or would be very useful to the jurisdiction. The two jurisdictions of QLD and VIC did not participate in this activity. An overview of each initiative is provided first, followed by a graph illustrating the results (figure 5.9).

- **SLIP (Shared Land Information Platform – WA).** SLIP is a technological infrastructure which facilitates the access of land and geographic information resources by users over the internet. It provides a single point of access for authoritative location information from a range of different departments and agencies within Western Australia.
- **GNAF (Geocoded National Address File – PSMA).** GNAF is an authoritative geocoded address index for all jurisdictions within Australia. It is populated with address information from all jurisdictional land agencies.
- **LIST (Land Information System Tasmania – TAS).** The LIST is a system which delivers integrated land information online. It is a whole of government service
which provides title and property information and spatial information for the state of Tasmania.

- **SIX (Spatial Information eXchange – NSW)**. The SIX system is an online portal which acts as the official source of NSW geospatial information. It provides access to the authoritative land and property information within the state of New South Wales.

- **NECS (National eConveyancing System)**. NECS is an initiative which builds upon the individual efforts of land registries within Australian jurisdictions to deliver a national online facility to service the major conveyancing needs of government and industry across Australia.

- **Spatial Information Services Stack (CSIRO and AuScope)**. The Spatial Information Services Stack is a suite of tools for spatial data interoperability using the OGC standards.

![Figure 5.9 Significance of initiatives for jurisdictions](chart)

**Figure 5.9 Significance of initiatives for jurisdictions**

Based on the overall ratings given by jurisdictions, the two initiatives of GNAF and NECS are the most useful to the jurisdictional organisations for managing land and RRRs. These two initiatives are both national focuses initiatives, aiming to integrate jurisdictional wide data for nationally focused business processes. The initiatives of SLIP, LIST and SIX received moderate ratings from the jurisdictions however it should be noted that in these cases, the jurisdiction from which the initiative came scored the system with a 5 for very useful. This altered the results slightly raising the overall rating and usefulness of the initiative. Emerging principle two of the RRRs toolbox discusses the role of emerging spatial technologies in land interest management. The principle outlines the potential for RRRs information in a range of activities if a spatial attribute was present. It highlights the importance of spatial and information technologies in this process, and thus that jurisdictions should support these technologies which are developing. The next section of the
questionnaire, section 6, focused on spatial enablement. The progress of spatial enablement in each jurisdiction will now be explored.

5.2.7 Section 6: Spatial enablement

Section 6 of the questionnaire explored aspects around whether RRRs information within the jurisdictions is geocoded in some way, whether the information is recorded in a standard way and what the relationship between components of the agency such as the cadastre and the registry is.

Spatial enablement of RRRs

The term spatial enablement refers to the use of location information such as coordinates or addresses to organise information. There are many benefits associated with achieving spatial enablement such as improved response for activities such as emergencies or disasters where specific information related to a location is required in as little time as possible, as well as a range of other activities such as management of large events or planning for development where location information is crucial. With these benefits in mind, the processes used within the jurisdictional land administration agencies are of interest to discover whether the organisations record each RRR in a standard way spatially, thus creating data which can support a spatially enabled society.

Each jurisdiction was queried regarding the way they record each RRR, and returned responses. The jurisdictions of ACT, QLD and WA all gave a positive response that their organisations record each RRR in a standard way spatially. The jurisdictions of NSW, NT and VIC all responded with a no regarding whether they record RRRs in a standard way spatially. The remaining jurisdictions, TAS and SA replied with the answers of partially and N/A respectively. The results are shown in figure 5.10 below.

![Spatial recording of RRRs](image-url)

**Figure 5.10 Spatial recording of RRRs**
Chapter 5: An investigation into Australian land administration systems

From the diagram shown the result – that less than half of the jurisdictions record their information in a standard way spatially can be observed. Best practice, based on land tenure principle two of the RRRs toolbox describes the need for a tool which outlines what information to collect for each land interest, and the specific attributes to be collected to enable integration and spatial enablement of each RRR. The principle explains that a tool for organising and understanding land interests is required, and that this tool needs to be implemented in a standard way.

Once an organisation has a process for recording RRRs and incorporating spatial enablement of information internally they have the ability to assist others in spatially enabling their RRR datasets. Of the eight jurisdictions within Australia, six gave a response that they support other departments and agencies within their jurisdiction in spatially enabling their RRR datasets - ACT, NT, QLD, TAS, VIC, WA. The remaining jurisdictions of SA and NSW responded that they did not assist others in the task of spatially enabling RRR datasets. Spatial and ICT principle one from the RRRs toolbox highlights the issues created when information is not recorded with a spatial attribute. The principle outlines the benefits stating that integration of data with other key datasets can take place once interests are spatially enabled, and in order for this to occur at a large scale interests which require spatial enablement need better identification.

**Parcel versus Non parcel**

A further aspect to the spatial enablement of RRRs and the recording of RRRs is whether the RRRs in a jurisdiction are spatially enabled and considered as separate layers (i.e. searchable by location/coordinated), or whether they are always linked to a parcel (i.e. searchable via parcel IDs). To determine this, each jurisdiction was queried regarding whether their RRRs were spatially enabled (non parcel), parcel based, or both – meaning searchable by location/coordinates AND via parcel ID information.

The results showed that the jurisdictions of NT, QLD and WA were able to conduct searches on RRRs data using either parcel or non parcel information. NSW is currently limited to parcel based searches, while ACT is spatially enabled and can search using location information, although not via parcel ID. TAS responded that their jurisdiction was partially spatially enabled, and not 100% complete in the process of having spatial attributes for all RRRs. The jurisdictions of SA and VIC did not respond to the question, so the progress of these jurisdictions in this area is not known. The RRRs toolbox cadastral and registration principle five recommends an approach which can cater for both parcel and non parcel RRRs. The toolbox principle indicates that best practice would be to adopt a spatially enabled approach to allow for these new non-parcel interests to be catered for.
Organising land information spatially

To further explore the spatial capabilities of each jurisdiction, whether geocoded information or location enabled services were used within the land administration agency’s was queried. All jurisdictions, except SA, responded that yes, location enabled services and geocoded information was used within the organisation.

Inter-jurisdiction cadastral relationships

The relationship that the key component of a land administration system – the cadastre, has with other integral elements such as the registry and broader spatial information sets within a jurisdiction is important to understand. Within all jurisdictions, except for QLD – where the registry is used only to establish local government areas, the registry play an important role and has a strong and linked relationship with the cadastre. The relationship between the cadastre and broader spatial information sets within jurisdictions is also strong and linked. In the majority of jurisdictions (ACT, NSW, SA, TAS, VIC, WA) the cadastre is used as the underlying primary layer for broader spatial information sets. In the NT jurisdiction, the relationship is slightly different, where the cadastre is used as the primary layer for most textual data, but not for other non parcel based spatial information sets. The jurisdiction of QLD did not respond to the question, therefore is not included in this discussion.

The RRRs toolbox cadastral and registration principle one outlines the importance of have a strong relationship between the cadastre and the registry, and the cadastre and broader spatial information. This principle argues that the cadastre and registry have much potential and should have wider utility. In the majority of jurisdictions they are linked, and coordinated. When combined with other data, from any area or application, the cadastre can have a significant impact by enabling an understanding of location through parcel boundaries and addressing. The principle highlights this initiative as a priority.

SDI within jurisdictions

Spatial data infrastructures facilitate the sharing of data between different stakeholders. An SDI encompasses the policies, access networks and data handling facilities, standards and human resources necessary for the effective collection, management access, delivery and utilisation of spatial data for a specific jurisdiction or community. Whether the land administration agencies within each state or territory of Australia had, or currently, is developing consistent SDI intra-jurisdictional standards was of interest. All jurisdictions, except QLD, returned a positive response to the question, stating that consistent SDI intra-jurisdictional standards were being developed, or already had been developed. The development and implementation of intra-jurisdictional standards for SDI is considered best practice as outlined by spatial and ICT principle five of the RRRs toolbox. This principle
recommends that SDI be implemented to enable effective integration of information within and between jurisdictions. It also suggested that having intra-jurisdictional standards in place is a positive move towards information sharing and a seamless government.

5.2.8 Section 7: Miscellaneous

The final section, section 7 of the questionnaire examined problems and issues of management, policy changes required, and the existing formal arrangements around creation and sharing.

Formal arrangements for creation and sharing

To better understand the creation and sharing of information within and between jurisdictions each jurisdiction was questioned regarding formal arrangements between local governments, national governments and the private sector. The results below are arranged by jurisdiction.

**Australian Capital Territory**

At the national level, the land administration agency within ACT has arrangements to share information with the Public Sector Mapping Agency (PSMA). This is an arrangement which all states and territories have. At the Federal government level, the organisation has an MOU arrangement with Geoscience Australia to share information. No local level arrangements were described; however the organisation has arrangements, formalised by an MOU for the sharing of information with NSW Land Information, and also National Capital Authority.

**New South Wales**

Within the land administration agency of NSW information is disseminated daily to agencies at the local and federal level. An MOU is in place as the formal arrangement for sharing. At the private sector level, data usage agreements are in place with clients relating to land information creation and sharing.

**Northern Territory**

At the local, federal, and private sector levels, formal arrangements for the creation and sharing of data are embedded in MOUs, acts, and system and data usage agreements.

**Queensland**

Within this jurisdiction, at the local and federal level, the department is bound by some legislative provisions regarding the sharing of land information. In other cases, the department has in place licence agreements for the sharing of information. Regarding the creation and sharing of information with the private sector, there are limited formal arrangements in place, however in some cases legislative provisions require the private sector to provide some information once collected.
Using land administration for land risk management

**South Australia**
At the local level, a formal arrangement exists between local governments and the Valuer-General for the sharing of information. At the federal level, the organisation provides data to Commonwealth agencies through data use agreements. No private sector arrangements for sharing information were mentioned.

**Tasmania**
In the state of TAS service level agreements exist with state and local organisations for the sharing of information. At the federal level, data license agreements with Commonwealth agencies such as AuScope, Centrelink, Australian Tax Office, Australian Bureau of Statistics, National water commission, and Geoscience Australia exist for the creation and sharing of information. For the private sector, data license agreements with various property information services exist. For the sharing of information with PSMA a deed of agreement exists.

**Victoria**
In VIC, at the local level subdivision and address information is shared. Local councils create the information and the land registry stores the information and makes it available. The mapping information that results is then made available by the organisation. The formal arrangements were detailed. For the federal and private sector levels, information is shared with PSMA. Formal arrangements for sharing with these levels include sales agreements and licensing agreements.

**Western Australia**
The organisation shares information with local governments, specifically cadastral information and rates, as well as a range of other information available through the organisations online platform for land information. At the federal/national level information is shared at with the organisations of PSMA, ICSM, and ANZLIC. No formal arrangements between the organisation and local governments or national organisations were discussed however. For the private sector, agreements between the organisation and the private sector businesses are in place.

From the results displayed, different creation and sharing arrangements which exist in jurisdictions have been described. What the findings show is that a range of different agencies and governments require this information. Land policy principle six of the RRRs toolbox discusses the creation of formal policy arrangements for the sharing of land information. The principle promotes formal arrangements through policies for sharing and coordination of information to encourage collaboration and cooperation between different levels of government.
**A national system**

The final question of the questionnaire asked organisations whether their jurisdiction supports the notion of a national system of baseline policies and procedures to administer RRRs. The majority of the jurisdictions (ACT, NSW, NT, SA, TAS, VIC, WA) indicated that they would be interested, but recognise that there are many problems and obstacles associated with implementing such a system. While it would be a ‘national system’ jurisdictions indicate that the management and maintenance needs to remain at the state level, and by adopting the policies, integration would be possible. Policy principle three of the RRRs toolbox addresses the use of land policy frameworks for recognising the complexity of RRRs relating to land. It outlines the need for a holistic approach to RRRs through the implementation and adoption of policies by governments.

**5.3 Analysis of overarching settings**

To understand the results of this analysis for each jurisdiction in greater detail, the findings presented in the previous section have been summarised into the four overarching categories of policy factors, legal factors, institutional factor and technical factors. The principles presented in the RRRs toolbox are grouped where appropriate into each of these categories and are arranged as follows: the policy category includes only the results from the policy principles of the toolbox; the legal category includes the results from the legal principles, the tenure principles, and the cadastral and registration principles of the toolbox; the institutional category combines the results from the institutional principles and the HR and capacity building principles of the toolbox; and the technical category includes the results from the spatial and ICT principles, and the emerging principles of the toolbox. Combining similar principles of the toolbox will provide a broader picture of what is occurring within each jurisdiction from a particular setting. As each jurisdiction is arranged differently based on their jurisdictional constitution and history, grouping the results into these overarching categories will facilitate the comparison of jurisdictions. From the comparison, the jurisdictions which are most aligned with the recommendations of the RRRs toolbox and are successful in the management of RRRs from a policy, legal, institutional and technical setting will be revealed. Additionally, whether land administration agencies are motivated by the idea of risk management, and how they are motivated will emerge.

A further element to this analysis is the assessment of how information regarding *risk* is managed by organisations. The notion of risk and risk information stems from RRR theory, and in many cases, risk is considered a fourth RRR – rights, restrictions, responsibilities and risk. Therefore, an understanding of the policy, legal, institutional and technical setting for how RRRs are managed by land administration agencies within each jurisdiction can provide
valuable insight into the management of risk information. The results of this analysis will contribute to the understanding of jurisdictions which are best equipped to manage risk based on their current management of RRRs, and will contribute also to addressing important research questions. Each setting will now be looked at to assess the progress of jurisdictions in addressing the principles outlined for best practice in managing RRRs.

5.3.1 The Policy Setting

A policy is a course of action adopted by a government, business or individual (Mattingly 2002). In this analysis the interest is focused upon the policies defining how state level governments and specifically the land administration departments within each organisation, respond to policies focused on managing land information. Policies for the effective management of land need to be comprehensive and integrated, equitable, sustainable, efficient, and flexible. The questionnaire conducted aimed to determine the current policies and planned action for policies regarding RRRs within each jurisdiction. Table 5.11 displays the results from the study. The results show the four policy principles which were addressed in the questionnaire, and whether each jurisdiction was aligned with the policy or not.

<table>
<thead>
<tr>
<th>Policy Principle</th>
<th>ACT</th>
<th>NSW</th>
<th>NT</th>
<th>QLD</th>
<th>SA</th>
<th>TAS</th>
<th>VIC</th>
<th>WA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land policy frameworks must recognise that land is more than parcels</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Land policies must reflect the whole of government nature of land administration</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Local level empowerment in land policy design is essential</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Integration of land policies across and between levels of government is critical</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

The most obvious details shown from the table is that the jurisdiction of NSW is aligned with all four principles while none of the other jurisdictions have succeeded, and that all jurisdictions are aligned with the first and fourth principles. The first principle focused on a national system of policies for RRRs, which each jurisdiction has indicated that they would support. The fourth principle was concerned with formal arrangement for sharing and creation between the land administration agency in each jurisdiction and local government, federal government, and the private sector. Both of these two principles are important in the management of RRRs, and also critical in the management of risk. Support for the first policy principle regarding a national system of policies is extremely important for the management
of risk as recent events within Australia has shown that risks are increasingly becoming national problems, and disregarding the jurisdictional boundaries. For effective management of risks to take place a national system of policies for the management of land information is required. The alignment of all jurisdictions with this policy is a positive indicator for successful risk management and RRR management. The fourth policy principle, which all jurisdictions are aligned relates to collaborations and sharing arrangements between different levels of government. All jurisdictions responded that there are arrangements in place to allow for this sharing to take place. All jurisdictions following this best practice method for RRRs is important in the management of risk as the existence of these relationships underpin the success of risk management at all levels. For risk management to be successful, all levels of government need to be working together the enable all aspects of the community to benefit. Local governments, from the bottom up can assist communities at the local level to understand the risks firstly, and then, using the resources made available from the sharing arrangements outlined in policy, can assist citizens in implementing effective risk management strategies. Federal governments can take advantage of this information to identify problem areas for all of Australia and work on plans to mitigate and manage the risks, and the private sector such as insurance companies can use the information to feed into their risk management processes to improve available options for stakeholders. Policies which include the sharing of RRRs and risk information between local government, federal government, and the private sector can promote improved approaches to risk management and can assist with the resilience of communities at large.

The remaining two policies principles which relate to whether a jurisdiction has an overarching framework for recording RRRs, and whether local governments are included in the vision for RRRs, were responded to very differently by each jurisdiction. As mentioned earlier, the state of NSW was aligned with all four policy principles; however the remaining jurisdictions are aligned with only one of these two remaining principles, or neither of these two remaining principles. The results for the jurisdictions of ACT and SA show that these two jurisdictions include local government within their vision for RRRs and agree that local government empowerment in land policy design is essential; however they currently do not have an overarching policy for the recording of RRRs. The state of VIC is opposite in this respect, aligning with the principle for an overarching policy for the recording of RRRs, understanding that land policies must reflect the whole of government nature of land administration, however not including local government within their vision for RRRs. The remaining jurisdictions of NT, QLD, TAS, and WA were aligned with neither of these two principles, all responding that they have no overarching framework for recording RRRs, and that they also do not include local governments within their vision for RRRs.
These two policy principles which have been variously adopted by jurisdictions show the disparate nature of the jurisdictions. As outlined by the RRRs toolbox and all of the policy principles, a whole of government approach which supports sharing and overarching policies for the management of RRRs is best practice. While some jurisdictions have progressed in this area adopting some of the principles, only one jurisdiction has adopted all of the recommended principles in the area of policy.

Policies are one of the most important aspects which should be considered for the management of risks. The implementation of policies can enable the sharing and collaboration required for effective management practices to be in place. As risk does not discriminate against boundaries within Australia and risk events at a large scale are becoming more frequent, overarching policies which can support cooperation within and between jurisdictions is essential. This includes consideration of local governments within a jurisdiction as well as consideration of federal government or the private sector at the national level. The creation, adoption and implementation of a national system of policies will facilitate the sharing of data between jurisdictions and support the needs of risk management.

5.3.2 The Legal Setting

The legal setting refers to the framework of laws, executive orders, and other legal instruments which set the ground rules for governmental and non-governmental activities related to the management of RRRs and risk information (Mattingly 2002). How land administration agencies adopt, implement and respond to legislation can reveal much about an organisation and the direction the organisation is planning for the future. The questions assessed under the overarching legal setting include questions regarding the legislation covering RRRs management and creation, the availability of RRRs information, the legislated requirements describing what or how an RRR should be recorded, and the publishing of RRRs data. The results of these questions are shown in Table 5.12.
Table 5.12 Summary of legal setting results for each jurisdiction

<table>
<thead>
<tr>
<th>Legal Principle</th>
<th>ACT</th>
<th>NSW</th>
<th>NT</th>
<th>QLD</th>
<th>SA</th>
<th>TAS</th>
<th>VIC</th>
<th>WA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government accountability must be embedded into legislation</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Spatial extent, duration and people impacted must be defined in legislation</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>The property object: a new tool for organising and understanding land interests</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0.5</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Cadastral and registration systems should have wider utility</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Cadastral and registration systems should manage only some interests</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Non-parcel interests are on the rise, but, parcels still dominate</td>
<td>0.5</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0.5</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>3.5</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

The first principle listed in the table suggests that the accountability of government should be embedded within legislation to encourage governments to allow stakeholders to be aware of the RRRs and risks which have a relationship to parcels of land. Of all the jurisdictions however, only three jurisdictions have requirements embedded within the legislation stating that this RRR and risk information must be made available. The second principle in the table is adopted by only the jurisdiction of ACT. This principle recommends that the spatial extent, duration, and people impacted be defined in legislation.

The final four principles listed in the table have received more attention from the jurisdictions, with at least four or more jurisdictions following the suggested actions outlined in the principle. The first recommends that RRRs be recorded in a standard way spatially, and that a common procedure be adopted by all jurisdictions to assist in the organising and understanding of land interests. The second advises that the resources already available within land administration system be made use of to enable wider utility of the information. The third builds on the previous principle clarifying that while these systems should have wider utility, the interests that they manage should remain within their ability, and the final principle outlines the changing nature of land administration and suggests that while non-parcel interests are becoming more common, parcel based interests should remain an option and be catered for.

All of these legal focused principles are important for the management of RRRs, and should be adopted by organisations in all jurisdictions. Of specific importance however to the
management of risk are a number of principles within this legal setting. The key principles which directly impact upon the management of risk include:

- Government accountability must be embedded into legislation
- Spatial extent, duration and people impacted must be defined in legislation
- Non parcel interests are on the rise, but, parcels still dominate.

These three principles, if adopted can have direct influence upon the management of risk. While all principles have an impact upon risk as risk is included within the existing RRRs of which the principles are created for, these highlighted principles have a strong connection to the risk management process.

The first of these principles – which outlines the importance for government accountability to be embedded into legislation, is important for improvement to the risk management process as it promotes public information for private owners. Within the risk management process identifying the risks which impact upon a specific property is one of the key stages, and is a step which supersedes all other steps. Without legislation such as this in place the ability of a stakeholder to access this information to enable thorough risk identification to take place is limited. Adoption of this principle allows jurisdictions to become aligned with the current federal government strategy which promotes community resilience and the management of risks at the local level.

The second risk oriented principle - which advocates the definition of spatial extent, duration and people impacted within legislation, is relevant to the management of risk as it clarifies the land interests for stakeholders. By adopting the recommendations of the principle, the complexity of land interests to be captured can be easily categorized which simplifies the risk management process. Assigning land interests to predefined categories enables a stakeholder to access specific details by querying a range of different attributes improving the search for risks.

The final risk management oriented principle advises that both spatially enabled interests and parcel based interests should be catered for within a land administration agency. This is relevant to the management of risk as the way that the data is recorded, can be searched upon, and is linked to the parcel is important in identifying a risk and determining whether it is relevant or affects a certain parcel. The spatially enabled interests allow for a search to easily be conducted and have greater flexibility for interests which are non parcel based. The parcel based search is more rigid however can still generate the similar results for the user, however if opting for this method, the cadastres must be capable of integrating with these new layers of spatial interest. Adopting a spatially enabled approach enables even the most basic user to
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conduct searches on interests for a specific area. The institutional setting will now be explored.

5.3.3 The Institutional Setting

The institutional setting refers to the linkages between and among organisations at the local, state, and national levels and between government and non-government organisations (Mattingly 2002). How an organisation is coordinated internally and externally and within and between jurisdictions is of interest. The questions used to assess this particular setting focused on the department within a jurisdiction responsible for RRRs, relationships between different departments within a jurisdiction, and jurisdictions' relationship with the general public. The results of these questions are shown in Table 5.13.

Table 5.13 Summary of institutional setting results for each jurisdiction

<table>
<thead>
<tr>
<th>Principle</th>
<th>ACT</th>
<th>NSW</th>
<th>NT</th>
<th>QLD</th>
<th>SA</th>
<th>TAS</th>
<th>VIC</th>
<th>WA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leadership: a single information coordination body is required</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Structure: government remains decentralised but collaboration is essential</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Custodianship: control of information remains decentralised with government agencies</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Processes: government should be organised around land activities not institutions</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Individual properties are heavily burdened</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

The results within the table do not display much variation. Four of the jurisdictions are aligned with all of the principles assessed, and the remaining four jurisdictions all vary on the same principle. The principle which shows a discrepancy between the jurisdictions with half aligned with the principle and the other half not is on the topic of aggregating the management of RRRs into one department. The principle recommends that the management of RRRs remain within the primary department which created the information. As that department is most familiar with that specific information it is more cost effective and resource effective to have the department which created the information manage the information. Aggregation of information at a higher level is important for jurisdictions to move forward and to be able to facilitate a range of activities; however aggregating the actual management of the information is not best practice.
From the perspective of risk management there are two key principles from the institutional setting which are important. The first principle of which holds significance for the management of risk is the second listed principle which advocates a decentralised but collaborative approach to the management of RRRs. This principle is essential for the effective management of risk as in order for the best management to take place information needs to be shared within governments in the most cost effective and efficient way. This principle promotes this idea. The second principle of importance for risk management is the final listed principle focused on the facilitation of access of information for citizens. This principle is supported by all jurisdictions and is important as the ability to find and make use of information describing risks is a key process within the risk management framework. The final setting – the technical setting will be assessed in the following section.

5.3.4 The Technical Setting

The technical setting refers to the different systems and infrastructures in place to carry out land administration activities and to improve current processes. How land administration agencies embrace technology and adapt to the fast changing nature of technology was assessed in the questionnaire. Special focus was given to the principles centred on the topics of spatial enablement, search functionality, standards, consistency, and initiatives. The results of these questions are shown in Table 5.14

<table>
<thead>
<tr>
<th>Principle</th>
<th>ACT</th>
<th>NSW</th>
<th>NT</th>
<th>QLD</th>
<th>SA</th>
<th>TAS</th>
<th>VIC</th>
<th>WA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acquisition: lack of datasets and lack of integration</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0.5</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Information: spatial extents, duration and people impacted must be recorded</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Access: land interest information and transactions should be online and affordable</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Infrastructure: SDI overcomes the need to reorganise government</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Standards: uniform spatial identifiers, units and access need to be developed</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Spatial and information technologies</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>4.5</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

The results displayed within the table show a variety of results from each jurisdiction. Only VIC and NT have responded in the same way, all of the other jurisdictions have results
showing the adoption of a combination of principles. The alignment of all jurisdictions with the spatial and technologies principle and the access of RRRs information is a significant outcome, highlighting consistency in key areas of the technical setting.

Focusing on risk management and broadening the analysis from RRRs highlights the importance of four principles within this setting. The principles which look at how a user searches and accesses RRRs and risk data and whether a jurisdiction is developing standards and has consistency for RRRs and risk terms and descriptions contribute to the success of the risk management process. How a user searches for RRRs and risk data is relevant as it considers the background of users and stakeholders who would be implementing risk management strategies. Generally these users are not experts in land interests or in mapping, therefore the process for accessing information should be simple, straightforward and intuitive. The ability to search in a variety of ways such as spatially or by a parcel ID increases the opportunity for non-experts to locate and identify the data required to manage risks. Further expanding on this issue, and as touched on in previous settings, the ability for stakeholders to access information is critical within the risk management framework. Supporting online and affordable RRRs and risk information is essential for stakeholders to be able to implement effective risk management strategies.

The remaining two principles for effective risk management which are centred on the consistency and standardization of RRRs and risk information are important for improved implementation at the national level. As risk events do not respect administrative boundaries, organisations acting at the national level, or organisations collaborating between jurisdictions need to be able to share information to manage the risks. These two principles support this vision and are essential for not only successful RRRs management but risk management as well. The relevant research questions will now be examined.

5.3.5 The research questions

The four research questions investigated within this thesis were:

1. Are land administration agencies motivated by the notion of risk management? If yes, how? And how might they be motivated in the near future?
2. How do land right holders perceive their role in risk management?
3. What should be the relationship between land right holders, risk, and government? Or what are the various options?
4. How can land administration systems support risk management?

Of relevance in this chapter are the first question and the fourth question. The second and third questions will be addressed in the following chapters after the qualitative risk
management investigation has concluded. In this chapter the first question is addressed and in the final inferences made in chapter seven the fourth question will be answered resulting from the combination of the findings from the quantitative and qualitative studies.

To answer the research question to be addressed in this chapter the findings which relate to the management of RRRs and risk are considered. The initial results of the study were analysed and discussed, and then further analysed and arranged into the overarching categories of policy, legal, institutional and technical settings. Understanding the strengths of each jurisdiction in relation to the four overarching settings was critical to answering the research questions and addressing the motivations of land administration agencies in regards to the notion of risk.

The initial findings of the research carried revealed that of the 23 principles which were addressed and measurable in the questionnaire, every principle was attended to by at least one of the jurisdictions. Not a single principle included within the study was ignored or not acknowledged in some way by at least one of the eight jurisdictions. The jurisdiction of Victoria overall was most aligned with the principles and was found to have addressed successfully 70% of the principles.

Observation of the results from the perspective of the four settings of policy, legal, institutional and technical for RRRs reflected different a result. Within each of the settings which grouped similar principles, each jurisdiction was assessed based on their alignment with principles from each category. Overall NSW achieved the most alignment with the policy setting, ACT was most aligned with the legal setting, the jurisdictions of NT, TAS, VIC and WA were equally aligned with the institutional setting, and QLD was the most aligned with the technical setting based on the analysis of the results of the questionnaire using the land administration RRRs toolbox.

From this analysis, a further step was taken where risk was singled out and focused upon. For each setting, the principles which were found to be specifically relevant to risk were identified and tallied a separate from the remaining principles. As risk is a component within the overall RRRs group, indicating which principles were important to risk independent of RRRs reflects the interest of each jurisdiction in risk. The results of the alignment of jurisdictions with risk specific principles are shown in table 5.15.
The results of the table show the alignment of each state to the principles within each setting which have a direct impact on risk management independent of the overall RRRs assessment. As shown, as a whole, the state of TAS was found to be the most proactive in following the recommended actions outlined by the RRRs toolbox principles which were identified as risk management related. At a high level, all of the jurisdictions reflect similar results with minimal variation across all settings.

Returning to the research question under scrutiny, which poses the query of: Are land administration agencies motivated by the notion of risk management? If yes, how? And how might they be motivated in the near future? A number of outcomes can be discussed.

Firstly, to determine whether land administration agencies are motivated by the notion of risk management, how land administration agencies manage RRRs was examined. As the component of risk is included within the overarching concept of RRRs, an assessment based on the application of the RRRs toolbox and principles is justified. The assessment showed which jurisdictions were reacting to developments within the area of RRRs management, and which jurisdictions were managing rights, restrictions, responsibilities and risk well based on the recommendations of the RRRs toolbox. The response and the alignment of jurisdictions with these principles which was established from the assessment show that land administration agencies are motivated by notion of RRRs, and therefore also by risk. Further, from this, the results were broken down into policy, legal, institutional and technical overarching categories. From the data and the results of the analysis, an understanding of the policy, legal, institutional, and technical setting for how RRRs (and therefore risks) are managed by land administration agencies was attained. From these results the motivations of land administration agencies in each jurisdiction can be determined.

The factors which motivate land administration agencies to participate in risk management are summarised below using the identified overarching groups of policy, legal, institutional and technical:

<table>
<thead>
<tr>
<th>Setting</th>
<th>ACT</th>
<th>NSW</th>
<th>NT</th>
<th>QLD</th>
<th>SA</th>
<th>TAS</th>
<th>VIC</th>
<th>WA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Policy Setting</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Legal Setting</td>
<td>1.5</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1.5</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Institutional Setting</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Technical Setting</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>6.5</strong></td>
<td><strong>6</strong></td>
<td><strong>8</strong></td>
<td><strong>7</strong></td>
<td><strong>6</strong></td>
<td><strong>8.5</strong></td>
<td><strong>8</strong></td>
<td><strong>8</strong></td>
</tr>
</tbody>
</table>
Using land administration for land risk management

**Policy**

A range of policy factors which show how land administration agencies can be motivated from the idea of risk management exist. They are outlined below.

**A national system**

For effective risk management to take place, a national system of policies for managing land interests in required. Implementing a system of national policies which would allow for consistency across all jurisdictions negates the need for a new national federal agency to manage this information, allowing for each jurisdiction to continue with the role they currently hold, while contributing to a national vision. This would mean that across Australia, all of the RRRs and risks would be aligned, allowing for risk management to take place at the national level. The motivation for land administration agencies to retain their current role and administrative powers motivates them to adopt the requirements needed for effective risk management.

**Formal arrangements**

Formal arrangements between local government, federal government and the private sector allows for improved sharing of data for applications such as risk management. Land administration agencies are motivated by the idea of these arrangements as it enables relationships to be developed, and potential licensing and sales of data to occur.

**Legal**

The legal factors which motivate land administration agencies to participate in the area of risk management are detailed below.

**Government accountability**

There is a movement within government towards government accountability. In terms of land administration this means making RRRs information available through legislation. While only some of the jurisdictions have proceeded and created legislation for this, the overall movement and pressure from federal government and citizens, and the rivalry between jurisdictions to not be behind in development encourages and motivates the remaining jurisdictions to make this a priority.

**Legislated requirements**

Already with the increasing publicity of disasters and risk events are the requests for information detailing these risks rising. As the primary department responsible for this information land administration agencies already need to address and meet these demands. The introduction of such legislation where the recording of details such as spatial extent, duration and people impacted becomes a requirement is a motivating factor for land
administration agencies to embrace the idea of risk management as it opens up a business opportunity for the department based on something which they are required to do in any case.

**Making use of existing resources**

Best practice dictates that jurisdictions move towards spatially enabled layers for RRRs and risk. As the land administration agencies already possess this information, an opportunity to put this information to use is a motivation. Much time and resources are put into creating such data, a chance to use the information for applications such as risk management where real and measurable results can be seen is a sizeable incentive.

**Institutional**

The institutional factors which motivate land administration agencies to participate in the area of risk management are detailed below.

**Federal government**

As a result of recent disasters within Australia the Federal Government has promoted disaster resilience as a strategy which should be adopted. This strategy supports the preparedness of communities at a local level for a range of disasters which might affect them. To achieve preparedness the adoption of the risk management process can assist in identifying and assessing these risks. In order to successfully implement these stages of the process, information regarding land interests is required. For this reason, land administration agencies are motivated to address the needs of the jurisdiction and other departments within the government.

**Meeting internal and external demands**

Significant resources which are being expended by jurisdictional governments as a result of disasters occurring creates pressure for land administration agencies. As the custodians and maintainers of a range of data which can impact and contribute greatly to the areas of disaster management and risk management, the demands to share this information are increasing. In response to increasing costs and more frequent events, governments are moving towards a ‘mitigation over recovery’ mindset which requires updated and parcel relevant data from land administration agencies. The demands of different departments within government for information for risk management purposes are becoming motivating factors for land administration agencies. They are motivated by the fact that sharing improves economic efficiency and by the ability to easily share information and embrace the information needs of stakeholders.
Using land administration for land risk management

**Technical**
The technical factors which motivate land administration agencies to participate in the area of risk management are detailed below.

**Standards**
The application of risk management varies from the local level to the national level. In order for effective and consistent results standards are required. Uniform spatial identifiers, units and access need to be developed and implemented in all land administration agencies. The motivation for land administration systems is that standards will enable better ordering, integration and searching of core land interest information. The impetus of risk management provides the means for the standards to be implemented and the overall land administration agency receives the benefits.

**Spatial and information technologies**
The attention that risk management is receiving and the investment being allocated to risk management motivates land administration agencies to become involved and support the idea. Spatial information technologies have a very close relationship to all land interest management systems and therefore have a prominent role in the management of risk. Opportunities for land administration agencies to improve their systems and develop new technology stem from the notion of risk management.

The second aspect of the research question raised the question of how land administration systems might be motivated in the future. Two overarching ideas were raised and are discussed below.

**Reduced accountability**
If the information is made easily available and accessible by land administration agencies, the responsibility for having knowledge of such risks is reduced as all individuals and stakeholders have equal opportunity to be made aware of such details. The liability for having possession of such information is removed from department, jurisdiction and government. With the increase in large scale or large impact events, the extent to which governments can be held accountable is yet to be determined.

**Increased revenue**
By increasing the awareness of risk management and the risk management processes, a demand for such information by society is due to increase. This would boost the number of inquiries and sales of this information. As a result, the potential for additional income for the jurisdiction is substantial.
5.4 Chapter summary

Land administration agencies, whether they recognise it or not are already motivated by the notion of risk management based on their interest in the management of RRRs. The notion of risk itself can be, and is considered in many groups as an extension to the theory of RRRs – a fourth RRR – rights, restrictions, responsibilities, and risk. The compliance with a range of principles from the RRRs toolbox which have been outlined as principles which directly relate to the requirements of risk management show that whether consciously or unconsciously a movement towards a risk management oriented organisation is taking place.

This quantitative study into land administration systems within Australia has provided insight into the current management of land information by land administration agencies in each jurisdiction.

Three research questions remain which have not been addressed in this chapter:

- Question 2: How do land right holders perceive their role in risk management?
- Question 3: What should be the relationship between land right holders, risk, and government? Or what are the various options?
- Question 4: How can land administration systems support risk management?

These questions cannot yet be assessed without the risk management stakeholder qualitative case study. These results and findings of this case study are provided in the next chapter.
Chapter 6 – Results of the risk stakeholder case study
6.1 Introduction

The case study analysis of a range of stakeholders involved in the process of managing risk to land provided valuable insight into how the process of risk management is applied to land within society. This chapter now examines a range of stakeholders within society responsible for the management of land. The investigation of stakeholders focused on the different hazards which created a risk, how those hazards were identified, the assessment of the risk, and the treatment of the risk. The research question addressed in this chapter sought to understand how land right holders perceived their role in risk management. A qualitative method was identified as the most appropriate approach to answer this research question.

Two primary forms of data collection techniques were utilised in this case study. Firstly, a questionnaire in both an online and paper based form was used to collect data from stakeholders at the citizen level and the local government level. The questionnaire was based around the ISO risk management framework and each question related to one process within the risk management framework. The second form of data collection was semi-structured interviews carried out with stakeholders at the local government level. The interview questions were based around the information lifecycle and the tasks of planning, obtaining the information, storing and sharing the information, maintaining the information, the application of the information and disposal of the information. The list of questions for the semi-structured interviews is given in Appendix 6.

This chapter is structured in three parts. The first part of the chapter describes and analyses the results from the citizen stakeholder group, the second part of the chapter describes and analyses the results from the local government stakeholder group, and the third part of the chapter then compares the findings from each stakeholder group to identify differences across and between stakeholder groups. Finally, some conclusions from the case studies are presented.

6.2 Citizen level

The aim of the citizen level investigation was to determine how citizens perceive their role in the management of risk and to understand what information and resources are used in decision making and implementation. The citizen stakeholder group represents individuals who hold ownership or leasing right over land. To achieve an in-depth understanding of these stakeholders, and cover a broad range of perspectives, citizens within the states of New South Wales and Victoria, who were either leasing a property, or owned and occupied a property were invited to participate in the questionnaire.
6.2.1 New South Wales

From the questionnaire conducted, a total of 37 responses were received from the state of New South Wales. Twenty of these responses were from citizens who owned and occupied land and property, and 17 responses were from citizens who leased land and property. Table 6.1 summarises the types of properties which were included in the New South Wales citizens’ responses. The results are classified using dwelling structures categories outlined in the 2011 census results from the Australian Bureau of Statistics.

Table 6.1 Types and number of properties included in NSW citizen questionnaire

<table>
<thead>
<tr>
<th>Property Description</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Separate house</td>
<td>19</td>
</tr>
<tr>
<td>Semi detached house, row or terrace house, townhouse etc.</td>
<td>4</td>
</tr>
<tr>
<td>Flat, unit or apartment</td>
<td>8</td>
</tr>
<tr>
<td>Other (farm etc.)</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>37</strong></td>
</tr>
</tbody>
</table>

The broad types of properties included allow for a range of different risks, and management techniques to be explored. It is expected that hazards and management strategies will vary between property types such as a detached house, a townhouse or apartment, or a farm.

6.2.2 Victoria

From the questionnaire conducted for the Victoria side of the study a total of 45 responses were received. Of these responses, 22 were received from owners and 23 were received from citizens who leased the property. Table 6.2 summarises the types of properties which were included in the New South Wales citizens’ responses.

Table 6.2 Types and number of properties included in VIC citizen questionnaire

<table>
<thead>
<tr>
<th>Property Description</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Separate house</td>
<td>15</td>
</tr>
<tr>
<td>Semi detached house, row or terrace house, townhouse etc.</td>
<td>9</td>
</tr>
<tr>
<td>Flat, unit or apartment</td>
<td>16</td>
</tr>
<tr>
<td>Other (farm etc.)</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>45</strong></td>
</tr>
</tbody>
</table>

The two property types of flat, unit or apartment and detached house were selected the most frequently within this state. This is to be expected as within Victoria, country and suburban areas have a high percentage of detached houses as the main form of residence, and within the urban areas apartments and units are common.
6.2.3 Questionnaire analysis

The approach of the analysis was to conduct a questionnaire focused on the risk management practices of citizen stakeholders to reveal their needs, perceptions, and to understand their current risk management activities. Within this section the responses to the questionnaire will be analysed and discussed. Four different variables were assessed within this questionnaire:

- Owners within the state of New South Wales
- Lessees within the state of New South Wales
- Owners within the state of Victoria
- Lessees within the state of Victoria

Based on the question asked, the results will be analysed and discussed within these four categories, or may be combined to reflect all citizen responses within a specific state, or combined to show responses from all at a citizen level. The arrangement of the results will be outlined for each question discussed. In total there were six sections within the questionnaire: the risk management plan; the risks; risk analysis; risk information; risk treatment; and monitoring and review.

Risk management plan

The first section of the questionnaire, the risk management plan referred to the risk management approach taken by the citizen, the plan in place, and the objectives of the plan. The results from this section addresses the question of how land right holders perceive their role in risk management by revealing at the initial stage, whether a plan is in place, and the objectives of the plan which informs the role understood by each stakeholder.

The decision to actively develop and implement a risk management plan differs from citizen to citizen. To understand to what degree citizens within New South Wales and Victoria had made arrangements for managing known risks such as bushfire, flood, storm events, the question of whether a risk management plan was in place was posed. The results (table 6.3) show within each state and within each land right holder category the number of respondents who have and have not developed and implemented a risk management plan. All of the participants within the survey responded to this question.

| Table 6.3 Results showing land right holders who have a risk management plan |
|---------------------------|-----------------|---------------|-----------------|---------------|
| **Risk management plan** | **NSW** | **VIC** | **Overall** |
| | Lessee | Owner | Total | Lessee | Owner | Total | Total |
| Yes | 3 | 10 | 13 | 2 | 11 | 13 | 26 |
| No | 14 | 10 | 24 | 21 | 11 | 32 | 56 |
From results shown in table 6.3 it can be seen that within both states, the owners of the property have developed and implemented risk management plans more than lessees. In NSW 50% of owners have a risk management plan and only 18% of lessees in this state have. In VIC 50% of owners have a plan while only 9% of lessees do. Overall, only 33% of respondents have a risk management plan developed and implemented. The greater rate of owners having a risk management plan in place than of lessees is to be expected as the owners have a vested interest in the overall protection of the property, while the lessees generally have an interest in the contents of the property only, and do not have as high an interest in the overall property.

To identify the objectives of each group and to better understand the motivations of having or not having a risk management plan, the participants were asked whether they have any risk management objectives, and if so, what the objectives were. Table 6.4 displays the results showing whether each group has risk management objectives. The specific objectives of each group are discussed in table 6.5. All of the participants gave a response to this question.

**Table 6.4 Results showing land right holders who have risk management objectives**

<table>
<thead>
<tr>
<th>Risk management objectives</th>
<th>NSW</th>
<th>VIC</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lessee</td>
<td>Owner</td>
<td>Total</td>
</tr>
<tr>
<td>Yes</td>
<td>6</td>
<td>17</td>
<td>23</td>
</tr>
<tr>
<td>No</td>
<td>11</td>
<td>3</td>
<td>14</td>
</tr>
</tbody>
</table>

The results show that overall as a group; owners within each state returned a higher positive response to having objectives in place than lessees. Within NSW 85% of owners have objectives for risk management, while only 35% of lessees do. In VIC, similar results are displayed with 68% of owners having objectives in place while for lessees, only 35% do.

The specific objectives of the respondents are summarised in table 6.5. As not all respondents had risk management objectives, the list below relates only to the land right holders who responded that they had objectives. Some respondents also listed multiple objectives.
Using land administration for land risk management

Table 6.5 Results showing the objectives of land right holders

<table>
<thead>
<tr>
<th>Risk management objectives</th>
<th>NSW</th>
<th>VIC</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>To protect the contents of property through insurance</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>To protect the property and contents through insurance and mitigation actions</td>
<td>1</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>To protect the property and contents through insurance</td>
<td>0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>To protect the property and contents through insurance and security systems</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>To mitigate against bushfires</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

The table highlights the difference in terms used which indicates the type of land right holder. When the term ‘contents’ only is listed, it generally refers to a lessee. When the term ‘property and contents’ is listed, an owner is often the respondent. A range of other objectives which are not included in the table are listed below. They were excluded from the table as they are very specific objectives and were mentioned by only one respondent. These objectives include:

- To protect against disasters and theft (owner)
- To protect the property and contents against fire and public liability claims through insurance (owner)
- To mitigate against intentional and unintentional damage to the structure (owner)
- To protect against theft (lessee)
- To reduce the risk of fire through mitigation actions (lessee)
- To protect the property through mitigation actions (owner)
- To ensure body corporate carries out adequate mitigation (owner)
- To protect the property against bushfire, insect infestation, soil erosion (owner)
- To protect the property and contents (owner)
- To protect the property, contents, produce and crops through insurance and mitigation actions (owner)
- Mitigate costs arising from natural disasters or theft. Establish price protection for a percentage of expected (average) production in any season (owner)

As can be seen from the list, the majority of the objectives relate to a specific risk, and are individual objectives. As was shown in the table, and reflected in these listed objectives, the difference between the land right holders can be observed from the scope of their objectives. The owner generally includes both the property and the contents, and refers to hazards which
could affect both, while the lessee is generally concerned with risks which might have an effect primarily on the contents. Overall, the majority of objectives referred to a risk treatment action, either to mitigate against the risk, or to transfer the risk (insurance).

From this first section of the questionnaire an understanding of the risk management practices and objectives of citizens as a stakeholder was established. From this understanding, the types of risk which are of concern to citizens can be explored. The following section of ‘the risks’ investigates this.

**Section summary – the risk management plan**
- Of all the respondents, 32% had a risk management plan in place. Most of these respondents belonged to the category of owner, few were from the lessee category
- 89% of the objectives listed for risk management referred directly to the application of a risk treatment – specifically, risk reduction and/or risk transfer

**The risks**
This section of the questionnaire aimed to understand the different risks posing a threat to land and property. Each participant was asked to identify from a list, the risks which pose a threat to their land and property. If there was a specific risk which posed a threat which was not on the list, participants were able to add it to the list. Table 6.6 displays the results.

**Table 6.6 Risks identified by respondents as being a threat to their land and property**

<table>
<thead>
<tr>
<th>Hazard</th>
<th>NSW Lessee</th>
<th>NSW Owner</th>
<th>Total</th>
<th>VIC Lessee</th>
<th>VIC Owner</th>
<th>Total</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>riverine flooding</td>
<td>8</td>
<td>5</td>
<td>13</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>18</td>
</tr>
<tr>
<td>bushfire</td>
<td>8</td>
<td>8</td>
<td>16</td>
<td>4</td>
<td>9</td>
<td>13</td>
<td>29</td>
</tr>
<tr>
<td>earthquake</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>11</td>
<td>7</td>
<td>18</td>
<td>24</td>
</tr>
<tr>
<td>severe weather</td>
<td>10</td>
<td>17</td>
<td>27</td>
<td>20</td>
<td>19</td>
<td>39</td>
<td>66</td>
</tr>
<tr>
<td>cyclone</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>7</td>
<td>3</td>
<td>10</td>
<td>14</td>
</tr>
<tr>
<td>tsunami</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>landslide</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>sea level rise</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>house fire</td>
<td>10</td>
<td>16</td>
<td>26</td>
<td>18</td>
<td>15</td>
<td>33</td>
<td>59</td>
</tr>
<tr>
<td>fraud</td>
<td>4</td>
<td>1</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>drought</td>
<td>6</td>
<td>6</td>
<td>12</td>
<td>1</td>
<td>4</td>
<td>5</td>
<td>17</td>
</tr>
<tr>
<td>disease outbreak</td>
<td>3</td>
<td>5</td>
<td>8</td>
<td>4</td>
<td>3</td>
<td>7</td>
<td>15</td>
</tr>
<tr>
<td>asbestos</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>pests</td>
<td>9</td>
<td>13</td>
<td>22</td>
<td>8</td>
<td>12</td>
<td>20</td>
<td>42</td>
</tr>
<tr>
<td>vandalism</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>burglary</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>erosion</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>69</td>
<td>84</td>
<td>153</td>
<td>87</td>
<td>83</td>
<td>170</td>
<td>323</td>
</tr>
</tbody>
</table>
The results show that overall the risk of severe weather presented a threat to the land and property of the most number of citizens, followed by the risk of a house fire, and pests such as white ants. Possible reasons for why these risks rated highly could be attributed to the fact that geographical location does not influence these particular risks – meaning that these risks can occur in all areas and therefore are relevant to all respondents, while risks such as tsunami, sea level rise, erosion, and landslide present a threat only within certain areas such as along the coast or a river and therefore are not relevant to all respondents.

To determine the actual level of threat that each of these risks present, each respondent was asked to rate each risk as a threat level of none, low, low to medium, medium, medium to high, or high. This would expand on what was shown in the previous question to reveal whether the threat simply existed, or whether it presented a high level of threat. Figure 6.1 displays the results.
The figure shows that a large number of respondents felt that the risks of severe weather, house fire and pests were high. The medium and high ratings which were collected for the risk of bushfire also shows that for some respondents within the survey, a substantial threat is felt regarding this risk. The risks of tsunami, sea level rise and cyclone received a high response of low threat level which could be attributed to those risks not being very likely within either the jurisdictions of New South Wales or Victoria. The risk of riverine flooding also did not rate within the highest perceived threats. A higher threat might have been expected due to severe flooding events occurring within Australia in recent times, however as the respondents of this questionnaire were located within the two states of New South Wales and Victoria, and the majority of the flooding occurred in the state of Queensland, the lower rating could be attributed to the location of the respondents, and a perception that the threat does not extend to their location.

The next question respondents were asked to address was, of all the possible risks, which risk posed the greatest threat to land and property. The results are shown in table 6.7 below.

<table>
<thead>
<tr>
<th>Risk</th>
<th>NSW</th>
<th>NSW</th>
<th>NSW</th>
<th>VIC</th>
<th>VIC</th>
<th>VIC</th>
<th>VIC</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>bushfire</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>severe weather</td>
<td>4</td>
<td>6</td>
<td>6</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>25</td>
</tr>
<tr>
<td>house fire</td>
<td>10</td>
<td>6</td>
<td>15</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>38</td>
</tr>
<tr>
<td>riverine flooding</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>drought</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>earthquake</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>pest</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>erosion</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>vandalism</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

The table shows that the two risks of severe weather and house fire are the two single risks which citizens view as posing the greatest threat to their land and property. Reasons given as to why citizens selected these risks as the risks which posed the greatest threat were summarised into the following reasons: the most likely to occur, the land and property was vulnerable to that risk, the land and property was in proximity to a hazard which could result in the risk event, the risk event has occurred in the past, or the risk event – if it were to occur would have the highest consequences (figure 6.2).
Thirty-five percent of respondents listed the reason for selecting the risk as the greatest threat due to it being the most likely, and thirty-four percent responded that they were vulnerable to that specific risk.

To understand how at risk each citizen feels to the specific risk which poses the greatest threat, the likelihood of occurrence of the risk and the consequence of occurrence of this specific risk occurring was collected. The results are shown in table 6.8.

The majority of citizens have rated the risk which poses the greatest threat to have a likelihood of either possible or likely, and a consequence of moderate and major. Some citizens listed risks which are within the extreme section (red) however the majority of risks listed fit within the high (orange), medium (yellow), or low (green) categories. In order to better understand how the respondents came to this understanding of the risks that they face, how each risk was identified and analysed will be explored and discussed in the following section.
Section summary – the risks

- One-fifth of all respondents view the risk of severe weather as a threat to their land and property.
- Citizens feel at risk due to a belief that the risk is likely, they feel vulnerable to the risk, the land and property is in proximity to a hazard, the risk has occurred in the past, or they feel that the risk would result in the highest consequence.
- The majority of citizens rated the risk which presented the highest threat to their land and property as a high risk. This shows that many citizens perceive a substantial threat to their land and property from at least one risk source.

Risk analysis

The third section aimed to understand how each risk was identified and analysed. This again informs the research question by revealing the resources utilised by stakeholders in understanding risks. In order to gain this understanding a series of questions focused on the methods used by citizens and the type of information employed in the identification and analysis process. Understanding how a risk was initially identified by citizens was the first step in this process. The results from respondents showed that a range of different methods and reasons were utilised and listed for the identification of each risk (table 6.9).

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Reason</th>
<th>Count</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>bushfire</td>
<td>Local knowledge</td>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Identification of hazard</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Awareness groups</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>drought</td>
<td>Local knowledge</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>earthquake</td>
<td>Identification of hazard</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Most likely event</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>erosion</td>
<td>Visible risk</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>house fire</td>
<td>Most likely event</td>
<td>11</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>Identification of hazard</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Local knowledge</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Common sense</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Has occurred in the past</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>pests - white ants</td>
<td>Expert consultation</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Visible risk</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>riverine flooding</td>
<td>Identification of hazard</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Has occurred in the past</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Local knowledge</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>severe weather</td>
<td>Has occurred in the past</td>
<td>7</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>Identification of hazard</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Most likely event</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Awareness groups</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>vandalism</td>
<td>Local knowledge</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
Local knowledge was listed for more than half the risks as an identification factor for risks. The identification of the hazard by the citizen themselves was also listed in more than half the risk scenarios. As the table shows, some of the factors listed were official or authoritative sources of information such as expert consultations and awareness groups, some were based on historical events or knowledge such as respondents who listed ‘has occurred in the past’ or ‘local knowledge’, and some of the identification techniques were based on current assessment by the land right holder, such as ‘visible risk’ and ‘identification of hazard’. Of the techniques used to identify the risk, ‘identification of hazard’ was the most frequently listed – with 23 respondents listing this as the way they identified the risk, which was followed by ‘most likely event’ and ‘has occurred in the past’ with listings of 14 and 13 respectively.

To determine how the identification of these risks came about, respondents were asked to list the sources which provided information to assist in this process. The results of this inquiry could be grouped into one of eighteen different categories (table 6.10).

<table>
<thead>
<tr>
<th>Information</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local knowledge</td>
<td>12</td>
</tr>
<tr>
<td>Media</td>
<td>11</td>
</tr>
<tr>
<td>Weather information (BOM)</td>
<td>8</td>
</tr>
<tr>
<td>Common sense</td>
<td>7</td>
</tr>
<tr>
<td>Observation</td>
<td>6</td>
</tr>
<tr>
<td>Online</td>
<td>4</td>
</tr>
<tr>
<td>Historical evidence</td>
<td>4</td>
</tr>
<tr>
<td>Professional consultant</td>
<td>4</td>
</tr>
<tr>
<td>CFA/RFS</td>
<td>3</td>
</tr>
<tr>
<td>Smoke alarm information</td>
<td>3</td>
</tr>
<tr>
<td>Insurance information</td>
<td>3</td>
</tr>
<tr>
<td>Local government</td>
<td>2</td>
</tr>
<tr>
<td>Emergency services</td>
<td>2</td>
</tr>
<tr>
<td>Building notice information</td>
<td>2</td>
</tr>
<tr>
<td>iPhone app</td>
<td>1</td>
</tr>
<tr>
<td>SES</td>
<td>1</td>
</tr>
<tr>
<td>Parcel information</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>74</strong></td>
</tr>
</tbody>
</table>

The highest ranking category as the most used source was local knowledge, closely followed by the media. Within smaller local communities local knowledge is often a highly regarded source of information as it combines historical evidence with past experience which often spans 20 years or more. The category of media encompasses television broadcasts, newspapers, and magazines, and as an easily accessible resource with a level of authority, it is not a surprise that this resource was utilised. The Bureau of Meteorology also received a
high response with many people using the weather information to guide the management of risks such as severe weather, flooding, and cyclones. The remaining sources of information vary but include organisations such as local governments, and agencies such as the CFA (Country Fire Authority VIC), RFS (Rural Fire Service NSW) and SES (State Emergency Service).

In order to understand the methods, if any, which were used by citizens to analyse this risk once it had been identified as a threat the respondents were asked to list the techniques which had been used. Table 6.11 displays a summary of the results. A total of 33 respondents listed a method, and 46 respondents noted that no method was made used.

Table 6.11 Methods used to analyse risks

<table>
<thead>
<tr>
<th>Method</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk matrix</td>
<td>10</td>
</tr>
<tr>
<td>Common sense</td>
<td>9</td>
</tr>
<tr>
<td>Official warnings</td>
<td>3</td>
</tr>
<tr>
<td>Weather forecasts</td>
<td>3</td>
</tr>
<tr>
<td>Local knowledge</td>
<td>2</td>
</tr>
<tr>
<td>Past experience</td>
<td>2</td>
</tr>
<tr>
<td>Professional consultation</td>
<td>2</td>
</tr>
<tr>
<td>Technical assessment</td>
<td>1</td>
</tr>
<tr>
<td>Insurance information</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>33</strong></td>
</tr>
</tbody>
</table>

The top two responses given were risk matrices and common sense. From the range of responses received, some can be classified as valid risk analysis techniques such as the use of a risk matrix, professional consultation or technical assessment, while other responses such as common sense, local knowledge and past experience were not the rigid techniques expected. The information used in the overall risk management process of risks affecting the land and property of citizens provides further insight into how risk analysis is carried out and why certain techniques were made use of. This risk information was explored in the following section.

Section summary – risk analysis

- Risk identification was most commonly carried out at the individual level with self assessment, common sense and local knowledge assisting in the process.
- When making decisions regarding risk, local knowledge and the media were the most referenced sources of information.
- The risk matrix and common sense were the two most common ‘analysis methods’ used by citizens.
Risk information

Section four of the questionnaire focused on the information used to execute risk management decisions and the origins of this information.

Accessing the information

Accessing the information is one of the biggest issues faced by citizens when trying to manage risks affecting their land and property. In order to access the information they first need to locate the information, whether it be from a government department website, another online resource, from the local government offices or an insurance company, and once they have found it they need to be able to either view the information, download it, receive a copy of it etc. Whether there is access privileges attached to the information or a fee associated to the access of such information can drastically alter whether a citizen achieves their goal of obtaining the information pertaining to the risk. The results of whether citizens had accessed any information about risk are shown in table 6.12.

<table>
<thead>
<tr>
<th>Relationship</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lessee</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td>Owner</td>
<td>15</td>
<td>21</td>
</tr>
<tr>
<td>Total</td>
<td>23</td>
<td>41</td>
</tr>
</tbody>
</table>

The results show that overall, 23 respondents had accessed information about risk affecting land and property, while 41 respondents had not. The relationship of whether the respondents were owner occupiers of the land and property or were lessees is also shown. It can be seen that more owners had accessed risk information than lessees, but a similar number from each category had not accessed information. Whether information has been accessed might be influenced by the types of risks faced, or by the relationship to the land. As title-holders of the land and the property, owners might be more risk averse than lessees as they have a vested financial interest in the entire land and property, while lessees, as only occupiers of the land and property might be concerned with the contents of the property only.

The type of information accessed, and whether it was spatial or non spatial information was the next question asked. Eight citizens responded positively, while 37 responded that they had not accessed spatial information. The spatial information accessed included: Google maps and layers within the program such as routes, parks and open areas; the iPhone application ‘fires near me’ which monitors and alerts users of fires in New South Wales which are near the person; other forms of maps; and weather and climate information provided through different websites such as Elders insurance and the Bureau of Meteorology (BOM).
Of the citizens which accessed the risk information (spatial or non-spatial), there were organisations where they obtained the information include: the Bureau of Meteorology, local government organisations, fire services including the Country Fire Authority (CFA VIC) and the Rural Fire Service (RFS NSW), insurance companies, various websites online, state government departments, media organisations (local newspapers, magazines etc), State Emergency Services (SES), and private companies (pest/building inspectors). The most frequented place for risk information was the Bureau of Meteorology website, followed closely by local governments, fire services, insurance companies, and the internet in general. Whether this information was obtained freely or whether there was a cost associated with it, such as a license fee was then questioned. The results show that 49 respondents obtained the information freely, while only 1 person paid for a license to access the information. The format of the risk information accessed is broken down in figure 6.3 below.

**Figure 6.3 The format of the information collected by citizens**

As the figure shows, a large percentage of the risk information was obtained verbally. The format of brochure was also popular. Both of these versions are obtained in person which is an interesting result considering the easy access to online resources. The preferable format for risk information for citizens is shown below in figure 6.4.

**Figure 6.4 The format of the information collected by citizens**
The figure reflects an increase in information provided as a map or overlay, through email, or as a document summary. Information in the format of a brochure, fact sheet, and full document remained relatively the same, and suggestions for other formats, including verbal information which was the most common format, decreased. Formats suggested by respondents in this category included information provided by a professional consultant, and information provided through the media such as newspapers and television broadcasts. The results demonstrate that citizens have a preference for quick and easily accessible information in the form of email and fact sheets, and that they prefer a visualisation of the risk information through a map display of the data.

**Using the information**

Once the information was obtained, how the information was used to manage risk was important to understand. Responses from citizens revealed that the information received was used in a number of ways, such as:

- To confirm or support initial risk identification and analysis
- To assist in mitigation and preparedness activities
- To motivate citizens to obtain insurance
- To assess the current risk management strategies in place
- To provide motivation to seek further information regarding the risks

This shows that stakeholders make use of the information in a number of ways and that not all information is treated the same. It is applied to a range of different phases within the risk management process. Understanding the different information requirements of citizens is therefore an important task. The information that citizens have listed as useful in the identification, management and assessment phases of the risk management is shown below in table 6.13.

<table>
<thead>
<tr>
<th>Table 6.13 Risk information type requests by citizens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information Type</td>
</tr>
<tr>
<td>Location specific risk information</td>
</tr>
<tr>
<td>Accurate risk information</td>
</tr>
<tr>
<td>Risk mitigation information</td>
</tr>
<tr>
<td>Brochure</td>
</tr>
<tr>
<td>Professional consultation</td>
</tr>
<tr>
<td>Map of risks</td>
</tr>
<tr>
<td>Weather information</td>
</tr>
<tr>
<td>Historical location specific risk information</td>
</tr>
<tr>
<td>Property value information</td>
</tr>
<tr>
<td>Fact sheet</td>
</tr>
<tr>
<td>iPhone app</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>
Citizens listed information which was accurate, specific to a location, and useful in carrying out mitigation techniques as information most useful to them in implementing successful risk management strategies. Based on the information received from previous questions, information which is easily accessible, for example available online is also a preference. With the technology available today, expectations for this type of information by citizens is becoming expected. Along with the technology for information holders to disseminate information to users, is the ability for users to disseminate information of their own through volunteered geographic information. This can be distributed through social media networks and other available and often free resources. Of the citizens sampled, four out of 82 responded that they had created information themselves about risk. The remaining participants responded that they had not created any risk information. Of the participants which had created information, social networks were the most used with warnings posted by the user via these networks. How this information, once obtained, is converted into effective risk treatment action is explored in the following section.

Section summary – risk information

- The most popular places to access information for risk management were listed as the website of the Bureau of Meteorology, local council offices and websites, the Country Fire Authority (in person and online) and insurance company websites
- All respondents except one accessed sources of data that were free for their risk management activities
- For risk management purposes, citizens want information that is: location specific; accurate; and informative of risk mitigation strategies

Risk treatment

The results of the risk treatment section are presented in the two sub sections of risk treatment of priority risk, which looks at the treatment implemented for the risk identified as the highest priority for each respondent, and risk treatment of all risks, which explores the overall treatment plan for all identified hazards affecting a respondent. The treatment options selected, and whether a treatment is applied at all contributes to the understanding of the risk management roles perceived by stakeholders.

Risk treatment of priority risk

How risks which present the biggest threat to the land and property of citizens are treated in terms of risk management is of interest in this study as it reveals what treatment options are used most frequently, and what treatment options are most available to citizens. The different treatment options utilised by owners, lessees and the combined results are shown in figure 6.5 below.
The figure shows that mitigation actions/reduce is the most implemented treatment of all available treatments. It also shows that the transference of risk is more than twice as common in owners as in renters which again might refer to the relationship and financial consequences resulting from a risk affecting the land and property. The options of avoid and retain are used less often by both parties.

The reasons for the selection of the treatment options include: advice given which nine respondents listed; the most appropriate actions – which was listed by thirteen respondents; cost; common sense; responsibility; peace of mind; and lack of knowledge, which were all listed by one or more respondents.

The selection and implementation of treatment for all possible risks affecting the land and property of citizens is now discussed.

**Risk treatment of all risks**

As there are a large range of risks which affect the land and property of a citizen, making a decision regarding which risks need to be treated, and what treatment action is appropriate for what risks is a difficult decision. To understand which risks render which treatment decisions by citizens, respondents of the questionnaire were asked to indicate which treatment action is the most appropriate for managing each risk which is relevant to the respondents land and property. The results are summarised below in figure 6.6
Chapter 6: Results of the risk stakeholder case study

Figure 6.6 Treatment selections for all relevant risks

From the figure it can be seen that for the majority of risks, the option to avoid is not a treatment option selection by many citizens. This could be due to the risk not being relevant to many respondents or simply that it is a risk which cannot be avoided. The treatment options of reduce and transfer are selected regularly throughout the figure for most risks, and particularly for the risks of pests, house fire, and bushfire. This is expected for risks such as bushfire where a range of mitigation strategies exists, and much information is available on how to implement such strategies. Risks where there are few mitigation actions that can take place, such as drought and earthquake, are therefore expected to have a higher retention rate which is reflected in the figure also.

Moving from the treatment options which are appropriate for each risk to which treatment options require priority, respondents were asked to indicate the treatment of which risks were considered high priority and low priority.
Results show that overall the risks of cyclone, tsunami, landslide, and sea level rise received a low priority rating for treatment implementation. This could be due to the likelihood of the risk, and also due to the treatment options available. Risks such as bushfire, severe weather, house fire, and pests received ratings of high priority by many. These risks, as discussed before, have many treatment options which might explain why they can be marked as high priority – as they are easily available and affordable options.

Within the treatment options available, the selection of transference of a risk often means the purchase of an insurance policy to cover the cost of damage which is passed on to the insurance company in exchange for an agreed amount premium. To determine how popular this treatment option was, respondents were asked to indicate whether they had obtained insurance for any risks. Looking at the responses of all respondents, 71% of the citizens who participated in the questionnaire hold insurance for one or more risk events.

Figure 6.8 below divides the responses into the two relationship types studied: lessees and owners.
The results show a visible difference between owners and lessees. Of the owners sampled, almost all have obtained insurance to cover the negative effects of risk events, while for the groups of lessees sampled, less than half of respondents have taken out insurance. As discussed in earlier sections, there are a range of reasons which contribute to these findings.

The final section of the questionnaire, monitoring and review which looks into the actions taken after risk treatment has been carried out is discussed below.

**Section summary – risk treatment**
- Risk reduction and risk transfer are the most commonly applied risk treatments by citizens
- Citizens have indicated that the treatment of house fire and bushfire is high priority, and of higher priority than other risks
- 93% of owners and 46% of lessees hold an insurance policy against risks which affects their land and property

**Monitoring and review**
The results of the monitoring and review section of the questionnaire are presented in the three sub sections of emerging risks, updating information, and volunteered geographic information.

**Emerging risks**
The monitoring and review phase of the risk management process is the last phase of the cycle and involves going over the known risks and updating any information relevant to the effective management of the risks. Of the respondents, thirteen indicated that they had carried out this updating process, while 40 indicated that they had not. From this question, respondents were then asked whether during this monitoring and review process whether any
new threats or risks had emerged that were not known in the initial process. Of the respondents, 51 had not found any new risks, while three had. The small response of three in this case looks insignificant, however depending upon the risk; increased risk awareness for three citizens could have significant impacts if the risk event were to occur now as opposed to previously when they were not aware of the risk.

**Updating information**

The topic of updating information is a relevant one when discussing risks. As risks and risk events are dynamic, current and accurate data is critical to ensure effective action has been taken. Within the questionnaire carried out, seven respondents had updated information while 46 had not. Again, the significance of these results are dependent on the specific risks where the information was or was not updated, however in all cases, the use of the most recent information for the management of risks is best practice. For the cases which did update their information, the parties which supplied the revised data were: Elders, Bureau of Meteorology, private builder, insurance companies, RFS, SES, a body corporate, and the local government. As not all citizens had received updated information regarding their risks, whether or not they would find value in being provided with information such as this was asked. The results showed that 77% of respondents did find value in updated risk information.

**Volunteered geographic information (VGI)**

The final question asked was whether volunteered geographic information had been taken advantage of in risk management activities or for the purposes of risk management. Eighty percent of respondents indicated that they had not, while twenty percent said that they had.

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### Section summary – monitoring and review

- Three-quarters of the citizens who participated do not update their risk information
- 77% of citizens would find value in receiving updated risk information
- 20% of citizens utilise volunteered geographic information for risk management purposes

### 6.2.4 Summary

Overall, the risks experienced by citizens in both states and both categories were similar and did not show much variation. The treatment and management of risks however differed between the two groups of owners and lessees, which reflected the different risk management perceptions held. The differences in terms of risk preparation, analysis, information sought and overall treatment was determined to be a product of the relationship which each stakeholder has with the land and property. As lessees their interest in and motivation for preserving and maintaining the overall land and property as a whole is less than an owner
who has a much higher financial interest. The lessee’s interest stops with the internal contents of the property, and therefore their risk management strategies do not extend as far as the owners category. The conclusion is that the type of land right held of the land and property vastly impacts the risk management choices.

During the subsequent risk analysis stage of the process, the consultation of outside information was not as common as local knowledge or personal opinions. The information provided by emergency services and other authoritative sources in the area of risk are extensive and valuable and should be consulted more frequently and utilised by citizens for these types of tasks.

Information which is specific to the parcel which the citizen is managing, is accurate, and has detailed information regarding possible treatment strategies for a range of risks, and most importantly is free, is a standard which citizens now demand. Current resources offer different parts of this description, however there is not ‘silver bullet’ risk management resource for citizens which encompasses all of these qualities yet.

The management processes of another stakeholder group – local governments will now be examined to determine the differences and similarities in the risks experienced, the information required, and the treatment strategies implemented.

6.3 Local government level

For the local government level assessment the two jurisdictions of New South Wales and Victoria were the focus. Within these two jurisdictions, a range of local governments were invited to participate in an in-depth questionnaire, a semi-structured interview, or both the in-depth questionnaire component and the interview component.

The goal of the study was to achieve at least eight responses from each jurisdiction overall with six responses to the questionnaire in each state, and at least two semi-structured interviews carried out in each state. The interviews which were carried out were scheduled for one hour each, and on all occasions the interviews were concluded between 30 minutes and 1 hour. The in-depth questionnaire which was distributed as an online form, on average, took the respondents 1 hour and 42 minutes to complete. As it was a qualitative study the details rather than the quantity of information collected was important. Due to the geographical location of the researcher, more interviews were able to be conducted in Victoria than in New South Wales; however the quota required was met for both states. The results of the in-depth questionnaire and interview will now be discussed following a brief overview of the two jurisdictions discussed.
6.3.1 New South Wales
There are 152 local government areas in New South Wales. The chief responsibilities of local governments are the provision of community facilities, maintenance of infrastructure such as roads, town planning and development approvals, and the management of waste disposal.

From the state of New South Wales three semi-structured interviews were conducted and seven questionnaires collected. The map below shows the distribution of the data collected.

![Map of New South Wales Local Government Areas](image)

*Figure 6.9 Map of participating LGAs in NSW*

The participating local government organisations included:

- Albury City Council (Interview)
- Armidale Dumaresq Council (Questionnaire)
- Bankstown City Council (Questionnaire)
- Campbelltown City Council (Questionnaire)
- Dubbo City Council (Questionnaire)
- Hornsby Shire Council (Interview)
- Lockhart Shire Council (Interview and Questionnaire)
- North Sydney Council (Questionnaire)
- Wyong Shire Council (Questionnaire)

6.3.2 Victoria
There are 79 local government areas within Victoria. The role of local government in this state is comparable to New South Wales local governments where the management of community facilities, roads, waste and development are key activities.
From the state of Victoria five semi-structured interviews were conducted and ten questionnaires collected. The map below shows the distribution of the data collected.

![Map of Victoria Local Government Areas](image)

**Figure 6.10 Map of participating LGAs in VIC**

The participating local government organisations included:

- Bass Coast Shire Council (Questionnaire)
- Brimbank City Council (Questionnaire)
- City of Melbourne (Interview and Questionnaire)
- City of Monash (Interview)
- East Gippsland Shire Council (Questionnaire)
- Golden Plains Shire Council (Questionnaire)
- Hume City Council (Questionnaire)
- Indigo Shire Council (Interview)
- Macedon Ranges Shire Council (Questionnaire)
- Moira Shire Council (Questionnaire)
- Nillumbik Shire Council (Interview)
- Rural City of Wangaratta (Interview)
- Strathbogie Shire Council (Questionnaire)
- Surf Coast Shire Council (Questionnaire)

### 6.3.3 Questionnaire analysis

Within this section the responses to the questionnaire will be analysed and discussed either as a whole, or divided into the two jurisdictions sampled – New South Wales and Victoria.

**Risk management plan**

The first section of the questionnaire, the risk management plan referred to the risk management approach taken by local governments, the plans in place, and the objectives of
each plan. The results of these questions contribute to the overall understanding of the role local governments perceive as ‘their role’ in the management of risk to land and property.

**Formulation of risk management plan**

The implementation of an effective risk management plan is an important part of maintaining a safe community. To determine whether the existence of a risk management plan was common throughout local councils, respondents were asked to indicate whether their organisation had a risk management plan. The results of the question are shown in table 6.14 below and illustrate that of the organisations which responded, 88% had a risk management plan in place, while 12% responded that they did not.

<table>
<thead>
<tr>
<th></th>
<th>NSW</th>
<th>VIC</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>5</td>
<td>9</td>
<td>14</td>
</tr>
<tr>
<td>No</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 6.14 Organisations which had a risk management plan in place

Possible reasons for why two organisations indicated that a risk management plan was not in place within their jurisdiction could be due to a number of reasons. One possibility is a lack of resources or a problem with resource availability within the organisation. Another possible reason could be related to the terminology used within the questionnaire which specified a risk management plan rather than an emergency management plan. Within the organisation an emergency management plan might exist which may in fact cover much of what a risk management plan might, however it is not viewed as a risk management plan because of the terms used. The objectives of the risk management plan are therefore important factors for understandings the intentions of the plan, whether there is a distinct difference between a plan called a risk management plan and a plan called another name such as an emergency management plan.

In order to discover this, each questionnaire asked what the risk management objectives of the organisation were. The responses received from the local government participants were able to be organised into the four main categories of: business related objectives, public safety objectives, mitigation action objectives, and asset management objectives (table 6.15). The business related objectives address the management of risk to the Council as a business. They outline a need to reduce the exposure to risk and to reduce the financial impacts of any risk. They also aim to ensure correct processes such as audits, insurance and training for staff in the areas of risk is taking place.
Table 6.15 the risk management objectives of local governments in NSW and VIC

<table>
<thead>
<tr>
<th>Council management</th>
</tr>
</thead>
<tbody>
<tr>
<td>- To identify, analyse, evaluate, control and document Councils risk exposure</td>
</tr>
<tr>
<td>- To reduce Councils exposure to risk</td>
</tr>
<tr>
<td>- To identify, analyse and assess all risks that are likely to impact on the City</td>
</tr>
<tr>
<td>and plan strategies that recommend treatment options</td>
</tr>
<tr>
<td>- To reduce Councils exposure to financial claims</td>
</tr>
<tr>
<td>- To reduce the costs of Council insuring against risk</td>
</tr>
<tr>
<td>- To ensure accountability and responsibility is assumed for risk management at</td>
</tr>
<tr>
<td>all levels</td>
</tr>
<tr>
<td>- To ensure compliance with the relevant legislation, regulations, and industry</td>
</tr>
<tr>
<td>standards</td>
</tr>
<tr>
<td>- To regularly audit internal processes</td>
</tr>
<tr>
<td>- To monitor and review risks to ensure risk exposure remains within acceptable</td>
</tr>
<tr>
<td>levels</td>
</tr>
<tr>
<td>- To raise the awareness of risk management and to educate employees on good risk</td>
</tr>
<tr>
<td>management practices</td>
</tr>
<tr>
<td>Public Safety</td>
</tr>
<tr>
<td>- To ensure the safety of residents</td>
</tr>
<tr>
<td>- To minimise risk to the public</td>
</tr>
<tr>
<td>- To achieve safety goals</td>
</tr>
<tr>
<td>- To address human, environmental, cultural and financial risk</td>
</tr>
<tr>
<td>- To ensure the sustainable management of land and property</td>
</tr>
<tr>
<td>Mitigation Actions</td>
</tr>
<tr>
<td>- To identify and implement controls to reduce risk and eliminate high risk</td>
</tr>
<tr>
<td>activities</td>
</tr>
<tr>
<td>- To identify, assess, and mitigate risk exposure</td>
</tr>
<tr>
<td>- To identify areas at risk to natural disasters</td>
</tr>
<tr>
<td>- To reduce identified risks to an acceptable level</td>
</tr>
<tr>
<td>- To reduce the impact of natural disasters and climate change</td>
</tr>
<tr>
<td>Assets</td>
</tr>
<tr>
<td>- To maintain assets from deterioration and premature capital renewal or replacement</td>
</tr>
<tr>
<td>- To protect assets from damage from weather events and natural disasters</td>
</tr>
<tr>
<td>- To ensure a safe and sustainable future for the community through proper asset</td>
</tr>
<tr>
<td>management practices and service delivery</td>
</tr>
</tbody>
</table>

The public safety objectives address the safety and wellbeing of residents within the municipality, and promote a sustainable and risk free environment. The mitigation objectives aim to reduce the impact of identified risks through mitigation actions and to address developing concerns such as climate change. The final objectives category of assets focuses on maintaining Council property again natural disasters and other risk events which in turn supports public safety.

The scope of the risk management plan reflects the extent to which the local government applies the objectives. A large scope which can incorporate a range of objectives might be relevant in larger councils which have a high population and a business focused approach, while a smaller scope which focuses on the assets within the municipality and maintaining these for the good of the community might be more relevant in larger rural councils. Each respondent for the local government was asked to indicate the scope of the risk management
plan and the findings were summarised into four different scopes which each council can be
categorized into (table 6.16).

<table>
<thead>
<tr>
<th>Table 6.16 The scope of the risk management plan</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scope outlined by Council</strong></td>
</tr>
<tr>
<td>All categories of risk including: strategic risks, operational risks, financial risks, reputational risks, legal and regulatory risks, business disruption, human resources risk, and environmental risk</td>
</tr>
<tr>
<td>All hazards and risks</td>
</tr>
<tr>
<td>Council assets including roads, community and recreational buildings and property assets</td>
</tr>
<tr>
<td>All council activities and assets</td>
</tr>
</tbody>
</table>

The first description of the scope of the risk management plan is very broad and includes a
range of activities within the risk management plan. Of the eleven councils which responded
to this question within the questionnaire, three councils had this broad scope. These three
councils, while not within the metropolitan areas were located in areas with larger
populations and larger areas to manage. Two councils had a broad but non-specific response
which included all hazards and risks within the scope of their risk management plan. Three
councils included all council assets within the scope of the risk management plan, and three
again included all council assets as well as activities within the risk management scope. The
councils which included activities as well as assets within their risk management scope were
all metropolitan local government areas within each state jurisdiction. As a result, it would be
expected that these councils host many activities that are large scale, and would therefore
include these events alongside the assets within the scope.

Another important detail to be understood aside from the scope of the risk management plan
is how often the plan will be reviewed and reassessed. As each council maintains a different
cycle for reviewing and assessing risks, how often the risk management plan is revisited was
asked (table 6.17).

<table>
<thead>
<tr>
<th>Table 6.17 Timeframe of the risk management plan</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Timeframe</strong></td>
</tr>
<tr>
<td>Annually</td>
</tr>
<tr>
<td>2 years</td>
</tr>
<tr>
<td>3 years</td>
</tr>
<tr>
<td>4 years</td>
</tr>
<tr>
<td>5 years</td>
</tr>
</tbody>
</table>

The majority of councils responded that their risk management plan was revisited annually
and addressed then. Of some of these responses, the annual review was noted as a minor
organisational stakeholders

In order to better understand the role of the council in the risk management process, and their internal and external responsibility, each council respondent was asked to list the key internal and external stakeholders of the organisation. A range of stakeholders were listed, and many were common throughout both jurisdictions. The most noted stakeholder was the executive leadership team which incorporates the general manager, CEO and other high level members (table 6.18). The stakeholders with the title of asset manager, risk management committee or department, and the property manager or department were listed as the next most important internal stakeholders in the management of risk to land and property within the jurisdiction.

Table 6.18 Key internal stakeholder for the management of risk to land and property

<table>
<thead>
<tr>
<th>Key Internal Stakeholders</th>
<th>NSW</th>
<th>VIC</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Executive leadership team</td>
<td>8</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td>Asset manager</td>
<td>5</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Risk management committee/department</td>
<td>2</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Property Manager / Department</td>
<td>2</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Councillors</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>GIS Team</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Municipal Emergency Manager</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Bushfire management officer / Municipal fire prevention officer</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Risk management officer</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Municipal Recovery Manager</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Director of Planning and Community</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Director of Engineering Services</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Audit Committee</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Department Director</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Risk Coordinator</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Financial Services Manager</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Insurance Officer</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>All Staff</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Dept. of Environment and Primary Industries</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Technical Staff</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Maintenance Department</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Directors</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Depot Staff</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Parks services</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Projects committee</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

From there, stakeholders such as the Councillors and the GIS team were mentioned as internal stakeholders within each state, as well as stakeholders who had specific and general assessment and another timeframe such as 3 years or 5 years existed for a major review of the plan. For the remaining councils, a range of review dates existed between the 2 year and 5 year mark.
risk management roles. A range of other stakeholders were mentioned, but were listed less than twice by local government representatives.

External stakeholders for the management of risk to land and property at the local government level, as listed by the representative from the local government included the community, rate payers and residents, contractors and a range of emergency services organisations such as the SES, police in both states – Victoria Police and NSW Police, fire services such as CFA, RFS and MFB, and ambulance services (table 6.19).

| Table 6.19 Key external stakeholder for the management of risk to land and property |
|--------------------------------------|------|------|------|
| External Stakeholders               | NSW  | VIC  | Total|
| State Government Departments        | 6    | 7    | 13   |
| Community                            | 5    | 2    | 7    |
| Rate Payers / Residents              | 5    | 1    | 6    |
| Contractors                          | 1    | 5    | 6    |
| Fire Services (MFB, CFA, RFS)       | 1    | 4    | 5    |
| State Emergency Service (SES)       | 1    | 3    | 4    |
| Community Groups                    | 0    | 4    | 4    |
| Police (VIC and NSW)                | 1    | 2    | 3    |
| Volunteers                          | 1    | 1    | 2    |
| Service/Utility Providers           | 1    | 1    | 2    |
| Parks and Wildlife Groups           | 2    | 0    | 2    |
| Ambulance Victoria                   | 0    | 1    | 1    |
| Federal Government                   | 1    | 0    | 1    |
| Local businesses                    | 1    | 0    | 1    |
| Roads and Maritime Services         | 1    | 0    | 1    |
| Department of Local Governments     | 1    | 0    | 1    |
| Catchment Management Authority      | 1    | 0    | 1    |
| Council Committees                  | 0    | 1    | 1    |
| Council Insurers                    | 0    | 1    | 1    |
| Red Cross                           | 0    | 1    | 1    |
| Regulatory Authorities              | 0    | 1    | 1    |

Other external stakeholders mentioned included a range of different state level government agencies, such as departments which deal with land, the community, transports, the environment etc, and the federal government departments in general. Additionally, other non-governmental group which deal with these issues such as utilities companies, local businesses, and parks and wildlife groups were listed.

The next phase of the questionnaire explored the specific risks which affect the land and property of local governments. This will be discussed and the results presented in the following section.
Chapter 6: Results of the risk stakeholder case study

Section summary – the risk management plan

- Of all the local government respondents, 88% had a risk management plan in place
- The risk management objectives of local councils fall into one of the four categories of: council management, public safety, mitigation actions, and assets
- The executive leadership team is the most important internal stakeholder
- The community, residents, and rate payers, followed by emergency services organisations and state government departments are the key external stakeholders

The risks

This section of the questionnaire aimed to understand the different risks which pose a threat to the land and property managed by the local government organisation. Each participant was asked to indicate whether each risk listed was a threat to the land and property of the organisation or not, and to include any further risks which were not listed (table 6.20).

Table 6.20 Risks identified by LGA as being a threat to land and property of the organisation

<table>
<thead>
<tr>
<th>Hazard</th>
<th>NSW</th>
<th>VIC</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Riverine flooding</td>
<td>6</td>
<td>7</td>
<td>13</td>
</tr>
<tr>
<td>Bushfire</td>
<td>7</td>
<td>7</td>
<td>14</td>
</tr>
<tr>
<td>Earthquake</td>
<td>5</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>Severe weather</td>
<td>7</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>Cyclone</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Tsunami</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Landslide</td>
<td>3</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Sea level rise</td>
<td>3</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>House fire</td>
<td>5</td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td>Fraud</td>
<td>4</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Drought</td>
<td>5</td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td>Disease outbreak</td>
<td>4</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Asbestos</td>
<td>4</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Pests</td>
<td>4</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>Blue green algae</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Unsustainable financial situation</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Major transport accident with hazardous substance</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>64</strong></td>
<td><strong>63</strong></td>
<td><strong>127</strong></td>
</tr>
</tbody>
</table>

The results show that a range of different risks affect organisations in both New South Wales and Victoria. Riverine flooding, severe weather, bushfire, drought and house fire are all
relevant and high rating risks within both states, while risks such as tsunami and cyclone do not rate very highly. The three risks of blue green algae (which affect the river system), an unsustainable financial situation, and a major transport accident with a hazardous substance were all suggested as additional risks which have an effect on the land and property within the jurisdictions that suggested them.

To understand the relevance of each of these risks which have been identified as risks which pose a threat to land and property managed by the local government organisations, the threat level of each risk was requested. Each respondent was asked to rate on a scale of low to high the threat each risk presented (if any at all). The results of this investigation are summarised in figure 6.11 below.

![Figure 6.11 Threat levels of each risk](image)

The figure shows similar results to the citizen’s questionnaire in that a large number of respondents indicated that cyclone and tsunami were not high threats. A large number of respondents in this questionnaire also indicated that landslide and sea level rise were not high
threat risks either. These results could be related directly to the location of the local
government organisations who participated in the questionnaire and could reflect whether
many organisations have coastal geographies, or alpine or mountainous terrain. The risks of
riverine flooding, bushfire and severe weather were rated as a high threat by many of the
local government respondents which might also reflect the geography of the local
government area.

The next question respondents were asked to address was, of all the possible risks, which risk
posed the greatest threat to the land and property of the organisation. The results are shown in
table 6.21 below.

<table>
<thead>
<tr>
<th>Risk</th>
<th>NSW</th>
<th>VIC</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bushfire</td>
<td>3</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Severe weather</td>
<td>2</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Riverine flooding</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Unsustainable financial situation</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

The table shows that the two risks of bushfire and severe weather pose the greatest threat to
the land and property of the local government organisation, followed by the risk of riverine
flooding. The risk of unsustainable financial situation was a suggested risk by a participant.
Reasons given as to why respondents for the local government organisations felt that these
risks posed the greatest threat were able to be summarised into the following four reasons: the
risk posed the greatest threat because high vulnerability exists in regards to that risk, the risk
if it were to occur would create the highest consequences (in terms of physical damage,
financial damage, safety for citizens etc), this particular risk has occurred in the past, and
there is a proximity to the hazards which makes it a high threat (figure 6.12).

![Figure 6.12 Reasons for considering the risk a threat](image-url)
Almost half of the respondents listed the reason why this risk poses the greatest threat as either high vulnerability (to the risk) or highest consequence (if the risk were to occur).

To understand how at risk each local government organisation is in regards to the risk (selected above) which poses the greatest threat, the likelihood of occurrence of the risk, and the consequence of occurrence was collected. As was shown above, the reason behind the risks selected as the greatest threat above was attributed to a vulnerability to that risk, and a severe consequence of that risk for some organisations, so whether these factors are highlighted in the following data will be of interest. The results are shown in table 6.22.

<table>
<thead>
<tr>
<th></th>
<th>Unlikely</th>
<th>Rare</th>
<th>Possible</th>
<th>Likely</th>
<th>Almost certain</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Catastrophic</strong></td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td><strong>Major</strong></td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td><strong>Moderate</strong></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td><strong>Minor</strong></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Insignificant</strong></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

The majority of local governments have rated their greatest risk as a likely or almost certain event with a moderate or major consequence. Two of the local government organisations have listed the consequences as catastrophic. Overall six local governments have indicated that the risk which poses the greatest threat is an extreme risk (red section), while eight have listed it as a high threat risk (orange section) and only one has listed their greatest risk as a medium threat (yellow section). The results shown here reflect and support the reasoning behind the selection of these risks as the most threatening risks for the local government municipality and organisation. To burrow further into the issue of risks and the risk management strategies, how each risk was identified and analysed will be explored and discussed in the following section.

**Section summary – the risks**

- Severe weather, bushfire and riverine flooding are the top three risks which affect the land and property of the local government respondents
- 41% of local government respondents rated bushfire as the biggest threat, 35% selected severe weather, and 18% riverine flooding
- The majority of local government respondents rated these risks as **high or extreme** risks
**Risk analysis**

The third section of the questionnaire aimed to understand how the risk, indicated above as the greatest threat to the organisation, was identified and analysed. In order to gain this understanding, each participating organisation was asked to explain how. Seven of the local government participants responded that the risk was identified through an internal risk management study, four responded that the risk had occurred in the past – and that from this experience knowledge of the risks existence was found, two participants responded that data from past events helped them identify the risk – which is similar to the previous reasons, and the remaining three organisations gave the individual responses of: expert software assisted in the identification process; internal and external risk management studies identified the risk; and the risk was identified as it was known to be the most likely event.

The methods used to identify and assess these risks included the risk matrix, methods outlined in the ISO risk management standards, methods outlined in CERA – the Community Emergency Risk Assessment manual, and through inspections. Of all these methods listed, the risk matrix was the most commonly utilised. While a range of methods for assessing risk and for making decisions regarding risk exist, the information available is one of the primary factors. Without the information, the methods have nothing to be applied to. To gain a greater understanding of the information used to manage or make decisions regarding risk at the local government level, participants were asked to list the different types and sources of information used within the risk assessment process. The results of this show that a range of different organisations are engaged in the gathering of this information (table 6.23).

<table>
<thead>
<tr>
<th></th>
<th>NSW</th>
<th>VIC</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal and external advice</td>
<td>1</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Weather information (BOM)</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Historical data</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Advice of other agencies</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>SES advice</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Flood studies</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Organisational financial information</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Organisations mapping layers and overlays</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Victorian Coastal Inundation dataset</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Data modelling</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

The most commonly used was internal and external advice, which can be expanded to include a range of emergency services and support agencies such as the Rural Fire Service, Country Fire Authority, State Emergency Services, Victoria Police, and NSW Police etc. Information from the Bureau of Meteorology was also utilised as well as historical data about specific
local government areas. The presentation of this information sourced to assist in the overall analysis of risks was most commonly presented as a report, fact sheet or in the format of a map. As many of the organisations listed have spatial capacity and specific GIS personnel, the presentation of such information in the format of a map is not surprising. Depending on the person who requested the information, the presentation of the information might be specific to their role, i.e. if they are in a GIS role themselves, they might be given data or a map, whereas an executive role person might prefer or receive the information in the form of a report or fact sheet. The specific details of the information used within this process are explored below.

**Section summary – risk analysis**

- 44% of local councils which participated used an internal risk management study to identify and analyse risks which affect the land and property of the organisation
- The risk matrix is the most common tool used for assessing risk within the local jurisdictions and determining risk ratings for each risk

**Risk information**

Section four of the questionnaire focused on the information used to execute risk management decisions and the origins of this information.

**Accessing the information**

The accessing of information can be one of the biggest barriers in effective management of risk. How a local government acquires information for the management of risks relevant to their municipality is therefore of interest, as well as whether there are any problems encountered in this process. Whether any information at all was accessed outside of the organisation for the purposes of risk management was the first question posed. Of the participants which responded to this question, it was found that the majority of local governments source information for risk management purposes (table 6.24).

<table>
<thead>
<tr>
<th>Table 6.24 Risk information accessed</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSW</td>
</tr>
<tr>
<td>-----</td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
</tbody>
</table>

Whether the specific information accessed was spatial or aspatial in nature was also of interest. Thirteen of the participants responded that the information was spatial, while one responded that it was not. The type of spatial information utilised included GIS maps and layers which included flood precincts, bushfire zones, cadastral overlays, buffer zones created using other layers, layers sent from Melbourne Water, as well as other types of spatial
information such as weather forecast maps, and models created from LiDAR information. The specific organisations which supplied this spatial information included: State government departments, the Bureau of Meteorology, fire agencies, consultants, state treasury, Melbourne Water, CSIRO, and State Emergency Services. The state government departments, the Bureau of Meteorology, and fire agencies were the most utilised resources for this information. This reflects the data showing that the three most identified risks were severe weather, bushfire and riverine flooding. Regarding the custodianship of this information once the data is received – the organisation which created the information remains the custodian. The format of the data obtained from the organisations listed above is shown below in figure 6.13.

![Format of risk information collected](image)

**Figure 6.13 Format of the information collected by local governments**

The figure shows that the information was collected in a range of different formats. The most common format was as a full document or in the format of a map or overlay. The use of GIS information was shown to be popular as it allows for spatial information to be shared. Other formats used to a lesser extent included brochures, fact sheets, emails, verbal information and URL links to other information. To learn more of what information format is the most useful for managing risks which threaten the land and property of local government organisations, the format which would be preferred was asked. The most popular response to this question was for maps and overlay – a spatial format, closely followed by a full document which would include detailed information about the risk (figure 6.14).
Figure 6.14 Format preferences for risk information

A preference for information delivered in an email format was observed, as well a preference for information in the format of a document summary. Verbal information was shown to be not wanted at all, with no requests for this format, and the demand for brochure and fact sheet format remained the same.

**Using the information**

Once the information was obtained, how the local government organisations made use of the information contributed to the overall understanding of the purpose of such information. Responses from the local government participants revealed that the information received was used in a number of ways, such as:

- For audit and financial planning purposes
- To add to the pool of knowledge
- To supplement current understanding
- For comparative purposes by staff
- To assist with risk identification
- To assist with the proper allocation of resources
- To help determine the likelihood and consequence ratings
- For modelling purposes
- To contribute to emergency and risk management plans

This shows that the information received is utilised by local government organisations for a range of risk management stages. Because the uses are shown to be so diverse, whether there are any information gaps or whether there was a lack of information for a certain stage within the risk management process was of interest. The question of what information does the organisation require, or would like to have to improve the current risk management processes
was posed to the organisations participants. The responses were grouped around similar themes which included:

- Improved weather information: as severe weather is a risk experienced by all local governments to some degree, and experienced at the high to extreme level by many; the need for accurate and timely storm weather information is important. Information requested by local governments included improved information to indicate the severity of the coming weather, improved radar information, and improved warning systems for storms.
- Improved flood mitigation and management information: information which includes up to date modelling information and accurate accompanying data such as soils and topology.
- Increased detail in fire risk data
- Government legal instruments: such as lease terms, indemnities, insurance requirements etc.
- Open access licensing to GIS based programs: to allow for different formats of GIS data layers to be accessible to all.

The requested information, while quite broad is not unachievable and could be enhanced with relationship building between organisations which supply the information as well as state governments who allocate budgets. Improvements in this respect need to be prioritized. The current information however is faring well with all local government respondents indicating that the information which they did acquire was useful in answering their queries regarding risk management. How this information, once obtained, is converted into effective risk treatment action is explored in the following section.

**Section summary – risk information**

- The most popular places to access information for risk management were listed as state government departments, the Bureau of Meteorology, and fire agencies
- The majority of information collected for risk management purposes is in the format of a full document, map/overlay or a fact sheet. The preference would be for a map/overlay or full document
- For risk management purposes, local governments want improved weather, flood mitigation and management, and fire risk information as well as open access licensing to GIS based programs
Risk treatment
The risk treatment section is divided into the two areas of ‘risk treatment of priority risk’ and ‘risk treatment of all risks’ for the presentation of the results. The first section looks at the treatment implemented for the risk identified as the highest priority for each local government organisation, and the second explores the overall treatment plan for all identified hazards affecting a local government organisation. Again, the treatment implemented informs the role local councils have in managing risk to land and property within their jurisdiction.

Risk treatment of priority risk
How risks which present the biggest threat to the land and property of a local government organisation are managed and the treatment options selected reveals the resources available to a local government organisation. Why these treatment options have been selected is also of interest. The respondent for each local government was asked to indicate which risk treatment options were being applied to the risk which presented the greatest threat to the land and property of the council. The results are shown in figure 6.15 below.

![Figure 6.15 Distribution of risk treatments](image)

As the figure shows, the reduction and mitigation option is the most popular choice, whether a range of options are selected or not. The other methods – transfer, avoid and retain are not made use of as much, however depending on the risks in questions, which are bushfire, severe weather and riverine flooding mostly in this group, the options might vary. As the risks mentioned cannot be avoided and there are many mitigation options that can be carried out to reduce the severity of the risk event it is expected that the reduce treatment option should be popular. The reasons given by the respondents for the selection of the above treatment options include: cost which nine respondents listed; advice given – which was listed by four respondents; analysis; practicality; community expectations; legal
responsibilities; traditional knowledge; requirement for innovation; achievable objectives; and public safety, which were all listed by one or more respondents.

The selection and implementation of treatment for all possible risks affecting the land and property of local government organisations is now discussed.

**Risk treatment of all risks**

Referring back to all possible risks which may affect the land and property managed by the local government organisation, each respondent was asked to indicate the treatment the organisation has selected to manage each relevant risk (figure 6.16).

![Figure 6.16 Treatment selections for all relevant risks](image)

As the figure shows, the reduction and retention strategies are heavily utilised in the management of most risks. For risks which are relevant to the majority of local government areas such as severe weather and bushfire, the mitigation strategies far outweigh the other possible options. The importance of effect management for these risks is shown in the next figure, figure 6.17, where the priority for the implementation of such treatments is shown.
The three risks of severe weather, bushfire, and riverine flooding, shown to have the biggest impact upon local governments are rated as high priority for management. Other risks, despite having a high consequence or a high likelihood, but not both are not as urgent in the matter of treatment, or may not have any effective treatment options available to address the risk. The treatment option of insurance is often a popular one if the price is at level which enables local governments to purchase it. For the local governments within the questionnaire, just over three quarters had obtained insurance as a treatment option for one or more risk.

The final section of the questionnaire, monitoring and review, looks into the actions taken after risk treatment is complete.
**Section summary – risk treatment**

- Risk reduction and risk retention are the most commonly applied risk treatments by local government organisations
- Local government respondents have indicated that the treatment of bushfire, riverine flooding and severe weather are the highest priority risks
- 77% of local government organisations hold an insurance policy against risks which affect the land and property managed by the organisation

**Monitoring and review**

The results of the monitoring and review section of the questionnaire are presented in the three sub sections of emerging risks, updating information, and volunteered geographic information.

**Emerging risks**

The monitoring and review phase of the risk management process is the last phase of the cycle and involves going over the known risks and updating any information relevant to the effective management of the risks. Of the local government respondents, thirteen indicated that their organisation had carried out this updating process, while three indicated that their organisation had not. From this question, the local government participants were then asked whether the risk management plan itself was updated based on trends, successes, changes or failures observed. Fifteen local government organisations responded positively, while one responded that no, this updating phase did not take place.

**Updating information**

The monitoring of the internal and external contexts is a necessary process in the effective updating of information for the purposes of risk management. Of the local governments which participated in the questionnaire, fourteen responded that these contexts were monitored as part of the updating process; while two answered that they did not monitor these contexts. Monitoring the contexts allows for any emerging risks to be detected that were not present during the initial risk assessment. Four of the local government organisations responded that they had detected new risks in this way, which they were not aware of previously.

In order to assist this process, updated information needs to exist to replace the previous information which is no longer as current. Monitoring the accuracy of the information is one part of this process. Of the organisations involved, eight had monitored the accuracy of their information whereas seven had not. While not all of the organisations manage to update their information themselves, it is a process they all agree is beneficial with all local government
organisations agreeing that they would find value in being provided with updated risk information.

**Volunteered geographic information (VGI)**
The final question asked whether volunteered geographic information had been taken advantage of in the risk management processes of the organisation or not. Some examples of this include the tweeting of known hazards or risk events to citizens within the municipality, or of receiving information from the public regarding potential or current risks. When asked this question, twenty percent of the local governments responded positively. This shows a positive step towards embracing current technologies and new trends in the management of risk. From recent risk events within Australia, the use of such information has proven useful and is worth exploration by organisations at the local government level.

### Section summary – monitoring and review
- 81% of the local governments who participated update their risk information
- All of the local government organisations which participated responded that they would find value in receiving updated risk information
- 20% of local governments who participated have utilised volunteered geographic information for risk management purposes

### 6.3.4 Questionnaire summary
Overall, the risks experienced across both jurisdictions did not vary much and the overall risk management process was similarly aligned. Almost all of the jurisdictions had a risk management plan in place, and the risk management objectives of all of the councils were consistent with the four categories of council management, public safety, mitigation actions, and assets. The information collected across both states was very similar, despite coming from departments in two different states, and the application of the information was shown to be very similar. As previous risk management processes which were well aligned across states, the risk treatment practices and monitoring and reviewing practices were also very similar between the two jurisdictions. The interview data collected from local governments will now be discussed below.

### 6.3.5 Interview analysis
To obtain a more in-depth understanding of local governments and their risk management processes, local government organisations in the two case study jurisdictions of New South Wales and Victoria were invited to participate in a semi-structured interview. Overall, eight interviews of local government organisations were carried out – three in the state of New South Wales, and five in Victoria. The following organisations participated:
Albury City Council: a regional city located in New South Wales on the Murray River, just north of the Victorian border. The population of the municipality was counted as 47,810 people in the 2011 Census, and the population density as 156.3 persons per square kilometre.

Hornsby Shire Council: An outer suburban area of Sydney surrounded by bushland and bordering the Hawkesbury River. The shire covers approximately 462 square kilometres and within this area 6,000 hectares of public bushland. The population of the municipality was counted as 156,847 in the 2011 Census, and the population density is 339.5 per square kilometre.

Lockhart Shire Council: a rural council in an agricultural and pastoral area of the Riverina, around 100km north of the Victorian border, and around 60km from the nearest regional city. The shire covers approximately 2895.9 square kilometres with a population of 2998 people and a population density of 1.0 person per square kilometre.

City of Melbourne: the capital city of Victoria and encompassing the CBD area. The council has a much larger population during the working week, but retains a large population as residents also. The council area covers 37.4 square kilometres, has a population of 93,625 people and a population density of 2503.3 people per square kilometre.

City of Monash: a suburban area of Melbourne located 20km south east of the CBD. Predominately a residential area with substantial industrial, commercial and recreational areas. The council area covers 81.5 square kilometres, has a population of 169,280 people and a population density of 2077.1 people per square kilometre.

Indigo Shire Council: a rural area at the base of the Alpine region with a collection of historic towns. The council area covers 2040.1 square kilometres, has a population of 15,178 and a population density of 7.4 people per square kilometre.

Nillumbik Shire Council: an outer suburban area of Melbourne located 25km north east of the CBD. A predominantly residential area with communities in typical urban settings ranging to remote and tranquil bush properties. The shire covers 432.3 square kilometres, has a population of 60,342 and a population density of 139.6 people per square kilometre.

Rural City of Wangaratta: a regional centre for rural Victoria, located 250km north east of Melbourne. The council area covers 3644.8 square kilometres, has a population of 26,815 and a population density of 7.4 people per square kilometre.

The findings from each individual interview are summarised under the headings of: the risk management plan, the risks, the risk management process, roles within the organisation, risk
information, information creation, collaboration and information access, information dissemination, and updating procedures. These summaries are located in Appendix 7. The overall findings from the interviews are discussed below.

6.3.6 Interview summary

Overall, the roles of each local government organisation, whether in New South Wales or Victoria are similar. The information made use of such as cadastral and address data, as well as planning overlays which reveal flood and bushfire zones seems common across all local governments, as well as the use of GIS as the tool for viewing and manipulating this data. While the technical abilities available vary significantly across organisations due to some organisations having dedicated GIS personnel with high skill levels, and others having the software and some training for how to use it, overall each organisation seemed capable of meeting the requirements necessary for carrying out effective risk management. As the organisations locations vary, the types of risk, expectations from the community and the role of the organisation appears to vary. Councils within urban and suburban areas are viewed by the community differently than councils within rural areas. To address this, it was found that many of the councils interviewed had programs in place or under development to improve interaction and communication with the community, and to improve education regarding effective risk management within the community.

6.3.7 Overall summary of local government

The study conducted into the risk management practices of local governments utilised the two data collection formats of questionnaires and semi-structured interviews. As a result, two different perspectives of the risk management process were gained. The information collected provided different layers of understanding and different insights into the risk management process at the local government level and contributed towards the overall outcome which addresses the research questions. In order to reach this outcome the research questions will now be examined.

6.4 The research questions

The four research questions investigated in this thesis are:

1. Are land administration agencies motivated by the notion of risk management? If yes, how? And how might they be motivated in the near future?
2. How do land right holders perceive their role in risk management?
3. What should be the relationship between land right holders, risk, and government? Or what are the various options?
4. How can land administration systems support risk management?
Question one was addressed in Chapter 5 and three questions remain. Of relevance in this chapter is the second question. The third and fourth questions will be addressed in the following chapter after the final inferences have been made and the findings from the quantitative and qualitative studies have been combined.

To answer the question of how land right holders perceive their role in risk management, the findings generated from the study into the risk management practices of citizens and local governments are considered and are examined across the dimensions of the risk management framework (table 6.24). Each aspect of the risk management process is addressed separately by each stakeholder group below.

<table>
<thead>
<tr>
<th>Risk Management Stakeholders</th>
<th>Citizens</th>
<th>Local Government</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk management plan</td>
<td>There was a stark difference between the category of owners and lessees – based on responsibility (financial). The owners take a more risk averse approach than the lessees with a higher rate of risk management plans in place, higher rate of objectives in place, and more specific objectives overall. As an entire group, the implementation and overall understanding of risk management was average. The owner’s category seems to be more aware of their role in the risk management process as there are significant financial consequences which can result from not managing risks, the lessee group appear to be less aware of the risk management process and their role within the process.</td>
<td>The local government as a stakeholder group seem to recognise their role in the risk management process as it is legislated. Plans are implemented, objectives determined, and the roles clearly defined. Their biggest challenge is to fulfil their legislative role as well as address the expectations that citizens may have. From the data gathered, in some circumstances, there is a disconnect between what the defined role of local government is, and what the community understands it to be.</td>
</tr>
<tr>
<td>The risks</td>
<td>Overall the risks which were selected as relevant to this stakeholder group were similar between the individual categories of owner and lessee. The risks of severe weather, house fire and pests were selected, and pose a threat to both categories. The selection of these risks, which are consistent between categories, and also across stakeholder groups show that understand the real and present risks and have taken some responsibility of the risk management process by recognising those risks.</td>
<td>The risks selected by local governments included severe weather, bushfire, and riverine flooding as the three biggest threats to the land and property they manage. These three risks have the ability to impact severely on their assets so local governments understand that their role it to implement treatments to minimise the damage that these risks might present to both their assets, and areas of the community which they are responsible for.</td>
</tr>
<tr>
<td>Citizens understand that identifying</td>
<td>The local councils understand that</td>
<td></td>
</tr>
</tbody>
</table>
### Risk analysis

Risks are their role, and implementing treatment, however their understanding of the analysis process was not high. More than half of the respondents had no methods in place for analysing the risk. There is a perception that if the threat level was extreme or high they would not be able to live in that location, therefore it must not be at that level. An opinion that the government would intervene before the threat created significant danger, therefore analysis at the individual level is not necessary as long as the actual risks are known.

### Risk information

The majority of citizens seek free resources only. Citizens observe risk related information such as weather updates for severe weather and forecasts for bushfire risks and act accordingly. They also rely upon services engaged, such as insurance companies to carry out the research required. There is also a perception that the media and government would again inform of the risk if it were likely to become extreme and provide the necessary information.

Local councils utilise information available from the state government and other organisations to carry out their risk management activities. Some councils create risk information (such as flood levels, asset location) and view this within their role. Not all local governments have the resources available to create this information however they still recognise this within their role.

### Risk treatment

Citizens recognise and understand their role in treating risks. The majority of citizens have acted and applied treatment to risks which warrant treatment. A number of citizens, mostly from the lessee’s category have not implemented any treatment, however the results show that overall citizens identify that the management of risks which affect their land and property is their role. There is small perception that if a risk of large scale occurred the government would intervene and assist citizens.

Local governments identify with their role in the treatment process. They apply a range of treatments to risks which threaten the land and property managed by their organisation. These activities include engineering works such as building retarding basins, organising slashing of grass, sandbagging, as well as more. The view their role in the treatment phase to extend only to the assets owned and managed by the council, the roads, parks, medium strips and any other land under council management.

### Monitoring and review

Citizens have a responsibility to monitor and review risks and risk information, which the majority of citizens understand. Although they understand their role in this process, most citizens do not actively participate in this process.

Local governments understand this process and recognise that they have an obligation to keep informed of new risk information. As a result they review their information and risk management plans often and act based upon the results.
This comparison is useful in identifying the strengths and weaknesses of each stakeholder in their risk management practices and to expose areas where a lack of responsibility is occurring. The expectations of each stakeholder were revealed as well as the reality of what each stakeholder is enacting in their risk management practices. Any neglected or overlooked areas by a stakeholder or any areas receiving a lot of attention and interest were uncovered. The results obtained relate directly to the research questions which underpin this research and provide significant input into the land risk management framework proposed in the following chapter.

6.5 Chapter summary

This chapter has undertaken a comprehensive study into the risk management practices of citizens and local government in their processes of addressing risk which threatens land and property. The stakeholder case study provided a detailed insight into the risk management practices of both citizens and local governments for the management of land and property. The comparisons have identified important gaps and overlaps in the overall management of risks affecting land and property in society.

In the previous chapter the first research question was addressed, and within this chapter the second research question was answered. Two research questions remain:

- Question 3: What should be the relationship between land right holders, risk, and government? Or what are the various options?
- Question 4: How can land administration systems support risk management?

These will now be addressed in the following chapter. Chapter seven brings together the results and ideas of the previous two chapters and combines them to develop a framework for managing risks to land and property.
Part 4:
Synthesis
Chapter 7 – The land risk management model: design and development
7.1 Introduction
This chapter discusses the design and development of the land and risk management model based on the results of the Australian case studies. The analysis of the Australian state level land administration investigation into the management of rights, restrictions and responsibilities (RRRs) and the risk management stakeholders case studies were completed in chapters five and six. The outcomes from these two chapters provide the foundation for an improved understanding of the motivations for land administration agencies to support risk management and how land right holders perceive their role in managing risk. This chapter now integrates these findings into a model which better reflects the risk management process for managing land related risks by stakeholders.

In the first part of the chapter, the model development process is discussed, including the integration strategy and key findings from chapters five and six. The developed model is then presented and the individual components of the model are described. Finally, the remaining research questions are addressed through the discussion regarding the model.

7.2 Model development
The devastating aftermath of flood, bushfire, earthquake, storm and many other events within developed countries around the world suggest that there is a need for a new paradigm of risk management – a ‘sustainable risk management’ approach. It is a concept where local stakeholders look forward and develop the future they will live in, rather than accepting simply what happens (Myers 1998). This concept demands the empowerment of stakeholders, and integrated consideration of social, economic and environmental consequences of disaster and risk events. The new paradigm must go beyond simply reducing losses to building sustainable risk management strategies at the local, state/regional, and national level. In order to achieve this vision, the approach to the process of risk management needs to be transformed. The development process of the land risk management model explores these issues and uses the results of the investigations into land administration systems and risk management stakeholders to address the proposed vision.

7.2.1 Development process
The mixed method research approach has enabled a study of the land administration systems across all jurisdictions within the case study country of Australia to take place, as well as a case study of risk management stakeholders. In addition to the results from these investigations, the existing theory and knowledge base developed from an extensive literature review of land administration systems and risk management provided a solid foundation on
which to build the model. Figure 7.1 illustrates the process that was used to develop the land risk management model.

The results of the land administration systems study contributed to a clearer understanding of legal, policy, institutional and technical issues which need to be addressed in order to achieve effective management of land risk information.

The risk management stakeholder’s case study highlighted issues and obstacles encountered by stakeholders in their quest to manage risks which affect land and property. It also identified requirements of stakeholders and provided an understanding of their role in, and expectations of, the overall risk management process. The findings from these two investigations were integrated with the existing knowledge base on land administration and risk management to compile a model which demonstrates how land administration systems could support the process of risk management.

**7.2.2 Bringing together the research outcomes**

To support the integration of the findings from the two investigations carried out on the case study country of Australia – the quantitative investigation into the land administration systems in the state and territory jurisdictions of Australia, and the qualitative case study of risk management stakeholders within the two Australian states of New South Wales and Victoria, the issues from each study were identified and summarised.
Using land administration for land risk management

The issues identified from the land administration systems study were collated into the four groups of legal, policy, technical, and institutional (figure 7.2). Each group identifies factors to be addressed to enable land administration agencies to support risk management.

![Figure 7.2 Classification of issues from LAS study](image)

These factors were developed from the case study of Australian land administration systems however they can be translated at an international level to other developed countries with established land administration systems. As identified in the study, each of these overarching factors and the issues within require attention in order for effective land risk management to take place.

From the risk management stakeholder’s case study, a range of issues emerged and were summarised into the six elements below (figure 7.3). The issues identified are relevant to both citizen stakeholders and local government level stakeholders, and again represent issues which can be translated to other contexts.

![Figure 7.3 Classification of issues from risk management stakeholders study](image)

The three elements of risk management plan, risk information and risk treatment revealed the most pressing issues for stakeholders, however overall, for effective risk management to take place the seamless application of all elements needs to occur to ensure that all areas of the process are being addressed. The issues raised through the case study analysis are generic issues which can be applied to all contexts and represent concerns faced by stakeholders in the management of land related risk.

The key issues which emerged from the two investigations carried out were used to inform the development of the model which integrated the results and findings to address the
overarching research question. The development of the model and the integration of these factors and issues are discussed in the subsequent section.

7.3 The land risk management model

Based on the identified requirements of the risk management stakeholders and the capabilities of the information providers, specifically land administration systems, the land risk management model was developed which incorporates the findings of the research and focuses on the necessary components for effective and improved management of risk which affects stakeholders and threatens land and property. The land risk management model is illustrated in Figure 7.4 below and is made up of the three primary elements: the context, the land risk management process, and social outcomes. The model represents a ‘to be’ situation for the management of risk affecting land and property and acts as an illustrative guideline for achieving effective risk management within a country context.

![Figure 7.4 Land risk management model](image)

As the model shows, the context of the country and the risk factors and stakeholder within this context feed into the land risk management process of the model continually to enable current and relevant information to influence the land risk management process. The outcomes of the process contribute to the social outcomes and build towards reaching effective risk management for society. Lessons learnt from this element are fed back into the context to enable the context to adapt to the outcomes achieved.
The context element of the model includes both key stakeholders and risk factors as primary considerations in the process of managing risks to land. The key stakeholders participate in the process of risk management and have interconnecting roles, and the risk factors dictate the types of risks possible as well as the likelihood, consequences and vulnerabilities of different locations. This component of the model will be discussed in further detail in section 7.3.1.

The land risk management process component consists of five main elements, namely: the risk management process, information infrastructures, land administration data, users and stakeholder relationships, and data and exchange maintenance. This component of the model will be detailed in section 7.3.2.

The social outcomes component of the model outlines the benefits which can be attained with the implementation of an effective system. Each of these components is important and builds towards and contributes to the overall outcome of effective risk management. Each element of the social outcomes component and the overall goal of effective risk management are discussed in section 7.3.3.

7.3.1 Contextual factors

Within the context section of the diagram, the two elements of key stakeholders and risk factors are considered.

**Key stakeholders**

The key stakeholder’s element of the context examines the different groups of people which hold an interest in the management of a range of risks affecting land. From the study conducted, five main stakeholders relevant to the broader context emerged, along with a range of other interest groups. The five key stakeholders include:

- **Local governments**: local governments are generally involved in the day to day management of their communities. This role can include the management of community facilities, assets such as roads, and decisions regarding planning and development. Their focus is often on the preservation and maintenance of these assets, and the management of risks which affect these items and areas included within their responsibility.

- **State or regional governments**: state level or regional government generally manage the larger assets of jurisdictions such as main roads, public transport, public housing, education facilities, health facilities, as well as manage large scale development,
infrastructure and water. The role of this level of government is dependent on the government arrangement for each country and the country context.

- National governments: National level government are generally responsible for larger scale infrastructure such as airport areas, defence land and property, and telecommunications. The role and responsibility of this key stakeholder is also largely dependent on the political structure of a country.

- Private sector: the role of the private sector such as insurance companies in the management of risks affecting land includes identifying and analysing a range of different risks in a range of different areas to develop a policy to provide protection from risk to the customer. They do not hold rights over the land insured under their organisation; however they have an interest in the management and mitigation of risks affecting the land and property insured.

- Citizens: the rights that citizens hold over land can include land ownership, the leasing of land as a lessee, or the leasing of owner land as a lessor. The role that each of these relationships create in terms of management of risks to the land is diverse and based on a range of factors.

Other key stakeholders within the context with a lesser role include community groups, not for profit organisations and other organisations which assist in risk mitigation and risk identification activities. Public and private utility organisations are another key stakeholder group which contributes to the management or risks affecting land and property.

Overall, the interaction of these key stakeholders is dynamic and often overlapping. As the local government level works to protect government assets and maintain facilities, mitigation actions benefit residents of that community with private land. Regional level and national level government’s involvement in the management and mitigation of large scale risk events also creates advantages for a wide range of stakeholders.

**Risk factors**

The risk factors element of the context looks at the range of aspects which impact on the efficient and effective management of risks affecting land and property. The factors include geographic locations, environmental conditions, risks, proximity to hazards, and vulnerabilities.

The first and second factors, geographic locations and environmental conditions refer to the way that the ecology, landscape and climate of a location can impact on the types of risks experienced, the consequences of the risk experienced, the likelihood of occurrence of risks, and the frequency of occurrence of risks. For example, the impact of heavy rainfall within an
urban area might create the risk of flash flooding, while in a rural area, the ground is able to absorb the majority of the water. Similarly, depending on where land and property is located, the impact of an earthquake might have vastly different consequences. The climate of areas can be influential as areas which reach extreme temperatures during different seasons become more vulnerable to risks which are more likely during these climate conditions, for example, the risk of bushfire can be increased when specific environmental conditions such as high temperatures, dry vegetation, high winds, and lightning and storm events occur. Another aspect is the types of risks which can be experienced.

The next element of the risk factors, risks, notes all of the possible risks which could take place affecting the land and property of a land right holder. Understanding the risks which are possible helps to define the context so that adequate risk management can take place. Without this knowledge, the information required for the management of risks would not be well defined, and the range of potential risks which could have an effect would not be known.

The proximity to hazards aspect addresses the impact of space and proximity to hazards which could result in a risk event. An example would be having large trees close to a residential property which could create a fire hazard or block gutters, or having property alongside a river or coastal boundary which could be affected by erosion, storm surge or sea level rise. The closeness to the hazards increases the likelihood of the risk and the overall vulnerability.

Finally, the inclusion of vulnerabilities as a risk factor is to distinguish between the likelihood of a risk occurring, and the overall affect that the risk has. The higher both of these elements rate, the higher the vulnerability of the land and property, however the vulnerability can be reduced by altering the likelihood and/or the impact of the risk through mitigation and management of the risk.

7.3.2 Land risk management process

The five key elements in the risk management process will now be discussed.

Risk management process

The risk management process enables a range of stakeholder to manage risks. In the context of this research it is applied to the management of land and property. In order for the risk management process to operate effectively for land management, quality information is required from a range of organisations and agencies. Due to this, the risk management component is connected to the information infrastructure which provides information at a countries national scale due to the network of organisations included within this component.
Figure 7.5 The risk management element of the land risk management model

The risk management component is also connected to the land administration data component (an information infrastructure itself) as it provides the vital and comprehensive land information required to support the management of risks affecting land.

The management of risk to land can be benefited by a process which incorporates land information in a number of ways. As the roles and responsibilities of users differ in the process of land risk management, as was demonstrated from the Australian case study into risk management stakeholders, access to authoritative and detailed information about land parcels is essential for stakeholders. Table 7.1 below outlines how different types of information created, maintained or managed by land administration agencies can contribute to the phases of the risk management process.

<table>
<thead>
<tr>
<th>Information</th>
<th>Risk management phase</th>
<th>How the data contributes to phases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address information</td>
<td>• Establishing the context</td>
<td>• Internal and external context: address information can assist in understanding the external context by identifying where the property is in relation to other properties and risks.</td>
</tr>
<tr>
<td>Parcel information</td>
<td>• Establishing the context</td>
<td>• Internal and external context: understanding where a property is in relation to other properties, critical infrastructure, and emergency facilities.</td>
</tr>
<tr>
<td>Elevation data</td>
<td>• Establishing the context</td>
<td>• Contour information which can be used to calculate slope and potential risks which might occur from a specific gradient - a high slope can be a potential hazard for landslides or fires.</td>
</tr>
<tr>
<td></td>
<td>• Risk assessment (specifically risk identification and risk analysis)</td>
<td>• Slope and contours can also be used to determine where water would flow if there was a large downpour.</td>
</tr>
<tr>
<td>Hydrology</td>
<td>• Establishing the context</td>
<td>• Establishing the context phase: proximity of a water body or</td>
</tr>
</tbody>
</table>
Using land administration for land risk management

<table>
<thead>
<tr>
<th>Information</th>
<th>Context</th>
<th>Water way to the property</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Establishing the context • Risk assessment (specifically risk identification and risk analysis)</td>
<td>• Risk evaluation stage: information about specific waterways can be used to determine whether the risk meets the determined acceptable level.</td>
</tr>
<tr>
<td>Satellite Imagery</td>
<td>• Establishing the context • Risk assessment</td>
<td>• Risk treatment: information to help with mitigation and reduction techniques.</td>
</tr>
<tr>
<td></td>
<td>• Establishing the context: identification of any threats that are visible – such as a neighbouring vast area of bush or forest from satellite images.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Vulnerabilities of a specific property such as structures or objects within a yard which may cause damage or be damaged within a large storm event.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Viewing how close a property is to a river, to the coast, to industrial building and other areas</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Risk assessment: external threats or man-made hazards might be observed or distinguished from the imagery.</td>
<td></td>
</tr>
<tr>
<td>Planning Information</td>
<td>• Establishing the context • Risk assessment (specifically risk identification and risk evaluation)</td>
<td>• Establishing the context: land use zones, restrictions and overlays pertaining to the land.</td>
</tr>
<tr>
<td></td>
<td>• Establishing the context: land use zones, restrictions and overlays pertaining to the land.</td>
<td>• Distinguish between residential, industrial and business zoned land (information which is usually easy to obtain), as well as identification of farming zones, green wedge zones, and areas subject to conditions such as flooding, erosion and bushfires (information which is often more difficult to acquire).</td>
</tr>
<tr>
<td></td>
<td>• Establishing the context: location in relation to main roads and arterial roads which would be required for evacuation. Whether the property is located within a contained court or estate which has only one entrance/exit point.</td>
<td>• Risk assessment: identification of whether the property in question is within or located near a bushfire zone or a flood zone.</td>
</tr>
<tr>
<td></td>
<td>• Establishing the context: where all major roads and access points are to your property is crucial if a risk event occurs.</td>
<td>• Risk evaluation: whether the flood zone is a 1 in 20 year flood zone, or a 1 in 100 year flood zone - to determine whether the risk is acceptable based on defined risk criteria.</td>
</tr>
<tr>
<td></td>
<td>• Location in relation to main roads and arterial roads which would be required for evacuation. Whether the property is located within a contained court or estate which has only one entrance/exit point.</td>
<td>• Risk treatment: The information can assist with the selection of relevant mitigation strategies, and some transference options such as insurance.</td>
</tr>
<tr>
<td></td>
<td>• Risk assessment and treatment: improving understanding of how long and far emergency services would have to travel to reach a property.</td>
<td></td>
</tr>
</tbody>
</table>

As the table shows, land administration information and the additional land data which is supported by the land administration data can contribute significantly to the process of land risk management. The integration of this data into the overall land risk management process is integral. The risk management component within the model is the integrator of these two parts and allows stakeholders to utilise the information for risk management tasks. Based on the type of stakeholder carrying out the risk management process, and the role or responsibility of that stakeholder, the process can be adapted to source and provide the
necessary information to carry out land risk management procedures and to incorporate the relevant contextual information.

**Information infrastructures**

The information infrastructures component is one of the primary components of the land risk management process as it contains all of the silos of information pertaining to the management of land and risk from a range of different departments and organisations across a specific country (figure 7.6). The type of information that can be integrated into the process at this stage is not restricted at all and can expand far beyond basic risk and RRRs information. The information from this element feeds into the risk management process to support decision making by the users. As an example within the expanded version of the land risk management process highlighting the information infrastructures component, some of the infrastructures have been labelled to demonstrate the different types of information or the different organisations that could contribute to the information infrastructure. To elaborate further on the infrastructures, the country of Australia which acted as the case study country for this research will be applied to the diagram to demonstrate the types of infrastructures which can be included within this component of the model. For this Australian context, six main information providers have been identified as appropriate for inclusion, namely: federal government departments, state government departments, local governments, emergency services, private sector, and volunteered geographic information sources (VGI).

![Figure 7.6 The information infrastructures element of the land risk management model](image)

Each of the information infrastructures are networked together to allow for the sharing of data and improved communication. It should be noted that based on the diagram representation it
is wishful thinking that all of these information providers can be contained within neat silos of information to be networked. Each organisation or agency organises their information separately and often not in easily integrated formats. However, within increased research and development in this area, harnessing this data might soon be a simple and easily achieved task, therefore all organisations and contributors should be considered. Each data supplier of the information infrastructures presented as an example from the Australian context will now be elaborated on below.

Federal government departments
The federal government departments silo in the information infrastructures element would contain organisations and departments such as: the Bureau of Meteorology which is highly utilised by citizens for risk management information; Geoscience Australia which provides a range of land and hazard related data to governments at state and local level; and various other departments such as: Department of Sustainability, Environment, Water, Population and Communities, Department of Human Services, Department of Industry, Innovate, Climate Change, Science, Research and Tertiary Education etc. which all deal with information important to the management of risk to land and property in some degree.

State government departments
Departments within each state or territory level of Australian governments host and maintain a range of different datasets relevant to the management of risk to land and property, often at a large scale. Areas subject to hazards, critical infrastructure, state assets etc are all recorded by different departments such as environmental departments, transport departments, health departments, and education departments. Also within the state government departments are the government based insurance agencies which organise and manage risks internally for the state or territory. Additionally, land administration agencies are included within this category however as outlined earlier, due to the large involvement in this area they are discussed separately. In this proposed model, the different departments within a jurisdiction would be networked to allow for the sharing of information.

Local governments
Local governments in Australia create and store all types of data relevant to the management of risk. After a risk event such as flooding or severe storm has occurred, the information specific to that event is often recorded and input into a GIS system and a layer created for use in future planning and risk management strategies. The sharing of such data with state government departments such as the planning department would enable comprehensive risk management practices to take place.
Private sector
The private sector silo includes a range of organisations and businesses which deal with information relevant to the management of risk affecting land and property. Insurance companies, banks, private utility companies etc are all possible contributors to this component.

Emergency Services
Emergency services as well as being stakeholders in the management of risk to land and property are information sources. Organisations such as emergency response services, metropolitan fire response organisations, rural and country fire services, law enforcement agencies such as the police, ambulance services and many other emergency organisations all have information important for land risk management. Combining this emergency information with other valuable information from other infrastructures through a networking approach can offer substantial advantages to stakeholders.

Volunteered geographic information
With the improvements in technology and the ubiquitous nature of smartphones, the ability for citizens to contribute information regarding risk is enormous. Information contributed by citizens can be used to gather ‘on the ground’ information which often offers currency to other datasets. Reliability is an issue experienced when using this type of information; however as a supplementary source of information it can be advantageous. While currently, a unified database for this information does not exist, the possibility exists in the future, and as such the inclusion of this data source is relevant and also justified by the uniqueness of the information offered.

All of the information infrastructures discussed as components of the proposed land risk management model add significant benefit to the overall process of managing risk to land and property. The networking and sharing of information within and between information infrastructures would enable the current steps in the risk management process to be streamlined. This would save time and money in the development of information for the management of risks affecting land and property, and would reduce duplication of data. Cooperation from these agencies and organisations would contribute to the overall goal of effective land and property risk management practices for all stakeholders.

Land administration data
Another element to be integrated and networked with other information sources within the information infrastructure is land administration data, for example, parcel and address data. Within the model, this element has been detached to represent the need for this critical information source to be included within the information infrastructures as it is an integral
component, but in many contexts not considered for the management of risks to land. As the model depicts, land administration data should be included as an information source to enable the dissemination and use of authoritative information in the process of managing risk to land.

The key information within the land administration data component of the model is the parcel and address information. As outlined earlier, this cadastral information is integral to the effective management of land. In countries with established land administration systems there are agencies dedicated to the creation and maintenance of this important information. If these agencies are currently disparate, the ability to network this information within the country would improve communication and land management abilities (figure 7.7).

![Figure 7.7 The land administration data element of the land risk management model](image)

Bringing together these resources at a national level would assist in a range of land risk management tasks, especially events which require cooperation from multiple jurisdictions. This authoritative land administration information can be applied to a range of different risk management tasks to improve the efficiency of the process.

In order for this networking to take place, a range of different legal, policy, technical and institutional issues which were identified though the land administration agency study need to be addressed, and are included within this element.

A major issue within this area for a range of country contexts is the access of this information for different stakeholders. As the results of the case study research carried out on the country of Australia showed, currently, depending on what jurisdiction a stakeholder is from, citizen
access to such information is varied. The results from the Australian case study illustrate this (table 7.2).

<table>
<thead>
<tr>
<th>Data / State</th>
<th>ACT</th>
<th>NSW</th>
<th>NT</th>
<th>QLD</th>
<th>SA</th>
<th>TAS</th>
<th>VIC</th>
<th>WA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address information</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>G</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Parcel / property information</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>G</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Elevation data</td>
<td>✓</td>
<td>X</td>
<td>✓</td>
<td>G</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Hydrology information</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>G</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Satellite imagery</td>
<td>✓</td>
<td>✓</td>
<td>X</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>X</td>
<td>✓</td>
</tr>
<tr>
<td>Planning information</td>
<td>✓</td>
<td>C</td>
<td>✓</td>
<td>G</td>
<td>G</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Transport information</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>G</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

✓ = free to access online  
G = only available in GIS format – *.shp, *.tab.  
C = available for certain council areas only – not whole jurisdiction  
X = no free data accessible online

For most jurisdictions in the case study country of Australia this information is available freely to users; however, in some jurisdictions this information is restricted by access rights, information format, or cost. The restriction of format in this example – where the data is available only in GIS formats, is a not a complete restriction as other software packages can open the data in table format, however the visual interpretation is lost when viewed only as table data which significantly limits the value for the user and is therefore viewed as a restriction. Depending on the stakeholder, the way that the information is used varies and therefore the user requirements such as the format, ability to download, ability to edit etc. differs. To better improve the risk management process land administration agencies should aim to meet the needs of such stakeholders.

As a critical component in the management of risk affecting land and property these issues should be addressed and resolved in all countries that experience access issues. The ability for all stakeholders to access relevant information about land and property is a critical factor in achieving effective risk management of land. This issue was discussed in chapter five along with the other issues regarding land administration agency involvement in land risk management. As a result, a range of motivational factors for agencies were developed to
highlight the advantages of being involved in land risk management activities. Included within this land administration data element are the motivational factors which offer incentives for land administration agencies to participate in the process of land risk management. When these issues are addressed and overcome, the model can be realised.

**Users and stakeholder relationships**

The users and stakeholder relationships component refers to the different relationships which exist between stakeholders, and the different people participating in the risk management process. This component focuses on whether they communicate and cooperate effectively, whether the roles and responsibilities of the management of risk to land and property are well defined, and whether there is support provided for the risk management process. This component feeds back and forth into the risk management process to enable the roles and responsibility of users to be updated and adapted based on the different relationships that exist and the access rights and permission which exist for each user.

![Figure 7.8 The stakeholder relationships element of the land risk management model](image)

Based on the results discussed in chapter six regarding risk management stakeholders, it was found that currently the roles of stakeholders and the expectations of different stakeholders in the risk management process were not aligned. These lessons and the overall issues identified from the study can be applied to other contexts to determine areas for improvement for stakeholder interactions. In order for effective risk management to take place, each stakeholder group needs to cooperate with related stakeholder groups. Not every stakeholder group has to connect with every other group; however, through a network of support, the implementation of effective risk management processes should be achievable. Each stakeholder has stronger connections with certain groups, for example, the relationship between citizens and their local council is important, as is the relationship between citizens...
Chapter 7: The land risk management model

and national businesses such as insurance companies which can assist them with insurance options for their land and property. Similarly, the relationship between a state or regional government and a local government needs to be established so that funding and organisation for risk mitigation actions can be discussed, while a regional or state government also needs to remain connected to the federal government organisations which can impact on the risk management process through policy implementation. Overall, identification and recognition of users and stakeholders as well as their individual roles and responsibilities is required for an effective land risk management process to take place. Interaction between the parties is instrumental to the success of this; therefore an understanding of the relationships between users and stakeholders is important.

Data exchange and maintenance

The data exchange and maintenance component of the model refers to issues such as: the reviewing, improvement and updating of information for the risk management process; interoperability; the creation of information by stakeholders; and the exchange of information between stakeholders.

The continual and consistent reviewing and updating of information enables a standard of quality to be maintained in the data used for the management of risks affecting land. As risk information is dynamic, the regular updating processes will enable users to be confident that the data utilised is of a high quality. Interoperability as a part of this process assists in the integration of different sources of information to enable better quality analysis to take place (figure 7.9).

Figure 7.9 The data exchange and maintenance element of the land risk management model
The data exchange element allows for the sharing of information between networks including volunteered geographic information created by citizens. It enables social media information to be included as a data source which assists stakeholders such as governments to identify vulnerable residents and areas which require risk management attention.

Through the data exchange and maintenance component information is filtered back and forth from the risk management process to the information infrastructures. As a result the communication and interaction between the different information providers improves, the sharing of information eliminates duplicate data, and as a result resources such as money and time are preserved.

### 7.3.3 Social outcomes

The outcomes component of the model acts as a tool by which the effectiveness of both the contextual elements and the land risk management processes can be measured. One key aspect of this research was to identify how land administration agencies could assist in the improvement of societal risk management. As the results from the case study into the Australian context indicate, the use of land and property information in this process would assist in enabling a range of risk management objectives to be achieved.

![SOCIAL OUTCOMES](image)

**Figure 7.10 The social outcomes element of the land risk management model**

With the integration of the land administration information into the risk management process a system which supports stakeholders in implementing effective risk management for land and property has emerged. The system has a number of elements which come together to
culminate in this overall social outcome. Firstly, authoritative risk data – data which is supplied by trusted sources which describe and outline details regarding a range of risks. This social outcome results from the integration of land administration data into the overarching network of information infrastructures. Secondly, community access – the ability for a range of stakeholders to obtain information required for risk management freely and in an easy and simple manner. This outcome occurs as a result of carefully managed stakeholder relationships and collaboration between stakeholders enabling access information for all users, particularly to authoritative information. Thirdly, improved decision making which results from the integration of the first two elements of authoritative risk data and community access. The risk management process which is supported by good information from the information infrastructures contributes to overall improved decision making by users. This leads to the fourth element – disaster resilience – which can be enhanced through risk management practices which are created using good risk information. Enabling access to relevant information which can support decision making for risk management purposes for all users contributes to improvements throughout the community at large. Supporting stakeholder groups of this size enables resilience towards disasters and risk events to develop within and across different groups. If all of these outcomes are realised through the integration of land administration and risk management, supported by additional networked information from a variety of infrastructures and an understanding and support of stakeholders, then effective risk management for society can be achieved.

7.4 The research questions

This chapter addressed two of the four research questions:

- Question 3: What should be the relationship between land right holders, risk, and government? Or what are the various options?
- Question 4: How can land administration systems support risk management?

The development and discussion of the land risk management model provides answers to these two questions. Firstly, the relationship between citizens and government (shown to both be stakeholders in the management of risk affecting land and property), and risk was discussed within the context element of the model as well as the users and stakeholder relationships component of the model. The model, in addition to the outcome of the case study carried out in the Australian context, shows that there is overlap between risk management roles of different stakeholders and that there are close relationships between all stakeholders when address the issue of managing risk to land. The relationships between different stakeholders are also dynamic as the roles in managing risk differ and the kinds of
Using land administration for land risk management

risks to be addressed vary. Stakeholders such as citizens and the different levels of governments need a relationship based on trust, communication and cooperation between each stakeholder in the risk management process. The stakeholders (citizens, government at all levels, private sector) should take ownership and responsibility for the management of risk, and coordinating with other stakeholders to ensure that a comprehensive plan for managing each risk is implemented is a role for all stakeholders which is dependent on a good relationship. If all stakeholders understand and acknowledge their role in the risk management process then harmony between all stakeholders and the monitoring and management of risk should take place. As all risks are different, there is no ‘one size fits all’ model. A range of factors such as the types of risks and the nature of those risks, the role of each stakeholder, and their individual responsibilities, as well as the risk management goals of each stakeholder can all influence the way that risks are managed. These factors and impacts should be considered when utilising the model.

The second question addressed land administration systems directly and queried how land administration systems could support risk management. Again, using the land risk management model this question has been addressed through the discussion of land administration data in the land risk management process element of the model, and through the discussion of the risk management process within the model which utilises land administration data as an information source. Elaborating on the discussion into the land administration agencies, the type of information supplied, the ability for the information to be easily integrated into the risk management process, and the benefits which result from the support of the land administration information is summarised in table 7.3.
Table 7.3 Land administration data beneficial for risk management processes

<table>
<thead>
<tr>
<th>Data / Information</th>
<th>Establishing the context</th>
<th>Risk assessment</th>
<th>Risk treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Risk identification</td>
<td>Risk analysis</td>
</tr>
<tr>
<td>Address info.</td>
<td>✓ Internal and external context</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parcel info.</td>
<td>✓ Parcel details</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elevation data</td>
<td>✓ Slope and contours of property</td>
<td>✓ Problem slopes</td>
<td>✓ Vulnerable areas</td>
</tr>
<tr>
<td>Hydrology info.</td>
<td>✓ Proximity to water</td>
<td>✓ Nearby waterways</td>
<td>✓ Details of water bodies</td>
</tr>
<tr>
<td>Satellite imagery</td>
<td>✓ Overall viewpoint</td>
<td>✓ Visible threats</td>
<td>✓ Proximity to vulnerabilities</td>
</tr>
<tr>
<td>Planning info.</td>
<td>✓ Relevant zones and overlays</td>
<td>✓ Zones which present a threat</td>
<td>✓ Level of threat, e.g. flood – 1 in 100 year</td>
</tr>
<tr>
<td>Transport info.</td>
<td>✓ Major road locations</td>
<td>✓ Access points</td>
<td>✓ Problems with access</td>
</tr>
</tbody>
</table>

As demonstrated above, land information held by land administration agencies has relevance in the process of risk management and can provide support to the risk management process. The phases of establishing the context, risk assessment, and risk treatment in particular can be enhanced though support from land administration systems.

7.5 Chapter summary

This chapter discussed and presented the land risk management model. A number of concepts and findings from the investigations undertaken into land administration agencies and risk management stakeholders were organised to culminate in the output. The findings from the previous two chapters were drawn together to identify core issues and factors that could form the foundation for the model.

The model consists of the three core components of context, the land risk management process, and social outcomes, which interact to demonstrate the complex relationship which can exist between the areas of land administration and land risk management within a country context. The sub-components address different aspects related to integrating land administration information into a land risk management process and include: key
stakeholders, risk factors, risk management process, information infrastructures, land administration data, user and stakeholder relationships, data exchange and maintenance, and social outcomes. The resulting discussion of the model provided responses to the remaining two research questions which addressed the overarching question of how can land administration activities support societal risk management. Having introduced and discussed the model, the following chapter applies the model to a real world application and evaluates the model against a framework to assess its value.
Chapter 8 – Model implementation and the land risk prototype
8.1 Introduction

This chapter examines the land risk management model developed in the previous chapter and looks at how this model could be implemented as a prototype for a risk management application. The model is applied in this way to address the potential of and practicality for such a model in real world implementation. To fully address the research questions the demonstration of both the concept of the model, as described in chapter seven, and the reality, described in this chapter, is required. To carry out this implementation, first the background of the land risk management model is discussed to determine the goals and the purpose of the new prototype. Next, a conceptual design for the prototype is constructed using the land risk management model developed in the previous chapter as a framework. Following the development of the conceptual design for the prototype, the architecture for the system is outlined and described in detail. Finally, a prototype based on all the elements introduced in the land risk management model is designed to be put forward as an example for the potential application of the model. The implementation of the land risk management model as a prototype demonstrates the operational function of the model and how the model could impact upon societal risk management when applied as a real world application. The result of the implementation will determine whether the land risk management model provides guidance and assists in the achievement of the overarching social outcomes of effective risk management through the secondary social outcomes of authoritative risk data, community access, improved decision making, and disaster resilience. The chapter concludes by discussing these issues and evaluating the application and implementation of the land risk management model.

8.2 Application methodology

In order to evaluate the potential of the land risk management model developed in the previous chapter a prototype was utilised as a tool for assessment. The advantage of testing the model using a prototype is that it enables the use of the model in a real world application to be assessed. The prototype developed to test the land risk management model demonstrates a web based system designed for use by a range of stakeholders, but focuses on citizens and primary implementers of risk management. The key objective of the land risk management model is to contribute to the improvement of societal risk management practices through the integration of the two disciplines of land administration and risk management. The application addresses a need within society for improved access to information for managing risks which affect land and property, and for improved education on how to effectively carry out the risk management process and to apply risk management strategies. The increased
ability of stakeholders, especially citizens, to access information and apply risk management strategies is demonstrated and showcased by the system.

The application and assessment of the model to determine its potential for improving societal risk management in a real world situation is carried out by developing a land risk management system to demonstrate the value of integrating land information with risk management processes. The prototype system incorporates the three components of the land risk management model (context, land risk management process, and social outcomes) and all of the elements within these components within its design. The aim of the model and the problems which the model addresses are discussed first to direct the development of the model. Within this part of the prototype development process the context and the social outcomes are the main focus.

Once the purpose and aim of the prototype system are determined from examining the land risk management model, how the prototype system will operate and what the system is trying to achieve is illustrated in the conceptual design. Through the conceptual design stage of the prototype development process an understanding of what is to be achieved is reached and how the context components, land risk management process components, and the social outcomes components are to be addressed and integrated into the system is determined.

Once the conceptual model has been finalised it is transformed into the architecture of the system which outlines the individual elements of the prototype and describes them in detail. The architecture specifies the workings of the system and all of the individual components required for such a system to be constructed effectively.

The final stage of the prototype development was to design the overall system and to detail each phase of the prototype system in operation. The system allowed for the identification, analysis, and evaluation of risk through integrated sources of information, and the presentation of a range of treatment options, which were guided from the land risk management process element of the model developed in chapter seven. Through the web based system presented, the value of making informed decisions using authoritative and up to date information is demonstrated. The system was presented as a prototype website called ‘www.riskfinder.org.au’ and each element was illustrated and described.

The final stage of the method involved analysing the development of the land risk management model into a web based system for improving societal risk management. Whether the land risk management model, which was used as the underlying structure and guideline, generated a prototype which could demonstrate value, quality and had potential was a primary factor. The background to the prototype system will now be discussed.
8.3 Background to prototype
The development of the land risk management model in the previous chapter acted as the first step towards improved management of risk to land and property; however, in order for effective risk management to take place at the broader community level, stakeholders and decision makers need support. A prototype system which implements the teachings of the land risk management model into an accessible resource for stakeholders is one possibility. One important aspect to be addressed however is how the stakeholders and decision makers can make use of the information once it is accessible. In recent years, the need for decision makers to appropriately select and utilise information has been emphasised (Simonovic 1998). The land risk management model addresses this first challenge, proposing a system which would enable the delivery of information to decision makers. How they should use this information however requires further support. One option for supporting stakeholders and users in applying the information for land risk management are decision making support systems which could be integrated into the prototype design. Decision support systems are designed to interactively support the decision making process for a range of different stakeholders and enable information to be made available and at the same time offer assistance to users. Incorporated into the design are elements of the human decision making process to address stakeholder needs and improve overall success for users (Simon 1960; Forgionne 2000). The decision making process can be integrated into the prototype system along with the knowledge obtained from decision support systems to ensure that stakeholders are comfortable with the process of managing risk to land, and are capable of implementing effective strategies for themselves. The next section of the chapter addresses the conceptual design of the system and the critical components required to implement a successful land risk management model.

8.4 Conceptual design of the system
The conceptual design outlines the function of the proposed prototype and the components within the system. This stage of the process transforms the land risk management model from a framework into a system design which incorporates the key elements of the model. In order to address the land risk management needs of stakeholders the prototype should provide:

- Central access and presentation of relevant information for the management of risk affecting land;
- Guidance on how to utilise this information for appropriate risk management decisions;
- A web-based interface accessible by all stakeholders;
Chapter 8: Testing the model through a land risk prototype

- An interface which would allow users to input location based on address or coordinate information;
- An ability to verify location information;
- A user centred viewpoint.

Features built into the web interface should allow for users to select specific risks to focus on during the risk management process, or to make the selection of ‘all risks’ which will return all of the information about risks affecting the location selected. The type of information that is returned should also be able to be determined by the user, with a choice between authoritative information, volunteered geographic information, or, a combination of both. Once a parcel has been selected by a user, and the search for risks utilising the available information has been completed, the risk management process should commence. For the user, this involves following a series of guided steps which address each element of the risk management framework. The outcome of the process and the system is a range of products which can be used to visualise risks and how and where these risks affect the user. Additionally, a range of supportive materials for managing the risk, such as treatment options, evaluation techniques and references to other supportive information are provided.

The conceptual design which incorporates the elements of the land risk management model, and all of the features outlined above is illustrated in figure 8.1 below. The concept demonstrates how stakeholders can utilise available technology to process the inputs (information infrastructure data) into problem-relevant outputs (social outcomes). The system utilises information drawn from the knowledge base to assist users in performing these tasks.

![Figure 8.1 The conceptual design of the system](image-url)
Four main elements exist within the design: technical platform, the risk management process, input, and outputs. The land risk management process of the model makes up the risk management process and the inputs section of the conceptual model. The social outcomes element is represented by the outputs section of the diagram, and the context is an integrated part of the technical platforms where the stakeholders and the risk factors can be defined. Each element of the conceptual model will be now discussed in more detail.

**Technical platform – elements and components**

The technical platform element within the conceptual design has two main elements embedded within this component: the interface and the analytical component – a GIS system. Each component will be discussed below in detail.

**Interface**

The interface of the system is a critical component as it is the main point of contact between the user and the system. It is critical that the interface should be user friendly and easy to use for all stakeholders. To make the system appealing and recognisable to the largest group of users possible a map interface and layout similar to related web based systems which have embedded maps was used. The visually powerful use of maps within the interface improves the ability of stakeholders to understand and interpret information about risks relevant to their land and property, and can assist in improved spatial thinking (National Research Council 2006; Battersby et al. 2011). A central toolbar and progress tracker is also integrated into the web based system to assist in navigation through the web based system and to enable the user to watch and track their progress through the risk management process.

**GIS**

Included within the technical platform section of the conceptual diagram is an analytical engine as part of a geographic information system (GIS). A GIS is computer system which capture, store, query, analyse and display geospatial data (Chang 2009). In this case, a web GIS system is utilised, which extends the traditional desktop functionality to the internet. The advantage a GIS has over other systems is that it has the ability to handle both spatial and non spatial information and spatial analytical tools which enables a vast range of activities to be carried out using the technology (Peng and Tsou 2003; Tate et al. 2011). The GIS directly supports the intelligence phase of the decision making process, and the dynamism, accessibility, interactivity and interoperability which a web GIS provides allows for the use of maps not only as means for displaying results, but also as a tool which supports decision making (Kraak 2004).
Risk management process
Following on from the technical platform, the next element of the conceptual model is the processing phase. This phase refers to the application of the identification, analysis, evaluation and treatment phases of the risk management process.

Risk identification
The first phase of the risk management process involves organising the problem parameters. Before this phase commenced the specific parcel for which the risk assessment and treatment was taking place should have been identified. Once the specific location is known then the application of each step of the risk management process can begin. As each specific parcel is different, and has different interests and risks affecting it, the management of risk is required to take place on a parcel by parcel basis. Organising the problem parameters entails accessing the database through the input section of the system, extracting the decision data and problem pertinent data, and organising the information in the form needed by the solution model and methodology.

Based on the given location, relevant information regarding risks affecting the selected parcel of land will be returned from the input section of the system. Based on the type of information requested, whether it is authoritative information, volunteered geographic information, or both, the information will be sorted from most pertinent to least pertinent and then presented to the user. The presentation of the information will be in map form, as a polygon or point or line overlaid on the map interface. The functionality of the map interface provided by the GIS system will enable the user to turn on and off the different layers, changing the way that they are overlaid – such as bring certain layers to the front of the view and send other layers to a view behind this layer.

Once the different risks related to the parcel are presented as overlays on the map the user is prompted to identify specific risks which they are interested in managing. This can be based on the information presented from the search selected from a predefined list. The user selected which risks they would like to proceed with in the risk management process and the system begins the next stage of the process – the risk analysis.

Risk analysis
The second phase of the process, the risk analysis process involves structuring the problem and attaching parameters to a model. The process within the system is to access the model base, retrieve the appropriate decision model, and assign parameters to the decision model (figure 8.2).
Where there are a number of risks to be managed, parameters would be assigned to the
decision model for each separate risk. The parameters which are assigned are determined by
the user for each specific risk. The model guides the user through the process, however the
actual value determined is the result of the users own individual analysis.

**Risk evaluation**

The third phase of the risk management process is to make use of the decision model to
determine outcomes from the analysis carried out by the user. The outcomes of the model
applied to different risks will create a rating which will be calculated using the model and
presented to users to evaluate. The information will be presented in a table format displaying
all of the different risks identified and analysed so that the user can view the overall picture to
conduct an informed analysis. Information is provided to the user to explain the result of the
analysis and to assist with the evaluation process. The conclusion of the evaluation process
involves a user progressing to the risk treatment stage of the process.

**Risk treatment**

The risk treatment phase is focused on determining the best possible solution for addressing
risks to enable effective management to take place. The treatment process identifies four
different strategies which can be used to manage a risk. Individually, each risk is processed
through the risk treatment cycle and each strategy is considered to determine whether the
adoption of that treatment would be the best outcome for the user (figure 8.3).
To aid in the selection of an appropriate treatment the model base is accessed to retrieve the appropriate solution method which determines an alternative or the alternatives among all possible alternatives to reach a result that best meets the decision criterion (or criteria).

**Inputs**

There are three main inputs to the system: the database management system, the model management system, and the knowledge management system.

**Database management system**

The database management system maintains the link to the database which contains information on both spatial and non-spatial information. Within the database the data is directly related to the hazards and other relevant information for management of risk to land.

**Model management system**

The model management system connects directly to the model database which acts as a repository for the formal models, which are generally in the form of tabular models, conceptual models or mathematical models, and also information regarding the methodology required for developing solutions to the problems (Forgionne 2003).

**Knowledge management system**

The knowledge management system links to the knowledge base and contains information such as formulas for converting the available data regarding the known hazards into the problem parameters. Within the database there are also models which can be used to guide the user in selecting decision alternatives for the treatment and overall management of the risk.
Outputs
The output section of the system supplies all of the final information to the user. The main components of this section include the status reports, the parameter and outcome forecasts, recommended actions, and outcome explanations and advice.

The status report is the main output of the system. It incorporates all of the other elements. The report output at the end of the process summarises all of the information captured during the risk management process. It details the parcel which was selected as the parcel to have the risk management process applied and includes information on all of the risks which were found to have a relationship with that parcel. The information regarding those risks is included in the report as well as the parameters set for each risk within the risk management process. Also included are the results of the evaluation and the treatment options available as well as the treatment option selected. Further resources relevant to the risks managed during the process will also be included in the report output. The architecture of the system which details the structure of the system is now detailed and discussed.

8.5 Architecture of the system
The system developed has a three-layer architecture design: the user interface layer, the application layer, and the knowledge and data layer (figure 8.4).

![Figure 8.4 The architecture of the system](image)

Each layer of the architecture and the components which sit within each layer will be discussed in detail below.
The user interface layer

The user interface is a critical component of the system architecture acting as the link between the front end of the system and the back end of the system. A successful interface allows for a user to easily access the information they require and to make effective risk management systems without facing any confusing content or not understanding the process of the system. The interface layer has the role of generating the web pages which allow a user to access the functionalities of the system which are made available through the application layer (Fogli and Guida 2013). Within the architecture, two main components within the overall interface exist: the dialogue management system and the web interface.

Dialogue management system

The dialogue management system is the system responsible for providing the interface between the user and the rest of the components of any decision technology system. It provides the mechanisms whereby data and information are input to the system from the user and output from the system to the user (see figure 8.5) (Sugumaran and DeGroote 2011).

Web interface

When developing and designing a web interface there are five main issues which should be considered: accessibility, flexibility, interactivity, ergonomic layout, and processing-driven functionality (Galitz 2007; Maleczewski 1999).

![Figure 8.5 The web role of the web interface](image)

These issues translate into ensuring that the web interface is intuitive, that it can recover from unintended or mistaken actions, that efficient communication between the user and the system itself is possible, and that the ability for the user to understand the upcoming and completed tasks clearly is possible. The web interface should provide seamless interaction between a range of different users and the information provided in the database, document base, and model base.
The application layer
The application layer is composed of four modules: the data access module, the document access module, the core module, and the administration module.

Data access module and document access module
The data access module and the document access module both include logical components which are in charge of implementing informative support. These modules connect to the data base and the document base respectively and retrieve relevant information. Once retrieval has taken place the modules then sort the information according to the request of the user.

Decision Technology System (DTS) core module
The DTS core module is the heart of the DTS and is grounded on knowledge based reasoning engine. It is in charge of providing the specific normative support necessary to aid emergency managers in their job; more precisely, in front of events occurring in the emergency field, it suggests the most suitable intervention plans and offers support to their correct and effective execution (Fogli and Guida 2013).

Administration module (GIS)
The administration module is one of the main parts of the system providing the functions necessary to manage all data, document, and knowledge bases of the systems.

The knowledge and data layer

Data base
The database comprises all available resources including both spatial and non spatial data. This includes all relevant land and property information, geographical data, and data concerning the risk environment. The flexibility of the architecture enables a range of other data to be added into the database in the future if the purpose of the system adapts or the scope widens. This information is presented within the information infrastructures, land administration data, and risk factor elements of the land risk management model.

Document base
The document base stores a range of supportive information important for the final output of the risk management result.

Knowledge base
The knowledge base stores information which assists in the operation of the systems core module such as plans and relevant actions for managing risk.
Model base

The model base stores all models required for the management process of risks. The models include models for analysing and evaluating the risks, as well as models which assist in the risk treatment phase.

The next section of the documents details the web based system and how the prototype would actually look and act as an implementation of the land risk management model.

8.6 RiskFinder.org.au

The RiskFinder.org.au prototype illustrates and describes the application of the land risk management model as a web based system which would exist to assist different stakeholders to manage risks which affect land and property they have a relationship with. The web based system guides the user through the risk management process, as defined by the ISO 31000:2009 risk management standards (Standards Australia and Standards New Zealand 2009), to assist a user in understanding the different risks which affect a specific parcel of land, and the level of risk that hazard presents, and how that hazard can be treated to eliminate or reduce the impact that a hazard might have if it became a risk event.

To better understand the process which takes place, and to demonstrate the process the user would be guided through, figure 8.6 illustrates step by step the stages. The process shows what occurs within each different stage of the process, and what different elements of the system architecture are utilised at each point.
Using land administration for land risk management

As the figure demonstrates, within each stage of the risk management framework (establish the context, identify the risks, analysis of the risks, evaluation of the risks, and treatment of the risks), different processes occur which require input from the user (red boxes).

To demonstrate the web based system developed, each phase of the risk management process and the corresponding web page of riskfinder.org.au will be shown and discussed. The first page of the web based system is the home page which all visitors and users would be directed to (figure 8.7). The page has a main toolbar which is present on every page of the web based system to ease navigation, information on how the web based system works, a button which allows a user to begin the risk management process, and various other links to relevant information for a user such as FAQs, resources and overviews of the system. The page also has social media icons which allow users to input information and publish information through these websites and applications. The system is developed only as a prototype and is therefore not a ‘live’ website currently.

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**Figure 8.6 The risk finder process**

As the figure demonstrates, within each stage of the risk management framework (establish the context, identify the risks, analysis of the risks, evaluation of the risks, and treatment of the risks), different processes occur which require input from the user (red boxes).
Once a user elects to begin the risk management and clicks on the ‘findrisk’ button, they would be prompted to log in to the web based system using their user name and password, or asked to sign up to the web based system if they have not signed up in the past. This security enables different users to have different privileges, users to save and return to their risk management process if they do not complete the process in one sitting or if they would like to return to update the information or to review the results of their assessment, and for users to keep their searches and analysis private.

The next step, establishing the context, which would take place once a user signed in and decided to begin the risk management process is detailed below.

**Establish the context**

Within this first stage of the risk finder process a user is required to identify the parcel which will be assessed during the risk management process. The user can choose to enter the location of the parcel by entering an address, entering coordinates, or elect to navigate to the parcel manually through the map interface embedded into the web based system interface (see figure 8.8 and figure 8.9).
**Figure 8.8 The parcel identification process**

The process flow is shown above and the web based system representation is shown below.

**Figure 8.9 The interface for phase 1 of the risk management process**

Once a user decides what information they would like to input to identify the parcel to carry out the risk management process on they can select this option, which will expand to reveal the text boxes where the information can be input (figure 8.10).
Once a user inputs the relevant information regarding the parcel, the parcel will be searched and presented on the map interface within the web based system. The parcel to be analysed will be returned with a red border shown around it to indicate the parcel selected (figure 8.11).

The user will be prompted by the web based system to verify the parcel, and the user will have to indicate whether the system has returned the correct parcel – by selecting yes, or selecting no to indicate that it is the incorrect parcel and that another search should be
conducted. Once the correct parcel has been selected and verified by the user the next phase of the risk management process, risk identification will begin.

**Risk Identification**

The risk identification section of the process involves searching for information related to risks that is relevant for the parcel selected in the previous section. For this section a user will select whether they would like the search for risks conducted using authoritative information – for example information supplied by governments or other reputable sources; using volunteered geographic information – such as information supplied by other citizens or users; or all information which is available from both sources. Figure 8.12 shows the selection process.

Once the type of information is specified the search is conducted, and the results are returned and presented on the map (figure 8.13). The search returns all information available on hazards or risk that is related to the input parcel. The results of the search can also be modified based on a defined area. A user can input for the search to return information relevant to that parcel only, or to return information which within a defined distance or proximity to the parcel – for example within 100 meters of the parcel.
On this page, the results from the search are presented in a table under the heading ‘risk results’. The table shows the different layers illustrating the risks found which relate to that parcel. The user can turn on and off these layers to view them on by one or to view specific risks together, the user can also alter the order of the risks by dragging a risk to the top of the table or bottom of the table to alter the way the layer are overlaid on each other. The layer first in the table will always be the top most layer, and the last the bottom. If some layers are polygons or large overlays it might be easier to view lines or point layers on top of these layer for example. Within the final column of the risk results table are check-boxes which users can tick to show which risks they would like to analyse and continue the risk management process with. Once the risks which they would like to manage are selected, the user can select the ‘risk analysis’ button and can continue to the next phase of the risk management process.

**Risk analysis**

The risk analysis phase is focused on analysing the risks selected in the previous phase. There are a number of different analysis options defined within the system. Based on the risk selected for analysis, the system will determine the most appropriate model to use in the analysis. Once a risk is selected for analysis the system retrieves a model from the model base using the model management system. The model is then presented to the user, and the user assigns the
parameters to the models for the risk. Based on the type of risk which is being analysed, the models used may differ based on the available information. For more frequently experience risks such as floods and bushfire there may be more substantial information available from government stakeholder which can assist in the analysis, and for other risks, there may be less information which results in the user perspective playing a larger role. Once the first risk has been analysed using this process, the next risk is considered and the same process occurs – a model is retrieved and the user assigns the parameters. Depending on the type of risk under analysis, the same model may be used for a number of different risks. Figure 8.14 shows the interface of the riskfinder.com system at the beginning of the risk analysis phase.

Figure 8.14 The beginning of the risk analysis phase

The two risks which the user has selected to analyse are displayed in the risk analysis side of the interface, while the model application side is blank as no model has been retrieved yet. Once a user is ready to begin they can select the risk that they would like to analyse first by clicking the ‘analyse risk’ button. This will then prompt the system to retrieve an applicable model for this specific risk. The model retrieved for this risk is shown in figure 8.15 and figure 8.16. The specific model selected by the system is the risk matrix model which requires a user to assign the parameters by rating the likelihood and consequence of a risk event for the specified parcel of land.
As the figure above illustrates, there are a range of different options to select from, each with a small description to assist the user in determining which is the most appropriate. Once a user has selected the most correct option for the likelihood of this event occurring they select the next button to proceed to the second stage, which is rating the consequence.

Within this section of process, the user has to estimate the extent of damage which would result to the specified parcel of land if a flood risk occurred. Once a user has completed the model requirements for this risk, they can proceed to the next risk.
As figure 8.17 shows, the model selected for the second risk, bushfire risk, is the risk matrix model also. The user repeats the process of the risk matrix assigning parameters to the risk of bushfire.

Once a user has completed this process, as figure 8.18 shows, and there are no remaining risks, this process is complete and the user will proceed to the next phase which is risk evaluation.
Risk evaluation
The risk evaluation stage assesses all of the parameters assigned to the models by the user and generates a set of ratings from these models. Once the ratings are generated and presented to the user, the user evaluates the results and makes a decision regarding the treatment of the risk – whether it is necessary to treat the risk, or whether treatment is not required for the risk. Figure 8.19 shows the first part of the results presentation. The panel on the left of the screen shows each risk, what model was applied to that risk, and the score determined from the model and the parameters chosen by the user. The right hand side of the screen shows the risk rating descriptors and the recommended actions based on the score determined.

Figure 8.19 Evaluation phase – tabular display
The second view offered is the graphical display as shown in figure 8.20 which displays the results and where each risk fits within the model. Based on this diagram it can be seen that both risks sit within the moderate range of risk, and it is therefore recommended that the user continues with the risk management process and looks into risk treatment options.
Figure 8.20 Evaluation phase – graphical display

If a user decides to continue with the process, the user should select the ‘treat risk’ button and the next phase will commence.

Risk treatment
The risk treatment stage involves selecting one or multiple treatments to implement to address the threat that each risk presents. The process begins by a user selecting the risks which they would like to treat, and then the system will retrieve the specific risk treatment models and guide the user through the application of the model. The generic model for treatment is shown below (Figure 8.21). For each risk the different treatment options such as risk reduction strategies and transference options differ, however the format for implementation is the same.
Within the system a user would begin by selecting which risk they would like to look at treatments for, and then a series of questions regarding the treatment would be asked to determine which treatment option or options the user would like to investigate further (figure 8.22).

Once a user selects which risk they would like to apply the risk treatment process to first, the specific model for that risk is retrieved from the model base and a series of questions are presented to the user to guide the treatment selection. Figure 8.23 illustrates the first question of the treatment phase for the risk of flood.
Once a user makes their decision and selects ‘yes’ to avoid the risk, or ‘no’ to continue with other treatment options the user will be redirected to a new page. If the user selects to avoid the risk they will be directed to the resources page where a range of different references and documents are available regarding different risks and treatment strategies. From this page the user can also view or download the final report which is the primary output product. If a user selects not to avoid the risk then they will continue to the next stage of the risk treatment process: reduction strategies (figure 8.24).
Chapter 8: Testing the model through a land risk prototype

The second stage of the risk treatment process is the risk reduction treatment option. Within this stage a user can decide to implement some risk reduction strategies. If they select yes within this stage they will be taken to a page which lists all of the available risk reduction strategies for that particular risk. Figure 8.25 shows the risk reduction strategies page for the risk of bushfire.

![Risk reduction strategies page](image)

**Figure 8.25 The risk reduction options for the risk of bushfire**

Once they have selected a reduction strategy, or multiple strategies to implement, a user can exit the process then, content with their treatment selection, or they can opt to continue with the process and determine whether there are any other treatment options which might be useful to treat the risk. If the user is interested in implementing a specific strategy, or would like further information regarding that strategy then the user can select the strategy which will direct them to the resources page where they can find out more information regarding that strategy. In this way, the system could act as a hub for service provision where treatment providers, such as insurers, asbestos removal companies, land clearance specialists, building inspectors, pest control businesses and a range of others who can assist in risk treatment (avoidance, reduction, transference) could be linked with users requiring these services based on location. Once the user has collected or viewed enough information they can return to the risk strategy page and continue with the risk treatment process.

The next stage of the treatment process, if the user has not elected to already select a treatment and end the process, is the transference stage. The transference stage relates to the selection of another individual or organisation to take responsibility for the risk. This
generally in exchange for money, in the case of insurance, or some other arrangement. Figure 8.26 illustrates the risk transference stage of the system.

A user can elect to continue to the next treatment or investigate the transference options. If the user chooses to look into the transference options they will be directed to the resources page again where there is a range of transference options. They can then select a transference option and exit the process or select a transference option and continue with the process.

If the user returns to the treatment process, the final treatment option is to retain the risk. This can either be in the form of forced retention or self insured. The forced retention is the ‘last resort’ type option where a user does not have any resources to effectively manage the risk – for example, they cannot relocate from the area where the risk exists, cannot carry out mitigation strategies or any strategies which would prove effective (such as in the case of flood), and cannot afford insurance which would cover the possible damage as a result of the event, or if insurance is not offered for that risk at all. Self insurance is the other retention option which can be a result of a stakeholder having implemented a range of strategies, but as there is still some residual risk the stakeholder retains this risk, or alternatively, if the potential financial consequences of the risk are not exceeded by the cost of insurance (transference) the stakeholder might choose to retain the risk as the more financially viable option (figure 8.27).
Once a user selects either the self insurance or risk retention option the risk treatment process will conclude and the user will be directed to the resources page where the final output – the report will be available for the user to view or download, and a range of other resources are available to assist in the overall management of risks. If the user has multiple risks to manage, they will be directed to the first page of the treatment process to proceed with the next risk.

**Resources**

The resources page within the web based system has five different sub pages: resources by state, resources by risk, treatment: reduce, treatment: transfer, my outputs. Each page arranges the information in a different way for the user or supplies different resources. The first page, resources by state has a range of different links which are arranged under each state (figure 8.28).
This is useful to the user if they are interested in information pertinent to the jurisdiction which the land and property they are interested in managing is located in. If a user is interested in managing or finding out information regarding a specific risk then selecting the resources by risk page might be a suitable option for the user. This arranges all of the information relevant to a risk under one heading regardless of the jurisdiction from which it came. This is useful to the user as some jurisdictions may have resources which are helpful to the user despite originating from a different jurisdiction within Australia. The funding allocated within jurisdictions can also impact the availability of resources and whether there are a range of tools and information available, or limited. Having all the information in one location allows all citizens to take advantage of the information available (figure 8.29).
Chapter 8: Testing the model through a land risk prototype

The arrangement of the resources for the reduction treatment strategy is similar to the ‘resources by risk’ arrangement above, except that some of the resources are more specific to mitigation strategies. The transference treatment page of the resources is also a similar page except that this page is focused upon the transference of risk and has a range of resources specifically related to transference (figure 8.30).

The final page of the resources section is the ‘my outputs’ page. This page has all of the outputs of the risk management process carried out by the user. Here the user can download the final report and revisit the risk management process they carried out (figure 8.31).
Figure 8.31 The outputs page of the web based system

The report is automatically generated for the user based on the information input in the risk management process. Depending on how many risks are managed for the parcel the length of the report can vary substantially.

**Future Improvements**

Since the development of the prototype, which was informed by the land risk management model developed in chapter 7, further improvements to the system have been identified. Such future improvements of the system could include the adaption of the webpage for use on tablets or smart phones to increase the accessibility of the system. The web based system would need to be modified slightly to allow for input from a touch screen device however the main components could remain the same. Having this capability could allow stakeholders to carry out risk management on locations which they might be visiting or regularly frequent such as the workplace or a holiday destination. Though the role of the stakeholder and the rights the stakeholder holds over the land might differ slightly the need is still present. A stakeholder could use the system to determine whether there is any risk related to a destination they are visiting for a holiday or a short period of time. A readily available system which can be accessed through a portable device could allow users to determine quickly whether there is any risk of bushfire, flood, earthquake etc at a location they are visiting.

The conclusion of the prototype development and the ability of the land risk management model developed in the previous chapter to be used as a framework for this type of application are now discussed in the following section.
8.7 Conclusion of model implementation

The development of a prototype using the land risk management model as a framework to create a web based system for stakeholders to facilitate the risk management process was demonstrated above. To determine whether the model had potential in a real world system the resulting prototype and its ability to address the stakeholder’s needs was assessed. Whether the land risk management model, which was used as the underlying structure and guideline, generated a prototype which could demonstrate value, quality and potential was a primary factor. This was determined by how well the riskfinder.org.au system assisted in the achievement of the social outcomes of effective risk management, authoritative risk data, community access, improved decision making, and disaster resilience. The result the riskfinder.org.au application could have on each of these social outcomes is now discussed.

Authoritative risk data

Using the land risk management model as a framework for the implementation of the prototype system, a conceptual model and architecture which allowed for the seamless integration of a range of spatial and non spatial information, from a range of sources was developed. Included within the design was authoritative data about risk. During the guided risk management process which the prototype system facilitated, the ability for stakeholders to select authoritative data was included. This allowed stakeholders to be sure that the data returned was of an authoritative nature. The ability to source other data which was not authoritative was also a feature which allowed stakeholders to access all available data. This was a feature built into the model design which detailed the integration of a range of information sources in the information infrastructures and land administration agencies components.

Community access

The ability for the community and all stakeholders to access information relevant to the management of risks affecting land was a primary motivation for the development of the land risk management model which was carried on into the development of a land risk management prototype. Based on the land risk management model requirements the prototype incorporated the access of the community into the design. The land risk management model lists a range of stakeholders which all have different risk management needs. The log in feature of the prototype enables the system to differentiate between users to allow for different information access privileges, and alters the risk management process to be best fit for the user. As the role of government agencies is very different than citizens in the management of risks, which is informed from the context element of the land risk management model, the access types are altered. This allows for citizen stakeholder to
receive information and risk management strategies relevant to their situation, and other stakeholder such as governments to receive information relevant to their risk management requirements. At all levels however information is available, and there is no stakeholder group excluded from the system.

**Improved decision making**

The prototype developed from the land risk management model has shown to be able to improve decision making in a number of ways. Firstly, the system brings together a range of information and presents it all in the once place. The ability to look at multiple data sources focused on one parcel of land increases the chances for detecting risks. Decisions regarding what are considered threatening risks would therefore be improved. Secondly, the guided step by step risk management process enables stakeholders who are not familiar with the risk management process to work their way through it and be presented with a range of different risk management strategies. Finally, the risk management strategies presented allow for stakeholders to consider all the options and alter factors to best suit their context in order to determine the best outcome for them. Having this information which could not be sought before either through an inability to gather the data, or understanding of how to follow the process or implement strategies is beneficial to all stakeholders.

**Disaster resilience**

Disaster resilience is increased as more citizens become aware of risks which present a threat, their vulnerability to those risks, and the level of risk which exists. The prototype system developed from the land risk management model allows for the improvement of disaster resilience by supporting the three social factors above, as well as raising the awareness of risk management and improving the education of stakeholders in the area of risk management. Information of an authoritative nature as a resource, the ability to access a range of different information sources for all stakeholders, and assistance in the process of decision making all contribute to a community with good disaster resilience. The components outlined in the land risk management model all work together to promote these social outcomes which are conveyed in the prototype and shown to have value and potential.

**Effective risk management**

Effective risk management results if all of the above social outcomes are achieved. All of the benefits realised from the implementation of the land risk management model into a prototype system for the management of risk affecting land and property build towards a society which has effective risk management processes in place.
Based on the findings from the assessment of the model using the riskfinder.org.au prototype, the land risk management model has all of the components and elements necessary to achieve real world social outcomes.

8.8 Chapter summary

This chapter presented the prototype system developed as an application of the land risk management model which aids decision makers and all stakeholders in the process of managing risk to land. Within Australia there is a need for stakeholders to be able to access information regarding risks which affects their land and property and to make sensible and appropriate risk management decisions with this information. The theory behind human decision making and the different types of decision making support systems available were explored and discussed. From this theory the conceptual design and architecture of the prototype was developed using the land risk management model and the details were described in depth. Following the description each element of the prototype was illustrated, discussed, and the application of the process demonstrated. The conclusion of the chapter demonstrated that the system developed allowed stakeholders to easily access information about risk affecting a parcel of land and offers guidance to them through the risk management process as well as a range of resources to assist in the procedure. This as a result contributed to the achievement of the social outcomes and demonstrated that the land risk management model has potential as a beneficial real world application.

The next chapter will present the final conclusions of the research by firstly examining the overall achievements in response to the initial research questions and stated objectives. The significance of the research will be discussed and recommendations for further research will be presented.
Chapter 9 – Conclusion and future direction
9.1 Introduction

With the affects of risk events and disasters being felt around the world, developments in the area of risk management and overall resilience by the community is needed. The discipline of land administration has much to offer the realm of risk management however a limited understanding of how land administration information could be used to support the management of risks to land and property was the reality.

This research investigated the risk management practices of land right holders as well as each land administration agency in the case study country of Australia to determine generic issues related to both the needs of decision makers and the land administration information available which could meet these needs. The results of the study reiterate the importance of information sharing and coordination between agencies. A solution which integrates risk management processes into land administration systems through a networked approach addresses the problem specific to developed countries with established land administration systems.

This concluding chapter re-examines the research objectives and considers the outcomes achieved in this research. The significance of the research work to theory and practice is highlighted, the original research problem is reflected upon, and suggestions for future research efforts are outlined.

9.2 Research aim and objectives

As outlined in chapter 1, the central aim of this thesis was to:

To develop a model which demonstrates how land administration could support the process of land risk management

In response to this aim, a land risk management model was developed through the integration of the results from the investigations carried out on the case study country of Australia: the qualitative land administration study which looked at land administration agencies within the state or territory jurisdictions, and the results of the land risk stakeholder study which examined both citizens and local governments within the two states of Victoria and New South Wales. A mixed methods research approach was successfully utilised to achieve this aim. This research strategy provided a number of advantages, including the ability to investigate different dimensions of a research problem.

The land risk management model successfully integrated the land administration element with existing information infrastructures and then incorporated these elements into the overall process of risk management to address the needs of decision makers and land right holders.
The model recognises the requirements of a range of stakeholders in managing risk to land and property as well as the coordination issues which exist between different information infrastructures. In addition, the model was used to effectively demonstrate a real world example where stakeholders could implement land risk management processes through a prototype system. This revealed the strengths and weaknesses of the model.

The objectives of the research aim and the response of this research will now be reviewed and discussed.

9.2.1 Objective one

Objective: Examine existing theory on risk management and land administration. Specifically, review the current relationship between the concepts of risk management and land administration to create a new body of knowledge

A review of existing literature aided in the understanding of both the disciplines of land administration and risk management. Through the theory, relevant models were identified in the field of land administration which assisted in the understanding of motivations for supporting risk management. A number of gaps were identified in the literature however, including a lack of information on how land administration agencies can incorporate risk management processes, data sharing initiatives between states and other information infrastructures, and the specific application of risk management processes for managing land and property using information obtained from land administration agencies. The need for further understanding of each specific land administration agency was also highlighted. The investigation into the management of risk affecting land and property recognised the need to understand both the risks which can affect land and property of stakeholders as well as the process of managing these risks and the information which is useful within this process. The model developed recognised this and incorporated different information requirements to match a variety of risks as well as address basic land information needs.

9.2.2 Objective two

Objective: Assess the role and function of land administration systems and identify how they could support land risk management through legal, policy, technical and institutional changes

The investigation into land administration systems which looked closely at the management of land interests within a range of jurisdictions identified a range of legal, policy, technical and institutional issues which helped inform an understanding of how these systems could support land risk management. The institutional and legal aspects of the investigation helped define the role of land administration systems, while the policy and technical characteristics
assisted in identifying the function of land administration systems. The identified changes required to enable land administration systems to support land risk management included: the development of a national system of policies for managing land interests; implementation of formal arrangements between governments and the private sector for improved data sharing; government accountability through legislation to make land interest information available; legislated requirements to support the recording of details such as spatial extent, duration and people impacted; the utilisation of existing land information for other applications – such as land risk management; adaption of agencies to address internal and external demands; and adoption of consistent standards; implementation of spatial and information technologies. Of particular importance in the findings was the access of authoritative land administration information. The contribution of this information to the process of land risk management is considerable. Implementing the identified changes to achieve this outcome alone would provide significant support to the land risk management process, however, to successfully realise the land risk management model, all changes should be addressed.

9.2.3 Objective three

Objective: Identify the factors which motivate land administration agencies to support risk management activities

This research objective was informed by the results of the investigation into the land administration agencies within the case study country of Australia and the literature review. An understanding of the role of land administration agencies at a generic level was achieved from the literature review of the research. Gaps were identified however in relation to how land administration agencies respond to involvement in the area of risk management. In order to comprehensively address the research objective, information was gathered from the land administration agencies investigation to inform the result. These results, combined with results from the land risk stakeholder case study, which detailed the different needs of a stakeholder and risk management activities of importance, enabled a number of factors to be determined which reflected motivational aspects for land administration agencies. The motivating factors identified included: retention of the agencies current role through adoption of national policies; improved relationships and opportunities with the public sector; addressing public demand; duplication of data without duplicating resources – develop once and use many times; jurisdictional rivalry; contribution to a community imitative; improved economic efficiency and opportunity; reduction in liability; and increased business and income for the jurisdiction. The resulting factors were incorporated into the overall land risk management model to inform the contextual component and the land administration sub-component.
9.2.4 Objective four

Objective: *Determine the issues which prevent stakeholders from implementing effective land risk management strategies*

This research objective was addressed through both the stakeholder study carried out on citizen and local government stakeholder groups within the case study country of Australia, and the land administration agency study. The results of the investigation revealed two primary issues which impacted on the implementation of effective land risk management practices by stakeholders. The first was a difference in the understanding of the roles and responsibilities of each stakeholder. For the two stakeholder groups studied, there was a disparity between what the perceived role of each stakeholder was, and what the defined role was. For citizens, there was a perception that the government had a role in notifying and assisting them in implementing risk management practices and that the responsibility was shared between citizens and local governments. The defined role shows that the responsibility lies solely with the land owner/occupier. From the local government perspective, the understanding of the responsibility was clear, with well defined arrangement outlining what land and property should be managed and what was outside their scope. The role of local governments in managing risk to land and property was less clear however, with many expanding their role to include active land risk management in the community, promoting areas of risk and warning residents who are vulnerable. The second issue which impacted on the implementation of effective land risk management is the access to and awareness of information available for land risk management. Many citizens were not aware of the information, or were limited by their technology or the cost of the information, others were not aware that such information existed. Both of these issues are addressed through the land risk management model.

9.2.5 Objective five

Objective: *Design and evaluate the model and assess its implementation as a real world application for stakeholders*

To evaluate the land risk management model and determine its relevance, applicability and usability the model was implemented as a prototype system aimed at facilitating the decision making process for stakeholders wanting to manage risk affecting land and property. The prototype system demonstrated a website which would support stakeholders in each phase of the risk management process. The outcome of the implementation illustrated the value that the model brings to stakeholders who are not familiar with the risk management process. The model implemented as a prototype enabled stakeholders to undertake guided risk management processes and to put in place effective risk management measures. The needs of
stakeholders and the important role that they have within achieving overall community resilience was highlighted as was the critical role the underlying information infrastructures including land administration system have in supporting this process. The evaluation and implementation of the model concluded that the model was successful in facilitating the achievement of the social outcome of effective risk management through authoritative risk data, community access, improved decision making and disaster resilience.

9.2.6 The research hypothesis

The objectives of the research along with the research questions all contributed to achieving the research aim and enabled the research hypothesis derived in chapter 4 to be evaluated. The hypothesis derived was:

\[
\text{That the management of risk to land and property will be improved if:}
\]

- Land administration systems are used as a foundation;
- Land and property information is aggregated at a national scale;
- Emerging spatial technologies and concepts are utilised;
- Existing risk information is spatially enabled.

The research questions developed in chapter 4 were answered through the research conducted in the land administration agency investigation and the risk stakeholder’s case study. The answers to each of these questions all contributed to responding to and testing the hypothesis. The research hypothesis was evaluated by revealing the land information needs of risk stakeholders, the requirement of authoritative land information to achieve effect risk management of land and property, and, the need for land administration supported risk management processes which utilise the available spatial technologies. Further, the implementation of the land risk management model as a prototype system validated the hypothesis by demonstrating a system which uses land administration systems as a foundation, requires aggregated land and property information, utilises spatial technologies and spatially enables information about risk to achieve improved management of risk to land and property.

9.3 Conclusion on research problem

The research problem identified in section 1.2.1 of this thesis recognised that land administration systems have the potential to facilitate the management of risks to land and property, however, due to current administrative arrangements, are limited in their involvement. This research has confirmed that this problem exists and is preventing decision
makers and risk management stakeholders from implementing effective risk treatment. Further, the research showed that without increased information sharing and education, communities would continue to be affected by risk events and be unprepared with ineffective risk management strategies. Through the research carried out the needs of stakeholders wanting to manage risk were confirmed and the support which land administration systems could provide to the application of risk management was discovered. Legal, policy, institutional and technical issues were highlighted as the biggest factors to be overcome in achieving the societal outcome of effective risk management. The development of the land risk management model addressed these issues and suggested principles for overcoming the limitations. The final implementation of the model was a prototype for guiding stakeholders in the utilisation of resources to carry out effective risk management practices.

9.4 Main research outcomes

From this research five chief contributions to knowledge have been achieved:

- Identification of policy, legal, institutional and technical factors which motivate land administration agencies to assist in land and property risk management activities;
- Revelation of stakeholder needs within the process of risk management specific to land and property;
- Understanding of stakeholder perceptions and expectations within the land risk management process;
- Development of the land risk management model which outlines how each component is critical to the effective management of land and property for a broad range of stakeholders, and how each component is connected and can be arranged in order to achieve effective land risk management for society;
- Implementation of the land risk management model as a prototype system which provides guidance and strategies for decision makers wanting to implement the land risk management process to assess risk to their land and property, evaluate the risk and then treat the risk in an effective way.

9.5 Future directions

As an outcome of this research a number of areas for future research which could not be addressed within the scope of this research have been identified.
Adaption of the outcomes to the broader area of public safety

The outcomes of this research revealed how land administration systems could support the management of risks to land and property. This involved examining the discipline of risk management and determining how the process could be improved through the integration of land administration systems. The area focused upon was specific to risks which affected land and property. At a broader scale the issue of public safety is increasing in importance for governments around the world. How public safety could benefit from the support of land administration systems for a range of applications is a new opportunity to be explored. An example might be using land administration information to determine the temporal land use of the central business district within urban settings. During certain periods of time, the area would have a large population as people enter the area for employment, and at other times, the area would be populated with residents and visitors for recreational activities. How the land information could be applied to public safety to assist in planning for events such as terrorist scenarios, disaster scenarios, or crowd based scenarios for public events such as a parade or a marathon event through the city is a prospect to be explored.

Land administration supported risk management in other countries

Additional testing and refinement of the land risk management model in other country contexts or regions around the world would have been beneficial in achieving a more mature model. As the primary case study was conducted in Australia, adjustments to the model might be relevant based on findings from the application of the model to the contexts of other developed countries with established land administration systems. Another area for consideration might also be the application of the model – which was designed for developed countries with existing land administration systems, to developing countries. The findings from the model promote community resilience to risk and disaster events affecting the land and property of stakeholders. For countries developing land administration systems, some of the issues and challenges faced by countries with established systems might be circumvented by developing the land administration systems to accommodate and enable application of the land risk management model. This area of investigation requires further consideration by the research community.

Economic analysis of improved management of risks affecting land and property

Within the case study country of Australia from the year 2000 onward a number of large scale risk events took place which resulted in huge financial consequences for a range of stakeholders. Reassessments of insurance policies were undertaken by a range of stakeholders including governments, citizens, and the insurance companies themselves. The result of these assessments involved a large increase in premiums in many cases.
This is a problem which exists in a number of developed countries around the world. After significant events, for example Hurricane Katrina in the United States, huge financial impacts were experienced. The government was impacted – through having to respond and provide relief funding to those affected, the insurance companies were affected, trying to address the losses experienced from an event which did not align with actuarial assumptions, and the citizens were affected, trying to determine whether it would be better to rebuild or if it was financially possible to relocate to a less at risk area.

Improved land risk management processes, as demonstrated through the prototype, enable stakeholders at all levels to identify, analyse and evaluate relevant risks, and from there, assess treatment options. Based on improved understanding and acknowledgement of risk which might promote mitigation activities by citizens, raise awareness of the real threats which exist, and drive action to address these threats, how improved risk management practices for land and property management could impact on the financial cost of risks for all stakeholders could offer a significant contribution.

**Police state versus buyer beware**

Within society, there are two extreme government stances which can be taken – to police and monitor activities in which the government exercises rigid and repressive controls over a population, or to have an unregulated environment that allow citizens the freedom to make their own choices. In the context of managing risk to land and property, these two environments can materialise as firstly, for a police state: preventing people from living in areas which are known to be at risk, such as low lying areas which are vulnerable to flooding, limiting development in areas close to a fault line which could be affected by earthquakes, and blocking development in areas within bushland areas to eliminate bushfire risk; and secondly, for an unregulated environment, exercising a complete ‘buyer beware’ attitude that forces stakeholders to be completely responsible for identifying any risks to property and managing the application of appropriate treatments. The majority of developed countries fall somewhere between these two alternatives, offering freedom in some areas, and applying regulation in other areas. But in the context of managing risk to land and property where recent disaster and risk events in the developed world have resulted in excessive damage stemming from unpreparedness, what is the appropriate action?

Do governments stop people from living in areas because the risk is so high, and begin buying back already developed land that is deemed too dangerous to live? Should people who were unaware of the risk and subsequently have suffered significant loss in the value of their land and property as a result of risk information being made public be compensated? Should land developments be overruled to promote a risk averse society? Or should governments go...
the other way, and push it completely back onto the buyer? Should buyers be held accountable for their purchases and be forced to perform due diligence regarding property purchase? This issue needs further investigation to determine where the line should be drawn.

The link between good land governance and risk management
There is a link between good land governance and risk management which has yet to be fully explored. The Land Governance Assessment Framework (LGAF) developed by the World Bank looks at key areas where the policy of a country can be improved to benefit economic growth, social development, and environmental protection (Deininger et al 2011). It is a tool which can be utilised by policy makers and other stakeholders to address areas within the land sector which require attention. So far 21 different indicators have been identified within the key areas of: legal and institutional framework; land use planning, management and taxation; management of public provision of land information; and dispute resolution and conflict management. Further indicators which focus on the ability of government and citizens to manage land related risks could be identified and included.

9.6 Final remarks
The management of risks affecting land and property within Australia and around the world is becoming more important as severity and frequency of risk events increase. The need for society to address, prepare for and build resilience to these events has been demonstrated. A lack of resources for carrying out risk management procedures as well as problems with access to information, interpretation of information and education regarding management of risks to land was shown to be reality and a problem for greater society. Additionally, issues related to understanding the roles and responsibilities of stakeholders were identified as contributing factors to the problem. Support from land administration agencies and the systems that are maintained within government that manage land information can assist in this process and can contribute significantly to improving this problem, as was demonstrated through the results of the two investigations conducted in this thesis.

The overall significance of this work is demonstrated through the outcomes of the research, namely, the land risk management model, and the ‘risk finder’ prototype developed as a real world application of the model. The findings from this research and the land risk management model developed have the potential to improve the success and outcomes of future risk management for land and property. How countries can make the most of their functioning land administration systems is a key finding from this research. Furthermore, the prototype offers a new resource, harnessing existing information and infrastructures and
applying these to the risk management process to produce a step by step, user friendly way to realise comprehensive land risk management.

The identification of the barriers preventing improved land risk management opens the door for further investigation in the future to successfully accomplish effective land risk management implementation by stakeholders in developed countries, and potentially worldwide. The result of these outcomes would benefit all stakeholders including governments, the private sector and the community. To ensure a sustainable and resilient future, all individuals, communities, governments and private organisations must understand, acknowledge and manage appropriately risks affecting their land and property.
Using land administration for land risk management
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Using land administration for land risk management


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References


Appendix 1 – Papers resulting from this research

The author has published or contributed to the following publications during the course of the PhD research:


Appendix 2 – Land administration agencies questionnaire

A) Your Jurisdiction’s RRRs Policies and Legislation

A.1 Does your jurisdiction have an overarching framework or supporting legislation for recording RRR’s management or property inquiries?  Yes / No

A.2 Does your jurisdiction have an overarching vision or policy to implement or upgrade this framework?  Yes / No

A.3 If yes, is local government included within the vision or policy?  Yes / No

A.4 Are any measures in place to limit or reduce the amount of RRRs legislation within your state?  Yes / No

A.5 Is legislation that creates new RRRs developed and monitored in a formal way by an overarching management group in your state?  Yes / No

A.6 Is a requirement embedded into any legislation demanding for RRRs information to be made publicly available?  Yes / No

A.7 Is there a requirement in any legislation that states an RRRs spatial extent, duration, and people impacted be recorded in a uniform fashion?  Yes / No

A.8 Has your jurisdiction formally determined the number of RRRs within its statute books?  Yes / No

B) Your Organisation

B.2 Briefly describe your organisation’s reporting obligations, budget controls, and relationships with the Valuer General, Surveyor General, Registrar General, and any other key land and spatial information agencies:

B.3 What is the primary business model utilised by your organisation (e.g. government department, statutory authority, government business enterprise)? How are your activities funded?

B.4 Scale. Please indicate the number of actual transfers AND indicate the approximate number of live titles:
<table>
<thead>
<tr>
<th>Number of transfers</th>
<th>Year Ending</th>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of titles</th>
<th>Approximate number (Western Australia + Indian Ocean Territories)</th>
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</tbody>
</table>

B.5 Is your agency (or will it be) the lead agency in coordinating the integration of publication of RRRs information?

Yes / No

B.5 If no, who is (if anyone)?

C) Managing Your RRRs (or current property inquiry systems)

C.1 Which RRRs are considered title information (see glossary) by your organisation? Are they part of any guarantee of title (i.e. full or partial). Also describe whether they are parcel based or defined some other way (e.g. spatial extent):

  e.g. Freehold ownership (full, parcel)

C.2 Which RRRs are considered non-title information (see glossary) in your organisation? Also list the creator and the custodian of the information. Also describe whether they are parcel based or defined some other way (e.g. point):

  e.g. Contaminated soil area (EPA, linking mechanism, polygon)

C.3 How does your organisation determine what is title information and what is non-title information? Is the approach methodical?

C.4. In general, how is an RRR described, recorded (spatial extent, duration, people impacted, and integrated (if any)?
C.5 Is your organisation actively seeking to use its tools (registry and cadastre) to publish other RRRs information (i.e. currently non-title data)?

Yes / No

C.6 If yes, explain how:

C.7 Indicate the custodians of non-title land information with contracts for sharing, access, and distribution through your system. How are custodians identified?

C.8 Does your organisation charge for inquiries or custodianship? (How much?)

Yes / No

C.9 Indicate the quality controls and security mechanisms used in your organisation:

C.10 Indicate the processes used to verify and update title and non-title information (including management and communication of verification). Are there any update mechanisms within the titling systems that maintain the currency of RRR information?

C.11 Does your jurisdiction have any arrangements in place to achieve intra-jurisdictional consistency in basic RRR terms and descriptions (e.g. location, people, time, and activity). Is your organisation part of a larger suite of authoritative registers?

C.12 Estimate the current impact of the following influences on intra-jurisdictional management of RRRs (1 = low, 5 = high):

<table>
<thead>
<tr>
<th>Influence</th>
<th>Estimate of impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Privacy laws and principles</td>
<td></td>
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<tr>
<td>Whole of government information policy</td>
<td></td>
</tr>
<tr>
<td>Whole of government IT policies</td>
<td></td>
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<tr>
<td>Sharing of data</td>
<td></td>
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<tr>
<td>Currency of data</td>
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<tr>
<td>Commercial imperatives to meet outgoing from internal functions</td>
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<tr>
<td>Pricing policies</td>
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<tr>
<td>Whole of government licensing of access</td>
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<tr>
<td>Memoranda of Understanding</td>
<td></td>
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<tr>
<td>Spatial enablement of government</td>
<td></td>
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<tr>
<td>Development of a Spatial Data Infrastructure (SDI)</td>
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</tbody>
</table>
Using land administration for land risk management

<table>
<thead>
<tr>
<th>Address information</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Freedom of information requirements</td>
<td></td>
</tr>
<tr>
<td>Consumer protection</td>
<td></td>
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<tr>
<td>Social inclusion</td>
<td></td>
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<tr>
<td>Privatisation of processes</td>
<td></td>
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<tr>
<td>COAG harmonisation processes</td>
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<tr>
<td>Emergency services need for accuracy</td>
<td></td>
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<tr>
<td>Other (please identify)</td>
<td></td>
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</tbody>
</table>

C.13 Estimate the coverage of your land register:

<table>
<thead>
<tr>
<th>Type of interest</th>
<th>Estimated % coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freehold land</td>
<td></td>
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<tr>
<td>Long term commercial leases</td>
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<tr>
<td>Crown land</td>
<td></td>
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<tr>
<td>Local government assets</td>
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<tr>
<td>National government assets (Commonwealth land)</td>
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<tr>
<td>Mining rights</td>
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<tr>
<td>Carbon rights</td>
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<tr>
<td>Water rights</td>
<td></td>
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<tr>
<td>Aboriginal and Torres Strait Islander rights</td>
<td></td>
</tr>
<tr>
<td>Roads</td>
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<tr>
<td>Foreign ownership</td>
<td></td>
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<tr>
<td>Registered restrictions over land</td>
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<tr>
<td>Submerged land</td>
<td></td>
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<tr>
<td>Utility grids (as easements or otherwise)</td>
<td></td>
</tr>
<tr>
<td>Other examples of non-national registration practice</td>
<td></td>
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</tbody>
</table>

C.14 In the next decade, which of the initiatives below do you think will influence registration policy and practice? (1 = low, 5 = high):

<table>
<thead>
<tr>
<th>Land information trend and innovation</th>
<th>Estimate of influence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growth of national land information data sets, eg under climate control and emissions legislation</td>
<td></td>
</tr>
<tr>
<td>Increased use of GIS</td>
<td></td>
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<tr>
<td>Increased accuracy in GIS</td>
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<tr>
<td>Spatial enablement</td>
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<tr>
<td>Innovations in the web environment: crowd sourcing, the cloud</td>
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<tr>
<td>Increased demand for accurate land information for public safety, emergency management and disaster prediction and responses</td>
<td></td>
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<tr>
<td>Increased demand for accurate transaction information</td>
<td></td>
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<tr>
<td>Location Intelligence policies</td>
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<tr>
<td>Tax equity (e.g. GST on commercial land, CGT on non residential land, agricultural tax concessions)</td>
<td></td>
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<tr>
<td>Private sector services in GIS and land IT services</td>
<td></td>
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<tr>
<td>-----------------------------------------------</td>
<td></td>
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<tr>
<td>Land information agencies’ need for timely and accurate information about parcels and owners</td>
<td></td>
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<tr>
<td>National electronic conveyancing</td>
<td></td>
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<tr>
<td>Information streams and data generated from national electronic conveyancing</td>
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<tr>
<td>Visualisation of land and buildings</td>
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<tr>
<td>Development of a 3D cadastre</td>
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<tr>
<td>Increasing penetration of registration services in marine areas</td>
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<tr>
<td>Identification of building footprints in survey information accompanying applications for survey registration</td>
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<tr>
<td>Survey accurate cadastre</td>
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<tr>
<td>Electronic lodgement of survey plans</td>
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<tr>
<td>Development of extensive national datasets of land and building information</td>
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<tr>
<td>Non-parcel inquiries (e.g. noise limitation)</td>
<td></td>
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<tr>
<td>Assistance for management of owners corporations</td>
<td></td>
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<tr>
<td>Other (please identify)</td>
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</tbody>
</table>

C.14 Describe your organisations arrangements with the private sector in relation to Public-Private Partnerships or IT support with respect to the management of RRRs:

D) **Sharing and Providing Access to RRRs** (or current property inquiry systems)

D.1 In general, how does the public access RRRs information from your organisation?

D.2 Are any datasets subject to access controls? Which data? How and why?

D.3 Indicate the lowest and highest search fees for RRRs in your organisation:

D.4 How is pricing set?

D.5 Are commissions or other charges made for processing inquiries?
D.6 Indicate the arrangements with information brokers and third party retailers of RRR information.

D.7 Who are the key stakeholders and users of your data?

D.8 Circle the feature that best characterises the user experience in relation to accessing RRRs from your organisation in each line below:

Title information
a) Onsite / Online / Either
b) Map or spatial based search / Text search / Either
c) Immediate RRRs reports / Delayed or posted RRRs reports
d) Authoritative reports / Flagging reports (need to further inquire at custodian agency) / Both
e) Hardcopy Reports / PDF Reports / Online webpage reports
f) Spatial representation of interests / Textual representation of interests

Non-Title information
a) Onsite / Online / Either
b) Map or spatial based search / Text search / Either
c) Immediate RRRs reports / Delayed or posted RRRs reports
d) Authoritative reports / Flagging reports (need to further inquire at custodian agency) / Both
e) Hardcopy Reports / PDF Reports / Online webpage reports
f) Spatial representation of interests / Textual representation of interests / Both

D.9 How does a user search your RRRs data (circle or tick all that apply):

a) Parcel IDs (e.g. Show me all the RRRs at Lot 1 Plan 1)
b) Address (e.g. Show me all the RRRs at 9 Miller Street)
c) Spatial location (e.g. Show me all the RRRs within this selected area on the map)
d) RRR Type (e.g. Show me all the sites with soil contamination certificates)
e) Person (e.g. Show me all the RRRs that relate to Jude Wallace)
f) Time (e.g. Show me all the RRRs that applied on 27th June 2006)
g) Theme (e.g. Show me all the RRRs to do with waterways and waterlevels)
h) Combinations of the above
i) Other..........................................................

E) Your Platforms and Systems

E.1 Indicate generally the technical systems used by your organisation to manage and distribute RRRs or current property inquiry systems (e.g. database names, servers/systems, delivery/front end):

E.2 What is the architecture of each system? Are there any documents for their architecture? And how can they be accessed?

E.3 What are the key features of each system described above?
E.4 What are the underlying technologies used to develop each system described above (e.g. Oracle)?

E.5 Do the systems described integrate with other enterprise-wide systems? Is there integration with federal agencies? Is there integration with other jurisdictions? Or integration with local government?

E.6 Indicate when the systems were previously significantly upgraded:

E.7 Indicate any plans for future expansion of your systems:

E.8 Indicate initiatives from agencies that might be useful to your organisation. Use a scale of 1 – 5, starting with not applicable, ending with very useful.

<table>
<thead>
<tr>
<th>Initiative</th>
<th>Estimate of significance to future planning in your agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLIP (WA)</td>
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<tr>
<td>GNAF (PSMA) Geo-coded national address file</td>
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<tr>
<td>LIST (Tasmania)</td>
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<tr>
<td>SIX, Central Register of Restrictions (CRR) (NSW)</td>
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<tr>
<td>NECS National Electronic Conveyancing</td>
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<tr>
<td>Register of administrative interests (Qld)</td>
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<tr>
<td>Spatial Information Services Stack (SISS)</td>
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<tr>
<td>GeoScience Australia</td>
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<tr>
<td>Others…</td>
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</tbody>
</table>

F) Spatially Enabling RRRs (or current property inquiry systems)

F.1 Does your organisation record each RRR in a standard way spatially? Yes / No

F.2 Does your organisation assist others in spatially enabling their RRR datasets? Yes / No

F.3 In your organisation are RRRs spatially enabled and considered as separate layers (i.e. searchable by location/coordinates) OR are they always linked to a parcel (i.e. searchable via parcel IDs) Spatially Enabled / Parcel Based / Both

F.4 Does your jurisdiction have plans to build a survey-accurate cadastre? Yes / No

F.5 If yes, how and when?

F.6 Does your organisation already use location enabled services and geocoded information? Yes / No
F.7 Indicate the potential for use of the parcel map (and other maps) for organising land information in your organisation.

F.8 What is the relationship between the cadastre and the registry in your jurisdiction?

F.9 What is the relationship between the cadastre and broader spatial information sets in your jurisdiction?

F.10 How does your organisation deal with different definitions of boundaries (e.g. rigid planning zones vs. flexible cadastral boundaries)

F.11 Is your jurisdiction developing consistent SDI intra-jurisdictional standards?

F.12 Does your jurisdiction see the benefit of the integration of spatial and aspatial information?

G) Miscellaneous

G.1 Indicate current problems and issues in information management experienced by your organisation. Include land information or datasets that is unusual or problematic.

G.2 Should the administration of government be willing to change, what legislative changes would facilitate your organisation’s land information policies?

G.3 When is stamp duty payable? How is stamp duty collected? What documents attract duty (contract of sale or transfer of land)?

G.4 Describe any formal arrangements between state and territory governments and local governments relating to land information creation and sharing.

G.5 Describe any formal arrangements between state and territory governments and national government relating to land information creation and sharing.
G.6 Describe formal arrangements between state and territory governments and private sector relating to land information creation and sharing

G.7 Does your jurisdiction charge Ad Valorem for transfers of land?

G.8 Does your jurisdiction use a data set of “official values” to ensure duty is correctly accessed and, if so, what values does it use

G.9 Do jurisdictions support a National system of baseline policies and procedures to administer RRR’s?

End of Questions
Thank You
Appendix 3 – Pre survey letter

Pre-survey letters were sent to local governments in the two case study states of New South Wales and Victoria to invite them to participate in the survey and to familiarise them of the intending survey. They were asked to nominate a senior member of the organisation for participation in the research.

Find a copy below:

This is to invite you to participate in a University of Melbourne research project titled: **Engineering Land and Property Risk Management through Spatial Enablement**. The research is part of an Australian Research Council linkage project in collaboration with the industry partners: Land Victoria, Land and Property Management Authority - New South Wales, Landgate - Western Australia and PSMA Australia Limited. It is being conducted at the Centre for Spatial Data Infrastructure and Land Administration (www.csdila.unimelb.edu.au) within the Department of Infrastructure Engineering (formally Department of Civil and Infrastructure, Environments, and Geomatics) at the University of Melbourne.

As the most recent natural disasters such as bushfire, flood, and severe storms demonstrate – risk is all around us, and individual, governments, and organisations alike can be affected. These risks create uncertainty and put at risk the financial stability and wellbeing of Australians. Management of these risks is necessary, and access to accurate and timely information about these risks is crucial for effective risk management.

The research focuses on understanding the current arrangement of risk information associated with properties in Australia, specifically how this information is coordinated, aggregated and disseminated to stakeholders. This study is framed within the proposition that improved access to timely, accurate and consistent information on risk for governments, business and citizens will facilitate improved risk management strategies.

This study aims to gather some information regarding how risks that threaten the land and property of your municipality are managed. More specifically, the objective is to gain a better understanding of the approaches and information used to treat risks.

This email is to seek your support and participation in the study, and to request the nomination of a senior staff member of your council (as a main contact) who has a role related to managing risks (such as flooding, bushfire, sea level rise, severe storm etc) which affect the land and property managed by the council. It would be greatly appreciated if you could provide the contact details (phone number and e-mail address) of the nominated staff member.

As soon as contact details are received the nominated staff member will be forwarded a survey link through which they will be asked to complete an on-line survey.

Thanking you in anticipation of your assistance and contributions.

Kind regards,

**Katie Potts**

*PhD Research Student*

*Centre for SDIs and Land Administration*
Appendix 4 – Citizen questionnaire

Understanding Risk Management Practices in Relation to Land

Engineering Land and Property Risk Management through Spatial Enablement

You are invited to participate in the above research project, which is being conducted by Prof. Abbas Rajabifard and Dr. Rohan Bennett (supervisors) and Ms. Katie Potts (PhD student) of the Department of Infrastructure Engineering (formerly Dept. of Geomatics) at The University of Melbourne. This project will form part of Potts’ thesis, and has been approved by the Human Research Ethics Committee.

The aim of this study is to develop a model and associated tools which more effectively supports the coordination, aggregation and dissemination of consistent information on risk between governments at all levels, citizens and business. You will be asked to participate either through an interview and/or by completing a questionnaire. Through the interview and/or the questionnaire you will be asked to provide some information about how you or your organization manages risk to land and property, and how decisions regarding risks which affect land and property managed by you or your organization are made. We estimate that the time commitment required of you should be around 20 minutes.

Please be advised that your participation in this study is completely voluntary. Should you wish to withdraw at any stage, or to withdraw any unprocessed data you have supplied, you are free to do so without prejudice. Due to small sample size, you might be identified as a participant. However, the confidentiality of the information you provide will be safeguarded, subject to any legal requirements. In addition, please note that if you are in a dependent relationship with any of the researchers your involvement in the project will not affect ongoing assessment and management.

By clicking 'Yes' below you have agreed to participate in the study

Should you require any further information, or have any concerns, please do not hesitate to contact either of the researchers: Prof. Rajabifard: +61 3 8344 0234, Dr. Bennett: +31 (0)53 4874 339, Ms. Potts: +61 3 8344 6771.

I agree to participate in the questionnaire

☐ Yes

Where necessary, a pseudonym may be used in place of my actual name in any extracts quoted in writing unless I authorize consent to use my name by ticking yes below.

I agree for my full name and position to be used in any publications where extracts from this questionnaire are quoted

☐ Yes
☐ No
Understanding Risk Management Practices in Relation to Land

Introduction

This research is part of an Australian Research Council linkage project in collaboration with the industry partners: Land Victoria, Land and Property Management Authority - New South Wales, Landgate -Western Australia, and PSMA Australia Limited. The overarching project aims to design, build and manage a new infrastructure to integrate disparate state based land information and administration processes to meet national needs. This study is aimed at understanding the current arrangement of risk information in Australia, specifically how this information is coordinated, aggregated and disseminated to stakeholders. This study is framed within the proposition that improved access to timely, accurate and consistent information on risk for governments, business, and citizens will facilitate improved risk management strategies.

The aim of this questionnaire is to gather information on the risks that threaten the land and property of people. More specifically, the objective is to understand the approaches used to treat risks. Within this questionnaire there are six sections that aim to assess six different areas of risk management.

The first section is focused on the risk management plan. The questions are aimed at understanding the context of the land and property being surveyed and the approach taken towards risk management for this specific property. The second section is aimed at understanding the different risks that pose a threat to this land and property. The third section aims to understand how identified risks are analysed. Section four looks at the information used to make the risk management decisions and where this information originated. Section five and six look at how the risks are treated based on the risk management objectives identified and the information made available, and the monitoring and review of these decisions.

The results of this survey will be used to create aggregated statistical summaries and will be accessible to survey participants and distributed through publications. Confidentiality of individuals will be fully preserved in the collection and reporting of the results.

The survey should take approximately 20 minutes to complete. I thank you in advance for your cooperation in providing this information.

Further information on the project can be found on the website: http://blogs.unimelb.edu.au/nimli/

Details

Name: 
Address: 
City: 
State: 
Post Code: 

For the purpose of this questionnaire, please select one parcel/property which you own or use. Use this parcel when answering all questions.

Please indicate your relationship to the selected parcel below:

- Owner/occupier
- Lessor (owner who leases property)
- Lessee (renter)
- Other (please specify)
Understanding Risk Management Practices in Relation to Land

Please provide a description of the parcel/property (for example: farm, apartment, townhouse, terrace house, detached house and land, semi-detached etc.):
## Understanding Risk Management Practices in Relation to Land

### Section 1 - Risk Management Plan

Section 1 investigates the risk management plan in place for the parcel/property identified (if one exists) in the details section above. A risk management plan for the purpose of this survey is defined as a scheme specifying the approach, the management components and resources to be applied to the management of risk.

1. **Do you have a risk management plan for your land and property?**
   For example, have you made any arrangements for managing known risks such as bushfire, flood, title fraud etc.?
   - [ ] Yes
   - [ ] No

2. **Do you have any risk management objectives?**
   For example, to protect the contents of your property through insurance, to mitigate against specific risks such as bushfire by clearing land of dead plant matter etc.
   - [ ] Yes
   - [ ] No

3. **If yes, what are the main objectives?**

---

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Section 2 - The risks

The following questions are directed at the risks which affect or are relevant to the parcel/property identified in the details section.

1. What risks can be identified as being a threat to your land or property?

Please tick all relevant risks.

- riverine flooding
- bushfire
- earthquake
- severe weather (includes: storm wind gusts, lightning, hail, thunderstorms, intense low pressure systems, tornados, heavy rainfall, flash flooding, heat wave, blizzards)
- systemic (includes gale force winds and storm surge)
- tsunami
- landslide
- sea level rise
- other fire related incident (house fire)
- fraud
- drought
- disease outbreak
- asbestos
- pests (white ants, locusts, fruit fly)
- other (please specify)

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### Understanding Risk Management Practices in Relation to Land

2. Please indicate the level of threat each risk represents.
   
   **1 = low threat, 5 = high threat**

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<tr>
<th>Risk</th>
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<td>Other</td>
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*severe weather (includes: storm wind gusts, lightning, hail, thunderstorms, intense low pressure systems, tornados, heavy rainfall, flash flooding, heat wave, blizzards)

*cyclone (includes gale force winds and storm surge)

*pests (white ants, locusts, fruit fly)

*fire (other fire related incident - not bushfire related)

3. Of the above risks, which risk poses the greatest threat to your land and property?

4. Why do you consider this risk the greatest threat to your land and property?
5. For the risk selected above - [Q11], within the timeframe of the next ten years, please rate the likelihood of this risk occurring (i.e. the chance or probability that the risk will occur) and the level of consequence that would result (i.e. the significance or result) if this risk occurred.

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<th>Consequence</th>
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### Understanding Risk Management Practices in Relation to Land

#### Section 3 - Risk Analysis

All questions will now be asked in terms of the risk you identified in question 3 of section 2 ([Q11]) as the risk which poses the greatest threat to your land and property. Please answer the following questions in terms of this risk.

1. **How did you initially identify the risk of [Q11]?**

2. **What information did you use to manage or make decisions regarding the risk of [Q11]?**

3. **What methods (if any) were used to analyze this risk?**
   (i.e. determination of the likelihood and consequences, listing of attributes of the risk, use of a risk matrix, etc.)
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Section 4 - Risk information

This section investigates the information available that describes the risk you identified in question 3 of section 2 ([Q11]) as the risk which poses the greatest threat to your land and property. Please answer the following questions in terms of this risk.

1. Have you accessed any information about the risk of [Q11]?
   For example, the information could come from a government department website, other online resources, local government offices, insurance company etc.
   - Yes
   - No

2. If yes, how did you use this information?
   For example did it help you identify the risk of [Q11]? Did you use the information to seek further details on the risk?

3. Have you used any spatial information to manage this risk? If yes, please describe the spatial information utilized.
   Spatial information is data or datasets which have a spatial attribute. Types of spatial information include maps, geographic information systems (GIS), cadastral data, positioning data (GPS) etc.

4. Where, or from which organizations did you obtain the information about the risk of [Q11]?

5. How was the data accessed?
   (online, are there licenses required?)
   - Online (freely)
   - Online (license required, or special access rights required)
   - In person (verbally)
   - From an organization (brochure or document)

6. Was the information free, or was there a fee to obtain it?
   - Free
   - Fee required
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7. When was the information created?
   What was the date listed on the information?

8. Who is the custodian of the data?
   A custodian is the person or organization with the right to determine how the
   information will be managed and any access constraints, with accompanying
   responsibilities towards the maintenance, quality and enabling appropriate access to
   that information (the owner of the IP). It is not necessarily the person or organization
   who created the data.

9. Have you created any information yourself about risk?
   For example, have you contributed to any websites, uploaded information onto the
   internet, created maps etc.?
   □ Yes
   □ No
   If yes, describe

10. What was the format of the information you collected regarding the risk of [Q11]?
    □ Brochure
    □ Fact sheet
    □ Full document
    □ Document summary
    □ Map / overlay
    □ Email
    □ Verbal information
    □ Other (please specify)

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11. What format is preferable for you?
☐ Brochure
☐ Fact sheet
☐ Full document
☐ Document summary
☐ Map / overlay
☐ Email
☐ Verbal information
☐ Other (please specify)

12. What information do you require or would you like to have to identify, manage, or assess risks that affect your land and property?

13. How do you, or would you, use this information? What are the specific applications that the information is/would be used for?

14. If you store information (as a custodian or a user), do any external parties have access to that information?
☐ Yes
☐ No
☐ N/A

If yes, who are the external parties:

15. Was the information you acquired about the risk to your property useful and able to answer your queries?
☐ Yes
☐ No
☐ N/A
16. How do you organize your risk information?
Please select the most appropriate answer

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<th>Paper vs. Digital</th>
<th>No System vs. Categorized</th>
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17. Please comment on any other issues related to risk information:
Appendix 4

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Section 5 - Risk treatment

Risk treatment is a stage of the overall risk management process. In the risk treatment process there are four main options that are available: avoid, reduce, transfer and retain.

![Risk Treatment Options Diagram]

1. What risk treatment options (if any) are being applied to the risk of [Q11]? And if any, how are they being applied?
For example, avoidance of the risk, reduction of the risk, transference of the risk, retention of the risk.

- [ ] Avoidance of the risk
- [ ] Reduction / mitigation of the risk
- [ ] Transference of the risk
- [ ] Retention of the risk

If yes, how:

2. What are the reasons for the selected risk management treatment?
E.g. cost, analysis, advice, external reasons.

If applicable:

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### Understanding Risk Management Practices in Relation to Land

3. Referring back to all possible risks which may affect your land and property, what is the most appropriate treatment for dealing with each risk, or how have you managed each risk below?

**Please select a treatment below which you have either carried out, or plan to undertake. If the risk is not applicable to your land and property please select N/A.**

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<th>Risk Description</th>
<th>Avoid</th>
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<th>Transfer</th>
<th>Retain</th>
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*severe weather (includes: storm wind gusts, lightning, hail, thunderstorms, intense low pressure systems, tornados, heavy rainfall, flash flooding)

cyclone (includes gale force winds and storm surge)

pests (white ants, locusts, fruit fly)

fire (other fire related incident - not bushfire related)
### Understanding Risk Management Practices in Relation to Land

#### 4. What is the priority for the implementation of treatment for these risks?

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*pests (white ants, locusts, fruit fly)
*fire (other fire related incident - not bushfire related)

#### 5. Have you obtained insurance for any risks?

- [ ] Yes
- [ ] No

If yes, which risks
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**Section 6 - Monitoring and review**

In this final section the monitoring and reviewing processes are explored. The monitoring and review process is important for improving future risk management and for ensuring the most efficient and effective methods are in place. The following questions are directed at all risks affecting the selected parcel/property.

1. Once treatment has been carried out on each risk, have you sought out or obtained further information in order to remain updated on risks to your land and property?
   - Yes
   - No

2. Have you identified any emerging risks that weren’t present during the initial risk assessment?
   - Yes
   - No
   - If yes, which risks

3. Have you updated any of the information you received, or monitored the accuracy of the information?
   - Yes
   - No
   - If yes, what is the frequency of the updates?

4. If the updates came from an external party, what is the name of the party that provided the updated information?

5. Would you find value in being provided with updated risk information?
   - Yes
   - No
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6. In recent time a large amount of new information has been made available through mediums such as Google Earth, Open Street Maps, and other similar applications where there is scope for citizens to volunteer or share information based on locations. This information which is provided by citizens is referred to as ‘volunteered geographic information’ or VGI. Have you taken advantage of volunteered geographic information (VGI) for risk management purposes?

☐ Yes
☐ No
Thank you for your participation.
Appendix 5 – Local government questionnaire

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Engineering Land and Property Risk Management through Spatial Enablement

You are invited to participate in the above research project, which is being conducted by Prof. Abbas Rajabifard and Dr. Rohan Bennett (supervisors) and Ms. Katie Potts (PhD student) of the Department of Infrastructure Engineering (formerly Dept. of Geomatics) at The University of Melbourne. This project will form part of Potts’ thesis, and has been approved by the Human Research Ethics Committee.

The aim of this study is to develop a model and associated tools which more effectively supports the coordination, aggregation and dissemination of consistent information on risk between governments at all levels, citizens and business. You will be asked to participate either through an interview and/or by completing a questionnaire. Through the interview and/or the questionnaire you will be asked to provide some information about how you or your organization manages risk to land and property, and how decisions regarding risks which affect land and property managed by you or your organization are made. We estimate that the time commitment required of you should be around 20 minutes.

Please be advised that your participation in this study is completely voluntary. Should you wish to withdraw at any stage, or to withdraw any unprocessed data you have supplied, you are free to do so without prejudice. Due to small sample size, you might be identified as a participant. However, the confidentiality of the information you provide will be safeguarded, subject to any legal requirements. In addition, please note that if you are in a dependent relationship with any of the researchers your involvement in the project will not affect ongoing assessment and management.

By clicking 'Yes' below you have agreed to participate in the study.

Should you require any further information, or have any concerns, please do not hesitate to contact either of the researchers; Prof. Rajabifard: +61 3 8344 0234, Dr. Bennett: +31 (0)53 4874 339, Ms. Potts: +61 3 8344 6771. Should you have any concerns about the conduct of the project, you are welcome to contact the Executive Officer, Human Research Ethics, The University of Melbourne, on Tel: +61 3 8344 2073 or Fax: +61 3 9347 6739.

I agree to participate in the questionnaire

☐ Yes

Where necessary, a pseudonym may be used in place of my actual name in any extracts quoted in writing unless I authorize consent to use my name by ticking yea below.

I agree for my full name and position to be used in any publications where extracts from this questionnaire are quoted

☐ Yes

☐ No
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Introduction

This research is part of an Australian Research Council linkage project in collaboration with the industry partners: Land Victoria, Land and Property Management Authority New South Wales, Landgate Western Australia, and PSMA Australia Limited. The overarching project aims to design, build and manage a new infrastructure to integrate disparate state based land information and administration processes to meet national needs. This study is aimed at understanding the current arrangement of risk information in Australia, specifically how this information is coordinated, aggregated and disseminated to stakeholders. This study is framed within the proposition that improved access to timely, accurate and consistent information on risk for governments, business, and citizens will facilitate improved risk management strategies.

The aim of this questionnaire is to gather information regarding how risks that threaten land and property of different organizations are managed. More specifically, the objective is to understand the approaches used to treat risks. Within this questionnaire there are six sections that aim to assess six different areas of risk management.

The first section is focused on the risk management plan. The questions are aimed at understanding the context of the organisation and the approach they take towards managing risk to land and property. The second section is aimed at understanding the different risks that pose a threat to the land and property managed by the organization. The third section aims to understand how each organization analyses the risks that they have identified as posing a threat. Section four looks at the information used to make the risk management decisions and where this information originated. Section five and six look at how the risks are treated based on the risk management objectives identified and the information made available, and the monitoring and review of these decisions.

The results of this survey will be used to create aggregated statistical summaries and will be accessible to survey participants and distributed through publications. Confidentiality of individuals will be fully preserved in the collection and reporting of the results.

The survey should take approximately 20 minutes to complete. I thank you in advance for your cooperation in providing this information.

Further information on the project can be found on the website: http://blogs.unimelb.edu.au/nimb/
Understanding Risk Management Practices in Relation to Land

Please provide a brief description of the land and property managed by the organization:
### Understanding Risk Management Practices in Relation to Land

#### Section 1 - Risk Management Plan

Section 1 investigates the risk management plan in place for the organization identified in the details section above. A risk management plan for the purpose of this survey is defined as a scheme specifying the approach, the management components and resources to be applied to the management of risk.

1. **Does the organization have a risk management plan?**
   - Yes
   - No

2. **In terms of land and property within your jurisdiction what are the risk management objectives of the organization?**
   
   For example, what are the (financial, safety, environmental) goals of the organization related to controlling risk to land and property.

3. **What is the scope of the risk management plan?**
   
   For example, what is included in the plan, what is excluded? Are certain assets or areas excluded from the plan?

4. **List up to 5 key internal stakeholders of the organization and explain their role in the risk management process?**
   
   For example, the property owner, head of department, GIS operations staff, minister, local council authority.
   
   1.
   2.
   3.
   4.
   5.

5. **List up to 5 key external stakeholders for the organization.**
   
   For example, citizens, other businesses, other government departments
   
   1.
   2.
   3.
   4.
   5.
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6. Who is responsible for implementing the risk management process with respect to land related issues?
   E.g. who is the person or entity with the accountability and authority to manage a risk?

7. What risk assessment methods are used to assess risks affecting land and property managed by the organization?
   (i.e. determination of the likelihood and consequences, listing of attributes of the risk, prioritization of risks, qualitative or quantitative measures, modelling, application of a risk matrix etc.)

8. What is the timeframe of the risk management plan?
   For example, how often are the risk management objectives revisited - 1 year, 2 years, 5-10 years etc.
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### Section 2 - The risks

The following questions are directed at the risks which affect land and property managed by the organization.

1. **What risks can be identified as being a threat to the land or property managed by the organization?**

*Please tick all relevant risks.*

- [ ] riverine flooding
- [ ] bushfire
- [ ] earthquake
- [ ] severe weather (includes: storm wind gusts, lightning, hail, thunderstorms, intense low pressure systems, tornados, heavy rainfall, flash flooding)
- [ ] cyclone (includes gale force winds and storm surge)
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- [ ] landslide
- [ ] sea level rise
- [ ] other fire related incident (house fire)
- [ ] fraud
- [ ] drought
- [ ] disease outbreak
- [ ] asbestos
- [ ] pests (white ants, locusts, fruit fly)
- [ ] other (please specify)

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2. Please indicate the level of threat each risk represents to your organization.  
   1 = low threat, 5 = high threat

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<td>Other</td>
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*severe weather (includes: storm wind gusts, lightning, hail, thunderstorms, intense low pressure systems, tornados, heavy rainfall, flash flooding)
*cyclone (includes gale force winds and storm surge)
*pests (white ants, locusts, fruit fly)
*fire (other fire related incident - not bushfire related)

3. Of the above risks, which risk poses the greatest threat to the land and property managed by the organization?

4. Why do you consider this risk the greatest threat to the land and property managed by the organization?

5. For the risk selected above - [Q16], within the timeframe of the next ten years, please rate the likelihood of this risk occurring (i.e. the chance or probability that the risk will occur) and the level of consequence that would result (i.e. the significance or result) if this risk occurred.

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<thead>
<tr>
<th>Likelihood</th>
<th>Consequence</th>
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Using land administration for land risk management

Understanding Risk Management Practices in Relation to Land

Section 3 - Risk Analysis

All questions will now be asked in terms of the risk identified in question 3 of section 2 ([Q16]) as the risk which poses the greatest threat to the land and property managed by the organization. Please answer the following questions in terms of this risk.

1. How did the organization initially identify the risk of [Q16]?

2. What information is used by the organization to manage or make decisions regarding the risk of [Q16]?

3. How is the data presented?
   For example, in map format, report, combination of both, fact sheet etc.

4. What methods (if any) were used to analyze this risk?
   (i.e. determination of the likelihood and consequences, listing of attributes of the risk, qualitative, quantitative, modelling, risk matrix, etc.)
## Understanding Risk Management Practices in Relation to Land

### Section 4 - Risk information

This section investigates the information available that describes the risk you identified in question 3 of section 2 ([Q16]) as the risk which poses the greatest threat to the land and property managed by the organization. Please answer the following questions in terms of this risk.

1. **Has the organization accessed any information about the risk of [Q16]??**
   For example, the information could come from a government department website, other online resources, local government offices, insurance company etc.
   - [ ] Yes
   - [ ] No

2. **If yes, how did the organization use this information?**
   For example did it help the organization identify the risk of [Q16]?

3. **Has the organization used any spatial information to manage this risk?** If yes, please describe the spatial information utilized.
   Spatial information is data or datasets which have a spatial attribute. Types of spatial information include maps, geographic information systems (GIS), cadastral data, positioning data (GPS) etc.

4. **Where, or from which organizations did the organization obtain the information about the risk of [Q16]?** (spatial or non-spatial information)

5. **How was the data accessed?**
   (online, are there licenses required?)
   - [ ] Online (freely)
   - [ ] Online (license required, or special access rights required)
   - [ ] In person (verbally)
   - [ ] From an organization (brochure or document)

6. **Was the information free, or was there a fee to obtain it?**
   - [ ] Free
   - [ ] Fee required
## Understanding Risk Management Practices in Relation to Land

### 7. When was the information created?
What was the date listed on the information?

### 8. Who is the custodian of the data?
A custodian is the person or organization with the right to determine how the information will be managed and any access constraints, with accompanying responsibilities towards the maintenance, quality and enabling appropriate access to that information (the owner of the IP). It is not necessarily the person or organization who created the data.

### 9. Has the organization created any information yourself about risk?
For example, has the organization contributed to any websites, uploaded information onto the internet, created maps etc.?

- [ ] Yes
- [ ] No

If yes, describe:

### 10. What format was the information the organization collected regarding the risk of [Q16] in?

- [ ] Brochure
- [ ] Fact sheet
- [ ] Full document
- [ ] Document summary
- [ ] Map / overlay
- [ ] Email
- [ ] Verbal information

Other (please specify):
### Understanding Risk Management Practices in Relation to Land

**11. What format does the organization prefer the information to be in?**

- [ ] Brochure
- [ ] Fact sheet
- [ ] Full document
- [ ] Document summary
- [ ] Map / overlay
- [ ] Email
- [ ] Verbal information

Other (please specify): [ ]

**12. What information does the organization require or would like to have to identify, manage, or assess risks that affect the land and property managed by the organization?**

[ ]

**13. How does the organization use or how would the organization use this information? What are the specific applications that the information is/would be used for?**

[ ]

**14. If the organization stores information, do any external organizations have access to that information?**

- [ ] Yes
- [ ] No
- [ ] N/A

If yes, who are the external organizations: [ ]

**15. Was the information the organization acquired about the risk to the land and property managed by the organization useful and able to answer queries?**

- [ ] Yes
- [ ] No
- [ ] N/A
### Understanding Risk Management Practices in Relation to Land

16. **Does the organization store metadata?**
   Metadata describes data and provides information about the content of data - 'data about data'.
   - [ ] Yes
   - [ ] No

   If yes, what approach and tools are used

17. **Please comment on any other issues related to risk information:**

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Section 5 - Risk treatment

Risk treatment is a stage of the overall risk management process. In the risk treatment process there are four main options that are available: avoid, reduce, transfer and retain.

1. What risk treatment options (if any) are being applied to the risk of [Q16]? And if any, how are they being applied?

For example, avoidance of the risk, reduction of the risk, transference of the risk, retention of the risk.

[ ] Avoidance of the risk
[ ] Reduction / mitigation of the risk
[ ] Transference of the risk
[ ] Retention of the risk

If yes, how:

2. What are the reasons for the selected risk management treatment?

E.g. cost, analysis, advice, external reasons.

[ ]
Understanding Risk Management Practices in Relation to Land

3. Referring back to all possible risks which may affect the land and property managed by the organization, what is the most appropriate treatment for dealing with each risk, or how has the organization managed each risk below?

Please select a treatment below which the organization has either carried out, or plans to undertake, and provide a short explanation as to why the organization has chosen that treatment. If the risk is not applicable to the land and property managed by the organization please select N/A.

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<thead>
<tr>
<th>Risk</th>
<th>Avoid</th>
<th>Reduce</th>
<th>Transfer</th>
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*pests (white ants, locusts, fruit fly)
*fire (other fire related incident - not bushfire related)
### Understanding Risk Management Practices in Relation to Land

**4. What is the priority for the implementation of treatment for these risks?**

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**5. Has the organization obtained insurance for any risks?**

- [ ] Yes
- [ ] No

If yes, which risks

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Page 15
<table>
<thead>
<tr>
<th>Section 6 - Monitoring and review</th>
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<tbody>
<tr>
<td>In this final section the monitoring and reviewing processes are explored. The monitoring and review process is important for improving future risk management and for ensuring the most efficient and effective methods are in place. The following questions are directed at all risks affecting the land and property managed by the organization.</td>
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1. Once treatment has been carried out on each risk, has the organization sought out or obtained further information in order to remain updated on risks affecting the land and property managed by the organization?
   - Yes
   - No

2. Are the trends, successes, changes, and failures of the risk management plan monitored?
   - Yes
   - No

3. Are changes to the internal or external context monitored?
   - Yes
   - No

4. Has the organization identified any emerging risks that weren’t present during the initial risk assessment?
   - Yes
   - No
   If yes, which risks

5. Has the organization updated any of the information that was received, or monitored the accuracy of the information?
   - Yes
   - No
   If yes, what is the frequency of the updates?

6. If the updates came from an external organization, what is the name of the organization that provided the updated information?
Understanding Risk Management Practices in Relation to Land

7. Would the organization find value in being provided with updated risk information?
   ○ Yes
   ○ No

8. If the organization receives information updates, is the historical information removed from access and use?
   ○ Yes
   ○ No

9. In recent time a large amount of new information has been made available through mediums such as Google Earth, Open Street Maps, and other similar applications where there is scope for citizens and organizations to volunteer or share information based on locations. This information which is provided by citizens or organizations is referred to as ‘volunteered geographic information’ or VGI. Have you taken advantage of volunteered geographic information (VGI) for risk management purposes?
   ○ Yes
   ○ No
End of Questionnaire

Thank you for your participation.
Appendix 6 – Semi structured interview

Organisation: __________________________________________________________

Functions of Organisation __________________________________________________

(You may prefer to attach some printed material).

Name and position (optional) __________________________________________________

Classification of organisation (Tick the most appropriate one):

☐ Commonwealth government  ☐ State government  ☐ Local government

☐ Government corporation  ☐ Private sector enterprise

☐ Other (please specify): ____________________________________________________

A Information planning
1. What information do you require to manage risks to land and property?
2. What is your role in managing risk?

B Obtaining the information
1. What risk information does your organisation have? Does your organisation have information about risks such as sea level rise, flooding, bushfire, earthquake, fraud etc.?
2. Does your organisation create information about risk?
3. If not, who creates or collects the information you have about risk?
4. If it was created or collected by another agency, then who?
5. When was the information created?
6. Who owns the data?
7. Who is the custodian of the data?
8. What are the significant barriers to effective inter-agency collaboration and spatial data sharing?

C Storing and sharing the information
1. Who can access the risk information?
2. How is the information accessed?
3. What format is the information stored in?
4. Are there licenses required to access the information?
5. Does the organisation store metadata?

D Maintaining the information
1. Is the information updated?
2. If yes, when or how often is the information updated?
3. Who provides/supplies the updated information?
E  Applying the information
1. How does your organisation use the information about risk?
2. What information is used to manage/make decisions regarding risks?
3. How is the data presented to users?

F  Disposing of the information
1. If the information is updated, is the historical information removed from access?
Appendix 7 – Local government interview summaries

Albury City Council

The risk management plan
The risk management plan within Albury City Council is based on the ISO 31000 standards and is reviewed annually. To develop the plan, the high level stakeholders within the organisation, generally the managers and executives meet for a workshop to complete an internal review of risk. The workshop revisits the corporate risk management plan and from this risk areas within the organisation are developed. The areas identified are selected as areas which could become a problem in the future or could make the organisation vulnerable. Detail is then added on the nature of the risks faced and the level which would be deemed acceptable for these risks. From here, the plan is passed down the hierarchy to the relevant groups which develop strategies to address the risks identified in the plan.

The risks
The main risk identified as impacting on the land and property of the organisation was flooding as a developed portion of the municipality is within a flood zone. Bushfire is another risk identified as relevant to the council.

The risk management process
As a part of the risk management process, local knowledge plays a large part of the identification process. Once the risks are identified, the risk matrix strategy is used to determine a risk rating for each risk based on the likelihood and consequence ratings given by the council. Once the risk and its rating have been identified, the responsibility for the management of the risk is assigned to the most relevant group. In the case of flood as a risk, the engineering group is responsible as their expertise can be used to mitigate the risk.

For a particular case within the municipality, an area which is at risk of flood and lies within the flood zone, there have been mitigation activities carried out over a 20 year period to decrease the severity of the flooding. Due to the nature of the landscape however, flooding will always occur and it is not a part of the plan to completely eliminate the risk, only to reduce it to the acceptable level outlined in the risk management plan.

For the risk of bushfire, a mitigation action in place to reduce the likelihood, and also the consequences of a bushfire or grass fire is to monitor vacant land to ensure that adequate maintenance is taking place. If this is not occurring, and for example grass on the land becomes too high and creates a hazard, then the council has a strategy in place to intervene and request for the hazard to be addressed, if this does not occur, a fine is issue and the council addresses the hazards themselves.
Roles within the organisation
It is the role and responsibility of council to identify flood prone land within the municipality. In order to prevent public liability claims, council needs to be aware of areas which are at risk to ensure that inappropriate development does not take place. Under the Local Government Act 1993 local councils are to work with the Rural Fire Service to conduct the mapping of fire hazards and fire danger areas. This is another role for Council, and it is their responsibility to ensure that this relationship exists and that the correct bushfire preparation has taken place.

Risk information
Within the organisation a GIS system using the Weave program is utilised. Different layers of information and assets are managed using this system.

Information creation
The organisation creates a range of different GIS layers used in the management of risk. One example is logging the GPS location of warning signs which are put up in locations which have hazards to warn people as a form of remote supervision. Another example is the creation of layers which detail assets which require maintenance, or detail hazards which exist – such as broken footpaths or overhanging branches of a tree in a public place. The use of GIS technology eases the management process.

Information dissemination
In terms of disseminating information to the public, or having information available for the public to assist them in the management of risk which threaten land and property, a range of different maps are made available on the council website. Information regarding flood zones, bushfire zones, contours to determine runoff and a whole range of other maps are available as a pdf form free for the public to access.

Hornsby Shire Council
The risk management plan
The council has a risk management plan which has a big focus on climate adaptation. The focus on climate adaptation resulted from recommendations from the insurance sector. Within the risk management plan insurance arrangements are included.

The risks
The main risk that the council faces is from bushfire. There are over 14000 homes threaten by bushfire in the municipality, and in terms of all possible natural disasters, this is the biggest risk due to so much of the shire interfacing the bush. Another big risk for the council is severe weather which brings large scale storm events. In recent years, some major storms have impacted upon the area resulting in flash flooding events. As the area has many hills there is significant runoff which affects properties. The area is also situation along a river which opens into the ocean and as a result tides and storm surges are resulting events.
The risk management process
To assist in the management of risks, research from the CSIRO (Commonwealth Scientific and Industrial Research Organisation) has been used to support the climate change adaptation plan. The council bases their modelling on estimates published by the CSIRO.

Roles within the organisation
Within the council a full time employee for bushfire emergency management exists. As a part of this role risk assessments of areas within the municipality are carried out. The maintenance of fire trails is also undertaken in partnership with the Rural Fire Service. As much of the bushland is national park (state government land), the role of the council is secondary to the Rural Fire Service and agencies organised by the state government, however due to the proximity of residents of the municipality, the council has a vested interest in the effective management of bushfire risk.

Information creation
Within the council there is a dedicated GIS person for risk, and a whole GIS division in place. Within the division the state government cadastral data is utilised, as well as a range of other layers (over 100) which have been created by the council. These layers include, aside from general assets, flood mapping data which is collected after an event as a record of where flood waters reached and properties affected. The data collected from risk events such as floods are used for applications such as land development where overland flows are required.

Information dissemination
The council does not often receive inquiries regarding risk, however information and advice on planning and development which crosses over risk information is common. To assist in improved risk management practices the council has implemented an initiative for bushfires where a resource CD is distributed to residents in high risk areas to help with individual emergency planning and risk management strategies.

Lockhart Shire Council
The risk management plan
Within the council, an overarching risk management plan exists, and for the specific risk of flood, a floodplain risk management plan is in place.

The risks
The three main risks which exist for this council include bushfire, flood and pests. Flood is the most recent risk event to occur, with two major floods within eighteen months (the years 2010-2012). Before these two riverine flooding events a flood event had not occurred in the previous thirty.

The risk management process
As part of the risk management process the council works with the Rural Fire Service to manage the risk of bushfire, with the State Emergency Service and the state government water management body to manage the risk of flood, and with the Department of Environment and Heritage (state level) to
manage the risk of pests such as locusts. As a part of the increased management taking place for the risk of flood, an internal flood study is being conducted currently to address and review risk management strategies.

**Roles within the organisation**

One of the main risk related roles of the council is to maintain the fire trails, which is carried out by grading. The Rural Fire Service assists farmers and other land owners in the management of their land for the risk of bushfire and the council provide support to the RFS.

**Risk information**

Within the organisation a GIS system (MapInfo) with layers including council assets, buildings, and road networks including fire trails as well as cadastral data obtained from the state government is utilised. The cadastral data is used to link rates and property information, and other information such as bushfire and flood extent overlays are used in the risk management planning process. LiDAR information is also used in the management of floods, and is obtained from the state government as a part of a funded study into floods to improve the management of the risk. Further land and property data is accessed and used directly from the SIX viewer online which is managed by the Land and Property Information office of NSW state government.

**Information creation**

Council has the ability to create GIS layers and uses this technology to record where floods have taken place. The mapping of pests such as weeds is also a priority, but the council requires significant expertise and resources to carry out this project.

**Collaboration and information access**

For accessing data there is an agreement between the Land and Property Information office and local councils within NSW which enable staff to obtain and use the data for free. The use of LiDAR data for flood management is also supplied through the Land and Property Information office in conjunction with the Department of Environment and Heritage. Collaboration between agencies is often good, however due to different software availabilities problems can sometime arise due to file formats (between *.shp files and *.tab files), support at state level is provided for these instances though so often they are quickly resolved.

**Information dissemination**

Inquiries requesting information about risks from residents are not common within this council. The most interest stems from mitigation action carried out by council – such as levee banks for flood mitigation or organised burning for bushfire mitigation. Occasionally questions regarding specific parcels are asked and a map is requested, however this is not a common occurrence. As a larger municipality with a small population which contains many farmers, people are familiar with each other and discuss these issues between themselves.
Appendix 7

Updating procedures
There is a push from within the council and other councils within the state for the state level to update
the address dataset to proper addresses and not property names – as occurs for farms and other larger
properties. The standard created for addressing is also supported and encouraged. Currently council is
implementing rural addressing which assigns addresses based on distance to improve location
detection. This has a range of benefits, particularly in the emergency services area where it is critical
that locations are easily identified.

City of Melbourne
The risk management plan
The risk management plan in place for the City of Melbourne is developed in consultation with a
range of other agencies. Workshops are held to discuss and brainstorm to develop a comprehensive
plan which addresses all possible risks. After the development of the draft plan, it is reviewed by a
range of other agencies to ensure that nothing has been missed. The final product includes a generic
emergency management plan and specific plans which are catered to each individual risk. An example
is the flood management plan which is developed specifically for the risks of flood, storm surge and
flash flooding through consultation with Melbourne Water and the State Emergency Service (SES).

The risks
The main risks which impacts upon the land and property of this council is severe weather. As the
council is urban, severe weather where water is unable to drain can create flash flooding, lightening
can cause power outages, and high winds can affect buildings at put risk residents and citizens within
the CBD. As thousands of non residents visit the city each day for work the council has to take into
consideration these people as well as the rate payers within their municipality.

The risk management process
Methods used to assist the risk management process include the risk matrix and hot spot analysis. The
risk matrix is used in stakeholder meetings to help discuss each risk and to assist in the assignment of
an appropriate rating. All stakeholders provide suggestions and reasoning for likelihood and
consequence values and an overall rating is decided upon by the group. The hot spot analysis has a
focus upon capital works. Areas identified as at risk are monitored to enable a fast response if a risk
event occurs.

Risk information
Within the council, GIS layers from the state government (VicMap layers) such as zoning
information, cadastral information and addressing information are utilised in the emergency and risk
management planning process. Other layers such as asset layer, which are created by council are also
utilised and managed within the GIS system.
Collaboration and information access
The City of Melbourne is a resources rich council and has good access to information. They collaborate with a range of different agencies, including Victoria Police with whom they join forces with for emergency management planning.

Information dissemination
Within the City of Melbourne information is disseminated to the public via the council website and through social media such as twitter and facebook. A dedicated social media coordinator exists and it is their role to communicate information to the public regarding risks and emergency situations. All of the information available online is free to the public. Currently, within a neighbouring municipality, a proactive approach to flood management is being implemented where the council and the SES are delivering area specific pamphlets to residents at risk of flood. Based on the success of this venture, the City of Melbourne might implement a similar initiative to address risks.

Updating procedures
Once an emergency or risk event has occurred a multiagency debrief is held to address and review the risk management plan to improve the plan based on experience. This enables any oversights or newly identified risks to be incorporated into the plan.

City of Monash
The risks
The major risk which impacts the City of Monash is severe weather which creates the flow on risks of flash flooding and flooding as a result of heavy rainfall. The likelihood of this event occurring is almost certain, and the impact of this event can range from insignificant or minor to major. Private property can be impacted, which impacts on residents, as well as roads and drains, which are the responsibility of council.

The risk management process
Mitigation works are the most common treatment implemented within the council. Funding and priority based on need dictate what areas at risk are to be treated first. If a development is approved for one catchment area, then that money can be used to contribute to the mitigation work within that catchment area. Other funding received from council is distributed based on need. The level of water is used to determine priority, and if the level of flooding becomes so high that it enters habitable rooms then that area becomes a high priority based on the increased impact upon those citizens.
Recent mitigation works within the council include the construction of retarding basins to reach a construction rate of four basins in four years. The decision to build retarding basins as a mitigation strategy over other strategies was based on reports into effective mitigation action which recommended retarding basins as the best and most effective strategy.
**Risk information**

The Weave GIS system and VicMap data are heavily used within the organisation. Layers utilised include contours, planning overlays, cadastral and address information and points of interest layers which identify schools, hospitals and other important locations. The system itself uses the Weave interface within a web browser and has ArcMap running in the background, and allows the user to switch between a GIS interface with all of the spatial layers to Google street view to provide an ‘as is’ view of the world. Other information incorporated into the system is data received from Melbourne Water, and in the past LiDAR data received from private consultants used to identify areas at risk.

**Information creation**

Due to the GIS capabilities of the organisation, the creation of layers is possible. As a result layers showing the location of pipes and drainage systems as well as mitigation works such as retarding basins can be created. Layers which highlight known vulnerable properties or properties at risk of flooding in a heavy rainfall event can be recorded. Following any risk event information is recorded to identify any new areas at risk and information such as areas flooded on each property (house, yard, etc) and whether any habitable space was impacted such as the floor height. This information is then collated to create a new GIS layer. The information generated from this is then forwarded to the planning department so that it can be included in any new development or development decisions.

**Collaboration and information access**

No problems have been identified with other agencies in this area in terms of accessing information. In terms of accessing funding for mitigation works, collaboration could be improved. The data which is utilised in the GIS system (VicMap data) is received as a part of an agreement with the state government.

**Information dissemination**

Informing the public about risks which affect their land and property is becoming a greater role for council. Currently it is rare for residents to request this type of information, however providing this type of information is a priority area identified for action. Melbourne Water are providing support in this area by developing a vulnerability and awareness campaign, and the State Emergency Service (SES) are planning to visit residents in vulnerable areas to inform them of their risk and to share mitigation strategies. The properties targeted in this campaign are based on properties identified within the path of overland flow or properties known to have been affected in the past.

**Updating procedures**

The risk data within the council is updated on an ad-hoc basis which is dependent on when events occur and resources available during those periods.
Indigo Shire Council

The risk management plan
A range of different plans exist within the municipality such as the municipal fire management plan and the municipal emergency management plan. The municipal emergency management plan outlines the responsible agencies for each emergency type and is the overarching plan, review twice annually. The municipal fire management plan is developed specifically for the risk of fire and includes within the committee members from the Country Fire Authority, the Department of Sustainability and Environment, Parks Victoria and others. The fire management plan takes an all hazards approach, utilises the PPRR model – prevention, preparedness, response, recovery, and was endorsed by the council in January 2013. As a part of this plan, risk assessments of townships are carried out. Further to this plan, the council is a part of the Victorian Fire Risk Register with the Country Fire Authority.

The risks
The three risks of severe weather, flooding and bushfire all threaten the land and property of the organisation, with the risk of bushfire presenting the highest threat. The risk from severe weather creates high wind events and flash flooding. As areas of the municipality are surrounded by hills, severe runoff can take place resulting in extensive damage.

The risk management process
Local knowledge is a large part of identifying risks affecting land and property managed by the organisation. Field visits, site inspections and modelling are other techniques utilised. In terms of implementing mitigation action for the identified risks, a priority system is in place to distribute funding to the highest priority area.

Roles within the organisation
Council has a role to manage risks and hazards which impact on roads, roadside areas, and to keep a watch of private properties to identify any areas which might present a risk to the land and property managed by the organisation. Such a risk might be long grass which is not maintained on a vacant block. As it creates a fire hazard, it is the role of council to mitigate this risk by notifying the owner to take action, or to cut the grass and issue a fine.

To manage risks within the municipality the council works with the Country Fire Authority to share the responsibility of managing fire hazards, and with the State Emergency Service to provide support in the management of floods. The council itself is not involved in the response areas of managing risk unless an asset of the council, such as a road or the preschool had been directly impacted. Council is more involved in the policy aspects of risk management and in carrying out maintenance on assets. Their role is limited to these aspects as a result of limited resources.

Risk information
The council uses the GIS system Exponare which is a web based system. It incorporates VicMap data from government and council assets. It is not a highly used resource as staff capabilities are limited,
and often a paper based approach is preferred. The planning scheme is a highly used layer to show the wildfire zones, and the flood overlay utilised is supplied by Goulburn Valley Water.

**Information creation**
Using the GIS system the council is able to create asset layers which show the location of council buildings, powerlines, garbage bins etc.

**Collaboration and information access**
No barriers to accessing information or collaboration problems between agencies exist.

**Information dissemination**
Within the shire the requesting of risk information is rare. Following the 2009 Victorian bushfires a community meeting was organised by the Country Fire Authority to provide mitigation information to citizens. The first year it was held around 130 residents attended, the next year around 30 people, and the following year around 13 people attended. Based on these statistics the demand for information regarding the risk of fire has depleted. Any queries regarding maps or zoning information are directed to the state land department website as the local council website does not provide information in map format.

**Nillumbik Shire Council**

**The risk management plan**
The council has a municipal emergency management plan in place which is revisited and audited every three years. In order to keep the plan current, up to date, and inclusive of all risks, meeting are held every three months to gather feedback and discussion the current plan. Based on the outcome of these meetings the plan is then updated based on the outcome.

**The risks**
The five main risks which are identified within the municipal emergency management plan are: bushfire, structural fire, flood, storm, and heatwave. The risk of bushfire is the biggest perceived threat (by residents) however the risks of flooding and severe weather are also significant threats.

**The risk management process**
The process of risk identification is carried out through a brainstorming process with members of the council, Country Fire Authority, State Emergency Service, Melbourne Water and other relevant bodies present. Largely, logic is the main tool used. Based on the risks identified, the main mitigation works which are carried out include fire prevention activities and flood infrastructure updating (such as replacing drains). The council is also involved in the Victorian Fire Risk Register as another mitigation strategy which records the details of assets within the council, and specifically assets which are classified as critical infrastructure.

**Roles within the organisation**
The council is legislated to protect council reserves, roadsides, and other areas of council land, therefore, their mitigation activities are based around these areas. Problems currently exist within the
organisation as a result of the role of council being unclear. Local government seem to be viewed by the public as a service provider, which is a shift from previous views and as a result, a demand on local government has been created. The problem which stems from this view change is that unclear expectations have been created about what council should provide in terms of information, and what council should do in terms of risk management action. The problem is further exacerbated by a disconnect between the reality of where residents live – which is within a rural area surrounded by bushland and face a real risk of bushfire – despite living within 30 minutes of the CBD. Residents are unaware of the risks due to the proximity of the shire to the city, and as a result are not accepting their role in the management of very real risks.

Risk information
The VicMap layers of information are used within the Exponare GIS system in council. The cadastral and address layers as well as the planning overlays which show flood and bushfire zones are used. Melbourne Water supply catchment information for the municipality, the Bureau of Meteorology is accessed for information on historic water levels, and the Country Fire Authority provides information on past fires.

Information creation
Data on previous floods are recorded for future planning, as well as other layers detailing assets are created using the GIS technology.

Collaboration and information access
No problems accessing or gathering information from other organisations were noted, however high quality information in historical data was difficult to find.

Information dissemination
Bushfire inquiries are the most received regarding risk information, and this is not a rare occurrence. The council website provides information regarding preparedness for bushfires and supplies links to the websites of the Country Fire Authority and State Emergency Service which have more extensive information. Ongoing activities for preparing the community for hazards and emergencies exist with the aim to better support residents.

Rural City of Wangaratta

The risk management plan
The council has a municipality emergency management plan which follows the PPRR model – prevention, preparedness, response, recovery.

The risks
The major risks which threaten the council include severe weather, flooding and bushfire as well as transport and road incidents due to two major transport corridors passing through the municipality.

The risk management process
Local knowledge is the main source of information used for identifying risks.
Roles within the organisation
The council has the role within the risk management process of risk identification and mitigation; however this applies mostly to council assets, and not private property. This is often not well understood by residents, and a shift in the behaviour and perception of risk by resident is needed. The role of council is more related to an information and knowledge transfer broker rather than an implementer of large scale mitigation actions. Other risk management roles within the municipality belong to the Country Fire Authority, which assist the council with fire management.

Risk information
In their risk management activities council makes use of the VicMap wildfire and floodplain overlays within the planning data, as well as the cadastral and address data supplied by state government. The MEC Central software is used to create data to record events such as flooding or bushfire, and to record council assets.

Information creation
Council maintains their own GIS and use it to create asset layers. The program is used mainly for risk identification and to inform land use decisions. With this software council is able to input local knowledge into the system.

Collaboration and information access
Good collaboration between all agencies involved in the management of risk in the municipality exists and no problems are encountered when accessing information for risk management purposes.

Information dissemination
There are many residents which visit the council to obtain information on risk. Currently, the understanding of risk across the community needs to be improved. To assist residents, the council refers them to the state land department website where they can access maps showing cadastral, address, planning and other map layers, or they attempt to answer the questions and provide maps to the individual using the GIS resources within the council.

Updating procedures
The current information regarding risk held by the council requires updating to incorporate the risks that climate change introduces. More frequent and increased intensity and severity of weather events need to be prepared for which requires improved information sources.