

WHAT DOES 'SHARED RESPONSIBILITY' MEAN FOR FLOOD RISK MANAGEMENT IN AUSTRALIA?

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Abstract

Floods are one of the most common natural hazards experienced in Australia. Approximately 250,000 properties in Australia are located within the 1 in 100 year flood zone. Floods are the costliest natural hazard, and have caused over 2,000 deaths. As population in flood-prone areas increases, and considering the potential impacts of climate change on flood frequency, preparing for floods will become increasingly important. Extensive flooding in recent years, particularly during the 2010-2011 summer, has again made flood risk an important topic of research. The concept of shared responsibility, that hazard preparedness is the job of all sectors of society and government, has been a central focus of post-disaster inquiries and government hazard strategies. This thesis examines how shared responsibility applies to flood risk management.

Four key stakeholders were selected for this research: local councils, emergency services (the SES), the insurance industry, and residents. These stakeholders were selected as councils and emergency services are directly involved in flood planning and response, insurance has only recently become widely available in Australia, and residents are the people who experience floods on-the-ground.

This thesis asks what gaps exist in flood risk management in Australia, and what can be learnt from the recent floods to better implement shared responsibility. Four case studies are selected: Brisbane and Emerald in Queensland, both severely flooded during the 2010-2011 floods; Benalla in Victoria, and Dora Creek in New South Wales. Interviews were conducted with council, emergency service, and insurance representatives, examining their perceptions of their own and each others' roles and responsibilities, as well as their thoughts on individual's responsibilities in preparing for flood. The influence of socioeconomic factors of age, gender, and income, as well as flood awareness and flood experience, on residents' thoughts on flood risk and insurance are also examined.

Better understanding of the roles and responsibilities of each stakeholder is needed to improve flood risk management. This thesis finds that residents often expect more of official agencies such as council and emergency services, and are uncertain about personal preparation. For responsibility in flood risk management to be truly shared, individuals need to be encouraged to be more involved in their own flood preparedness. .

Candidate's statement

This thesis entitled *What Does 'Shared Responsibility' Mean for Flood Risk Management in Australia?* is submitted in accordance with the requirements for a Doctor of Philosophy of Macquarie University and has not previously been submitted for a degree at Macquarie University or any other institution.

I certify that this thesis is original research written by myself except where otherwise indicated. All ideas and research used by others has been acknowledged.

The research presented in this thesis was approved by the Macquarie University Ethics Review Committee, Ethics application reference 5201100474.

Pamela Box

3 June 2014

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List of acronyms

ACSES – Australian Council of State Emergency Services

ARI – Average Recurrence Interval

BoM – Bureau of Meteorology

COAG – Council of Australian Governments

CSIRO – Commonwealth Scientific and Industrial Research Organisation

ICA – Insurance Council of Australia

NCCARF – National Climate Change Adaptation Research Facility

NDIR – Natural Disaster Insurance Review

NSDR – National Strategy for Disaster Resilience

SES – State Emergency Service

Chapter 1. Introduction

1.1. Background and thesis overview

In 1908 Australian poet Dorothea Mackellar, living in England at the time, wrote her most famous verse, *My Country*, a remembrance of Australia as a land “of droughts and flooding rains”(Mackellar, 1993). Australia’s climate extremes, the droughts and the floods, are a definitive part of the country. Following a decade of drought, the years 2008 to 2012, and particularly the summer of 2010-2011, saw Mackellar’s flooding rains across much of the country (Bureau of Meteorology, 2012b). With so many floods occurring in a short space of time, gaps in the expectations and reality of how to respond to flood became apparent, as well as confusion over what coverage insurance offers to flood.

The population in locations prone to flood is increasing, with regions such as south-east Queensland among the fastest growing in Australia (Australian Bureau of Statistics, 2013d). Population increase in areas susceptible to natural hazards, and increasing value of property in at-risk areas, has been noted for a number of decades (Turner, 1979). Given this, and with the extensive flooding of the 2010-2011 summer in particular, how to better manage that risk is a topical discussion in Australia. Flooding has been the subject of much media coverage (Fraser, 2010, Cook et al., 2011, Elks and McKenna, 2011, Kissane, 2011) and multiple inquiries (Queensland Floods Commission of Inquiry, 2012, Comrie, 2011, Commonwealth of Australia, 2011) looking at the causes and responses to the floods, as well as flood insurance issues.

The process of this PhD has been shaped by recent events in Australia. The original project was focused on flood insurance, and the implications for high-risk communities of more accurate information and premiums. It was to look at the question of who should bear the cost of the risk and involve government, insurers, and the public as participants. When I began working on my PhD, Australia was at the end of a decade of drought (Heberger, 2011). By the end of my first year, the country had experienced its wettest September on record (National Climate Centre, 2010), and was in the middle of some of the most severe and widespread flooding in more than a generation (Bureau of Meteorology, 2011c). This changed the topic from something abstract to a very real issue affecting many people across the country. It also resulted in a shift away from the originally planned look at flood insurance and flood information to a broader discussion of stakeholders’ roles and responsibilities.

During and in the aftermath of the floods, there were discussions around the availability of flood insurance, the perceived failings of local councils and State Emergency Services in preparing for and responding to flood, and the level of responsibility individual residents should take for living in areas prone to flood (Local Government Association of Queensland, 2011, Standing Committee on Social Policy and Legal Affairs, 2012, Tovey, 2011, Bergin, 2011, Queensland Floods Commission of Inquiry, 2011). All of these issues are framed around issues of responsibility – who is responsible for what in regards to flood risk management? These questions refined the focus of this thesis to that of shared responsibility. To properly discuss responsibility in flood risk management requires the involvement of the key stakeholders, and an assessment of how well those stakeholders know their own and each others' roles. Public dissatisfaction over how the floods were handled, and lack of preparedness for flood, also highlights the need to know what factors affect individual's flood preparedness. For this reason, case studies were chosen as a way to assess the awareness of residents at risk of flood. A questionnaire was chosen for residents to keep their responses focused, and interviews for the other stakeholders to keep the discussion narrow but allow them to articulate their positions in detail.

This thesis looks at four stakeholders: the insurance industry; the State Emergency Service (SES); local councils; and individuals in flood prone areas. It covers four case studies, Emerald and Brisbane in Queensland, Benalla in Victoria, and Dora Creek in New South Wales. Through interviews and questionnaires, it looks at the roles and responsibilities of each stakeholder. It investigates how the responses given compare to each other, and how well they reflect the concept of shared responsibility.

Major events provide a “window of opportunity” for changes in policy and approach (Johnson et al., 2005), and the current period in Australia has seen discussions and debates following the 2010-2011 floods. The adoption of the National Strategy for Disaster Resilience (hereafter NSDR) (Council of Australian Governments, 2011) is one official decision that has been acted upon following the floods: it was originally drafted after the Black Saturday fires in 2009 and uses the Black Saturday Commission's definition of shared responsibility as its foundation for describing disaster resilience and listing the stakeholders involved. The standard definition of flood for insurance purposes is a second example of a change made using the window of opportunity (Australian Government, 2012).

The definition of shared responsibility used in this thesis is a combination of that given in the Black Saturday Commission into the 2009 Victorian bushfires and that subsequently adopted in the NSDR. The Black Saturday Commission defined shared responsibility as meaning

“increased responsibility for all...State agencies and municipal councils adopt increased or improved protective, emergency management and advisory roles. In turn, communities need to take greater responsibility for their own safety and to act on advice and other cues given to them” (Teague et al., 2009), while the National Strategy for Disaster Resilience describes it as “the collective responsibility of all sectors of society, including all levels of government, business, the non-government sector and individuals” (Council of Australian Governments, 2011). Mitchell used the term shared responsibility in his description of partnership, which he defined as “mutual cooperation and shared responsibility among individuals or groups to pursue a common goal” (Mitchell, 2006), arguing that partnership and cooperation is a necessity in hazard management, but also noting that different groups and stakeholders often have different interpretations of the same hazard which can limit the effectiveness of such partnerships.

This chapter provides context to the events, history, and themes that inform this thesis. The first section describes the research questions used and how each chapter will address those questions. The next section discusses the frameworks of concepts addressed throughout this thesis, explaining the links between the stakeholders, resources, and vulnerability factors. The Australian context and history of flooding is expanded upon, listing major flood events and responses, to demonstrate the impact of flooding in Australia and the necessity of good flood risk management. Particular attention is paid to floods in recent years, especially the 2010-2011 summer, which provided the immediate context for this thesis and informed its theoretical and practical focus. The third section of this chapter is the methodology. It describes how the project evolved, the selection of case studies and stakeholders, the process of research, and the theoretical background for the research. The final section of this chapter presents an overview of the layout and content of the proceeding chapters.

1.1.2. Research questions

This thesis looks at the concept of shared responsibility – that there are multiple stakeholders with different roles who are all involved in hazard management and response – to examine flood in Australia. Four key stakeholders – local councils, the State Emergency Service (SES), the insurance industry, and individual residents – have been selected to examine their experiences and opinions on shared responsibility and flood. Collaboration and sharing of responsibility on flood risk management requires involved stakeholders to be aware of their responsibilities, and to be enabled to undertake them. While the institutional stakeholders have more officially mandated responsibilities, individual’s preparedness is determined by much more personal factors.

Kunreuther et al (1978) argue that it is necessary for governments, insurers, and residents to have clearly defined their roles and responsibilities so that hazard plans can be effective. Their focus on insurance and the cost of floods is relevant here, but the issues addressed in this thesis are broader. The need for a clear understanding of each stakeholder's role and responsibility is recognised by Australia's national science agency, the Commonwealth Scientific and Industrial Research Organisation (hereafter CSIRO), as key for successful flood risk management (CSIRO, 2000). This thesis looks at flood risk management through the lens of shared responsibility. It asks what gaps exist in shared responsibility in flood risk management in Australia, and what can be learnt from the recent floods to better implement shared responsibility.

This thesis examines two principal research questions:

1. What gaps exist in flood risk management in Australia?
 - a. How do key stakeholders perceive responsibility is shared for flood risk management in Australia?
 - b. What can be learnt from the 2010-2011 floods?
2. What impact do socioeconomic and perception factors have on individual's understanding of flood risk and their likelihood to be involved in their own flood preparation?

With a predominant focus on how residents can be involved in their own flood protection and preparation, this thesis examines information availability, the roles of insurance, State Emergency Services, and local government, and surveys the knowledge and vulnerabilities of residents in four case study locations: Benalla in Victoria, Dora Creek in New South Wales, and Emerald and Brisbane in Queensland. This thesis investigates the importance of information availability for residents to be aware of and respond to their risk, and how all of these issues relate to shared responsibility.

Research question 1 is the focus of chapters 3 and 4. Chapter 3 discusses the availability and variability of flood risk information from local council websites. If flood information is of inconsistent quality or difficult to access it limits the ability of stakeholders to actively participate in their own flood risk management. In particular, it makes it difficult for individuals to be aware of their location's flood risk, in turn limiting their ability to take responsibility for their own preparedness. Information is also necessary for insurers to be able to accurately price the risk of flood at any given property. As such, a lack of information limits the ability of residents to prepare, and limits insurers from offering one particular option for individuals to

prepare for their own flood risk. Accurate information also makes it possible to identify areas that should not be developed due to their high risk, and is used by the SES to plan safe evacuation routes to use during events, and to advise councils on their local disaster plans. Chapter 3 includes discussion of information availability from councils affected by the 2010-2011 floods to specifically identify whether those areas have information available or are in need of improvement.

Chapter 4 addresses question 1b: *What can be learnt from the 2010-2011 floods?* It looks specifically at the roles of the four stakeholders, particularly the three institutional stakeholders of council, SES, and insurance, highlighting where assumptions stakeholders make about each other are incorrect and can limit flood risk management. This is a key gap, because the ideas of who will do what and the errors in assumptions can go unnoticed until an event occurs and miscommunications or poor coordination are exposed. Different assumptions also affect the management of flood risk as they can result in miscommunication and incorrect assumptions about which stakeholders are responsible for which tasks. As flood risk management is collaborative – a shared responsibility – mistaken assumptions suggests a lack of communication and interaction between stakeholders. Interaction and communication is necessary for effective flood risk management, and the lack of such collaboration is a ‘gap’ of poor flood risk management.

The second research question is addressed in chapters 5 and 6, which present the responses of residents in the four case study locations to questionnaires about their flood knowledge and preparedness. These two chapters assess the questionnaires to identify the variations within and between locations, and to determine what the causes of those variations are. This is so that those significant factors affecting individual’s preparedness can be identified and addressed in order to encourage individuals to participate in their own flood risk management. Identifying limitations on resident’s knowledge of and ability to prepare for flood risk is also necessary to better encourage residents to get involved in their own flood preparedness.

Chapter 3’s discussion of information availability is also important for addressing the second question, as information is a necessary element of flood knowledge, although it is only one of a number of components that inform individual’s flood preparedness. Identifying what issues affect an individual’s ability or decision to take their own flood preparedness measures is necessary to better encourage individual involvement in flood risk management. Residents’ shared responsibility must be enabled, and requires the identification of any barriers. The term hazard is used throughout this thesis, rather than disaster. A hazard is a source of potential harm (Emergency Management Australia, 2004), disaster suggests a lack of

controllability that is not consistent with hazard management. 'Disaster' refers to an event (Salter, 1997), denotes something uncontrollable and outside of expectation – as Cannon (1994) puts it, hazards are natural but disasters are not – but the term hazard makes clear that it is always existent, even without a specific hazard event.

1.1.3. Theoretical framework of the thesis

Responsibility and the roles of various stakeholders is an area much researched in natural and other hazards. In their research on air pollution, Bickerstaff and Walker (2002) found most interviewees had high awareness of the problem, moderate recognition of how individual actions contribute to pollution, but took little personal responsibility. They saw other actors, particularly government and industry, as predominantly responsible, and so felt they did not need to take action. The British Department For Environment, Food and Rural Affairs (DEFRA) 2005 report into management of climate change, flood, and coastal hazards called for a risk-driven 'holistic approach' involving all stakeholders (DEFRA, 2005). Johnson and Priest (2008) see this as a shift away from a government-centric approach to flood risk management to one that involves other stakeholders, from other agencies, businesses, down to the individual. They outline how responsibility is divided among key stakeholders, including government, local environment agencies, individuals, and the insurance industry. Although recognising the roles of different stakeholders is important, Johnson and Priest note that a lack of real clarity around those roles acts as a barrier to effective management of flood risk. Thus the need is not just to know that responsibility for flood preparation and management is shared between various stakeholders, but to clearly identify how to share that responsibility.

The concept of shared responsibility – that preparation for and response to natural hazards is the responsibility of multiple stakeholders – has been a feature of discussions about and responses to both bushfire and flood events in Australia in recent years. The concept was formalised in the National Strategy for Disaster Resilience (NSDR), which states "disaster resilience is a shared responsibility for individuals, households, businesses and communities, as well as for governments" (Council of Australian Governments, 2011). This acknowledges that governments and emergency managers, while important stakeholders in hazard management, are not the only stakeholders. Residents and communities also have a responsibility for their own preparedness. But what are the limitations on individuals taking that shared responsibility? It is necessary for residents to be properly informed about their risk, and they need to have the capacity to prepare for and respond to flood or other hazards. The resources available to individuals – both physical and mental – are key to how well they can prepare for flood. This capacity is affected by factors of perception and socioeconomics, which affect what individuals think about flood and what ability they have to prepare for flood.

The same ideas were being promoted before the use of the term 'shared responsibility'. The Emergency Management Australia Safer Communities manual talks of the need for hazard management to be multi-sectoral – involving multiple stakeholders – and empowering individuals and communities (Emergency Management Australia, 2002). Emergency Management Australia previously talked about an integrated approach (Emergency Management Australia, 2004) which, as with shared responsibility, discussed the need for multiple stakeholders, from government, emergency services, and the community, to be involved in hazard management. The CSIRO provides a detailed outline of the roles of different levels of government in floodplain management, as well as making comments about developers and the community (CSIRO, 2000). Importantly, in all of these discussions and descriptions, shared responsibility does not mean the same responsibility – the responsibilities of each stakeholder are different, and even the same stakeholder may operate differently in different locations. So shared responsibility should not be taken to mean matching roles.

One concern about the concept of shared responsibility addressed in this thesis is that in Australia, the actual roles of various stakeholders have not been well articulated. In particular, most of the inquiries say little about how individual residents should be involved in their own flood preparation, aside from that information should be available for them. For example, the Queensland Floods Commission of Inquiry (Queensland Floods Commission of Inquiry and Holmes, 2011) makes a number of suggestions for how councils, emergency services, and the Bureau of Meteorology could provide information to residents, but does not discuss the need for residents to be proactive in learning about and preparing for their own risk. While the role of individuals and communities has not been prominent in Australian inquiries, it has been discussed in the wider literature, particularly regarding developing countries. Another comparable example is the 2005 DEFRA *Making Space for Water* report, which gave specific suggestions of how to better inform the community, as well as how to improve linkages between different agencies and the private sector (DEFRA, 2005). This is expanded upon in chapter 2.

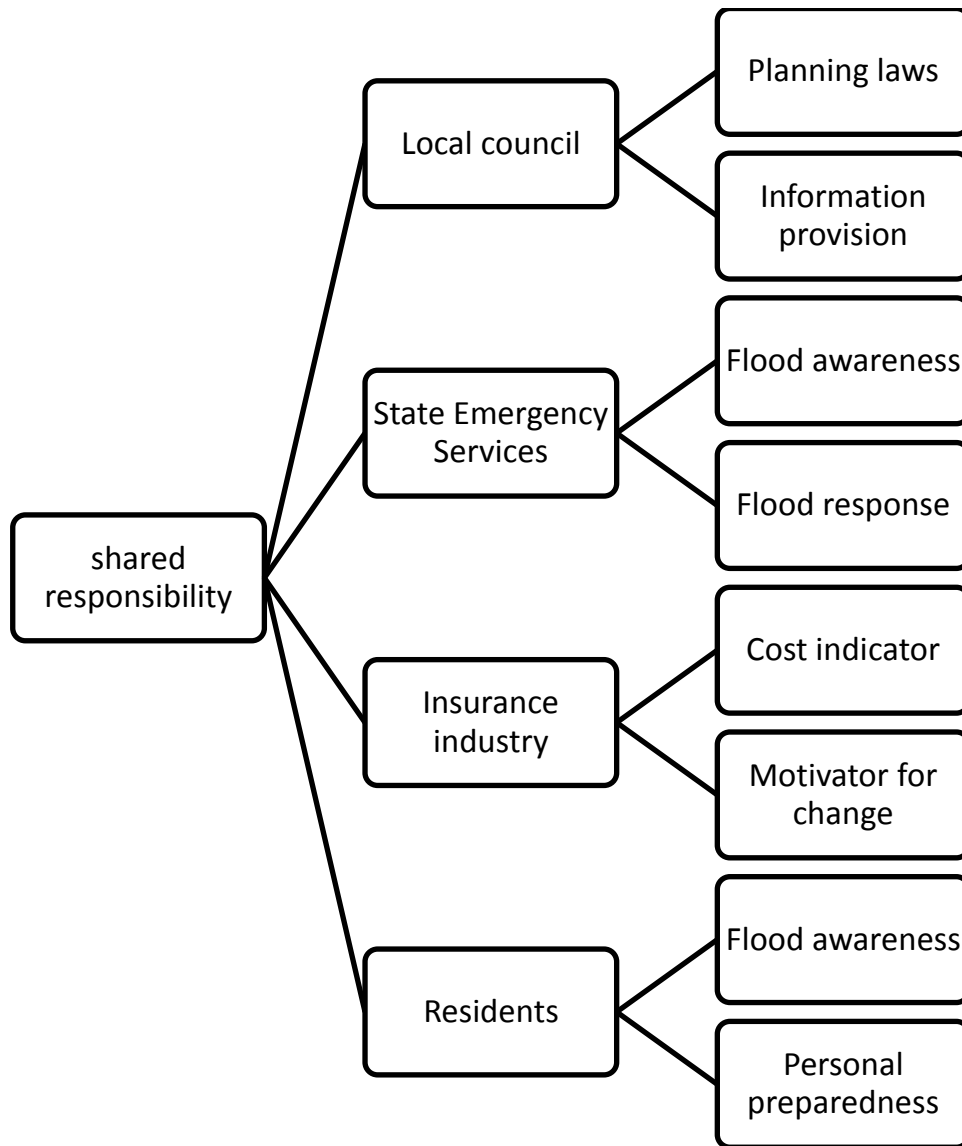


Figure 1: Conceptual diagram depicting the responsibilities of the four stakeholder groups examined. Source: author

The roles and responsibilities of the four stakeholders examined in this thesis are discussed in most detail in chapter 4. Figure 1 gives a simple representation of the key responsibilities of each of the stakeholders. Only a small number of the responsibilities of each stakeholder are given; the roles that are specifically theirs. This simplified list of responsibilities is also limited to those responsibilities discussed in this thesis. Information provision is only listed as a responsibility of council, but it is also part of the SES' flood awareness role. Information is created and used by councils, SES, and the insurance industry for their own purposes. The SES use flood information for public pre-event education and to inform their actions during events, while the insurance industry privately uses flood information to determine premium levels. But in both cases, much of the information would be produced by councils and then used by SES and insurers in their roles.

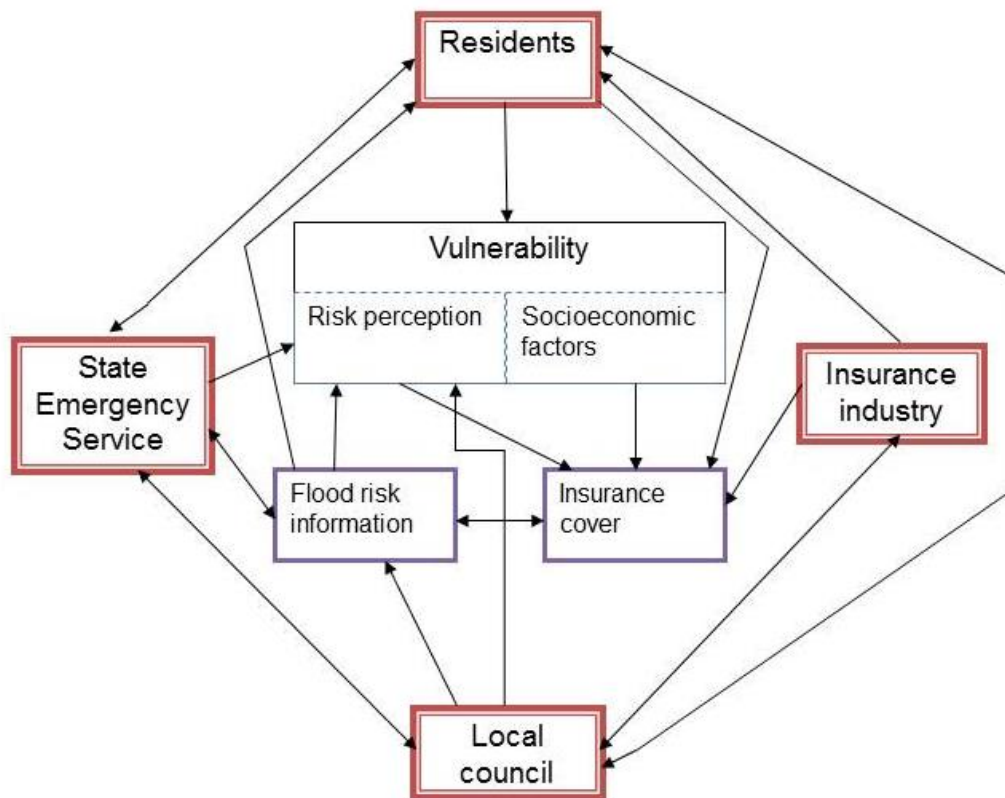


Figure 2. Conceptual diagram showing the interactions between stakeholders and various factors of flood risk management. Source: author

Figure 2 shows the connections between the stakeholders and factors examined in this thesis. The arrows indicate the direction of influence. Residents are recipients of councils' plans and education, of the SES' education and assistance, and of the insurance industry's policies. The figure is colour coded. The red boxes are the four stakeholders examined. Below that is vulnerability, and the two elements examined in this thesis, those of risk perception and socioeconomic factors. These are the conditions on which individuals make their flood preparedness decisions. Finally, the purple boxes are tools that are produced and used by the stakeholders to aid in flood risk management.

All three institutional stakeholders interact with residents by providing them with goods or services. The council designs and enforces planning laws and controls on building in flood prone areas, and is also a source of information about flood risk and events. The SES is a provider of information and education before an event, and assistance during an event (ACSES, 2012). The insurance industry provides insurance, which also acts as an indicator of the risk (Kunreuther, 1974). The SES work with councils in local disaster response plans, and provide information and assistance to the public. Residents own actions are influenced by available information and by their risk perception and socioeconomic capacity, all of which in turn influence their decision whether or not to take out flood insurance. Residents, in turn,

influence councils through voting, while some influence the SES by being volunteers. Nevertheless, residents influence on these two stakeholders is less strong.

Local councils interact with all three other stakeholders, and also produce flood risk information and inform about flood risk, making them an influence on risk perception. The SES and insurance industry do not have much direct interaction. While the potential for insurance to be a flood risk management tool is important, the insurance industry has the least interaction with the identified factors examined. The way in which these factors interact in Australia is informed by the country's particular flood history, climatic and environmental conditions, and policies and arrangements around flood and natural hazards.

1.2. Flooding in Australia

1.2.1 Australia's climate and weather

The CSIRO identifies four causes of flooding: heavy rain, storm surge, dam failure, and tsunami (CSIRO, 2000). This thesis is focused on the first type: flood caused by rainfall. Australia's rainfall is extremely variable (Pittock et al., 2006), and the country's weather patterns are affected by a number of climate patterns. The northern parts of Australia are tropical, and experience monsoonal rains and floods resulting from tropical cyclones. Tropical cyclones are common in the northern parts of Queensland, Northern Territory, and Western Australia, but have made landfall in northern New South Wales and have travelled as far south as Perth in Western Australia.

A number of climate patterns influence rainfall distribution in Australia. El Niño-Southern Oscillation has a strong influence on Australia's temperature and rainfall, with La Niña patterns bringing cooler, wetter weather. Many years with extensive flooding have coincided with La Niña patterns, including 1909, 1949-51, 1954-57, 1974, 1998, and 2010-2012 (Bureau of Meteorology, 2012b). The Indian Ocean Dipole also affects rainfall patterns in southern Australia. East Coast Lows are a common influence on rainfall in south-eastern Australia during the late-autumn early winter months from May to July. Extra-tropical cyclones also contribute to rainfall and flooding in the southern states. Tropical cyclones are a particular hazard in northern Australia, including the cities of Brisbane and Perth (Middelmann, 2007). Tropical cyclones do not frequently make landfall in southern Queensland, but there are some recorded, including a 1954 cyclone which crossed the coast at the Queensland-New South Wales border (Roche et al., 2013).

Australia experiences a range of flood types, ranging from flash floods with little or no warning time to slow moving floods that are known weeks or months in advance (Smith and Handmer, 1984). Riverine floods vary depending on the topography (Leivesley, 1984). Wide flat expanses, such as Channel Country in south-western Queensland and many other inland areas experience very slow-moving floods that can isolate communities for extended periods of time. Generally, rural areas experience wider, shallower, slower floods, and urban areas experience deeper, faster floods (CSIRO, 2000). Coastal flooding is caused by tropical cyclones. The country also experiences flash floods, such as the one that devastated Toowoomba and the Lockyer Valley in January 2011, and Wollongong in 1998. Dambreak flooding is a possibility and one serious incident has occurred, in Tasmania in 1929, with an Average Recurrence Interval (ARI) of approximately 10,000 years and killing 14 people, but these are exceedingly rare events (CSIRO, 2000).

Many parts of Australia can experience extreme rainfall. The highest recorded daily rainfall in Australia was 907mm at Crohamhurst, in the hills north of Brisbane, in early February 1893 (Bureau of Meteorology, 2013b). Other events include a storm in late November 1996, which produced falls of up to 400mm near Coffs Harbour, northern New South Wales, in less than 5 hours (Bureau of Meteorology, 2009). Sydney's highest daily rainfall, 327mm, occurred as the result of an East Coast Low in August 1986 (Bureau of Meteorology, 2009). All three of these events resulted in flooding. Some areas experience frequent flooding. The town of Grafton, in northern New South Wales, has recorded over 100 floods since 1839 at an average of more than one flood every two years, with more than 70 of those floods classified as 'moderate' or 'major' (Clarence Valley Council, 2013). A number of years have recorded multiple floods, with 12 years recording three or more floods.

1.2.2 Planning and flood

Australia has a three-tiered system of government, with federal, state, and local governments. State governments have constitutional responsibility for any policy relating to planning or natural resources, the federal government has no official role in planning laws (Smith and Handmer, 1984). It can be a provider of funding for mitigation works and disaster recovery. Planning laws are state level and implemented at the local level (Doyle and Kellow, 1995). As planning laws are made at state level, there can be variability in the nature and enforcement of flood planning laws between states. Some of this variation and how it affects information and planning is discussed in chapter 3.

The difference in height between different frequencies of flood is also dictated by topography. While the planning standard is generally of a flood extent that has a probability of occurring

once every hundred years ('1 in 100 flood'), the difference in height between a 1 in 100 flood and a larger flood, such as a Probable Maximum Flood (PMF), can be as little as a metre in parts of Channel Country, or as much as 12 metres for the Hawkesbury-Nepean in north-western Sydney (Ribbons, 1995). In the Georges River catchment in south-western Sydney, the number of properties at risk from a PMF compared to a 1 in 100 flood increases sevenfold from under 700 to over 5,000 (Bewsher, 2003). Understanding this is important for flood planning, particularly in areas with high populations where the impacts of a larger flood will be particularly severe.

The most extreme planning response to flood is relocation. Internationally, an estimated 20,000 people relocated following flooding along the Mississippi in 1993 (Faber, 1996). While there have been a number of towns relocated due to flood, these particularly extreme responses to risk are uncommon, because to do so is often impractical (Roder, 1961). Floods have led to the relocation of a small number of towns in Australia. After a number of floods during the 1840s, the town of Gundagai, a trading stop on the road from Sydney to Melbourne, was destroyed by a flood in 1852 which killed 89 of the 250 inhabitants and destroyed almost all buildings in the town (Coates, 1999). As a result, the colonial Governor agreed to make available land on higher ground for residents to rebuild on (Thomson, 1852). The town of Smithfield, in Queensland, was twice flooded during settlement in the 1870s, leading to the main settlement being moved to what is now the city of Cairns (Oliver, 1980). That same decade saw the relocation of Moama and Terrara, south of Sydney, to nearby Nowra (Smith and Handmer, 1984). In 1917, Clermont, Queensland was moved following a catastrophic flood, with buildings physically relocated by horse (Pullar et al., 1986). The location originally proposed for Maitland, a major centre in the Hunter Valley north west of Sydney, was rejected because it was considered too flood prone (King and Woolmington, 1960). The location ultimately chosen was still flood prone. Following floods in 1955, councils for both Maitland and the upstream town of Singleton proposed the relocation of those towns, but this suggestion was eventually rejected (The Muswellbrook Chronicle, 1955b).

The town of Gunnedah in north-western New South Wales was partially resituated during the town's establishment following a flood, resulting in the centre of town being built away from the river (McLean, 2006). Quilpie, in the Channel Country region of south-western Queensland, claims to have been specifically built out of the reach of floods (Quilpie Shire, 2011). Most recently, the town of Grantham, west of Brisbane and the site of the 'inland tsunami' in January 2011, is undertaking a voluntary relocation scheme for residents who no longer wish to live on the flood plain where the town was originally situated (Lockyer Valley Regional Council, 2011).

1.2.3 19th century experiences of flood

Australia has a long history of flooding, with records dating back to the early days of European settlement. The first discussion of flood in a newspaper is from 1803, the first year a newspaper was published in Australia. It recounts an order from the colonial Governor, criticising the “improvident method taken by the first settlers” in Windsor, on the Hawkesbury-Nepean Rivers north-west of Sydney, and advises settlers to maintain trees near the river to reduce the risk of flood (Sydney Gazette, 1803). Other early flooding on the Hawkesbury-Nepean occurred in 1801 and 1806 (Sydney Gazette, 1806b), and again in 1811, when settlers were advised to move to higher ground and told official assistance would not be forthcoming in the event of future floods should they remain in the flood zone (Sydney Gazette, 1811). In both the 1803 and 1811 cases, the emphasis was on the need for residents to take their own protective measures and be aware of the risk of their location.

In 1817, following another damaging flood at Windsor, then-Governor Lachlan Macquarie issued an edict chastising residents for their “wilful and wayward habit” of continuing to live in areas known to flood rather than in gazetted townships (Macquarie, 1817). Windsor has experienced a number of other floods, including one in 1867 which had an Average Recurrence Interval (ARI) of between 250 and 400 years (Keys, 1995, Ribbons, 1995). The region has not seen a flood since 1990, and complacency about the risk is now a concern. The population of the region has grown greatly, and evacuation of such a large number of people would be difficult (Armitage, 2012).

Many other years have seen significant floods. Melbourne experienced flood in 1839, a number of times in the 1840s, and its worst flood in 1863 (Otto, 2005). Bourke, in western New South Wales, was badly flooded in 1890 (Sydney Morning Herald, 1890). The Hunter Valley region north of Sydney experienced frequent floods. Some of the above-mentioned town relocations occurred following floods in the 19th century. The worst flood to date in the Hunter Valley region occurred in 1893, with the town of Maitland particularly badly affected (Sydney Morning Herald, 1893). Newspaper archives record details of many more floods, but detailed discussion is beyond the scope of this thesis.

The city of Brisbane, Australia’s third largest city, has experienced many severe floods since its settlement, many during the 19th century. Floods in Brisbane mostly occur in late summer or early autumn, with 26 of 37 floods over 2.74 metres (9 feet) between 1841 and 1974 happening in January, February or March (Director of Meteorology, 1974). Three floods – 1841, 1844, and 1893 – reached over 7 metres (23 feet) at the city gauge (Bureau of

Meteorology, 2013d). The 1893 flood was actually three separate events over a two week period in February, with two floods over 8 metres on either side of a smaller flood (Middelmann et al., 2000). While the construction of Somerset and Wivenhoe Dams has had the effect of mitigating some of the flood risk, those three floods are still considerably larger than any floods recorded since (Brisbane City Council, 1999).

Many of the floods which occurred in the 19th century were particularly severe. The floods in Brisbane, the 1867 flood at Windsor, the 1890 flood at Bourke, and the 1852 flood in Gundagai were larger than any events before or since. Knowledge of flood risks was limited, and many settlements were established in floodplains with no mitigation measures to protect them.

1.2.4 20th century floods

Numerous floods occurred during the 20th century, with two decades – the 1950s and 1970s, seeing a particularly large number of floods. Those two decades will be addressed in separate sections below, while this section will briefly cover other floods of the 20th century.

The winter of 1909 saw flooding across Australia, with particularly severe flooding in Victoria in mid-August (Hunt, 1909). In the 1920s, significant flooding occurred in Western Australia (The Register, 1926) and the aforementioned dambreak flood in Tasmania (Willis et al., 2007). Melbourne has experienced flooding on a number of occasions, the largest floods in 1934 (The Daily News, 1934). The town of Maitland experienced 32 major floods in the 50-year period 1908-1957 (Hawke, 1958). Apart from these floods, the first half of the 20th century saw fewer floods than had occurred in the 19th century, or in the mid-20th century.

In the time period 1967-1999, floods were the second-most common disaster type in Australia behind severe storms (Bureau of Transport and Economics, 2001). Sydney experienced flooding in 1986. Lismore, in northern New South Wales, experienced 20 floods between 1875 and 1980 which caused damage within the town (Smith, 1981). In 1998, Katherine in the Northern Territory experienced a flood larger than had been believed possible (Skertchly and Skertchly, 2000). The city of Wollongong, south of Sydney, also experienced severe flooding in 1998, which raised planning and insurance discussions (Fletcher, 2002).

1990 saw some severe floods in inland areas of Australia, with the towns of Nyngan, New South Wales, and Charleville, Queensland, worst affected. The flood in Nyngan was particularly severe: with an estimated ARI of between 200 and 250 years, the flood

overtopped the town's levee, leading to all 2,500 residents being evacuated by helicopter to nearby Dubbo and unable to return home for a number of weeks (Joy, 1993). Subsequent works have raised the levee a further metre above its pre-flood height (Wills, 1996). Charleville was also evacuated due to flooding (Handmer et al., 1999). While Nyngan residents had put their confidence in the levee to protect them, Charleville residents simply did not believe in the possibility of a flood larger than their previous record flood (Heatherwick, 1990). In both cases, assumptions about the size of potential floods contributed to residents being unprepared.

1.2.5 Flooding of the 1950s

A number of significant flood years occurred during the 1950s. Grafton alone experienced 21 floods during the decade 1950-1959 (Clarence Valley Council, 2013). Much of the flooding in the 1950s coincided with La Niña weather systems in the early and middle years of the decade (Bureau of Meteorology, 2012b), with New South Wales' two wettest years of the 20th century occurring in 1950 and 1956 (Bureau of Meteorology, 2009). 1949 saw flooding in the Macleay River in northern New South Wales destroy many buildings in the town of Kempsey (Bureau of Meteorology, 2009). The first flood year that decade was 1950, when floods affected central New South Wales, large parts of Queensland, and Gippsland in Victoria. In Queensland, floods were recorded in every month, with a number of rivers flooding multiple times, and record floods on many Channel Country rivers (Bureau of Meteorology, 2010b). Emerald, one of the four case studies examined in this thesis, experienced a flood in 1950 that was the town's worst recorded until the December 2010 flood (Regional Australia Institute, 2013). Late February 1954 saw a cyclone hit southern Queensland, causing severe flooding in large parts of Queensland and northern New South Wales, with the Tweed, Richmond, and Clarence catchments flooding simultaneously (Roche et al., 2013).

The most significant flooding during that decade occurred across the Hunter Valley and central New South Wales in February 1955. Particularly affected were the towns of Maitland and Singleton. In Singleton, almost every house in the town was flood-affected (Thorpe and Tweedie, 1956); the town of Warren had the same experience (Risk Frontiers, 2010). Rainfall amounts and flood heights during those floods were unprecedented at the time (Bond and Weisner, 1955), and have since been estimated at a probability of approximately 1 in 200 years (Keys, 1995). There were reports that the floodwaters in some areas were 30km wide, and record floods were recorded on the Hunter, Gwydir, Namoi, Macquarie and Castlereagh Rivers (Bureau of Meteorology, 2009, Thorpe and Tweedie, 1956). These floods also led to the creation of the New South Wales State Emergency Service (SES) as an agency dedicated to flood and disaster response (Keys, 2006). The fact that the majority of the

state's river systems flooded at least once between 1954-1956 – coming so soon after floods in 1949-1952 – was acted as a trigger for creating a coordinated agency to respond to floods.

In Queensland, the Burdekin and Fitzroy River systems experienced near-record floods in both 1954 and 1955 (Bureau of Meteorology, 2010b). Goondiwindi in Queensland was flooded three times in six months in 1956, leading to the building of a levee to protect the town (Bureau of Transport and Regional Economics, 2002). The 1956 floods were exacerbated by the catchments already wet from the floods of 1955, and despite the building of dams to try and manage and regulate the rivers, with the Murray and Murrumbidgee Rivers particularly badly flooded (O'Gorman, 2010). The waters of the Murray and Darling Rivers peaked simultaneously, severely threatening the town of Wentworth in south-western New South Wales (Bureau of Meteorology, 2009). The floods of 1956 still stand as records for a number of towns, particularly in the lower Murray-Darling Basin. Flooding also occurred along the Georges River in Sydney in 1956 (Maddocks, 2001), and in the Hawkesbury-Nepean and Bega Rivers the same year.

1.2.6 Flooding of the 1970s

The 1970s also saw extensive flooding, as well as providing the impetus to move from largely structural responses to flood, such as building levees to keep water out, to encompass land use planning and change how floodplains are used (CSIRO, 2000). Wider management approaches that considered social impacts and issues began to be used (Smith and Handmer, 1984).

The first major flood of the 1970s occurred in Woden Valley, a suburb of Canberra. Canberra has a low flood risk, but experienced severe flash flooding on Australia Day, 26 January 1971, killing 7 people (Bureau of Meteorology, 2009). Across that year, 60% of catchments in New South Wales experienced moderate or major flooding (Douglas, 1979). North-western New South Wales experienced flooding multiple times in the mid-1970s. The recurrence of floods multiple times in a short period of time (1971, 1974, and 1976) surprised many who did not anticipate that multiple large floods could occur so close together (Douglas and Hobbs, 1979).

Two major flood and disaster events occurred in 1974: the January flooding of Brisbane, and the Cyclone Tracy's Christmas Day impact on Darwin. The flooding of Brisbane on the Australia Day long weekend in late January 1974 was that city's first significant flood of the 20th century, with only one other flood over 3 metres having occurred in 1931 (Director of Meteorology, 1974). The flood was caused by the slow-moving and deteriorating Cyclone

Wanda which crossed the Queensland coast approximately 100km north of Brisbane on January 24 (Director of Meteorology, 1974). Approximately 13,000 properties in Brisbane were affected by the flood with water on their property (Macey, 1978). The 1974 flood also led to the establishment of the Queensland State Emergency Service, which emerged out of the Civil Defence Organisation, which had previously been involved in disaster relief following Cyclone Althea in 1971 (State Emergency Service Queensland, 2009).

While not a flood, Cyclone Tracy needs to be included in any discussion of natural disasters and hazard management in Australia. Cyclone Tracy's Christmas Day impact on Darwin is one of the most famous natural disasters in Australia's history. The cyclone made a direct hit on the city, severely damaging or destroying most buildings, with 60% unrepairable and only 6% still habitable (Mason and Haynes, 2010). Thirty thousand people, approximately two thirds of the population, were evacuated following the cyclone while the city was rebuilt (McNamara, 2012). A second event of such large scale occurring so soon after the flooding of Brisbane acted as a catalyst for national discussions of how to address natural hazards, and in particular, the role of insurance and the federal government (Dwyer, 2006).

While Brisbane was the most famous flood in 1974, extensive flooding occurred throughout much of Queensland and New South Wales, including from cyclones Zoe and Alice in March and April of that year respectively (Douglas, 1979). The floods of the 1970s also prompted national discussions of insurance and hazard protection, which are discussed in section 1.2.8 below.

1.2.7 Floods since 2000

While the first decade of the 21st century was largely one of drought in Australia, a number of floods did occur, particularly towards the end of the decade. Interest in flooding in Australia has been renewed following a number of years of severe floods. Strong La Niña weather patterns in 2010-2011 led to significant rainfall events and floods across much of the country, and the wettest two-year period on record (National Climate Centre, 2012). 2010 saw the wettest September on record (National Climate Centre, 2010), while 2011 saw the wettest March on record (Bureau of Meteorology, 2011f). The 2010-2011 summer floods were on a larger scale than any seen before, but they were not the only floods in recent years.

In June 2007, an East Coast Low caused severe storms and flash flooding across the Central Coast, Newcastle, and lower Hunter Valley regions of New South Wales (Jones, 2013). This resulted in some of the most significant flooding in parts of the Hunter Valley since the 1950s, including Maitland (Evans et al., 2008). One of the locations flooded in this

storm was Dora Creek (Jones, 2013), one of the four case studies examined in this thesis. In 2008, Queensland was affected by flooding, with towns such as Mackay and Charleville particularly affected (Apan et al., 2010). As noted above, these floods marked the ending of a decade of drought.

In September 2010, inland Victoria experienced severe flooding. The 2010 floods were the worst in over a decade and affected a number of large regional towns (McMahon, 2010). Over 5,000 requests for assistance were made to the Victorian SES (Victoria State Emergency Service, 2011). Disaster declarations and assistance under the Natural Disaster Relief and Recovery Arrangements (NDRRA) were made available for 34 of Victoria's 78 LGAs (Attorney-General, 2010). September 2010 was the wettest September on record in Australia, with three times the average rainfall falling (National Climate Centre, 2010).

The first floods of the 2010-2011 summer occurred in central New South Wales in the first week of December (Jopson, 2010). This was followed by floods in eastern South Australia on the 7th and 8th (Attorney-General, 2011), and in mid-December by monsoonal flooding in the Gascoyne River region of Western Australia, with some areas, including the regional centre of Carnarvon, receiving over 300mm of rain in a five-day period – an amount higher than the town's average annual rainfall (Bureau of Meteorology, 2010a). The major flooding in Queensland began at Christmas, caused by Cyclone Tasha (Bureau of Meteorology, 2011c). Severe floods occurred in the Fitzroy River basin in towns such as Emerald (Agius, 2010) and regional city Rockhampton (Ralston, 2010), whose flooded airport was closed for three weeks. A number of Queensland towns were flooded multiple times. The towns of Condamine, Dalby, and Theodore were completely evacuated due to flood. The 2010-2011 flood timeline provided in figure 3 on the following page gives a brief timeline of a selection of flood events.

Extreme flooding also occurred in Victoria, although these were overshadowed by the concurrent flooding of Brisbane. Some floods had estimated ARIs of 1 in 200 years (ABC News, 2011b). In Victoria in the first two months of 2011, over 4,000 properties were flooded and 13 rivers experienced their highest floods on record, and a further 5 rivers experienced their second highest flood on record (Victoria State Emergency Service, 2011).

In early February, Cyclone Yasi made landfall south of Cairns as a category 5 tropical cyclone (Bureau of Meteorology, 2011b). Significant damage occurred in coastal towns in northern Queensland (King et al., 2013). Yasi caused renewed flooding in inland Queensland, and stretching down through to central Victoria, as well as heavy rain falls in central areas of the Northern Territory.

During the 2010-2011 floods, almost all local councils in Victoria and Queensland were declared natural disaster zones due to flood and storm damage, as were the majority of councils in New South Wales and the Northern Territory, parts of northern Tasmania, eastern areas of South Australia, and the central regions of Western Australia. Media coverage of the floods and related extreme weather of the 2010-2011 summer was extensive. More than 330 articles were published in the Sydney Morning Herald alone in the months December 2010 to February 2011 on the floods, Cyclone Yasi, and related insurance discussions. The floods also made news internationally, particularly the flooding of Brisbane (Rourke, 2011a), and the scale of the area affected, larger than France and Germany combined (Rourke, 2011b).

For some of those affected by the floods, they discovered that their insurance did not cover flood damage (Drummond, 2011). Expectations for official help or action during a flood event also did not always eventuate, leading to dissatisfaction with local councils and emergency services in particular. Such a large number of events in a short timeframe also brought up discussions about how floods should be paid for, the role of various stakeholders, and why residents were not always as aware or prepared as they should have been.

Sydney did not flood in 2011, but did experience heavy rainfall, with July being the wettest since 1950 and wetter than some monsoonal cities (Rubeli, 2011). Northern New South Wales also saw flooding in June 2011 (McKenny, 2011). While the middle of the year had fewer flood incidents, October 2011 saw official declaration of a La Niña for a second year in a row (Bureau of Meteorology, 2012b).

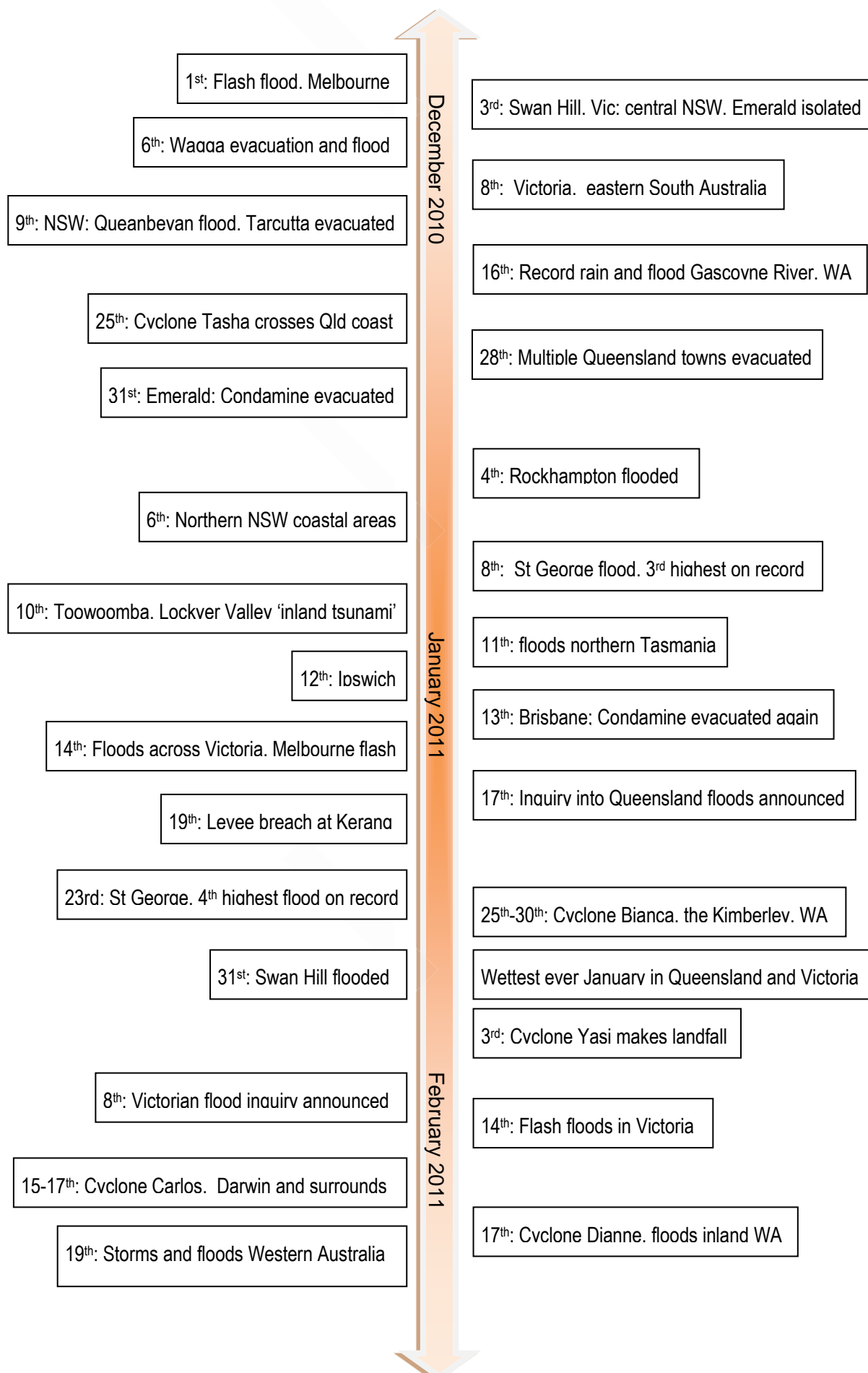


Figure 3. Timeline of selected events during the 2010-2011 summer floods

Floods in 2012 affected large areas of New South Wales, the southern and inland regions in particular. Storms in Sydney caused flash flooding in late February, with falls of up to 26mm in 10 minutes recorded (NSW State Emergency Service, 2012), and again in early March, with a number of train stations flooded (Cook and McKenny, 2012). In early March, the Warragamba Dam west of Sydney overflowed, causing some minor flooding (Wilson, 2012). The town of Moree was bisected by its worst flood in 30 years in early February, and 17 council areas were declared natural disaster zones due to flood in one week (Robertson, 2012). In March, the town of Wagga Wagga in south-western New South Wales narrowly escaped inundation (ABC News, 2012). Concerns about the structural integrity of the levee at the town of Hay in south-western New South Wales led to the SES issuing an evacuation order for the town, which was dismissed by council and ignored by residents. While the levee did hold, the town's ignoring of SES advice led to the Commissioner writing an open letter to the town to explain why the SES had ordered the town to evacuate and express how 'disappointing' it was that residents had not trusted the SES (Kear, 2012).

Western parts of New South Wales experienced extreme rainfalls in late February and early March 2012, with the town of Wilcannia receiving ten times its monthly rainfall in one weekend (Williams, 2012), and Ivanhoe receiving a year's worth of rain in one week, with dozens of towns in New South Wales and Victoria breaking daily rainfall records for the months February and March (Bureau of Meteorology, 2012a).

Table 1 provides a brief summary of the trends in flooding and responses to flood in Australia over the last two centuries.

19 th century	Extreme floods, minimal knowledge of risk, little or no mitigation
Early 20 th century	Fewer floods than preceding and following decades
Mid 20 th century	Repeated and widespread floods, establishment of NSW SES
1970s	Brisbane flood, Cyclone Tracy, federal discussions of insurance
Late 20 th century	Some significant floods, discussion of insurance and mitigation options
2009-present	Repeated, record-breaking, widespread flooding, inquiries, federal discussions of insurance

Table 1. Trends in flood and response in Australia

1.2.8 Insurance and cost of floods

Not only are floods one of the most common hazards in Australia, they are the most costly (Bureau of Transport and Regional Economics, 2002, Nakken and Mitchell, 1997). Flooding has both financial and human costs. Floods are the second-leading cause of death from natural hazards in Australia behind heatwaves (Coates, 1999, FitzGerald et al., 2010). Using data from 1967-1999, the Bureau of Transport and Economics calculated that floods count for at least one third of all disaster losses in Queensland, Victoria, Tasmania, and South Australia, and represented the largest proportion of natural disaster losses in Queensland and Victoria (Bureau of Transport and Economics, 2001). The cost of flood prevention works is normally divided between the three levels of government – local, state, and federal (Buckle, 2001). Research in the early 1980s estimated the annual cost of flood damage at \$19 million, and the cost of providing structural protection for developments at risk from a 1 in 100 flood at \$300 million (Smith and Handmer, 1984). In the ensuing 30 years, populations in flood prone areas have increased, as has the cost of property located in floodplains resulting in much higher potential damage costs.

One mechanism to alleviate the cost of flood is through insurance. Flood insurance has not traditionally been widely available in Australia. National proposals for a federal insurance scheme occurred following the significant floods of both the 1950s (Hansard, 1958) and the 1970s (Treasury, 1976). In the second case, proposals for a scheme were rejected on the basis that insurance is a private business and should not be the responsibility of government.

Lack of flood maps and information has been highlighted a number of times in making flood insurance provision difficult (Askew and Pilgrim, 1979, Smith and Handmer, 1989, Buckle, 2001, Smith and Handmer, 2002). More recent years have seen advances in knowledge about risk frequencies and technologies to quantify risk more accurately and on smaller scales. Better flood risk information, including the ability to give property-level risk ratings, has made flood insurance viable to offer, but also allows it to be priced to reflect the risk with high accuracy. This combines with misperceptions and lack of concern about insurance until floods occur, at which time many individuals discover their insurance does not include the flood cover they had assumed it did (Oliver, 1989). This sort of dissatisfaction was seen in the media coverage of the 2010-2011 floods (for example Brown, 2011; Drummind, 2011), and in the case studies presented here.

The insured losses from the 2010-2011 floods is over \$4.4 billion (Insurance Council of Australia, 2013), and the federal government dedicated \$5.6 billion to recovery and rebuilding (Gillard, 2011b). Some of the cost of the rebuilding was paid for by a one-year

tax levy paid by those unaffected by the floods (Gillard, 2011a). This decision raised debate about who is responsible for paying for flood impacts and recovery – while the federal government has always provided disaster recovery funds, the levy was to cover rebuilding of infrastructure in Queensland that the Queensland government had decided was too costly to insure.

1.2.9 Factors influencing future flood risk in Australia

While this thesis does not include discussion of climate change, research on the likely impact of climate change on Australia's weather predicts an increase in severity and damage resulting from flood in the future. While rainfall is predicted to increase in some areas and decrease in others, there are indications that high-intensity rainfall events will become more frequent in areas such as the lower reaches of the Murray-Darling Basin (Pittock et al., 2006). Sea level rise and coastal flooding are also likely to increase (Steffen et al., 2013). Those studies which have been completed predict an increase in severity and damage resulting from flood in the future, and calls for both planning for those risks and more equitably distributing the costs of such risks (Whetton et al., 1993, Smith, 1999, Thomas et al., 2011, Pearce et al., 2010). As well as the need to plan for changed flood frequencies is the need for more insurance cover of potential losses, and for buildings to be built to better withstand flood events (Yates and Bergin, 2009, Mortimer et al., 2011). Insurers include consideration about climate change in their assessment of future risks and losses (Crichton, 2002).

Issues of insurance and resilient housing are relevant not only to future climate change, but current flood risk. Following the 2010-2011 floods, some attention has been paid to planning laws and the role of state and local governments in addressing climate change's impact on future flooding (Godden and Kung, 2011), and the need for rebuilding to focus on anticipation of and resilience to future risks (Bun, 2012). The need for more funding to be directed towards mitigation and resilience was again recognised following the 2010-2011 floods (Bergin, 2011). Although, as discussed in chapter 4, stakeholders believe mitigation requires greater funding.

Brisbane is second on the list of the highest-risk areas of Australia in terms of population vulnerable to a 1 in 100 year flood (Leigh, 2005). Brisbane is not the only capital city in the top ten – Melbourne, Adelaide and Sydney (Hawkesbury-Nepean catchment) are fourth, sixth, and seventh respectively. However Sydney's overall risk is even larger, as the city contains multiple catchments. If the Georges and Parramatta River catchments are added to the number of properties at risk in Sydney, its exposure would exceed that of Melbourne, and

would place third on the list, with approximately 8,000 properties at risk. The potential impacts of flood in Australia's major cities, therefore, are very high, not just in terms of population at risk, but in property damage and economic impact.

Population growth and development of flood-prone areas will continue to put increasing numbers of people at risk of flood. The Hawkesbury-Nepean region already mentioned is a good example: currently-undeveloped areas have been earmarked for thousands more people, particularly in the area of Riverstone (Kelly, 2010). While the region has not experienced flooding in recent years, it has a history of severe flood, and a steep topography that would expose large numbers of properties in a flood larger than a 1 in 100 flood (Gillespie et al., 2002). Areas of south-east Queensland and northern New South Wales are also experiencing high population growth in areas with high flood risks.

As this overview has shown, flood is a widespread and recurrent problem in Australia. Not only this, but discussions about roles and responsibilities in flood preparedness have frequently followed flood events as far back as the early 19th Century. Discussions of cost and knowledge of flood risk have also frequently followed flood, and both are again topical due to the 2010-2011 floods. Given this context of Australia's extensive flood history, and particularly discussions about who is responsible for risk and response, this thesis examines issues of awareness, preparedness, and shared responsibility for flooding in Australia.

1.3. Methodology

1.3.1 Research approach

This thesis examines gaps in flood risk management in Australia and factors that affect individual's flood preparedness, using the recent floods as a context for discussions of roles and responsibilities. It examines four key stakeholders to determine how 'shared responsibility' can be articulated in flood risk management in Australia. This section will outline how the stakeholders included in this thesis were chosen, why interviews and surveys were chosen as data sources, and how case study selection was made.

The idea of shared responsibility – that responsibility for preparing for and responding to natural hazards such as floods is a job for multiple stakeholders – has been increasingly used in formal discussions of hazard in Australia in recent years. This thesis, started before the floods of the 2010-2011 summer, began by asking how residents could bear more responsibility for their own flood preparedness, particularly in relation to insurance and the

cost of high-risk locations. Throughout the research, the concept of responsibility, and the idea that multiple actors need to be involved to ensure successful flood risk management, continued to emerge strongly and this project shifted to look at more stakeholders than simply residents and their use of insurance.

This thesis used a mixture of qualitative and quantitative approaches to data collection, as different methods have different strengths and allow particular focuses. The adoption of a mixed methods approach facilitated the collection of responses from a variety of stakeholders. The information desired from residents is different to that needed from the institutional stakeholders, making a different approach appropriate. As Hay (2005) notes, making use of both qualitative and quantitative methods allows both individual and general responses to an issue to be presented. Interviews were used to allow respondents to give broader scope and detail in their responses, but they can also be coded to identify themes across respondents (Cope, 2005). For the resident questionnaires, both closed and open-ended questions were included. This allowed the collection of both qualitative and quantitative data from the same questionnaire (Hay, 2005).

Three forms of data collection were used in this thesis. The first was assessing local council websites to examine what flood information was available. The second form of data collection was a questionnaire distributed to residents in the four case study locations. It included demographic questions, questions about flood experience and awareness, flood insurance, and thoughts about risk reduction. The final form of data collection was interviews, conducted with the council, SES, and insurance industry representatives. Some residents also agreed to be interviewed, and some of their quotes are used in chapters 4-6.

For residents to be able to be involved in their own flood risk management and have responsibility for their preparedness, they need to be informed. To that end, the first element of this project was to investigate information availability on flood risk in Australia. The best way to access that information was considered. It was decided to look at flood information availability from local council websites, as they are a place where a large amount of information can be placed, and are accessible from any location with internet access. This makes council websites superior to council offices, as access to flood information is not dependent on office hours or a single location. It also made it possible to assess all councils, as I would be unable to visit all council offices across the country, and it would be unlikely that all councils would respond to requests for information. It should be noted that, while council websites have the advantages of the potential to make large amounts of information widely available, there are some groups, namely older residents and non-English speakers, for whom a council website may not be the most useful resource. Further steps would need

to be taken to specifically ensure that these groups receive adequate flood risk information. By examining all council websites myself I could ensure I used the same assessment and parameters for every location. The entire country was examined as flood planning laws are mandated by state government and implemented at the local government level, leading to variability both within and between states. While this study only assesses flood information available on council websites and not all flood information held by local councils, it presents an introductory overview of flood information availability in Australia.

The assessment of local council websites involved searching for keywords as well as looking at specific pages on each website. The list of councils was created using each state's local government associations or state and territory government local government departments and directories. Council websites were visited alphabetically by state, beginning with New South Wales and finishing with Western Australia. At each website, three terms were searched for: flood, flood map, and flood planning. Any environment, planning, and 'frequently asked questions' sections of each website were also examined, and all information regarding flood was noted. The amount and quality of this information was assessed to determine how accessible flood risk information is from Australian council websites, and what differences exist across the country. Flood risk information availability was chosen as a starting point for this study as individuals need to have access to information about their risk in order to undertake their own preparedness.

In order to assess residents' awareness and preparedness for flood, case studies of flood-prone areas were chosen as a key element of the research. The decision to compare different case studies was made prior to the 2010-2011 floods. When those floods occurred, they influenced the process of choosing case studies and the final case studies chosen. The initial focus was going to be a comparison of case studies of different sizes and types, looking at small and large settlements as well as coastal and inland locations. Following the 2010-2011 floods, extra parameters around flood history were added: namely, to select both locations that had flooded during that time period and others which had not flooded for a number of years. These parameters were added to see what influence experience had on people's awareness, insurance status, and thoughts about responsibility. A list of selection criteria was created for the case studies. The selection criteria included selecting locations in multiple states, different flood histories and particularly a mix of locations with recent and not recent floods, case studies of different sizes, and both stable and shifting populations. In addition to these specific criteria, note was made of any other issues about particular locations. For example, the rate of population growth in Emerald and the extensive media coverage in Brisbane were added as reasons to select those particular case studies.

Questionnaires were used in the four case study locations to assess residents' awareness of and preparedness for flood. Demographic questions about respondents' gender, household income, and age were included in order to assess whether individual's awareness and preparedness are affected by socioeconomic variables. Questions about flood awareness and experience, flood insurance, and flood information were also included, as well as questions on flood risk reduction. The risk reduction questions asked respondents to list what they felt were the best options that could be undertaken by council, SES, and themselves in reducing their flood risk. These three questions aim to investigate how individuals see responsibility for flood to be shared between themselves, council, and SES, and what assumptions individuals make about flood protection and preparedness. Copies of the questionnaires can be found in Appendix A.

The final form of data collection used in this thesis is interviews. Interviews were conducted with representatives of local councils, the SES, and the insurance industry. Each stakeholder was asked how they viewed their role in flood risk management, how they viewed each other's roles, what responsibilities they felt residents had to inform themselves about their flood risk, and whether they would support uniform national flood information standards. As with the risk reduction questions on the resident survey, many of these questions aimed to assess how each stakeholder believes responsibility for flood risk management is distributed amongst key stakeholders. These questions aimed to identify whether the different stakeholders had an accurate understanding of each other's' roles and responsibilities, as best practice flood risk management requires all involved stakeholders to not only know and perform their own role, but to know and understand the roles of others. The details of stakeholder selection are expanded upon in the following section, and copies of the questions asked to each stakeholder group can be found in Appendix B.

1.3.2 The stakeholders

The stakeholders selected are four key participants in flood risk management. While the focus of this thesis was shifted by the occurrence of the 2010-2011 floods, these four stakeholders were shortlisted as participants before those floods took place. Local councils implement local planning including around flood risk, and the SES are responsible for emergency response and involved in awareness and preparedness of communities. As such, these two stakeholders have official roles in flood risk management. Local residents, of course, are the people directly impacted by flood events. Insurance has largely been peripheral to the flood discourse in Australia due to the historic lack of availability of flood insurance. However flood insurance has been becoming increasingly available, particularly since about 2008. The value of insurance as an element of personal preparedness, and the

desire to examine the different responsibilities of key stakeholders, led to the inclusion of the insurance industry as study participants. Each of these stakeholders is identified as a central player by the NSDR (Council of Australian Governments, 2011).

Other stakeholders were considered for inclusion: state and federal governments, developers, and political parties. Political parties were rejected as a potential stakeholder following the 2010-2011 floods because I wanted to keep the focus of this thesis on individual residents, rather than government policy discussions. Given the number of ongoing inquiries announced in the immediate aftermath of the floods, I also thought it likely that both levels of government would defer comment until those inquiries were finished, which would not have fitted in my timeline. Those inquiries and policy discussions are, however, referred to throughout this thesis. Flood risk management is a necessity regardless of the political party in charge, and the public disagreements over how to respond to flood, while interesting, would have taken the focus away from the central ideas of this thesis on shared responsibility of the stakeholders. Federal government was rejected as the federal government does not have any legislated responsibilities around flood planning and management. The federal government does provide funding assistance to mitigation projects, as well as disaster relief and recovery funding, but they are not one of the on-the-ground players in flood. While some of the issues raised in this thesis do point to the need for national standards on flood, and federal government could have been included if the focus of discussion had been on that issue, it is in reality a sub-issue and not the focus. State governments are responsible for drafting planning laws and provide the framework within which local governments operate, but it is local government that implements them, making local government the more practical stakeholder to choose.

Major developers were approached to participate, as development in flood plains was raised as an issue by all other groups. However, of the dozen developers contacted via email, only one showed any interest. Many simply did not respond, and others declined to participate for commercial confidence reasons. The role of developers is important to consider – how much influence do they have over land use, how well do they incorporate flood risk into their developments, what attitude do they have to adapting or changing their developments in response to natural hazards – but they are beyond the scope of this thesis. Other stakeholders involved in flood risk management but not included in this thesis are catchment management authorities and the Bureau of Meteorology. The Bureau of Meteorology provides flood monitoring and forecasting services as well as publicising flood warnings. However their role is as a provider of information rather than coordination with other stakeholders, and so the focus of their involvement in flood risk management did not fit with the focus of this thesis.

Local council

In Australia, planning legislation is a state government responsibility, but its implementation is a local government responsibility. Local councils are not officially recognised in Australia's constitution, but they are the level of government that implements many of the state government's planning responsibilities (Doyle and Kellow, 1995). As such, they have the most direct involvement in flood risk by deciding where to place development and what restrictions to impose. Local councils make the immediate planning decisions, including on flood height levels and mitigation decisions. The CSIRO recognise local councils as the key local agency in floodplain management, both through their implementation of plans and their interaction with the local community (CSIRO, 2000). Variations between different councils in policies and resources also affect their flood planning decisions. While the 1 in 100 flood is the standard for most planning, some local councils use specific historic floods to determine their flood building standard.

Local councils interact closely with their communities and often their local SES unit. Local councils and insurers do not necessarily come into close contact, although, as will be noted in chapter 4, some councils have consulted with insurers or invited insurers to talk to their communities. Both elected council officials (mayors) and appointed council employees (environment or disaster officers) were interviewed. This was done to get a wider range of responses and to see if there were any differences between elected and appointed officials' views of flood risk management. The questions asked covered what priority they placed on flood risk management, their thoughts on the roles of the other three stakeholders examined, and the 2010-2011 floods.

A total of seven council officials were interviewed for this thesis, two each in Emerald, Benalla, and Dora Creek, and one in Brisbane. In Brisbane, only one representative for the local area studied was interviewed due to time limitations. Interviews were set up by phone or email beforehand, and all interviews were recorded. The recordings were then transcribed and the responses compared across locations, identifying similarities and differences in the responses of different council representatives.

State Emergency Services

The State Emergency Services (SES) were created following major disaster events to coordinate response to disasters. The floods of the mid-1950s prompted the establishment of the New South Wales State Emergency Service as the first dedicated natural disaster response organisation in Australia (Keys, 2006). Following the floods of 1955, a central body

to coordinate response to disasters was proposed as a necessary outcome (Hawke, 1958). The SES were preceded by civil defence agencies started during World War 2 for preparedness for responding to potential attacks (Britton and Wettenhall, 1990). By the mid-1970s, all states and territories had established an emergency services organisation, with the New South Wales and Queensland ones having legislated responsibilities (Townsend, 1979). As such, the SES are important players in flood risk management with clearly defined roles.

While their initial focus was on emergency response, their responsibilities were expanded to include preparedness and community education (ACSES, 2012). The SES often run community awareness campaigns about flood preparedness and safety. The most prominent role of the SES is in event response during floods and storms, performing evacuations, sandbagging, rescues, and other actions. The SES is largely a volunteer organisation, with few employed workers. Underneath its state structure, there are large regions and then smaller, local units who do the response for their area. The SES is therefore dependent on the time availability of its members for all their activities.

For this project, three SES representatives were interviewed. The SES has a three tiered structure, with local units within regions operating under a state leadership. For this research, representatives of local units were interviewed as they have direct involvement with their local communities. The SES in Brisbane was approached for interview, but declined due to the ongoing flood inquiry, instead pointing to their submission to the Queensland Flood Commission of Inquiry as their response. SES representatives were asked about their role in communicating about flood risk to residents, as well as what role they felt council and the insurance industry should play in informing people about flood risk and preparing them for flood. They were also asked about what responsibility they felt residents had to inform and prepare themselves for flood. The full list of questions asked can be found in appendix B.

The insurance industry

Flood insurance has been largely unavailable throughout much of Australia's history. Calls for some form of governmental insurance fund have been made multiple times, as noted above, with the most detailed investigation occurring during the 1970s (Treasury, 1976). Insurance has not historically been available due to lack of information to accurately price flood risk. As insurance has become increasingly available, it is able to be a key stakeholder in addressing flood risk.

This project's initial proposal had a central focus on insurance, as improvements in the quality of flood information have allowed flood insurance to be more accurately priced and

made more widely available, and was to look at the implications of that more accurate pricing and wider usage on responsibility and the cost of flood. With the occurrence of the 2010-2011 floods, the involvement of the insurance industry has continued but has shifted focus. Insurers were asked a narrower list of questions than either council or SES, with their question list being refined in response to the answers given in the council and SES interviews, as well as the questionnaire given to residents. Insurance representatives were asked whether they viewed their role as risk quantification or risk reduction, what responsibilities they felt councils, SES, and individual residents had in being aware of and preparing for flood, as well as what lessons they felt needed to be learnt following the 2010-2011 flooding. A copy of the questions asked of insurance representatives can be found in appendix B.

The insurance industry is represented in this thesis by one respondent each for three parts of the industry: one insurer, one reinsurer, and the Insurance Council of Australia. An insurance company representative was interviewed to get the perspective of a company that provides policies to individuals, while the Insurance Council of Australia, the body that represents most of the insurance industry in Australia in discussions with governments and the public. Reinsurers act as the insurers of insurance companies, and were selected as a participant as their financing decisions affect what premiums insurance companies can offer. This allows a representation of the different players in the insurance industry. This is a small number of participants and so cannot be taken as indicative of the entire industry, but it does provide an insight into issues that all three sections of the insurance industry are concerned with.

Residents

Floods become a hazard when they affect people. Residents experience the direct impacts of flood and need to know the risk and be able to prepare for it. Questionnaires were used to recruit the widest range of resident participants. This allowed more people to participate than would have participated in interviews. Using a questionnaire also allowed a narrower and more controlled focus than interviews.

Residents were chosen as a stakeholder as they are the ones who ultimately deal with floods. In order to best manage floods, the preparedness of residents is paramount. It is necessary to not just state that residents are an important player in the shared responsibility of flood risk management, it is necessary to know what they think about flood risk, what they think about other stakeholders, and what things may limit their preparedness. While many agreements, inquiries, and government documents talk about residents as the recipients of preparedness information and plans (Queensland Floods Commission of Inquiry, 2011,

Comrie, 2011), less attention is paid to how to get them involved and make them active participants in their own flood preparedness.

Residents' preparedness and socioeconomics were identified as key elements that can affect their ability to prepare for and respond to flood (Cannon, 2008, Adger, 2006, Cutter, 1996). The initial project focused particularly on flood insurance, and those questions have remained in the thesis. Questions on awareness and information sources have been included as individual's ability to act on their risk requires that they be aware of the potential for a flood.

1.3.3. The case studies

Case studies were used to look at how the various stakeholders view their risk and each other in practice. A list of potential case studies was collated, with the aim of selecting different case studies to reflect a range of sizes and flood histories. Following the 2010-2011 floods, case study selection explicitly included both locations flooded during that time period and locations that had not experienced recent flooding. The shortlist included a number of flooded towns in Queensland and Victoria, the two states worst affected by the floods. Some possible case studies were removed from the list because of cost or difficulty in accessing them for fieldwork – such as locations in Western Australia that would be expensive to get to. I wanted case studies in multiple states to see whether the different policy approaches in the different states had an impact on their preparedness. I decided to focus on the three eastern mainland states as they have most of the properties at risk of flood in Australia (Leigh, 2005). The four completed case studies are Brisbane and Emerald in Queensland, Benalla in Victoria, and Dora Creek in New South Wales (Figure 4).

The two Queensland case studies were completed in collaboration with a National Climate Change Adaptation Research Facility (NCCARF) funded investigation into the impacts of the 2010-2011 floods and adaptation strategies for residents. NCCARF is a government-funded research body at Griffith University which promotes research into the likely impacts of climate change in Australia. This project investigated the experience of the 2010-2011 floods in three locations, in Queensland and Victoria, looking at the impacts of the flood, individual's awareness and preparedness, and what factors affected their ability to prepare (Bird et al., 2013). A shortlist of potential case studies for my own research included the two Queensland locations selected for the NCCARF study. Brisbane being a capital city, and the first severe flood in a capital city in a generation, was a clear choice for a case study. The design of the questionnaire was undertaken with researchers from Risk Frontiers at Macquarie University and the Centre for Disaster Studies at James Cook University.

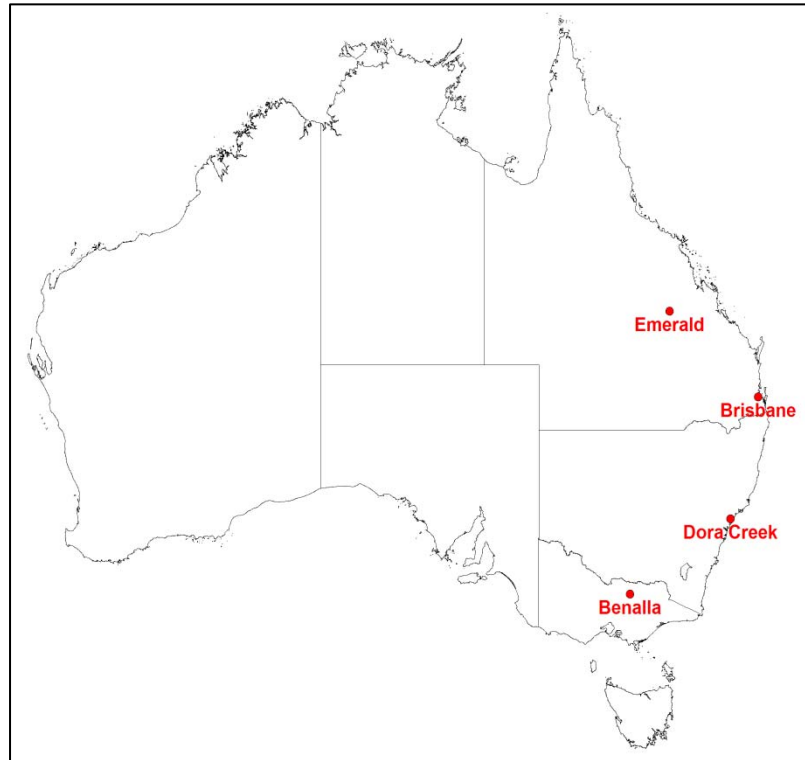


Figure 4. The four case study locations. Source: author

Brisbane is the capital city of Queensland and Australia's third most populous city. Brisbane and the wider south-eastern Queensland region is one of the fastest growing in Australia. The city is subtropical, and frequently experiences heavy rainfall in the summer which can lead to flooding (Brisbane City Council, 2013). As outlined above, the city has experienced numerous floods throughout its history, with the worst floods occurring in the 19th century. The case study area for this thesis was four suburbs: Chelmer, Graceville, Tennyson, and Rocklea, which were among the worst-hit areas of Brisbane. The four suburbs in this case study are located on the southern shore of the Brisbane River, southwest of Brisbane City (Figure 5). The survey area is also bisected by Oxley Creek, which flows into Brisbane River with its mouth facing upstream. The suburbs are of varying socioeconomic status, with Rocklea a working class suburb, while Chelmer is a more affluent riverside suburb. The suburbs of Rocklea and Tennyson are also affected by backflow flooding from Oxley Creek, as water from the Brisbane River either goes up the creek increasing the flood height or prevents water from leaving Oxley Creek, keeping water levels higher for longer. Some parts of Rocklea experience nuisance flooding from Oxley Creek and its tributary, Moolabin Creek, during heavy rain.



Figure 5. Map of Brisbane case study location and 2011 flood extent. Brisbane city is located to the north-east, beyond the top right corner of this map. Map produced by Keping Chen.

The town of Emerald is a fast-growing centre of the mining industry (Regional Australia Institute, 2013). It is an area with a transient population of short-term mining and agriculture

workers, so many residents are unfamiliar with the region. Emerald is the most affluent of the four locations, but the increase in mining in the region has also led to increasing house prices (Australian Bureau of Statistics, 2013c). The Nogoa River, which forms part of the Fitzroy River catchment, runs through the eastern side of the town. The town is located on both sides of the river, but the majority of the town is on the western side of the river. More flooding occurs on the western side of the river, which is lower than the eastern side. Emerald has an arid tropical climate, receiving more rainfall during the summer months than winter. It has had fewer major floods than the other case studies, but has had 5 severe floods since 1918, including the two recent floods in January 2008 and December 2010 (C&R

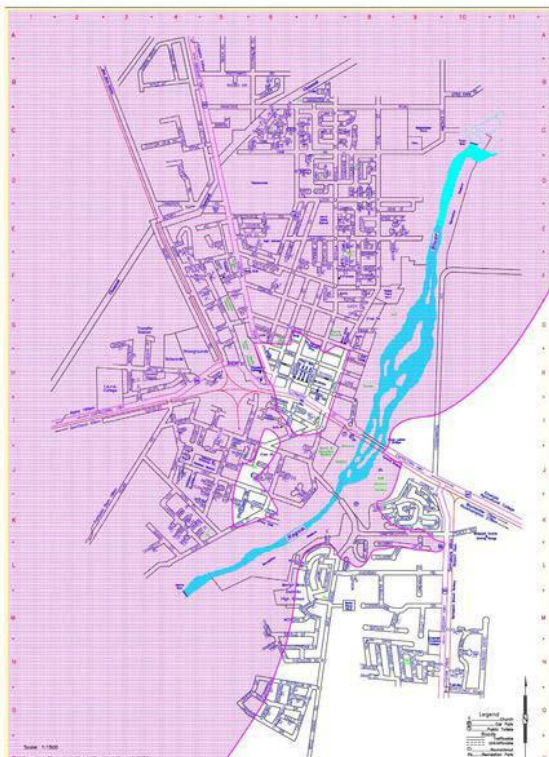


Figure 6. Map produced by Central Highlands Regional Council showing the predicted extent of the December 2010 flood in Emerald

Consulting, 2011). Figure 6 shows the extent of the 2010 flood. The Central Highlands Regional Council also developed an SMS alert system following the 2008 flood which was used to inform residents about the 2010 flood (Regional Australia Institute, 2013).

Benalla is the poorest of the four case study locations. It is a rural centre with a fairly stable population. Benalla is located on the Broken River in central Victoria, and is part of the Murray-Darling catchment. The river runs through the centre of the town, and water spreads out on both sides of the river during floods (Figure 7). In research conducted by Risk Frontiers in 2005 for the Insurance Council of Australia, it was rated as the location with the tenth-highest number of properties prone to inundation during a 1 in 100 year flood, with more than 3,000 properties at risk (Leigh, 2005). In a town with a population of just over 9,000 (Australian Bureau of Statistics, 2013a), this represents a significant proportion of the town. Benalla's last major flood, its largest flood in recorded history, occurred in October 1993. It was larger than previous predictions of a 1 in 100 flood, but studies undertaken following the 1993 flood recalculated the size of a 1 in 100 flood and concluded that the 1993 flood was a 100 year flood (Delatite Shire Council, 2002). Benalla also houses the regional offices of the SES for north-eastern Victoria, and was the location for a trial 'FloodSmart' education and information campaign in 2007 (Victoria State Emergency Service, 2008). The council also distributes a welcome kit to new residents which includes information about flooding in the town. As a result, Benalla residents have many resources to inform them about their flood risk.

Dora Creek is the smallest of the four case studies, with a population of only 1,600 at the time of the 2011 census (Australian Bureau of Statistics, 2013b). It is a small and geographically limited location, with the Creek through the centre of the town and low-lying swampy marshlands to the north and south of the town. Lake Macquarie itself is located to the east of the town, and water height in the lake can have an effect on flood heights in Dora Creek. Dora Creek was originally established as a logging community, as the Creek gave easy access to useful woodlands. I selected Dora Creek as one of my case studies due to its different flood onset time and its detailed flood information and flood

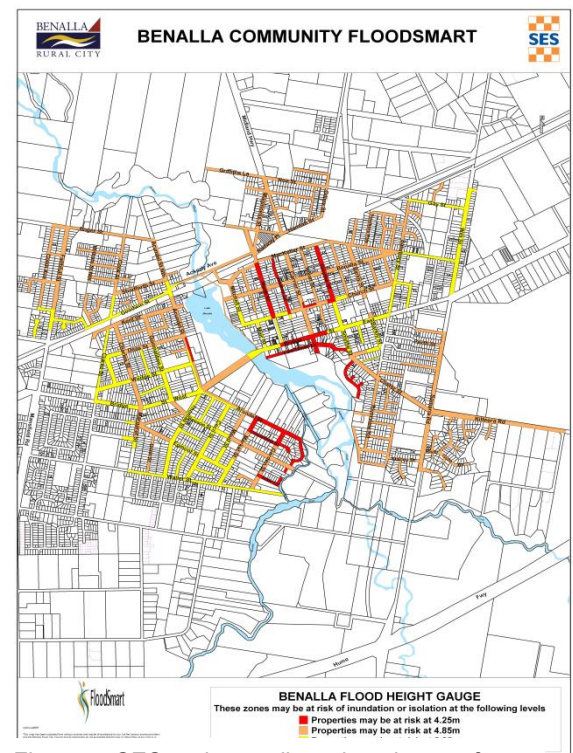


Figure 7. SES and council-produced map of flood-prone streets in Benalla

programs from Lake Macquarie Council. Dora Creek experiences flash flooding with little warning time. The last flood in Dora Creek occurred in 2007 on the Queen's Birthday long weekend, 9-11 June (Jones, 2013). None of the floods that have been recorded in Dora Creek have been as large as a 1 in 100 flood, so the town has not experienced any particularly severe floods.

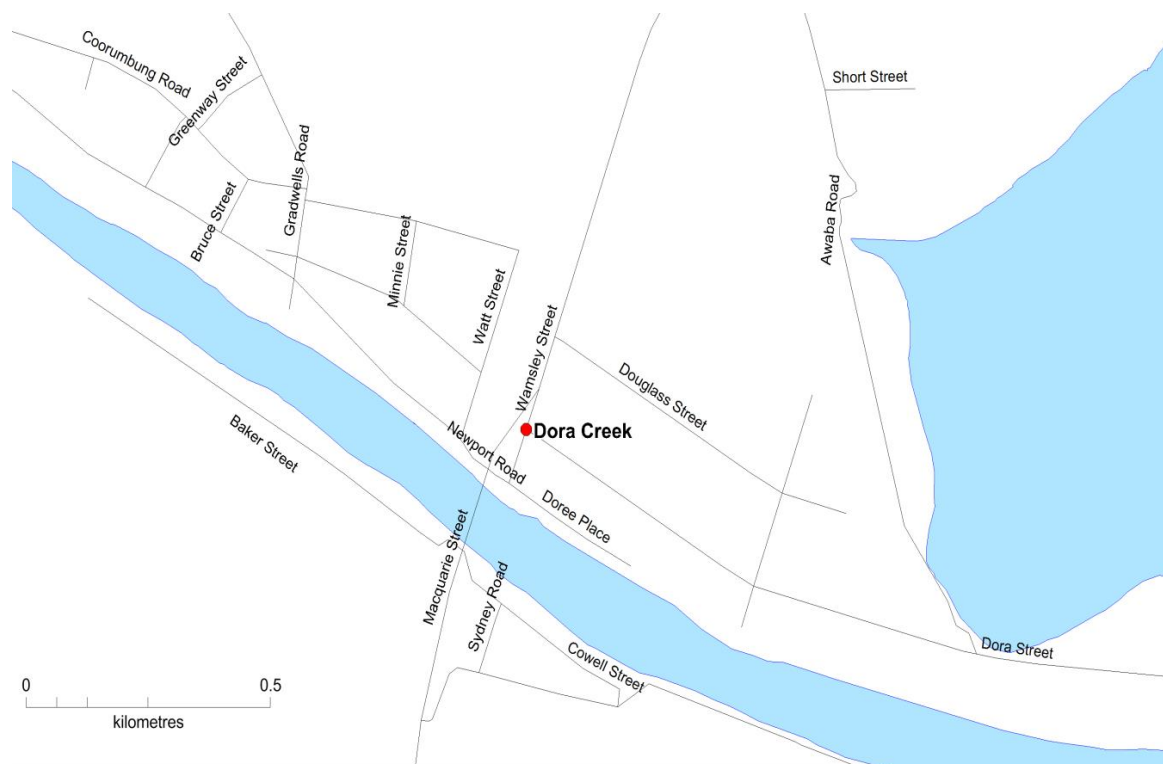


Figure 8. Dora Creek township. Map created by Keping Chen

1.3.4. Methodological limitations

There are a number of limitations to the methodological approach adopted for this thesis. The number of stakeholder groups included in this thesis is limited. While including a larger number of stakeholders would increase the breadth of this thesis, it would have limited the depth of investigation. Limiting the number of stakeholders allowed a more detailed focus to be paid to the selected stakeholders. In particular, only one of the three levels of government in Australia has been included in this study. Federal and state governments were not included. While the federal government is not directly involved in flood planning and management, they are involved in disaster response and with national policies such as the National Strategy for Disaster Resilience. Excluding the federal government from discussion limits the discussion of policy frameworks, and limits the ability to compare Australia to other countries. Excluding the federal and state governments in order to focus on the 'applied' case study side of floods means the state and federal frameworks are only briefly discussed. Only addressing one of three levels of government also limits the capacity to explore the

strengths or weaknesses of a three-tiered system in any detail. Finally, while comparisons are made between case studies in different states, excluding state governments as a stakeholder limits the detail of comparison.

The approach used for recruiting resident participants also had limitations. The participants were limited to those home when I doorknocked, and so may not be a representative sample of the area. The questionnaire did not ask about housing status, so no comparisons can be made between renters, owner-occupiers, and those with mortgages. Language, ethnicity, and education data was also not collected, so a number of potential sources of vulnerability are not addressed in this thesis.

The number of participants from both the SES and the insurance industry was small. This means no conclusive comments about the positions of these two stakeholder groups can be made. The questions asked of these two stakeholders were also limited in scope, so the results presented are not exhaustive discussions of the roles and responsibilities of these two stakeholders vis-a-vis and flood risk management. All SES representatives interviewed were from local units, with no interviewees from senior levels, so the perspectives presented are not necessarily those of the state-level organisation. For the insurance industry, single representatives from three sections of the industry are presented but again, these do not represent the positions of the entire industry.

This thesis only covers four case studies. By covering four case studies, it does not go into as much detail as focusing on one location would, nor does it consider a wide diversity of locations. Climate change and coastal flooding have been specifically excluded. It is also important to note that councils may have flood information that was not available on their websites, so the assessment of information availability presented in chapter 3 is only of online information, not of all flood information for a particular council. The analysis of the quality and accessibility was also subjective, and those with literacy issues, who are unfamiliar with or lack access to the internet, or who speak a language other than English may have difficulty in accessing or understanding online information. Turner (1979) also noted that people may misunderstand or dismiss information – information is only as valuable as it is understood and enacted.

1.4. Thesis structure

Figure 9 outlines the key themes of the research and which chapters they are included in. The literature review is presented in chapter 2, and chapters 3-6 cover the research. The right-hand column presents overlapping boxes of which chapters address which research

questions. Chapter 3's discussion of flood information availability broadly addresses research question 1, *what gaps exist in flood risk management in Australia?*, specifically looking at gaps in information quality and availability. Chapter 4 focuses on question 1a, *how stakeholders perceive responsibility for flood management is shared?*, but this is also discussed in chapters 5 and 6. Question 1b, *what can be learnt from the 2010-2011 floods?*, is covered in chapters 4 to 6 through asking the various stakeholders their thoughts on the floods. Finally, chapters 5 and 6 address question 2 on *the impact of socioeconomic and risk perception factors on resident's preparedness for flood*.

As this is a thesis by publication, these four chapters were produced as journal papers. Two papers – chapters 3 and 4 – have already been published, while chapters 5 and 6 have been submitted to journals. I was the lead author on three papers, and the sole author on one. Table 2 outlines my contribution to four components of researching and writing each paper. The Queensland fieldwork was completed as part of the NCCARF-funded research project outlined in section 1.3.3. and the contributions of other participants account for 20-25% of the research undertaken for papers 2-4 (chapters 4-6), as well as 25% of the data analysis for the Brisbane chapter.

	Research	Analysis	Writing	Overall
Paper 1	100%	100%	70%	90%
Paper 2	80%	100%	75%	85%
Paper 3	75%	75%	75%	75%
Paper 4	80%	100%	85%	90%

Table 2. Candidate's contribution to each paper

The first research chapter, chapter 3, discusses information availability from local councils. This paper provides context for the following chapters, by providing an overview of the breadth of flood risk in Australia and the variability in available information. Flood information is also necessary to inform residents of their flood risk and to enable their involvement in their own flood risk management. Flood information is also necessary for insurers to determine premiums, and for both councils and the SES to prepare for and respond to floods. Chapter 4 then moves on to the perceptions each stakeholder has of their own and each others' roles and responsibilities, before chapters 5 and 6 present the case studies themselves, and see if residents' answers match the expectations of the institutional stakeholders.

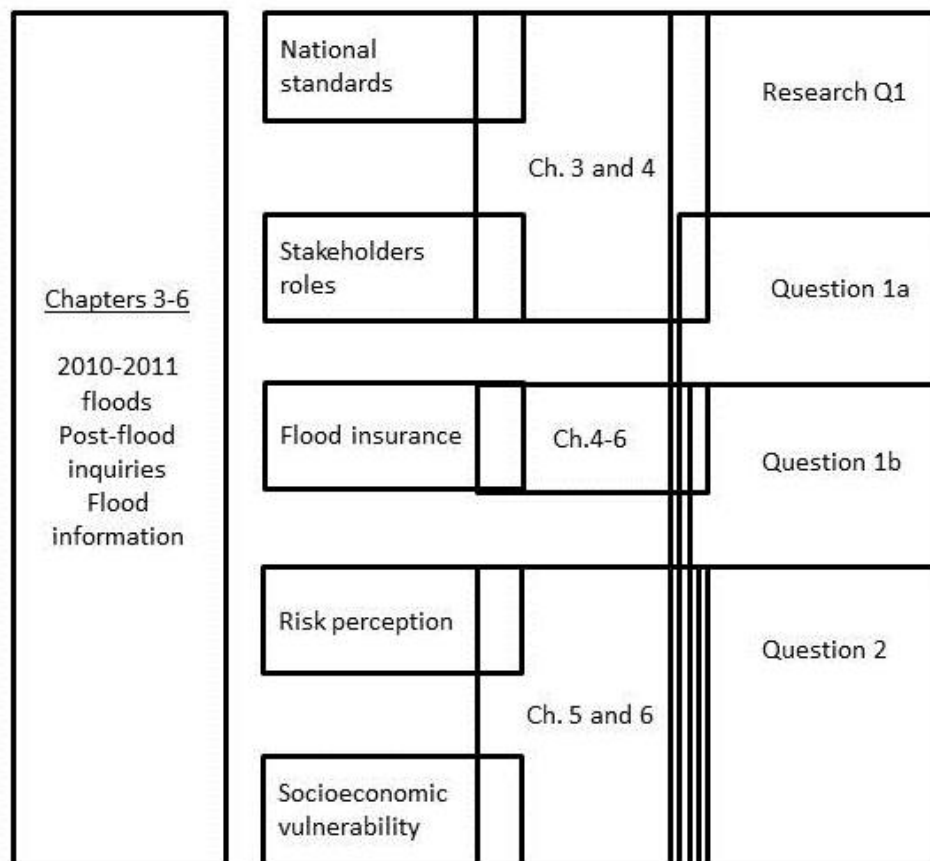


Figure 9: Conceptual diagram of key themes by chapter

Chapter 2 is the literature review. It contains 4 main sections. The first section presents an introduction to key concepts in flood risk management. The second section reviews the importance of flood information, as well as the role of socioeconomics and risk perception in influencing residents' preparedness. The third section looks at issues of cost and insurance, before the final section focuses specifically on Australia, and on discussions and inquiries that have followed major events.

Chapter 3 is the first paper, "How can residents know their flood risk? A review of online flood information availability in Australia". This paper was published in *Australian Planner*, Volume 49, Number 4 (December 2012). This paper is relevant to the planning community as flood risk management decisions involve land use discussions, and flood information informs the decisions of both planners and the public. It examines flood information availability from all local council websites across Australia. It presents the results of a website survey conducted between July and September 2010, which assessed what information about flood risk is available from council websites. Additional analysis of flood-affected locations was conducted after the extensive flooding of the 2010-2011 summer. For responsibility for flood to include residents, it is crucial that information is available, accessible, and understandable

for them to inform themselves about their risk. Accessibility was assessed by considering how easy relevant information was to find, and whether the most relevant results were the top search results, while quality and understandability were assessed by looking at the detail and clarity of information. For example, highly detailed flood risk maps on the second page of results for a search of the term 'flood' may have high quality but moderate or low accessibility, while a map that is the top search result but has only major roads marked is accessible, but of poor quality. The research found variability within and between states in terms of what sort of flood information was available. New South Wales and Queensland had the best availability and quality of information available, while Western Australian councils largely had little.

Chapter 4 is the second paper, "Flood Risk in Australia: Whose Responsibility is it, Anyway?" This paper was published in *Water*, Volume 5, in October 2013, in the special issue Flood Estimation and Analysis in a Variable and Changing Environment. It examines the perceptions of the four key stakeholders on their own and each others' roles and responsibilities in flood risk management in Australia. It includes data from interviews with council representatives, State Emergency Service representatives, and insurance industry representatives, as well as survey responses and comments from residents in the four case study locations. This paper looks at the perspectives these stakeholders hold of each others' roles in flood risk management. As the media coverage and subsequent inquiries following the 2010-2011 floods showed, there was a lot of confusion about the responsibilities of different stakeholders. However, these inquiries often lacked detailed reference to the responsibilities of residents. This paper shows that, despite seeming general agreement on the importance of flood risk management and the importance of cooperation and collaboration between the various stakeholders, it is not necessarily successful in practice. In particular, residents do not seem to have the same concept of their own responsibility as the other three stakeholders held. While the council, SES, and insurance representatives all emphasised the importance of residents being proactive in preparing for and informing themselves about flood, residents responses showed they largely view flood preparedness as the responsibility of the other stakeholders. This paper also points out that these different ideas about the roles and responsibilities around flood risk management can act as a hindrance to shared responsibility in flood risk management.

Chapter 5 is the third paper, "Shared Responsibility and Social Vulnerability in the 2011 Brisbane Flood". This paper was submitted to *Natural Hazards* in June 2013 and is currently under review. It presents a detailed case study of four of the worst-affected suburbs of Brisbane's January 2011 flood, using data collected with questionnaires. This paper is based on work that was part of an NCCARF-funded project into the 2010-2011 floods. This paper

focuses only on Brisbane because it shows some of the variation in awareness and preparedness even within one location, and because Brisbane was the most notable flood of the 2010-2011 summer. It was the first major flooding of a capital city in almost four decades. While Brisbane residents indicated a high level of flood awareness, with almost 75% answering that they were aware of the risk of flood when they moved to their current address, many residents were unprepared for the flood, with one third of respondents discovering their insurance was inadequate and did not cover them for flood. Residents were highly critical of government and emergency services, and were uncertain what actions they could take to take to protect themselves from flood, although they were positive about how the local community had responded and assisted itself in the flood's aftermath. This suggests that, while there was a lack of knowledge of how to be involved in their own flood preparedness, individuals are willing to share in preparedness and response if they know what to do.

Chapter 6 is the final paper, "Residents' attitudes to flood hazards in three Australian communities: The role of socio-economic factors and risk perception in household preparedness". This paper was submitted to *Disasters* in November 2013 and is currently under review. It compares three locations at risk of flood: Emerald in Queensland, Dora Creek in New South Wales, and Benalla in Victoria. It examines residents' attitudes towards flood risk, information, and insurance, and looks to see what influence socioeconomic or perception factors have on residents' preparedness, as well as how local community particularities, such as Emerald's high population turnover, influence residents' concern about and preparation for flood. This paper looks at three locations with a varied length of time since their last flood to see if experience and/or time influences residents' responses. It finds that socioeconomic factors such as gender and income have the least influence on individual's responses and preparedness, and localised differences are most important in directing residents' responses. Responses in Emerald in particular were affected by the fact many residents move to the area for employment and are unfamiliar with the risk of flood and with what flood preparedness actions they can take.

Chapter 7 is the conclusion and presents the key findings of this thesis and future gaps to be filled. It reiterates that shared responsibility is an important concept, but one that has not been clearly defined in practical terms. In particular, how to involve residents in proactive flood risk mitigation through personal awareness, insurance, and preparedness has not been discussed enough in Australia. The conclusion also promotes uniform national standards for flood risk management and flood information.

The final section is the Appendices. This section contains copies of the questionnaires used in each location, a sample consent form for the interviews with council, SES, and insurance representatives, and a short article I wrote that was published in the Macquarie University alumni magazine, Quest, on the summer 2010-2011 floods and issues arising from it.

Chapter 2. Flood risk management – a review of key approaches

2.1. Introduction

This chapter presents key literature used to shape the concepts of shared responsibility and flood risk management addressed in this thesis. It begins with an examination of key approaches in flood risk management and the roles of different stakeholders. It next looks at the role of information and various factors in either increasing individual's vulnerability or ability to prepare. Thirdly, it discusses the cost of natural hazards and approaches to paying for risk, and particularly the role of insurance. Finally, it provides the Australian context for this thesis, discussing how flood risk management has evolved in response to major flood events in Australia up to the present day. It highlights key discussions around flood risk management, looking at both factors that affect individual preparedness as well as theories and approaches of the other stakeholders.

2.1.1. Early approaches to flood

Flood risk management is the management of human activities and responses to land prone to flood (CSIRO, 2000). While floods can cause significant damage, floodplains are also useful for society for settlement and work (Burton et al., 1968, Leivesley, 1984). Floods are a concern due to their impact on human activities (Burton and Kates, 1963, Carr, 1932, Turner, 1979, White et al., 2001, Handmer, 2008). They are, as Quarantelli (1998) puts it, a social phenomenon, and the role of flood risk management is to minimise the impacts of flood events on human activity.

As humans make use of flood prone areas for settlement and economic activity, the flood risk needs to be mitigated. Mitigation is defined by Carter as “measures aimed at reducing the impact of a natural or man-made disaster on a nation or community” (Carter, 1991), while Mileti describes it as “policies and activities that will reduce an area's vulnerability to damage from future disasters” (Mileti, 1999). As a concept, mitigation recognises that while risk cannot be removed, certain actions can reduce it. Mitigation options can be divided into three categories: flood modification, property modification, and response modification (Bureau of Transport and Regional Economics, 2002). Early flood management focused on flood

modification, and involved attempts to control the river through dams and levees so that land could be used for settlements and agriculture (Plate, 2002, Quarantelli, 1998). Structural measures are the traditional flood modification approach, attempting to impede or control the movement of flood water, property modification involves development controls and modified building approaches, and response modification involves education, warnings, and planning to change the behaviours of residents.

How natural hazards are conceived has also shifted. Where hazard events were once seen as acts of God/Nature with people subject to nature, structural measures created a framework of man over nature (Burton and Kates, 1963, Britton, 2001). Shifts in the conception of natural hazards were important in the development of flood risk management. Quarantelli (1998) discusses the shift from perceiving disasters as Acts of God or Nature to Acts of Man, citing the damage caused by the Lisbon earthquake of 1755 as being due not only to the earthquake itself but also to the poor building construction – human activity was a direct contributor to the resultant damage.

Yet even when the processes were viewed as uncontrollable acts of Nature, there was a developing recognition that, while humans could not control the hazard itself, they are able to use the knowledge of where events occur and take precautions. This can be seen in the edict issued by Governor Macquarie following the 1817 flood at Windsor mentioned in chapter 1, where he reprimanded residents for living in known flood areas “as if putting at defiance that impetuous Element which it is not for Man to contend with” (Macquarie, 1817). Macquarie recognises that while floods are uncontrollable – and, at the time, little understood, especially as the colony was only a few decades old – the actions and decisions of people determine the impact those floods will have. Macquarie’s comments advocate disaster mitigation, recognising that the hazard itself cannot be prevented, but actions that increase or decrease the risks to and likely impacts on individuals and communities can. A large-scale shift towards disaster mitigation in many countries has been driven by a similar recognition, that governments responding to events is more costly than acting to prevent those events having such an impact (Quarantelli, 1998).

Structural measures can only provide protection to their designed level (Green, 2010). Overreliance on structural measures is problematic given the potential for events larger than the structure was designed for. As mentioned in the introduction, the town of Nyngan, Australia, experienced an ARI 200-250 year flood in 1990, which, despite preparation and attempts to hastily increase the height of the levee, resulted in the town’s 2,500 residents being evacuated when it became clear the levee would be breached (Keys and Campbell, 1991). As a response to the flood the height of the levee was increased for future events

(Wills, 1996). While the flood event at Nyngan was extreme, the confidence placed in the levee was common. Similarly, in Brisbane, many residents had assumed the Wivenhoe Dam had made their location 'flood proof'. The same misperception had been found following the 1974 flood about the Somerset Dam, constructed in the 1940s (Grigg, 1977). One study undertaken in the Maitland and Singleton areas 25 years after their 1955 floods found many residents now thought they were protected from future floods by levees. It also asked about preferred ways to reduce the risk of flood: 90% of responses concerned engineering works (Payne and Pigram, 1981). The existence of structural protections, and the lack of notable flooding over an extended period of time, had lead people to believe the flood risk had been removed.

Extreme floods can and do occur. As Bewsher (2003) puts it, rare floods are common – listing seven events larger than a 1 in 100 flood that occurred in Australia between 1975 and 1998, including two rainfall events that exceeded the previously-understood probable maximum event. Of the 2010-2011 floods, the storm that caused flooding in Toowoomba and the Lockyer Valley had rainfalls of up to 1 in 370 years (ABC News, 2011a). A number of floods in Victoria had frequencies of close to 1 in 200 years (Bureau of Meteorology, 2011e). The 1867 flood at Windsor, north-west of Sydney, has been estimated as between a 1 in 250 and 1 in 400 year event (Ribbons, 1995, Keys, 1995).

Structural measures can have the result of encouraging people into flood prone areas (Dacy and Kunreuther, 1969, Burby et al., 1985). In other words, 'successful' mitigation can result in a higher number of people with a lower level of preparedness living in areas prone to flood (Lustig and Maher, 1997). This is known as the 'levee effect' (Tobin, 1995), and is a result of excessive confidence being placed in dams and levees, where dams and levees are believed to have 'removed' the risk of flood (Burton and Kates, 1963, Burton et al., 1968). Kates (1976) found that, while fatalities were reduced, the cost of damage continued to increase despite the use of structural protections. These are related to what Burby (2006) describes as two further paradoxes: the safe development paradox, where policies such as structural protections and financial compensation make a flood prone location attractive; and the local government paradox, where officials pay insufficient attention to the risks by allowing development in hazardous areas, prioritising the economic benefits of development over the hazard risks. Examining Hurricane Katrina, he suggests that significant impacts were due to these two factors, and proposes mandatory local hazard and response plans. Balancing the interests local governments often have in growth with flood risk management often leads to hazard management losing out to development interests (Handmer, 2008). At times, developments rejected due to their location on flood-prone land have successfully challenged those restrictions, overriding existing planning laws (Bureau of Transport and Regional

Economics, 2002). Given the impossibility of building and maintaining structural measures that would be able to withstand all floods, researchers now advocate a strategy of designing for failure, with clear limits of capacity and mechanisms to safely relieve that once it is exceeded (Green, 2010).

Following flood events, residents are often in favour of structural flood protection measures (King and Goudie, 1997), and similar results were found in this research and are presented in chapters 5 and 6. Following the 2010-2011 floods, the then-opposition called for the building of more dams in Queensland, arguing that a lack of dams had exacerbated the floods (Joyce, 2011). This is an example of belief in the ability of structural measures to remove flood risk. Structural measures can be used to provide a level of protection to existing communities where there are limited mitigation options (Emergency Management Australia, 1999b). Structural measures can reduce the frequency of inundation from smaller events, reducing the cost of recurrent damage. One example is the town of Grafton, in northern New South Wales, noted in the introduction for the high number of floods it has experienced, which has seen a reduction in the damage caused by floods since the construction of a levee in 1970 (Bureau of Transport and Regional Economics, 2002). The towns of Roma and Emerald in Queensland experienced repeated inundation in the years 2008 to 2012. Both towns are unprotected by levees. The recurrent losses resulted in the state's largest insurer refusing to offer flood insurance in either town until they began flood mitigation. Emerald forms one of three case studies examined in chapter 6; it should be noted that the decision to withdraw insurance from Emerald was made after data collection for this thesis was completed, although the possibility had been raised. Both towns have since developed plans for levee works, and new insurance policies began being issued in Emerald in February 2013 (insurancenews.com.au, 2013a), and Roma in September 2013 (Insurancenews.com.au, 2013b).

2.1.2. Land use planning and 'soft' approaches to flood risk management

Moves away from structural responses to land use planning and other 'soft' measures increased in the 20th century. Research by Gilbert White identified the high cost of flood protections (White, 1936) and promoted land use planning and even removal of some activities from the flood plain as more efficient responses to flood risk (White, 1937). This broader approach to flood risk management recognised that rivers are not static systems, and flood risk management is a process, rather than a single action (Green, 2010, Plate, 2002), and structural measures can increase risk by increasing the number of people exposed to an extreme flood or shifting the flood risk to other locations up or downstream (Mileti, 1999, Plate, 2002). Johnson et al. (2005) discuss flood events and policy changes in

England and Wales, with a move from a utilitarian view favouring flood defence and interference, to flood risk management and humanity and the environment in commonality. Large-scale flood events reveal weaknesses in existing approaches, providing an opportunity for new approaches to be implemented. In particular, the failure of structural measures to protect against the floods of 1998 and 2000 led to a greater emphasis on warnings, education, and land use planning.

Zoning and land use planning are key alternatives to structural responses to flood. Zoning involves placing restrictions on the allowable uses of different plans – in this case, land prone to flooding (Bertholf, 1971). Where structural measures can create a false sense of security, planning and zoning laws have greater potential for education and engagement with the community (Burby and Dalton, 1994). The need for consistent state and federal planning frameworks was also noted by Mileti (1999). A lack of consistent state controls was found to result in Texas having less flood mitigation than Florida, with a state hazard planning standard (Brody et al., 2010). While at a state level Florida performed better than Texas, other research found that simply having state controls was not an indicator of whether development in hurricane-prone areas declined: the areas that did direct development away from identified hazard zones had local governments that were already proactive before the introduction of the state mandate (Deyle et al., 2008).

Floodplain management in Australia varies by state, with planning decisions made at the local government level under state legislation (Doyle and Kellow, 1995, Smith and Handmer, 2002). In more recent years, there has been a shift towards concepts of sustainable development and public engagement and consultation in planning decisions, as well as attempts to better include risk and hazard assessment in planning discussions (Emergency Management Australia, 2002). Emergency management decisions are also the jurisdiction of the states and territories, but also involve coordination of response in major catastrophes, financial and personnel assistance with the federal government for mitigation, emergency response, and rebuilding, as well as through agreements such as the Australian Emergency Management Arrangements (Attorney-General's Department, 2009) and the Natural Disaster Relief and Recovery Arrangements (NDRRA) (Australian Government, 2011), as well as the National Strategy for Disaster Resilience itself (Council of Australian Governments, 2011).

Under Australia's federal system, for the federal government to be involved in planning and emergency response requires the agreement of the state and territory governments. The provision of relief funding requires the relevant state or territory government to make a request first (Britton, 1986a). These measures are regulated by the NDRRA, which sets out what hazard events are eligible for assistance, how that assistance can be used, and how it

is applied for (Australian Government, 2011). Federal agencies are also involved in flood-related activities, with the Bureau of Meteorology monitoring river levels (Bureau of Meteorology, 2013a) and issuing flood warnings (Bureau of Meteorology, 2013c), with their responsibility for collection and dissemination of water information under the Water Act 2007 (Commonwealth of Australia, 2013b). The CSIRO and Geoscience Australia are involved in research and information (Britton, 1984), with Geoscience Australia providing basic flood information as well as a database of flood studies, coordinating the National Flood Risk Information Project, and producing flood reports (Geoscience Australia, 2013), and the CSIRO developing flood risk management guidelines (CSIRO, 2000). These organisations provide particularly valuable information about flood risk as well as mitigation and adaptation options.

In Australia, minimal use of land use planning was made in the first half of the 20th century, and with planning decisions and interest in flood regularly coming after major flood events (Smith and Handmer, 1984, Douglas, 1979). Smith and Handmer (1984) note that the New South Wales government, following severe flooding in the 1950s, encouraged local councils to use zoning laws to restrict the use of flood prone land, but a lack of funding and legal enforcement resulted in it being little utilised. While planning powers existed, the response to the 1950s floods was still predominantly one of building levees (Keys, 2006). Even up until the early 1990s, the majority of flood mitigation funding was spent on structural measures such as levees (Keys and Campbell, 1991). More recently, recognition that land use planning is a more cost-effective approach and limits the potential for future growth in flood costs has contributed to a greater emphasis on planning (Emergency Management Australia, 1999b, Bureau of Transport and Regional Economics, 2002), and integrating disaster mitigation into land use planning through the development of local flood plans and building and development standards and restrictions (Australian Government Department of Transport and Regional Services, 2002).

In addition to the increased use of land use planning is a growing recognition that, while there are general principles for approaches to flood risk management, the practical implications will vary in different locations, with one Bureau of Transport report highlighting case studies with a variety of approaches, from building levees and sealing roads to land use planning and voluntary purchase of houses in high-risk areas (Bureau of Transport and Regional Economics, 2002). While these are examples of successful approaches integrating local variation, others have been critical of a lack of consideration of larger floods, especially in locations such as the Hawkesbury-Nepean, where there is significant population living above the 1 in 100 flood zone, but within the boundaries of the 1867 flood (Gillespie et al., 2002). Bewsher (2003) give another Sydney example, the Georges River in the south-west

of the city, to highlight the differences in exposure between a 1 in 100 and a probable maximum flood (PMF) in terms of number of people liable to inundation and likely economic costs to argue that extreme floods need to be considered in land use planning, particularly in areas of high population. Most recently, reflecting on the 2010-2011 summer floods, Feddes (2011) suggested Australia should follow the Dutch example and use much higher planning standards, suggesting urban areas adopt at least a 1 in 1000 ARI.

Blong (2004) noted the existence of variation in the planning levels applied in different states, with Queensland in particular allowing development in areas of high risk. Queensland's approach has also been noted as historically decentralised, in contrast to New South Wales' more stringent and uniform policies, which have been more effective at reducing flood risk (Smith and Handmer, 2002). A review of New South Wales' planning system in 2011 included proposals for more closely integrating hazard risk and impacts into development assessments (Moore and Dyer, 2011).

Handmer (2008) lists three elements of risk management and who is involved with each in Australia: risk creation as due to private development and public planning laws; risk mitigation as local councils through planning laws, structural measures, and building controls; and residual risk, as government warnings and relief as well as insurance. The CSIRO outline four phases of flood plain management in Australia: structural works, planning, emergency management, and all-embracing planning, and note that structural works were the dominant approach until the 1970s (CSIRO, 2000).

Moves towards land use planning and risk management have also resulted in requirements for community involvement, largely through public consultation (New South Wales Government, 2005). While land planning is beneficial, a survey conducted by the Australian Local Government Association found some councils lacked the knowledge and resources to implement effective risk management planning themselves (Jenkins, 2006).

2.1.3. Stakeholders in flood risk management

Flood risk management is broader than the structural and land use planning decisions of governments, and relies on the cooperation and collaboration of other stakeholders. Responsibility for flood risk management has evolved from being solely the responsibility of government and is now divided among multiple stakeholders. This thesis covers four key stakeholders in flood risk management in Australia: local council, emergency services (the SES), the insurance industry, and residents. This is not an exhaustive list of stakeholders: also involved are catchment management authorities, state and federal governments,

businesses, the Bureau of Meteorology, and the wider community. Councils were selected as the one government stakeholder to include as flood and land use planning responsibilities lie overwhelmingly in their jurisdiction (New South Wales Government, 2005).

The shift towards the involvement of multiple stakeholders is a recognition that previous approaches which only used the knowledge of a single discipline – such as engineers for flood management – were inadequate (Brown et al., 1995). In particular, involving the community through consultation and education aims to increase their understanding and ownership of the risk and undertake their own preparedness (Burby et al., 2000, Pearce, 2003). Pielke Jr (1999) argues that the scale of flood events makes it difficult for local communities to manage flood issues alone, and that state and federal involvement is therefore necessary. While federal involvement in Australia is limited to mitigation and emergency relief funding, the CSIRO have advocated for integrated policy across all government levels (CSIRO, 2000).

Many emergency management and response organisations evolved out of civil defence bodies set up in the 1930s and 1940s (Britton, 1984, Quarantelli, 1998, Alexander, 2002, Mileti, 1999). These bodies, many started during WW2 as domestic preparedness agencies should an attack occur, began using their capabilities in responding to hazard events. As Alexander (2002) notes, evolving out of a military context, these organisations had a very procedural-technical focus to the exclusion of social and perception factors, and its focus on response rather than preparedness did not alter the risks or impacts of hazards. Dynes (1994) likewise critiqued the command and control approach and instead proposed three other C's: continuity, coordination, and cooperation, arguing that individual's behaviour in emergencies will follow the same routines as before, that decision-making needs to be done together with all involved stakeholders, and that communities and individuals need to be engaged in the process before, during, and after the event. Quarantelli (1998), who describes the emergence of fire services following the Great Fire of London as an early example of emergency agencies, notes that emergency response and research both emerged out of military interests and then grew due to a lack of military threats, leading civil defence agencies to shift to a natural hazards focus. Britton and Wettenhall (1990) describe the process in Australia, with Civil Defence groups originally begun during the 1930s, trained after World War 2 to prepare for potential air attacks that did not eventuate, and instead being called upon to respond to floods and other hazard events. The experience of multiple major hazard events between 1967 and 1974, starting with the Hobart bushfires and ending with Cyclone Tracy, solidified the shift to emergency service agencies (Gilmore, 1983). A number of eastern Australian coastal communities established local 'water brigades' as

informal rescue groups from the mid-19th century, but few were still in existence by the middle of the 20th century (Keys, 2006).

Civil defence and emergency response agencies gradually expanded their roles from event response. In Australia, where the formation of the country's first emergency agency, the State Emergency Service in New South Wales, was prompted by severe flooding in 1955, that role has expanded from emergency response to include education, training, warnings, and collaboration with local councils (ACSES, 2012). The 1989 State Emergency Service Act in New South Wales legislated the SES' expansion into flood preparedness in addition to its original role as a response organisation (Keys and Campbell, 1991). The majority of SES members are volunteers who assist in the event of a natural disaster (Britton, 1984). Between 1972 and 1981, all but two of Australia's states and territories introduced formal legislation setting out the roles of their emergency services (Britton, 1984). Tarrant (2006) provides an overview of the theoretical and practical evolution of emergency response in Australia, noting that moves from event response to hazard management have involved both a broadening of the role of emergency services and increased focus on public engagement and involvement, to expand emergency management beyond just the responsibility of response agencies to a broad community responsibility.

Stakeholder analysis looks at how to identify and involve all stakeholders in decision-making processes. Stakeholder analysis is particularly used in environmental disputes, and resource and land use discussions. Ramirez (1999) provides an overview of stakeholder management in environmental and natural resource contexts, and argues that effective decision-making relies upon common perceptions of each stakeholders' roles and responsibilities to ensure equal understanding on which discussion and collaboration can be built. Yet Quarantelli (1980), looking specifically at evacuation research, found many stakeholders have very different ideas of roles around emergency response, as well as a lack of cooperation and coordination with all involved groups. Rowe and Frewer (2000) argue that the different assumptions and perceptions held by different stakeholders is a key reason for public involvement in environmental discussions. Akter and Simonovic (2005) discuss stakeholder engagement in flood management and criticise a focus on economic valuations to the exclusion or downplaying of social and environmental considerations. Pearce (2003) discusses the need for community engagement and 'bottom up' approaches to be integrated into disaster planning, but also notes that traditional approaches of distributing information brochures and holding community meetings are not adequate to get significant community involvement. She also argues that, where consensus may be the aim for discussions of local resource use, they do not work for natural hazard discussions. Instead, mitigation and adaptation to the particular hazard are the needed end point and stakeholder and community

engagement needs to be more focused on involving all groups in knowledge of the hazard and of what options are available for mitigation and adaptation.

The view of individual residents and their role in flood risk management has shifted over time. While residents were once just the recipients of government planning, they are now active participants. Involvement of the community in managing an environmental or hazard issue can be undertaken in a number of ways. Brown et al. (1995) see two broad categories of formal and informal processes through which to include the public, including public votes, lobby groups, networks, and focus groups. Spyke (1998) suggests the public should have opportunities for involvement at three levels: at lawmaking, at policy implementation, and at the local level, and argues public involvement enhances community understanding and interest in the problem. Yet even with these approaches there can be limits to public involvement (Ramirez, 1999) and sometimes a lack of awareness of all stakeholders who should be involved, something Conacher (1980) notes in discussing resource management decisions that do not consider the views of recreational users of land.

Learned helplessness can result when there is no encouragement for residents to be active participants in their own preparedness and risk reduction. Recognising individuals as active rather than passive (Burningham et al., 2008) moves away from learned helplessness to encourage individuals to play a role in their own preparedness. A seemingly opposite idea that is prevalent in Australia and can have the same effect as learned helplessness is ideas of self-sufficiency and inevitability of hazard events, the idea that Australians are used to 'picking themselves up' after floods and fires; that natural hazards are a way of life in Australia, or, as one newspaper put it following the January 2011 flooding of Brisbane, 'the price of being Australian' (Huxley, 2011). The suburb of Depot Hill in Rockhampton is particularly flood prone, but their residents, known as 'swampers', see this as part of their identity and have little interest in moving (Andersen, 2011). Similarly, following the Black Saturday fires in Victoria in 2009, then-Prime Minister Kevin Rudd announced devastated towns would be rebuilt "brick by brick" (Nicholson and Rood, 2009), with no discussions about changes in building or land use in such risky locations.

Attitudes of residents towards different stakeholders have been examined by a number of researchers. In their analysis of the attitudes of four stakeholders – engineers, emergency planners/responders, the public, and researchers – in flood management, Green et al. (1991) found each stakeholder held differing views and expectations. The attitudes and ideas for risk response often vary between professionals and the public (Burton et al., 1968). McCarthy (2004), interviewing both residents and officials in two English case studies, found residents blamed officials for floods and expected them to remove the flood risk, while

research in Pennsylvania found residents saw flood risk management as a government responsibility and were often unaware of options they could undertake themselves (Lave and Lave, 1991). Yet other researchers found residents list themselves as having greater responsibility for self-protection than all three levels of government (Keogh et al., 2011). Terpstra and Gutteling (2008) investigated the expectations of responsibility of individuals and government for flood preparedness in the Netherlands and found that many residents had high expectations of governments to protect their properties, relying on the system of levees and dams long used in that country to prevent floods from affecting them. Soane et al. (2010) found that perceiving it as the government's role leads to individuals being less likely to take personal protection actions.

Looking at Australia, Britton (1986b) criticised what he saw as a lack of cooperation and integration between relevant agencies during the Ash Wednesday fires, which led to poor management and response. McLennan and Handmer (2012) discuss the heavy reliance of Australians on emergency services in response to natural hazards, and Dufty (2011) discusses the importance of community engagement, as opposed to information provision, so that individuals can make informed decisions. The interactions between councils and emergency services has been examined, with Keys et al. (2003) arguing the SES needs to be better engaged in council floodplain management discussions and decisions. The increasing reliance on emergency services to the detriment of personal preparedness stretches the SES' resources and reduces individual's personal preparedness (Gissing et al., 2010).

Community engagement has been an increasing element of hazard management discussions and decisions for the last three decades. One early work by Andrew Maskrey (1989) uses examples from Peru to argue for approaches to hazard and disaster mitigation that involve the affected community, rather than top-down governmental approaches. Maskrey argues that community members need to identify issues of concern to be brought to governments or other agencies. Looking predominantly at marginalised communities in developing countries, he focuses on the involvement of non-government organisation in implementing mitigation. One UN report on community-based disaster response describes it as a bottom-up approach working in collaboration with a top-down approach, where both formal and informal community groups work with government and other formal stakeholders (Pandey and Okazaki, 2005). The authors note that the local community has a particular interest in being involved in hazard discussions as they have the most to lose disasters, and, hence, the most to gain from mitigation. Others have suggested including representatives of particular vulnerable groups in discussions and design of mitigation programs (Comfort et al., 1999). Godschalk et al. (2003) see community stakeholders as not simply those who

respond to official plans, but as needing to be involved in decision-making and the implementation of mitigation plans. However, their review of five different case studies recognised the difficulty of achieving high interest and participation in mitigation discussions. They argue that one barrier to greater community involvement is the perception of mitigation as being technical and too complex for the general public.

Based on their level of organisation and formalisation, Dynes (1986) identifies four types of groups involved in disaster responses ranging, from established organisations with clear and pre-existing roles through to emergent groups that come into existence during disaster events. As with Maskrey, he critiques the traditional command and control approach to hazards, instead promoting continuity, coordination, and cooperation. With all three terms, he moves towards a problem-solving approach that can involve the wider community, rather than simply characterising them as victims of any particular hazard event. Finally, in describing disasters as social occurrences, he notes that any planning and response to such need to be approached from and with the involvement of the various social actors (Dynes, 1993). As with Comfort et al, he argues that the local community has a particular vested interest in hazard planning. While noting the positives of moves towards greater community engagement, there is still the potential for different understandings of those goals and differing ideas of how to achieve them (Rodríguez et al., 2006).

One key element of flood management is that of flood warnings. Heatherwick (1990) describes flood warnings as a three step process: monitoring of rainfall and river levels; the broadcasting of the warning itself once a predetermined trigger has been reached; and the response of the public to that warning. He also notes that warnings need to include information about both the expected impacts of a flood and advice on what responses individuals and communities should take. Warnings are more likely to be successful if they are specific, repeated by multiple sources and multiple times, and from official sources (Mileti and O'Brien, 1992). However, research shows the effectiveness of warnings is varied, and they are not a sufficient means to engage public preparedness (Penning-Rowsell et al., 2000). Individuals need to both believe the warning and personalise it as relevant to themselves, seeing it as something that will affect them (Mileti and Sorensen, 1990). Individual's perceptions of risk affect their likelihood to respond to warnings. Risk perception is expanded upon in section 2.2.3. below.

In recent years discussions in Australia have moved towards the concept of shared responsibility. The National Strategy for Disaster Resilience (NSDR) uses the Black Saturday Royal Commission's definition of shared responsibility as entailing increased but not necessarily equal responsibility for all stakeholders, including all levels of government,

individuals and communities, emergency services, and the private sector, and emphasises both the need for individuals to work on their personal preparedness and official agencies' responsibility to work to minimise risks (Council of Australian Governments, 2011, Teague et al., 2009). While the NSDR does discuss the importance of providing individuals and the community with flood risk information, it also emphasises the need for communities to seek out information, to be aware of vulnerable groups, to undertake property protection, and to seek out flood insurance (Council of Australian Governments, 2011). A further booklet was produced highlighting seven priorities for disaster resilience and including examples of programs and case studies, including communication guidelines, the National Flood Risk Information Project to develop a central location for flood information, and programs to encourage volunteering and encouraging individuals to have an emergency kit in case of emergency (Council of Australian Governments, 2012).

But the official inquiries held following the 2010-2011 floods did not include the same emphasis on residents' responsibilities: the Queensland Commission, in particular, instead focused on the public needing better warnings and easy access to good-quality flood information (Queensland Floods Commission of Inquiry, 2011). In Victoria, encouraging community resilience was acknowledged, and the descriptions of resilience and roles of different stakeholders outlined in the NSDR reiterated. It included recommendations for involving the public in flood planning discussions and the creation of emergency plans, as well as pointing to the Queensland Government-sponsored Harden Up website (www.hardenup.org, 2011) as a resource encouraging individuals to consider what they need to do to be prepared for a hazard event, but the majority of the focus was again on governmental and emergency services agencies responsibilities in pre-flood planning and event response, and on providing the public with information and education (Comrie, 2011). This is similar to a study following the 1974 Brisbane flood, where the most common response of interviewed residents about what changes they most desired was better flood information (Macey, 1978).

Eburn and Dovers (2012) looked at shared responsibility around bushfire and conducted interviews with fire managers, but found the conception of 'shared responsibility' held was simply for agencies to tell residents what to do and residents acting in response. This is not so much a view of shared responsibility as one of command and control, where residents are seen as recipients rather than participants. Any concept of shared responsibility needs to view all stakeholders as active participants in the process, something Eburn and Dovers' work suggests is often lacking in practice.

2.2. Promoters and limiters of residents' flood responsibility

2.2.1. Key concepts: vulnerability and resilience

Residents ability to participate in their own flood preparedness is affected by multiple factors. Three key elements are availability of information about the hazard, socioeconomic factors and capacity to respond to the hazard, and perception, understanding, and interpretation of flood risk. These all influence the vulnerability of individuals. Vulnerability is the susceptibility of biophysical and social systems to negative impacts from outside events and influences. Vulnerability research identifies a number of sources of and approaches to vulnerability, summarised by Adger (2006) as vulnerability as lack of entitlements, vulnerability to natural hazards, as exposure, as a social condition, and contextual vulnerability. In other words, vulnerability can involve proximity to a potential threat, lack of resources and capacity, and ability to respond to events. McEntire (2001) lists six categories of factors that influence vulnerability: physical, social, cultural, political, economic, and technological. One World Bank report notes that vulnerability as a concept is better suited to assessing susceptibility to different events as it recognises that individual situations are not static (Alwang et al., 2001): as people's capacity changes, so too does their vulnerability.

In the context of this discussion, vulnerability is a social phenomenon (Cutter, 1996), a function of exposure, sensitivity (e.g. access to a range of resources), and resilience, where resilience is the ability of an individual or community to recover from hazard events (Adger, 2006). It includes people's social capacity (Pielke Jr, 1999), their perception of and preparedness for risk (Britton, 1986b), the availability and comprehensibility of relevant information, and their attitude towards both the hazard and level of trust in the organisation informing them (Turner, 1979). While all these factors can influence individual's preparedness, the results can be mixed; Mileti and Sorenson's 1990 review of the existing literature on response to flood warnings found that official sources, being female, perceived risk, and high socioeconomic status increase individual's likelihood to believe and respond to warnings, old age was linked to not believing warnings, but the influence of experience was mixed, with some studies finding it increased response, while others found it decreased response (Mileti and Sorensen, 1990).

Cutter et al. (2003) describes a 'hazards-of-place' model of vulnerability, with geophysical elements such as topography and hazard proximity combining with 'social fabric' elements such as experience, risk perception, and the built environment to create place vulnerability. In other words, vulnerability is the combination of both natural and social elements. Mileti (1999) highlights shifting demographics and increasing urbanisation as increasing the

number of people exposed to natural hazards, and notes that vulnerability is further shaped by the built environment, politics and policies, and social characteristics, which are expanded upon in section 2.2.3. below. Turner et al. (2003) agree that vulnerability is affected on the macro scale by location and on the micro scale by individual's social characteristics. In addition, the built environment influences vulnerability as modes of development affect how susceptible people and locations are to hazard events (McEntire, 2001). McEntire notes that the built environment is one of the influencers of vulnerability that society has control over, making it an important consideration in risk reduction.

As Adger (2006) notes, vulnerability is affected by the increase or decrease of a system, individual, or group's resilience. Resilience is the ability of an individual, community, or system to recover from perturbations and shocks. Holling (1973) used the term to describe the ability of natural systems to adapt to and continue following outside influences, such as human activity. He contrasts this to stability, which he defines as the ability to return to equilibrium. In other words, stability is a system that is able to return to the same state, while resilience is a system which can adapt to change. Applying the concept to societies, Adger (2000) describes social resilience as a community's ability to respond to impacts on social infrastructure. Dovers and Handmer (1992) describe three approaches to resilience: resilience and maintenance, which aims to restore and maintain the status quo; change at the margins, where changes are made, but incrementally; and openness and adaptability, characterised by a willingness to undertake significant changes. They argue that the third approach, while difficult, has the best long-term application as it allows for proactive actions to reduce risk, rather than relying on reactive response. Expanding upon their typology further in 1996, they characterise the first response as denial of the need for change, type two as treating of symptoms, and type three as treating the causes (Handmer and Dovers, 1996). Tobin (1999) expands on what a resilient community looks like, seeing it as one that reduces the physical and social vulnerability of all parts of society, one which recognises planning as an ongoing process, and one that has cooperative networks both within the community and with outside governments and agencies. Yet in a review of research, Handmer and Dovers (1996) found that rhetoric of community engagement was not reflected in reality, with hazard management largely professionalised and removed from public involvement.

The Insurance Council of Australia defined resilience in the context of natural hazards as "the measure of a community's or individual's ability to respond effectively to change or an extreme event", listing emergency plans, land use and building controls and insurance as tools to improve resilience (Insurance Council of Australia, 2008). The NSDR lists four characteristics of a resilient community: functions under stress; is able to adapt to risks; is

self-reliant; and has sufficient social capital to respond to and recover from hazard events (Council of Australian Governments, 2011). The NSDR is a recent document, signed in 2011, so it remains to be seen what approaches are used to encourage its identified characteristics of a resilient community to be implemented in Australia.

These issues of vulnerability, resilience, preparedness, and responsibility fit under research question 2 which asks how socioeconomic and perception factors affect an individual's flood preparedness. Comfort et al. (1999), discussing Central America, argue that vulnerability was continually reinforced because recovery from previous disasters never included mitigation for future disasters; that is, future planning was not included in disaster response. Vulnerability affects the ability of individuals and groups to make use of hazard preparations and adaptations, as it affects their capacity to access and implement particular adaptations (Klein et al., 2003). Returning to the definition of resilience developed by Holling (1973), a group will continue to be vulnerable if post-disaster recovery only returns to the pre-disaster state, rather than developing the capacity to withstand and adapt to hazard events.

2.2.2. Flood information

Knowledge of flood risk is a requirement for individuals to take precautions. Kasperson et al. (1988) argue that information is one of the key elements in eliciting a public response to any risk or risk warnings. The ability to plan for and respond to floods has increased in recent decades with the advent of better technologies to measure the risk. Britton (1984) found that many councils did not have accurate or up-to-date information about their hazard risks, making those councils' plans inadequate for their current risk. This issue is one raised by research question 1, which asks what gaps exist in flood risk management in Australia. The lack of accurate information noted by Britton in 1984 is unlikely to have disappeared in the three decades since, and so deserves consideration when current flood risk management is examined. The NSDR also explicitly recognises communication and information as key elements of improving disaster resilience (Council of Australian Governments, 2011), as do the inquiries into the Queensland (Queensland Floods Commission of Inquiry, 2011) and Victorian (Comrie, 2011) flood inquiries. Both research questions 1a and 1b are raised here, with discussions of whose role it is to provide flood information, and problems with lack of information and knowledge exposed during the 2010-2011 floods.

Any provision of information needs to recognise that individuals interpret and respond to information differently (Kellens et al., 2012). Knowing how people decide about risk is a necessary element of effective information and education campaigns (Tarrant, 2006). Tarrant notes the need to involve risk management, technical data, social data, and education

strategies to effectively manage risk. Options for public engagement are numerous. Keys et al (2003) highlight a number of different local approaches to flood awareness, from colour-coded zoning, to fliers for each property's risk, to memorials and markers. Gissing et al. (2008) lists a number of ways to use information and warnings and ideas about community education, such as brochures, information displays, newspaper articles, and events commemorating major historic floods, and make specific mention of the need for engagement with other stakeholders. Yet having information available and undertaking community education problems does not guarantee individuals will understand and use such information. Paton and Johnston (2001) note three potential limitations: that people assume the group providing the information will undertake all action to prepare for any hazard event; that individuals will consider themselves better prepared than the wider community and so not take personal action; and that people will simply not remember the information when needed. Further, Vaughan (1995) notes that vulnerable populations, such as the elderly or ethnic minorities may not have access to all information, or may not understand it.

Flood risk information needs to be widely available and understandable for the public to be able to use it. The European Union's directive on flood information and mapping, adopted in 2007, makes accessible and understandable flood maps a priority (European Commission, 2007). In the UK, insurance companies undertook mapping because of a lack of quality government public maps (Crichton, 2002). Centralised and standardised flood information has also been suggested in Australia, with the CSIRO proposing a national database of flood information in 2000 (CSIRO, 2000). The Australian Flood Studies Database, established in 2004 as a central location for flood studies, particularly for councils to use, has not been well utilised (Middelmann-Fernandes, 2009), and nor do those councils with completed flood studies necessarily use that information in their planning decisions (Mason, 2002). But the existence of flood information can have a positive effect on planning. Research in the United States found that communities whose officials had viewed the Federal Emergency Management Agency (FEMA) flood maps for their area were almost twice as likely to undertake flood risk reduction, but that despite flood information being available almost a third of officials had not undertaken any community education (FEMA, 2011a).

The development of social media, GPS, and mobile technology creates new avenues for the distribution of flood information. Social media was used by authorities such as the police and emergency services during the 2010-2011 floods to spread information about the floods, give flood safety information, and dispel myths and rumours about the floods (Bruns et al., 2012). Official and unofficial social media sources were widely used by individuals to stay informed about the floods, and these sources were highly valued, with one survey finding 99% of respondents reporting the information available from Facebook groups was useful (Bird et

al., 2012). Social media can also allow incorrect or confusing information to be spread widely, but in the case of the Queensland floods, the Queensland Police ran a successful social media campaign, including a series of ‘#Mythbuster’ messages to correct incorrect information, which were widely distributed on sites such as Facebook and Twitter (Bruns et al., 2012). The federal and state governments have since developed a telephone and SMS warning system, Emergency Alert, to provide information during hazard events (Commonwealth of Australia, 2013a). Internationally, Dunbar (2007) lists a number of databases created by the National Oceanic and Atmospheric Administration (NOAA) to provide the public with information, but provides little detail on the information’s usability and none on how much use is made of it.

Misunderstanding and misperceptions of terminology can also affect individual’s perceptions and actions. For example, the term ‘100 year flood’ is commonly used to describe a statistical estimation of a flood that has a 1 in 100 probability of occurring in any given year (CSIRO, 2000), yet often poorly understood by the public. A lack of understanding that the descriptor is one of statistical probability, rather than a statement of frequency contributes to surprise or disbelief in the possibility of larger floods, or of multiple ‘100 year’ floods occurring close together. There is also often a lack of understanding that each flood has different characteristics, and that an actual flood will not necessarily correspond exactly to the bounds of the design flood used for planning (CSIRO, 2000). Bell and Tobin (2007) also found that some respondents questioned the ability of scientists to accurately estimate the size or scale of any particular flood, making them less receptive to warnings. The term ‘1 in 100’ or ‘100 year flood’ has been found to lead people to believe that those locations outside the identified zone are flood free (Burby et al., 2000, Pielke Jr, 1999). In chapter 5’s examination of flooded residents in Brisbane, the issue of misunderstanding of flood frequency is highlighted.

The value of detailed flood maps for land use planning and to enable more responsible use of hazard prone land was promoted in a symposium on flood in Australia in the mid-1970s (Askew and Pilgrim, 1979). Mapping was undertaken in New South Wales under the 1977 flood prone land policy. Concerns were raised about the impact that public information about flood risk would have on property prices, with people worrying that their homes would become unsellable (Handmer, 1985). Due to the public controversy, a review of the policy was carried out in 1984 (Dept. of Environment and Planning, 1984). This was as much a political issue as a policy issue, with the then opposition party distributing leaflets in some flood prone parts of south-western Sydney warning residents that if the current government was re-elected that it would “reduce the value of your home”, “washing the value of your home down the drain” (Handmer, 1985). Given the political outcry, the government moved

away from its policy, and flood mapping was largely halted for a number of years. In Victoria, flood mapping was also undertaken, but only for planning purposes, not for public information, meaning there was not the same controversy over the impacts of flood maps (Smith and Handmer, 1984). While a much larger portion of Victoria was mapped, those maps not being publicly available meant it also did not result in a more informed public. Leigh (2005) found that many councils did not make their flood information available to residents. Information availability is explored in detail in chapter 4 of this thesis, while chapter 5's discussion of Brisbane touches on both information availability and fears about the price impact of flood.

Brisbane residents complained about not having adequate information and warnings for the 1974 flood, but warnings were broadcast on television and radio (Director of Meteorology, 1974). These events become the impetus for pushes for better information, including mapping of flood hazards (Askew and Pilgrim, 1979). Importance of planning for flood by using land use restrictions and leaving flood prone areas undeveloped was already being recognised in Brisbane in the years immediately preceding the 1974 flood (Macey, 1978). Macey found zoning and information/education were the most favoured adjustments, although structural measures received less support.

2.2.3. Socioeconomic factors

The vulnerability of populations in high-risk areas is not determined only by their location, but also because of socioeconomic factors. Cannon (1994) differentiates between those exposed to a hazard and those vulnerable, arguing that vulnerable people are those for whom a hazard event is 'disastrous' – it is those who are particularly susceptible to negative impacts of a hazard event who can be described as 'vulnerable'. Cannon notes that this means the impact of hazard events ('disasters') can be reduced by addressing vulnerability factors, as well as by modifying the hazard itself (say, through the building of levees). Multiple socioeconomic factors can influence an individual's vulnerability, including gender, age, income, race/ethnicity, disability, language, education, and housing status. These factors can affect the resources – both physical and social connections – available for individuals to prepare for and respond to hazard events. The combination of and interaction between these variables make up an individual's "vulnerability bundle", which determine their potential exposure to harm during a hazard event (Cannon, 1994).

Emergency Management Australia identified three sets of variables that influence vulnerability to hazards: economic factors of wealth and resources available; personal factors of awareness, experience, and attitude; and locational factors (Emergency Management

Australia, 2002). These are important, if limited, factors to consider, but they leave out other socioeconomic variables such as age and gender. A Geoscience Australia report is even more extensive, listing 13 indicators of vulnerability, including insurance, disability, and car ownership on top of other socioeconomic indicators (Dwyer et al., 2004). They note that individual vulnerability is determined by the interaction between these factors, proximity to support services and recovery centres, and the policies guiding planning and emergency response at all levels of government.

This thesis focuses on three socioeconomic variables that can influence vulnerability: age, income, and gender. Age can be linked to vulnerability (Blaikie et al., 1994), often in combination with other factors such as income and disability. Both age and lack of income have been linked to higher morbidity in heatwaves, as older individuals, who are more susceptible to heat-related illness, do not use air-conditioning because of concerns about the cost (Fothergill and Peek, 2004). The influence of age on vulnerability can also be mixed. Tobin and Ollenburger (1992) found that while older respondents were more likely to have suffered the physical consequences of flood, they experienced less stress.

Low income can also contribute to an individual's vulnerability. Those with low incomes are often more likely to live in hazardous areas as such land can be cheaper, and are also more likely to live in lower-quality properties that will experience greater damage during hazard events (Mileti, 1999). A review of flood risk in the UK found those in areas at risk of coastal flooding were more likely to be poor, while areas at risk from riverine flooding had more mixed populations (Walker et al., 2006). Low income has been linked to a lack of flood insurance due to its actual or perceived unaffordability, seen as a luxury item rather than a necessity (Sheehan and Renouf, 2006). More broadly, low income results in lower capacity to pay for protections and modifications (Dwyer et al., 2004). Vaughan (1995) found that those on low incomes are also less likely to hear or trust warning messages, which again increases their vulnerability to hazard events. Yet reviewing the literature, Fothergill and Peek (2004) found those on low incomes see threats as more serious, but also corroborated Vaughan's findings that low income individuals are also less likely to hear or heed warnings. There is a clear link between vulnerability in terms of low income and a lower likelihood of individuals taking key personal preparedness actions.

Walker and Burningham (2011) found women and the elderly experience more negative impacts from floods. Fothergill and Peek (2004) linked low income to a lack of preparedness, and low socioeconomic status to lack of receiving or understanding warnings, with low education linked to fatalism and disbelief in the ability to take precautions, low income restricting what preparedness actions were affordable, and women more likely than men to

be in these two groups. It is women's higher representation in low income groups and lower average level of education, along with an often lesser access to resources, that makes women more vulnerable than men (Mileti, 1999, Blaikie et al., 1994). Enarson and Morrow (1998) list cultural expectations and family responsibilities as further contributing to women's vulnerability, particularly in developing countries. Using the example of Hurricane Andrew, Enarson and Morrow find that even women directly involved in relief and recovery, often of their own families, received less assistance from recovery agencies than men. These results suggest women will likely have lower levels of preparedness and ability to respond to flood.

Hurricane Katrina gives a clear picture of how socioeconomic vulnerability affects the outcomes for different individuals. Masozera et al. (2007) found that, while inundation affected all income groups, lower income areas had less ability to respond and evacuate, as well as lower levels of insurance. Poverty exacerbated the hurricane's impacts on the African American community (Cigler, 2007, Cutter, 2005). Poverty and lack of resources, including a lack of medical services during the event, also made those unable to evacuate more vulnerable (Redlener, 2008). While the physical exposure of all groups in the city may have been equal, the lower capacity of some groups resulted in their experiencing greater impacts.

An individual's preparedness is not just a function of their socioeconomic vulnerability, and such vulnerability is not a barrier to precautionary action (Paton, 2005). Some research has found no link between socioeconomic vulnerability and preparedness (King, 2001). Despite having fewer resources and experiencing many physical impacts of flood, Tobin and Ollenburger (1992) found older residents coped better psychologically than younger. Kuhlicke et al. (2011) looking at three case studies in Europe, found that the impact of socioeconomic factors was variable, and did not necessarily increase individual's vulnerability.

Vulnerability is influenced by but not dependent upon socioeconomic factors (Green, 2004). Socioeconomic factors interact with the hazard to affect an individual's capacity to prepare for and respond to flood (Cannon, 1994). Cannon also warns against seeing socioeconomic vulnerability as a reason to view individuals and communities as passive victims, as it reinforces reliance on official assistance rather than focusing on how to increase preparedness and resilience (Cannon, 2008). Socioeconomic factors can also influence an individual's response to risk, with Drabek (1999) noting that age and gender influence individual's awareness and their level of trust in warnings, with women and younger persons more receptive, while males are more likely to trust in their own capacity, and older residents may feel they have "seen it before", as was noted to have occurred in the 1955 Maitland flood. These findings are similar to those by Slovic (1999), who found having a high income

and being a white male were linked to low rating of risk, which he supposes to be due to seeing the world as less risky than women or minorities, and again having a higher trust in their own ability to respond to hazards.

2.2.4. Risk perception

The third element that can promote or limit an individual's flood preparedness is risk perception. As noted above in section 2.2.2, while information about hazards is necessary, it is not sufficient. Information itself does not necessarily result in people taking precautionary action, but is influenced by other factors such as resource availability and understanding of risk (Paton, 2005). Kates described the "prison of experience", suggesting that individual's previous experience and attitudes towards risk shape their thoughts about risk (Kates, 1962). Related is the availability heuristic, as described by Tversky and Kahneman (1973), where risks are judged by how remembered they are, whether through personal experience or other coverage.

One difficulty of risk perception is that frequencies are a measure of probability, making them difficult to conceptualise (Tarrant, 2006). Starr et al. (1976) argue that controllability is an important consideration in an individual's perception of risk, while Burton et al. (1968) argue that the response to uncertainty around hazard tends to fall into two categories: eliminate the hazard or eliminate the uncertainty: in other words, individuals will either dismiss the risk itself, or conceive it hazards as cyclic. Multiple studies, including in the United Kingdom (Burningham et al., 2008), the United States (Van Arsdol et al., 1964), and Australia (King and Goudie, 1997, Macey, 1978) have found that individuals often have a poor understanding of their own risk. In the British and two Australian studies, completed following major floods, respondents recounted being surprised at the size of the flood and often disbelief at the possibility of a future flood, while the American study, which examined a range of natural hazards in Los Angeles, found very few residents considered themselves to be at risk.

Even when a potentially catastrophic risk has been identified, it does not necessarily lead to preparedness. The potential for severe hurricane impacts on New Orleans was described as "a disaster waiting to happen" less than five years before Katrina (Fischetti, 2001), yet the city was unprepared, having placed too much faith in the city's levees to protect them (Comfort, 2006). Likewise in Brisbane there was widespread surprise when the January 2011 flood occurred, as many had believed the Wivenhoe Dam, constructed after the 1974 flood, had 'flood proofed' the city. Although this belief was widespread, Wivenhoe was not

constructed as a flood mitigation dam, but as a dual-purpose flood mitigation and water supply dam, and the need for non-structural mitigation such as land use planning to complement the dam was noted in technical assessments during the dam's construction (Grigg, 1977) and in the Brisbane Council's flood study (Brisbane City Council, 1999), which noted the community complacency resulting from this misperception as likely to increase damage from future floods. The impact of overreliance on structural measures has been highlighted above, as well as misperceptions about flood terminology. Structural measures are believed by some individuals to 'solve' the risk, with levees seen as 'eliminating' the risk (Tobin, 1995). Immediately after the 1974 Brisbane flood, almost 60% of respondents believed that the under-construction Wivenhoe Dam would greatly reduce or eliminate Brisbane's flood risk (Macey, 1978).

When comparing potentially severe risks, natural hazards are often perceived as lower risks, with hazard risks continually seen as less concerning than risks such as terrorism or, particularly during the Cold War, nuclear threats (Slovic, 1987, Slovic, 1999). Kates (1976) compared natural hazards to more every day risks found that, of the 12 options, flood was ranked ninth out of twelve options, more feared than public embarrassment but less feared than car accidents, robbery, tornadoes, illness and loneliness.

Information about a particular risk or hazard does not necessarily have the effect of leading to 'correct' risk perceptions as it will be viewed through the framework of an individual's existing beliefs (Slovic et al., 1982). Referring specifically to flood, they noted that flood insurance uptake is often low, and that people do not see it as worthwhile because of the low frequency of flooding, despite the high potential for damage. Browne and Hoyt (2000) also found that those who did not perceive flood risk as serious thought flood insurance too expensive and did not take it out. Similarly, Paton (2003) notes that people's awareness, concern, and capacity are as important as hazard information in determining whether they take precautionary action. Responding to the perception of flood insurance as too expensive and floods as too infrequent to be of concern, Michel-Kerjan and Kunreuther (2011) suggest a shift from single-year to multi-year insurance policies.

Perceptions about potential future events are often based on past events, which can lead to individuals preparing for a repeat of previous events, rather than the predicted event (King and Goudie, 1997). As early as 1806, reports exist in Australia of flood damage being exacerbated due to people's belief that another large flood could not occur (Sydney Gazette, 1806a). The 1955 flooding in Maitland is an example: while the warnings that the flood was going to be the worst recorded in the town were spread far, some elderly residents specifically refused to believe that any flood could again be as big as the 1893 flood which

they'd experienced in their youth (Hawke, 1958). The 1955 flood was larger than 1893, as predicted. Poor preparedness can also be compounded by assumptions about the size and frequency of different floods, where people mistakenly think their location is much safer than the reality. This was seen in the Katherine, Northern Territory flood of 1998, where people had thought the town was safe from anything up to a 1 in 200 flood, but was inundated by a flood of a magnitude less than 1 in 100, although inaccurate mapping of potential risk played a part in this case (Skertchly and Skertchly, 2000). In Darwin, Cyclone Tracy was preceded by Cyclone Selma, which passed without impact, leading many residents to dismiss the warnings about Tracy, thinking another cyclone could not happen so soon (McNamara, 2012). In chapter 5's discussion of Brisbane, a similar misperception about the potential for flood is discussed.

The influence of experience on an individual's risk perception can be influenced by the severity of the experience. Burn (1999) found that those with recent flood experience were better prepared during the 1997 Red River flood in Manitoba. Recent experience is also correlated with the purchase of flood insurance (Browne and Hoyt, 2000). While experience can increase risk awareness and preparedness, it does not always. Weinstein's review of research on preventative action around flood, smoking, and road safety, found results to be mixed, with experience not necessarily leading to protective action, especially if the experience was minor (Weinstein, 1989). Reviewing existing research on flood perception, Kellens et al. (2012) find huge variations in results, but found experience to be a better indicator of the likelihood of individuals to have taken precautions than demographic variables or hazard awareness.

Negative information about the actual or potential danger of a risk is a more powerful influence on individual's risk perception than positive stories, so damaging floods have more influence than successful mitigation and response (Slovic, 1999, Kasperson et al., 1988). Given the size, extent of damage, and media coverage, it would be expected that the Brisbane flood will have a long-lasting impact on residents' attitudes towards flood, and particularly their attitudes towards those officials many hold responsible for the flood.

2.3. Insurance and the cost of flood

The financial impacts of flood raise the question of who should pay for the costs of their impacts. The costs of flood can be borne by individuals, by government, or through insurance. Insurance allows the costs to be distributed in both place and time, reducing the immediate financial impact on those affected and enabling recovery (Vaughan, 1971). This section outlines the key issues around covering the costs of flood.

Government provision of assistance after disasters not only encourages settlement in hazard prone areas, it creates an expectation that such assistance will be forthcoming, describing it as akin to rewarding gamblers (Dacy and Kunreuther, 1969). The role of personal flood insurance is to put the bearing of financial risk onto those who bear the locational risk, rather than on the wider community. Some locations are inherently risky, and Burton et al. (1968) describe the cost of hazard events as “natural rent” for using particular locations and argue that it should therefore be paid by those located in those areas. With the losses from natural hazards around the world increasing (Swiss Re, 2003, Swiss Re, 2012), insurance is a key way to pay for the losses and damages caused by natural hazards. Of course, the shift in hazard frequency and intensity tempers Burton et al’s point somewhat, as, to extend their analogy somewhat, the increase in rent is not necessarily related to their actions. Development, climate change, population increase, and building practices all influence the size and extent of hazard events, and those decisions are largely not made by residents. Insurance does allow those living in areas at risk to pay part of the cost of that risk, but there are a number of other influences on risk which residents are not responsible for.

Increases in population and property in hazard-prone areas of Australia has resulted in a commensurate increase in insurance losses in research examining 40 years of data, beginning with the 1967 Tasmanian bushfires (Crompton and McAneney, 2008). They also note that the introduction of building standards in areas prone to tropical cyclones has had a mitigating effect on the cost of cyclone damage since its introduction in 1981 in response to Cyclone Tracy’s 1974 impact on Darwin. The number of declared disasters in Australia has increased significantly over this 40-year time period, with the number of declared disasters rising from 21 in the decade 1967-1976 to 71 in the decade 1997-2006 (Suncorp, 2013). Looking just at bushfires and over a longer timescale (1925-2009), Crompton et al. (2010) again found that increases in property losses were linked to increasing habitation of high-risk areas.

Lack of hazard information has historically been a barrier to providing flood insurance (Renshaw, 1961). Improvements in flood knowledge allow for better planning, and are particularly useful for the provision of flood insurance. The lack of flood information was frequently cited as a reason for flood insurance not being commonly available in Australia until very recently (Buckle, 2001). Increased accuracy of information allows the cost of the risk to be better reflected in the premiums charged (Roche et al., 2010), and insurance is now widely available in Australia. But this more accurate risk information needs to inform policy decisions (Insurance Council of Australia, 2011b). More accurate risk data does mean that, while those with low hazard risks could see a reduction in their premiums, those in high-risk areas will likely face large increases, and potentially be unable to afford cover. Roche et

al. (2010) go on to note that subsidising insurance in areas of known risk can encourage habitation of high-risk areas, resulting in even higher hazard costs. Better information and data comparison between different towns not only allows more accurate pricing of risk, it also helps identify the monetary benefits of mitigation measures such as levees (Suncorp, 2013). If these comparisons show a particular lack of mitigation in one location, and the cost of the risk is high enough, it can lead to a withdrawal of insurance, as was the case in Roma and Emerald, noted above in section 2.1.1.

Financial compensation after a flood event has occurred can act as an encouragement to increased habitation of the flood plain (Renshaw, 1961). Roche et al. (2010) note that government emergency relief funds encourage people to remain and rebuild in highly hazardous areas, citing the Black Saturday bushfires in Victoria in 2009 as one example. This is known as the Samaritan's dilemma. There are two further common issues regarding flood and hazard insurance; moral hazard and adverse selection. Moral hazard refers to consumers changing their behaviour and taking on greater risks when they have insurance cover (Crichton, 2002). An opposite but connected concept is that of adverse selection, which in flood insurance involves one party having information about a risk that the other does not, and results in higher costs. Reflecting on the United States' National Flood Information Program (NFIP), Burby (2001) notes that the program has not resulted in a reduction of development in identified flood prone areas and has in fact been accompanied by increased development, due to premiums too low to encourage change .

Kunreuther (1996) argues that lack of interest in risk reduction options prior to major events leads to higher costs after, a situation he terms the natural disaster syndrome. He also saw the low rate of insurance take-up as due to underestimating the risk and overestimating the cost of insurance, and suggested offering premium reductions for undertaking mitigation works such as using flood resilient building materials, or even refusing policies to anyone without mitigation. Further, he noted that government assistance acts as a disincentive for personal insurance as individuals expect financial help to be offered following a flood (Kunreuther, 2008), and other individuals do not seem interested in insurance until they've had a flood, others do not realise they can apply for it, or their understanding of the risk is poor (Kunreuther, 1984). As such, those who live in areas with the highest risk do not necessarily take on a financial burden commensurate to their risk. Most recently, Michel-Kerjan and Kunreuther (2011) noted that most policies under the NFIP last only a few years, and noted the poor understanding of risk and risk terminology, and suggested multi-year insurance contracts and premiums that more accurately reflect the actual risk.

There are a range of options for providing flood insurance, from no government involvement, to complete government system, to private insurance to relying on land use restrictions; Kunreuther (1974) suggests a combination of all three, with land use regulations to reduce risk, government assistance for vulnerable groups or to encourage the adoption of mitigation measures, and private insurance to ensure individuals take responsibility for their personal risk.

Flood insurance schemes vary across the world. The most prominent is the government National Flood Insurance Program (NFIP) begun in 1968 in the USA which provides government-backed insurance in identified flood-prone areas (Federal Emergency Management Agency, 2002). Earlier, small flood insurance schemes ran in the late 19th century in a few US cities, but a series of severe floods caused the company to go bankrupt in a handful of years (Dacy and Kunreuther, 1969). The NFIP also encourages better land use planning and community awareness, particularly through its community rating scheme (CRS) to encourage both individuals and communities to reduce their exposure (FEMA, 2011b). Yet the NFIP has been unsuccessful in discouraging development in flood-prone areas (Burby, 2001), and major events such as Hurricane Katrina have made the program costly (Thomas and Leichenko, 2011, Young, 2008).

The British floods of the 1950s and early 1960s were the impetus for expansion of flood insurance in the United Kingdom, including an industry-wide definition of flood (Arnell et al., 1984). The UK partnership between insurers and government involved insurers agreeing to offer insurance with the government agreeing to undertake mitigation and risk management, but lack of investment by government led to increasing losses (Crichton, 2002). However, as in the USA, the economic viability of this “Gentleman’s Agreement” has been challenged by multiple costly flood events in a short period of time, namely the 1998 and 2000 floods (Huber, 2004).

In Germany, a compulsory flood insurance scheme was proposed following severe flooding and premium increases in 2002 (Schwarze and Wagner, 2007). The scheme was rejected due to disagreements over the distribution of responsibilities between federal and state governments and legal concerns over making insurance mandatory. In New Zealand, where earthquake risk is particularly high, insurance is compulsory under the Earthquake Commission (Middleton, 2001). The rate of insurance cover and availability of government compensation also varies around the world. Crichton (2002) notes that insurance cover is close to complete in Israel, Spain and Portugal, and that some countries, such as Israel and Argentina, offer no government compensation after floods, while others, including Australia,

Canada, Belgium and France, offer compensation on an event basis, i.e. if the costs of an event exceed a predetermined amount.

Flood insurance has not been widely available in Australia until recent years. Major flood events have led to calls for some form of insurance scheme or insurance availability since at least the 1870s. The earliest discussions were requests for crop insurance made by residents in the Hunter Valley and Maitland areas (1875), which experienced frequent flooding and crop losses. The 1950s saw extensive flooding, particularly in the years 1950, 1954, 1955, and 1956. These again prompted a number of federal discussions of flood insurance, which can be found in Hansard, the record of parliamentary sessions in Australia (Hansard, 1950, Hansard, 1959, Hansard, 1958, Hansard, 1955). But these discussions were not acted on, with flood described as “an engineering problem, not a political problem” (Hansard, 1955 pg 1123). It was also seen as something that only affects certain locations and so should not be paid for by the wider public. Media coverage was critical of the idea as flood was seen as something that occurs in known locations and so can and should be prepared for (1954). Flood insurance was briefly discussed in the inquiry into the 1955 Hunter Valley floods but was advised against as “there should be no injudicious encouragement to continue defiance of the natural elements” (Hawke, 1958).

The most in-depth investigation into flood insurance occurred following the two disasters that bookended 1974: the flooding of Brisbane in January and Cyclone Tracy’s destruction of Darwin on Christmas Day. These two events led to serious proposals for a federal disaster insurance scheme, to consist of an insurance pool underwritten by the federal government and with regulated premiums (Treasury, 1976). But following a change in government, the new, economically conservative Coalition government decided that insurance was best left to private enterprise, and the governments should not be involved in the provision or availability of insurance (Howard, 1979).

Following floods in Sydney in 1986, a working party investigation was made into the possibility of extending flood insurance in Australia, but it was considered too difficult due to insufficient risk information for effective pricing (Lester, 1989). Floods in the late 1990s at Katherine, Northern Territory, and Wollongong, south of Sydney, again brought discussions of flood insurance to federal parliament (Hansard, 1998, Hansard, 1999), following outcry from residents who had their claims rejected because their insurance only covered storm damage. As recently as November 2010, a national insurance scheme was being suggested (Latham et al., 2010). Multiple times, when the issue of flood insurance has been brought up, the lack of detailed flood risk information has been raised as a barrier to its widespread provision in Australia (Askew and Pilgrim, 1979, Lester, 1989, Smith and Handmer, 2002).

Reporting on a 2001 workshop on flood insurance, Buckle notes that insurers were concerned not only about a lack of adequate flood information, but also the financial implications if they began offering flood insurance but no other companies did (Buckle, 2001). He goes on to note the value of mitigation in reducing premiums, which can be seen in the examples of Emerald and Roma noted above.

2.4. Flood risk management in Australia

2.4.1. Changes in flood risk management in Australia

Australia's flood history has been overviewed in chapter 1; this section will look in more detail at hazard planning and changes over time. The earliest media coverage, from 1803, some 15 years after the arrival of the First Fleet, criticises the "improvident method taken by the first settlers" in the Windsor area near the Hawkesbury-Nepean Rivers, north-west of Sydney, for clearing vegetation and potentially exacerbating the risk of flood (Sydney Gazette, 1803). It goes on to require those settling near rivers and creeks to maintain any trees in order to reduce the risk of flood. In 1811, the inhabitants of the Hawkesbury-Nepean were again criticised for living in flood-prone areas (Sydney Gazette, 1811). Macquarie's 1817 edict is the clearest example of early attitudes to flood risk management, with its blunt criticism of settlers living in known flood areas and threat to offer no future compensation should settlers remain in their flood prone locations (Macquarie, 1817). It puts much of the responsibility for flood risk management on residents for their individual decisions.

While the 1817 edict was a result of residents ignoring official advice, Australia's worst flood is an example of officials not listening to residents' concerns. In 1852, the town of Gundagai was destroyed by the single most devastating flood in Australia's history, with 89 of the approximately 250 residents killed and most buildings washed away (Sydney Morning Herald, 1852, Coates, 1999). Before the 1852 flood, residents had raised concerns about the town's location on the flood plain. Floods in 1841, 1844, and 1851 had already caused damage, and many residents requested the township to be moved from its location on the floodplain between the Murrumbidgee River and a tributary creek (see for example Sydney Morning Herald, 1844b, Sydney Morning Herald, 1844a, Sydney Morning Herald, 1845a, Goulburn Herald, 1851). These requests were denied, with the Governor stating "what a man buys, he buys for better or worse" (Sydney Morning Herald, 1845b), and that residents need to accept responsibility for the risk. Following the 1852 flood, however, the government established the town on higher ground (Thomson, 1852). Where Windsor residents were criticised for living in flood-prone locations outside the surveyed bounds of the settlement, in

Gundagai the surveyed location of the town was itself a high flood risk. Despite this, residents were still held primarily responsible for their situation until the town was destroyed by flood.

Flood risk management decisions are often made reactively, after a major event, rather than proactively working on mitigation. One early example of reactive response to a flood came in 1890, when the town of Bourke requested government assistance in the construction of a levee following a severe flood (O'Gorman, 2012). While Bourke was an important town, the government did not want to give the money and thereby invite other towns to request assistance. More recently, processes for applying for and receiving government funding for flood mitigation works have been formalised, and are normally funded on a 1:1:1 basis with costs divided between federal, state, and local governments (Buckle, 2001).

Resettlement is one option for responding to flood. Smithfield in north Queensland was flooded twice in the 1870s during its settlement, leading to the main settlement in the area being moved to what is now Cairns (Oliver, 1980). Other towns such as Clermont in Queensland have been moved following floods (McAneney, 2012, Pullar et al., 1986), and most recently the town of Grantham, one of the most severely damaged places during the 2010-2011 floods, was voluntarily moved to the hills above its original location (Lockyer Valley Regional Council, 2011). Proposals were made following the 1955 Hunter Valley floods to move the towns of Maitland, Muswellbrook, and Singleton, all severely affected, to new sites that were not flood-prone (The Muswellbrook Chronicle, 1955b, The Muswellbrook Chronicle, 1955a). This was decided be impractical, and instead only some of the worst-affected areas in Maitland were not rebuilt (Young, 1956, Farmer and Settler, 1955). More than 200 homeowners participated in a buyback program with the local council (Thorpe and Tweedie, 1956). This removal of a section of the town had been anticipated in 1855 (Maitland Mercury, 1855), but, as had happened a century earlier, the value of the location was decided to be more valuable than the damage caused by flooding.

Home buyback schemes are another option, but they have varying levels of success. Before the Brisbane flood in 2011, the council's voluntary buyback scheme had only approached 242 properties to participate, and had purchased less than 25% of properties approached in its five years of operation (Queensland Floods Commission of Inquiry, 2012). A relatively successful buyback scheme was implemented in the town of Kelso, New South Wales, following flooding in the 1980s, with 75 of 100 dwellings being removed in the 20 years following the flood (Keys, 2006). Other buy back schemes have been undertaken in Gunnedah and Carroll, towns in north-western New South Wales, and Fairfield, a suburb of Sydney, which has successfully bought or raised hundreds of homes (Bureau of Transport

and Regional Economics, 2002). Yet relocation of towns and neighbourhoods is not a practical response to flood risk, given the high population that lives in flood zones across Australia. Indeed, where Macquarie's 1817 edict included a stipulation that aid would not be forthcoming in the event of future floods if residents did not move out of known flood areas, it is highly unlikely that any similar approach would be suggested – let alone successful – now.

Some disasters have been followed by specific acts of parliament for financial relief, mitigation, and recovery, including Clermont (Government of Queensland, 1917), the Hunter Valley (NSW Government, 1956), and Darwin (Commonwealth of Australia, 1975). Other events have led to specific changes in policy. Following Cyclone Tracy in 1974, building standards for areas prone to tropical cyclones were strengthened, and buildings had to be built in order to withstand certain wind speeds, equivalent to the strength of a category 3 storm (Mason and Haynes, 2010, Walters, 1978). The explicit desire was to 'build back better', and to build better for the future, aids in reducing the cost of future disasters. Following the January 2011 Brisbane flood, Brisbane Council required any rebuilding (i.e. building of new properties) to be above the height of that flood, properties that were simply being repaired had no such requirement and so are still at the same height and with the same flood risk as previous (Brisbane City Council, 2011). These are examples of events encouraging innovation and new, more resilient, approaches (Dacy and Kunreuther, 1969). They contrast with the practice of building slab on ground properties in known flood areas, rather than traditional 'Queenslander' homes raised on stumps, an issue that has been recognised for over three decades as increasing the number of properties at risk of inundation during a flood (Oliver, 1980), leading to extra reliance on government relief payments.

One of the most common responses to hazard events is independent inquiries. Government inquiries have followed most significant disasters in Australia in the last century. Some of the discussions following the Hunter Valley 1955 floods have already been discussed, particularly around suggestions for relocation of towns. The Black Friday bushfire inquiry in 1939 made recommendations about land use management including promoting establishment of a state-level fire authority, identifying the fire risks of different regions, and putting the onus on landowners to reduce the fire danger on their own lands, and proposed community education programs (Stretton, 1939). The Ash Wednesday Commission made recommendations for government and emergency response agencies, including improved coordination between agencies, but its comments regarding the wider community were limited to needing better education (Miller et al., 1984). The Canberra inquiry focused largely on operational issues and again recommended public education, but did include the need to encourage individuals to make their own preparedness priority (McLeod, 2003). Two recent

inquiries have had a bigger discussion of individual's roles, those into the Black Saturday fires in Victoria in 2009, and into the 2011 Perth Hills fire. While the Black Saturday report made similar comments about operational issues as previous inquiries, its comments towards the community moved beyond education to make a clear emphasis on the need for individuals to have their own bushfire response plans – for all involved stakeholders to take 'shared responsibility' for bushfire risk (Teague et al., 2009). The Perth Hills inquiry built on the Victorian inquiry's discussions of shared responsibility, making explicit recommendations for agencies to collaborate, as well as again making clear comments on the need for community preparedness and ownership of risk (Keelty, 2011).

The focus of these inquiries is often on what governments and official agencies did or did not do before and during an event that could have been done differently and reduced the risk or damage or loss of life. The roles of different stakeholders such as emergency services or residents themselves are covered to varying degrees, and industry-specific inquiries, such as those by or into insurance, of course focus on that particular stakeholder. The inquiry into the 1955 Hunter Valley floods (Young, 1956) found residents mostly wanted governments to pay for flood controls, but it recommended discouraging development on flood plains and removing current properties, as well as restricting financial compensation for flood victims.

2.4.2. Research since 2010-2011 floods

The 2010-2011 floods made flood a topical field in Australia again after many years of public focus on drought and bushfire. Media coverage often played to ideals of 'Mateship' and the 'Aussie Battler' and the country's ability to cope with any hardship (Williamson, 2012, Huxley, 2011, Gillard, 2011c). Just as the 2009 Black Saturday fires had talk of rebuilding 'brick by brick' (Nicholson and Rood, 2009), the 2010-2011 floods coverage included many stories of those who would not let the floods defeat them, such as the 'swampers' in Rockhampton (Andersen, 2011). But this concept of toughness and resilience has been challenged as being a hindrance to proper mitigation and adaptation, and potentially leading to larger losses during floods and other natural disasters. Bohensky and Leitch (2013) argue that the focus of media coverage on short-term ideas of resilience, such as the Mud Army, takes focus and interest away from longer-term projects to mitigate or adapt to risk. The individualist ideal of this is also challenged by the money and resources that go into responding to hazard events.

One criticism made by the Queensland Flood Commission was a lack of resources in the SES to respond to the requests (Queensland Floods Commission of Inquiry, 2011). The reliance of the SES on manpower and resources from other agencies, government, and the

community was noted as a limitation by Britton (1984) a generation earlier. Reflecting on the Queensland inquiry, McGowan (2012) argued the focus on government and emergency services missed the potential to encourage individual's preparedness. It followed the same pattern as earlier inquiries in seeing the community as recipients, rather than participants.

Some studies have been conducted in the aftermath of these floods. Bohensky and Leitch (2013) examined media coverage, and discussions of resilience and climate change, finding little discussion of future risks from climate change or actions to take to increase resilience. Ryan (2013) asked residents in two flood affected Queensland towns, Toowoomba and St George, about the sources of information they used during the flood. While some frustration was expressed with 'official' channels, they were still the source residents turned to after personal connections such as family and friends. Researching the Brisbane flood, van den Honert and McAneney (2011) argue that while the operation of the Wivenhoe Dam contributed to the height of the flood, it is poor land use planning decisions that are the more significant contributor to the extent of flood damage. Lo (2013) argued that income and flood awareness were less important in encouraging the uptake of flood insurance than social expectations to have cover. But only 5% of Lo's respondents were inundated in the 2010-2011 floods, so it does not assess the impact of those floods on flood insurance cover, while Tarr (2011) criticised confusing and variable insurance policies and responses to flood, arguing in support of a standard definition of flood for insurance purposes. Hayes and Goonetilleke (2012) highlighted inadequacies in spatial flood information for responding to the flood, and argues there is an inadequate amount of current flood mapping. A national survey conducted following the 2010-2011 floods found that, while almost all respondents in all states and territories felt the government should invest in infrastructure to better withstand hazard events – with approximately a quarter of respondents wanting investment so that infrastructure could completely withstand hazard events, there was very little willingness to pay extra tax for that investment (MWH, 2011).

Under Australia's constitution, planning powers including floodplain management are the responsibility of the state government, rather than the federal government (Doyle and Kellow, 1995), with zoning decisions made by local government (Smith and Handmer, 2002). While planning and emergency management are state and territory responsibilities in Australia, the federal government is involved in response and funding of mitigation and adaptation works. Following the 2010-2011 floods, the rules on relief funding for states were revised so that state governments are required to have their public infrastructure and assets insured for flood otherwise they cannot get the same federal funding (Australian Government, 2011). The Australian Emergency Management Arrangements (2009) set out how collaboration and cooperation on emergencies is to progress, including roles of different stakeholders, with

very similar recommendations to those in the National Strategy for Disaster Resilience (NSDR) (Council of Australian Governments, 2011).

The floods of 2010-2011 received extensive media coverage (Erik Jensen, 2010, Fraser, 2011, Ralston, 2010, Cook and Reilly, 2011, The Sun-Herald, 2011). The floods in Toowoomba, the Lockyer Valley, and Brisbane received the greatest attention due to the dramatic images from the former two and the high population of the latter. The floods led to the production of a number of resources to educate the public, such as the Queensland Government's 'Understanding floods' booklet (Government, 2011), and the 'Harden Up' website (www.hardenup.org, 2011) which makes use of the idea of the 'tough' Australian to encourage individuals to prepare for hazards and provides general and specific information about natural hazards. 267 councils were declared federal disaster zones during the period 1 November 2010 to 30 March 2011 due to flood. The Bureau of Meteorology released a number of special climate statements on the extensive floods, both on specific locations (Bureau of Meteorology, 2011d, Bureau of Meteorology, 2011a) and more generally on the high rainfalls and widespread floods (Bureau of Meteorology, 2012b).

The 2010-2011 floods also exposed significant misperceptions around the role and coverage of insurance in Australia. Media coverage was often intensely critical of insurers, one program describing them as 'snakes in the grass' (60 Minutes, 2011, Brown, 2011). The consumer advocacy group Choice criticised the insurance industry for charging potentially unaffordable rates for properties at risk of flood (Choice, 2011). The media and political response to rejected insurance claims was one of apportioning blame, combined with an appeal to the 'Aussie Spirit' to encourage insurers to pay out on rejected policies (ABC News, 2011c). This presents a simplistic view of innocence and guilt in flood insurance and preparedness, rather than seeing insurers and residents as equal stakeholders in flood risk management to collaborate on the best outcome together. Instead, it requires a balancing of interests and a recognition that somebody will have to pay. Michel-Kerjan (2011) outlines the different approaches taken by a number of countries, and notes the need to encourage increased responsibility for those in areas at risk.

The need to more accurately price risk and respond to hazard risk was noted by others (Ergas, 2011, Ryan, 2011). The Insurance Council itself noted the need for improved flood mapping in Queensland to allow them to offer more policies (Insurance Council of Australia, 2011a), while the Local Government Association of Queensland dismissed the suggestion that councils had not been forthcoming with information (Local Government Association of Queensland, 2011). This suggests a lack of cooperation between councils and insurers, an issue explored further in chapter 4.

2.5. Conclusion

This chapter has provided an overview of key ideas in flood risk management in general, as well as specific contextual background on discussions in Australia. It has introduced the key elements examined throughout the rest of this thesis: the availability and importance of information about the flood hazard, the key stakeholders involved, including a discussion of the context for flood insurance discussions in Australia, and the socioeconomic and perception factors that affect an individual's ability to prepare for flood. Flood risk management has moved away from a focus on structural mitigation measures to include land use planning and emergency management, but the damages of flood events continue to increase. There has been an increased recognition that flood risk management is the responsibility of multiple stakeholders: governments, emergency response agencies, the insurance industry, and the local community. But particularly for individuals, there are limiting factors to their involvement, from their knowledge of the risk, to their socioeconomic capacity, and their perception of the risk. Following major hazard events, the ineffective planning and lack of coordination between different stakeholders is highlighted, but the roles individuals can play in their own preparedness are less discussed.

Chapter 3 expands upon the importance and availability of flood information. As noted, flood information is used for planning, determining insurance premiums, and educating individuals on their flood risk. Chapter 4 focuses on discussions of the roles and responsibilities of different stakeholders, and examines whether stated moves towards more collaborative approaches are reflected in each stakeholders' understanding of their own and each others' roles. Chapters 5 and 6 narrow the focus to residents, and the influence of socioeconomic and risk perception factors on their awareness, insurance, and involvement in their own flood preparedness. With the NSDR's stated aim of building a resilient country where individuals and communities are aware of and involved in their own preparedness, these chapters examine how well residents in four case study locations are taking on personal responsibility.

Chapter 3. How can residents know their flood risk?

A review of online flood information availability in Australia

This chapter fits under research question 1, and particularly the role of one stakeholder, local council. It establishes one key gap in flood risk management in Australia: that of uniformly available high-quality flood risk information. Flood information is necessary for encouraging shared responsibility in flood risk management, and is used by all stakeholders (Australian Emergency Management Institute, 2012). This first paper presents the results of a survey of all local council websites in Australia. This assessment was undertaken between July and September of 2010, a number of months before the 2010-2011 summer floods. The analysis was carried out in 2010, and then the data was reassessed following the 2010-2011 summer floods to examine what information had been available in affected councils.

The National Strategy for Disaster Resilience lists comprehensive local information about hazards as a key component of a resilient community, and notes the need for better quality information to be made more widely available from government and other sources (Council of Australian Governments, 2011). The CSIRO's 'best principles' also places responsibility on local councils to create flood risk information to inform individuals about flood risk (CSIRO, 2000). The Queensland Floods Commission of Inquiry highlighted a lack of information from local councils as an important issue to be addressed (Queensland Floods Commission of Inquiry, 2012).

Figure 1 in Chapter 1 listed the provision of flood information as one of the two main roles in councils' shared responsibility for flood risk management. Figure 2 in the same chapter noted that flood information informs residents' perception of their flood risk and is used by insurers in determining premiums. While this chapter looks specifically at publicly available information that residents would be able to use, insurers also use council-produced information, as do emergency services disaster response plans. In its discussion of information availability from those councils affected by the 2010-2011 floods, this paper also highlights the need for better flood information in highly flood-prone areas.

Some councils provided further information during the 2010-2011 floods – Ipswich, for example, published a list of every street likely to have been inundated. In preparation for

Cyclone Yasi, some northern Queensland coastal councils provided storm surge maps, and Rockhampton produced a series of flood maps for different potential flood levels. While this information is not entered into in detail in this paper, individual councils did make extra information available before and after the floods. One aspect raised in the media coverage of the floods was a lack of knowledge and understanding of flood risk of large sections of the community. While the particular research presented in this chapter was undertaken prior to the floods, some of the issues raised in it – variable quality and quantity of information, questions around how well it is understood, ease of access to information – were powerfully illustrated by the 2010-2011 floods.



Flood sign in Dora Creek. The Creek itself is visible in the background, as are some properties on the southern side of the Creek. 28 April 2012. P. Box

This chapter finds that nationally, less than half of all local councils have flood information available on their websites. The quality of information available from council websites was highly variable and lacked any uniform standard, meaning individuals in different locations have access to very different information, an issue since noted by the National Flood Risk Information Program (Australian Emergency Management Institute, 2012). This limits individual's 'shared responsibility' as they may not have access to sufficiently accurate information to adequately plan their own preparedness.

The floods caused a partial shift in the focus of this thesis, and a lesser focus on information in and of itself to a focus more on questions of roles, responsibilities, and vulnerability. However, information is still a key element. Availability of information, while necessary, is not sufficient in and of itself. As such, this paper gives an overview of the flood problem in

Australia, acting as a base on which future chapters discuss the roles and responsibilities of the four key stakeholders in flood risk management. It presents a broad introduction to one element of flood risk management, that of information and, by extension, knowledge. This paper also highlights the variability in information, which supports the proposal for national standards, which is further investigated in chapter 4. Chapter 4 also includes discussion of each stakeholder's role in providing or seeking out flood information, while in the case studies, discussed in chapters 5 and 6, residents speak about their awareness of risk and their interest in flood risk information. The primary responsibility council's hold for flood risk information is repeated throughout all four chapters.

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How can residents know their flood risk? A review of online flood information availability in Australia

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How can residents know their flood risk? A review of online flood information availability in Australia

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Widespread flooding across eastern Australia between November 2010 and February 2011 has again highlighted the country's susceptibility to natural disasters. The floods have also triggered discussion about flood awareness, risk information, and the role and responsibility of governments, insurance providers and residents. This paper examines the availability of flood hazard information on local government websites in Australia; it was completed in mid-2010 before the 2010–2011 flooding. The quality and accessibility of information is discussed, as are variations based on state and population size of different Local Government Areas (councils). Particular attention is given to those areas that experienced recent flooding, as well as to known areas of concentrated risk. There are large gaps in information availability, with less than 50% of councils provided flood risk information. A higher percentage of councils in the more populous states, some of which also have higher flood risk, provide information than those in less-populous states. Of those councils with a recognised flood risk, 67% provided flood information online.

Keywords: flood information; local government; flood risk; awareness

Introduction

Between November 2010 and February 2011, the most widespread flooding in decades occurred across much of Australia, particularly the states of Queensland and Victoria. The floods resulted in an estimated \$2.6 billion of insured losses (Insurance Council of Australia, 2011), with estimates in May 2011 putting the cost to Government at \$6 billion (Attorney General, 2011). In the aftermath, many questions have been raised about the level of awareness of flood risk in the wider community. These concerns are not new: previous studies have shown a lack of awareness of risk and vulnerability to flood and other natural hazards (e.g. King, 2000; Whittaker et al., 2010). One source of information in respect of flooding is information on Local Government (council) websites. In the past making such material available to the public has proved controversial (Handmer, 1985), but this view is changing. With this in mind, our study examines the current status of flood information on council websites. Before doing so, we briefly summarise some significant floods in

Australian history since European settlement and their impacts on policy.

In terms of fatalities, floods have been the second deadliest of natural disasters in Australia after heatwaves, having caused over 2200 deaths between 1788 and 1996 (Coates, 1999). Floods at Windsor, north-west of Sydney, in 1817 prompted the then Governor to issue an edict reminding settlers to reside within the surveyed bounds of settlements, and admonishing those living in known flood areas (NSW Department Environment and Planning, 1984). Windsor has flooded many times since the Governor's edict, including a flood in 1867 that is purported to have an approximate Average Return Interval (ARI) of at least 1 in 250 years (Gillespie et al., 2002).

In 1852, the town of Gundagai, south west of Sydney, was destroyed along with 78 deaths out of a population of 250, prompting its removal to higher ground (NSW Government, 1852). Other towns have also been wholly or partially moved following flood events, including Clermont, Queensland, in 1916, and a voluntary relocation program is currently underway

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in Grantham, Queensland, one of the worst-hit communities during the 2010–2011 floods (Wordsworth, 2011). At the time of writing, the relocation was in its early stages. Widespread flooding in the Hunter Valley, New South Wales, in 1955 led to the formation of the State Emergency Service (SES) (Hunter Valley Research Foundation, 1963), now responsible for emergency response and recovery from natural disasters.

The 1974 flooding in Brisbane caused by the passage of Cyclone Wanda caused insurance losses normalised to 2006 societal conditions of some \$3.3 billion and ranks third on the list of weather-related natural catastrophe losses (Crompton and McAnaney, 2008). The recent 2010–2011 floods were the most widespread since 1974 (National Climate Centre, 2011), and public concerns about flood planning, community awareness, insurance, and preparation, has led to one federal inquiry (National Disaster Insurance Review, 2011) and state inquiries in Queensland (Queensland Floods Commission of Inquiry, 2011) and Victoria (Comrie, 2011).

Recent estimates put the number of properties situated within areas having an annual probability of flooding in excess of 1% (i.e. an ARI of 100 years) at approximately 230,000 (Keping Chen, Risk Frontiers, personal communication). Rapid population growth in areas of high flood risk, such as south-east Queensland, northern New South Wales, and north-western and south-western Sydney is increasing the potential for damage and loss of life in future floods (Roche et al., 2011). It will be important for future planning decisions to take into account how best to mitigate this current and future risk.

The problem is exacerbated by the strict adherence to the 1-in-100-year flood as the planning level, meaning the implications of larger floods are rarely considered and the lack of building code constraints for residential construction for homes developed above the notional 1-in-100-year flood extent. The implications of this is that many of these homes are built on flood plains as slab-on-ground construction without consideration of the potential flood risk in terms of the depth of the water at frequency of flooding less than the 1-in-100 years (Roche et al., 2011). The Hawkesbury-Nepean catchment in New South Wales is one such recognised concentration of risk. Discussion of flood planning and mitigation often focuses on engineering works, or legislation. While important, none of these address an important question: how can residents of flood-prone areas know their flood risk and plan for flood events?

A prerequisite for raising awareness of flood risk is for location-specific flood risk information to be both easily accessible and understandable.

In response to criticism by the Insurance Council of Australia (Insurance Council of Australia, 2011), the Local Government Association of Queensland responded by releasing a statement after the recent Brisbane flooding that flood studies and maps have been ‘publically available for several years’ (LGAQ, 2011). However the ease of accessing this information and its suitability for allowing the public to personalise their risk is unknown. Moreover, the statement by the LGAQ ignores the fact that the information needs of different stakeholders – individuals, land-use planners, emergency managers and insurers – are very different. This paper looks at the problem only from the perspective of residents via a web-based search of flood information. We examine the flood information by state, population and in respect to councils with a known flood risk.

Methodology

Australia has 571 local councils and individually contacting each of these would have proved too logistically difficult. This being the case, a web-based review was chosen as the most practical means of getting an overview of what sort of information was readily available: websites are widely accessible to most people, and, unlike a council office, can be accessed any time. The survey was conducted between 15 July and 29 September 2010.

The survey involved using the ‘Search’ function to explore each website for the terms ‘flood’, ‘flood map’, and ‘flood planning’. In addition, the environment, planning, and ‘frequently asked questions’ sections were also explored. The findings were recorded in a spreadsheet, along with judgements about the quality and readability of the data, layout and ease of use of the website. Councils whose only mention of flood was in meeting minutes or annual reports were excluded from consideration. This decision was made as most of those discussions concerned the need for the completion of flood studies, rather than containing information of direct relevance to residents. Councils that only made reference to planned flood studies were also excluded. Locations of the remaining councils can be seen in Figure 1.

Results and discussion

Survey results

Of the 571 local councils identified, only 233, or 41%, had usable flood risk information on their websites, and only 132, or 23% of councils had a flood map available online. The quality of the information

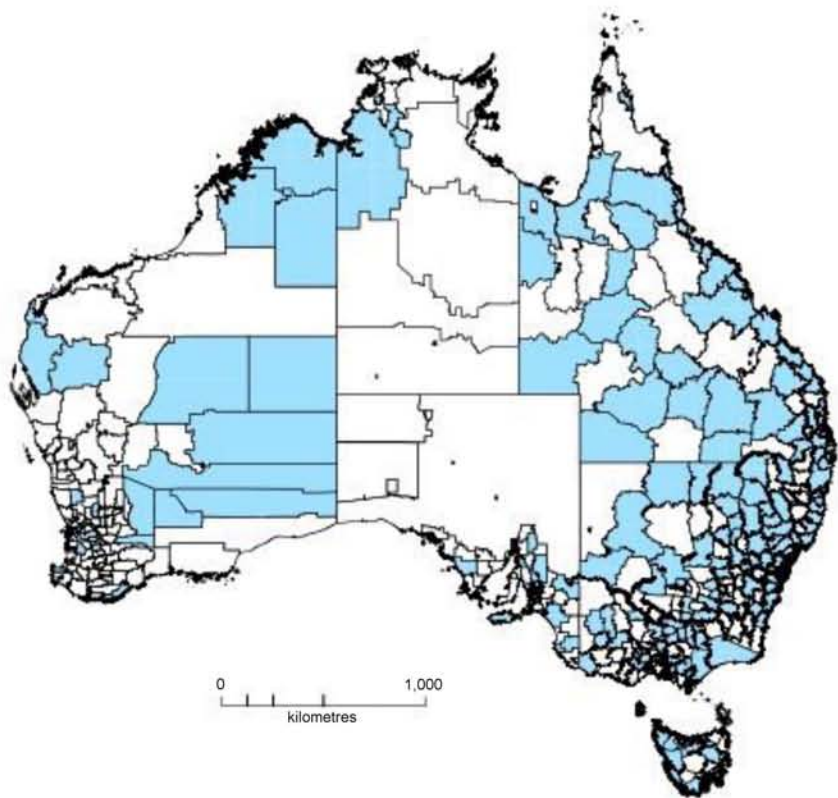


Figure 1. Councils with flood information.

varied widely, ranging from maps usually the extent of the 1-in-100-year flood as used in land use planning to highly technical flood studies, to dedicated pages on local flood risk, to SES brochures, to information on road conditions such as road damage or closures due to flood.

As well as variations in the quality of information, there were significant differences in the useability of websites. Table 1 outlines briefly some of the attributes by which websites were assessed. While some had well-organised flood sections with links and information provided clearly, others were poorly laid

out or lacked a ‘Search’ function, making it difficult for the user. At the other end of the scale, some councils returned an excessive amount of information that would prove too difficult for most residents to wade through: while the quality of information available may have been high, the useability of these websites themselves was low. A number of councils in Queensland have problematic search functions that do not allow a user to return to the list of results once one has been clicked on, and the so search had to be restarted. This feature may discourage people from looking further for information.

Table 1. Select attributes of council websites.

Good attributes	Poor attributes
High level of information	No information
Specific page on flood	Information hard to find or located in strange places
Clarity	Complex and technical language
Good search function	Poor or no search function
Results organised by relevance	Results not organised
Flood maps	No flood maps
Properties and ARIs marked on maps	Little detail and ARI not listed on maps
Both simple and detailed information	Only technical reports
Information relevant to local area	Lack of locally relevant information

Table 2. Number and percentage of councils providing flood information by state.

State/Territory	No. councils	With information	Percentage with information	Very good websites	Percentage
ACT	1	1	100%	0	0%
NSW	155	88	56.8%	25	16.1%
QLD	74	41	55.4%	14	18.9%
VIC	78	35	44.9%	11	14.1%
SA	74	32	43.2%	9	12.2%
TAS	29	10	34.5%	3	10.3%
NT	18	3	16.7%	1	5.6%
WA	141	23	16.3%	5	3.5%
Australia	571	233	40.81%	68	11.9%

Ten councils located in remote areas of Queensland and Western Australia only had information on road conditions. Remote councils face different challenges when it comes to flood risk management, with road conditions and access being of highest priority.

Six councils only had flood information contained within their local history page. For example, Quilpie in south western Queensland notes that the town was built outside of the reach of floods, while Gundagai in New South Wales, notes that the town was moved due to the 1852 flood, as has been mentioned earlier, but does not discuss contemporary flood risk.

A number of councils and regions make use of historic floods for maps, planning, or general information. Moora, Western Australia discusses its flood risk in relation to a 1999 flood event. Katherine, Northern Territory, maps the extent of the 1998 flood and Probable Maximum Flood. Other regions to use historic floods as reference points or planning levels are the Hunter Valley region in New South Wales, where councils often reference the 1955 floods, and the Riverina region of New South Wales and Murray River surrounds of Victoria and South Australia which use the 1956 floods. This allows residents to connect flood information to something concrete, rather than technical.

State by state comparison

Table 2 shows the results analysed according to state and territory. As the number of councils in each state is different, the table includes both total numbers and the percentage of councils in each state with flood information online. The flood risk in the ACT is quite low, and while the information available online is relatively minimal, the Territory website does provide SES flood and 'StormSafe' information brochures and so is considered to have 100% coverage for flood information availability.

As noted above the quality and depth of information varied between councils. Table 2 shows the

number and percentage of councils with some flood information and also the number and percentage of councils considered to have very good information. The very good councils were those who met most or all of the 'good attributes' criteria in Table 1.

The majority of Australia's flood risk is to be found in New South Wales and Queensland and these two states have the highest level of information availability, with more than half of all councils in each state providing some flood information on their websites. These states together are home to approximately 70% of properties at risk from over-ground flooding in a 1-in-100-year event (Leigh, 2006). In comparison less than 20% of councils in Western Australia and the Northern Territory provide flood information on their websites. The results for Western Australia are particularly low. With 141 councils, it is second only to New South Wales, and has almost twice as many councils as Queensland and Victoria. Many of its councils also have low populations. As will be shown in later discussion, the rate of information availability is significantly lower in councils with smaller populations. South Australia and Victoria have levels of flood risk information availability slightly above the national average of 41%. Victoria is home to a quarter of the nation's flood exposure (Leigh, 2006).

Flood-prone regions

More important than the general State-based information given above, is that provided by Councils with a known flood risk. A 2006 report by Risk Frontiers for the Insurance Council of Australia (Leigh, 2006) identified 215 councils in Australia as having within their jurisdictions towns with 200 or more residential properties at risk to over ground flooding with an ARI of 100 years. Leigh (2006) estimated an approximate total of 170,000 residential addresses in this category but recognised this could be lower bound as data did not exist at the time for a number of known flood-prone areas. Leigh (2006)

Table 3. Councils with identified flood-prone areas possessing information online.

State/Territory	No. flood-prone councils	No. with information	Percentage	Very good websites	Percentage
NSW	89	68	76.4%	23	25.8%
QLD	32	25	78.1%	14	43.8%
VIC	46	26	56.5%	9	19.6%
WA	19	7	36.8%	2	10.5%
SA	17	11	64.7%	5	29.4%
NT	5	2	40.0%	1	20.0%
TAS	7	5	71.4%	2	28.6%
Australia	215	144	67.0%	56	26.0%

specifically notes that New South Wales, Victoria, South Australia, Queensland and the Northern Territory are all likely to have more flood-prone areas than were identified at the time of writing. More recent estimates put the number of properties at 230,000 (K. Chen, Risk Frontiers, personal communication). Work is also being carried out by the Queensland flood recovery taskforce to map areas affected by last summer's floods.

As the Leigh report is six years old, it is likely that a more up-to-date assessment of flood-prone areas that included some smaller towns would see Queensland having close to half its councils with flood-prone areas, rather than the 32 listed in Table 3. Leigh acknowledged the lack of information available

in Queensland at the time in his report. Some councils have multiple flood-prone locations within their jurisdiction, and so have a greater need for flood information to be available to residents.

Nationally, two thirds of councils identified as having flood-prone areas had some flood information available online. In comparison to Table 2, which shows the overall percentage of councils in each state that have some flood risk information online, Table 3 shows that all states perform better when only those councils identified as flood-prone are analysed. For two, Western Australia and Northern Territory, the percentage more than doubles, although both are still below 50% and their percentages are notably lower than the other states. New South Wales,

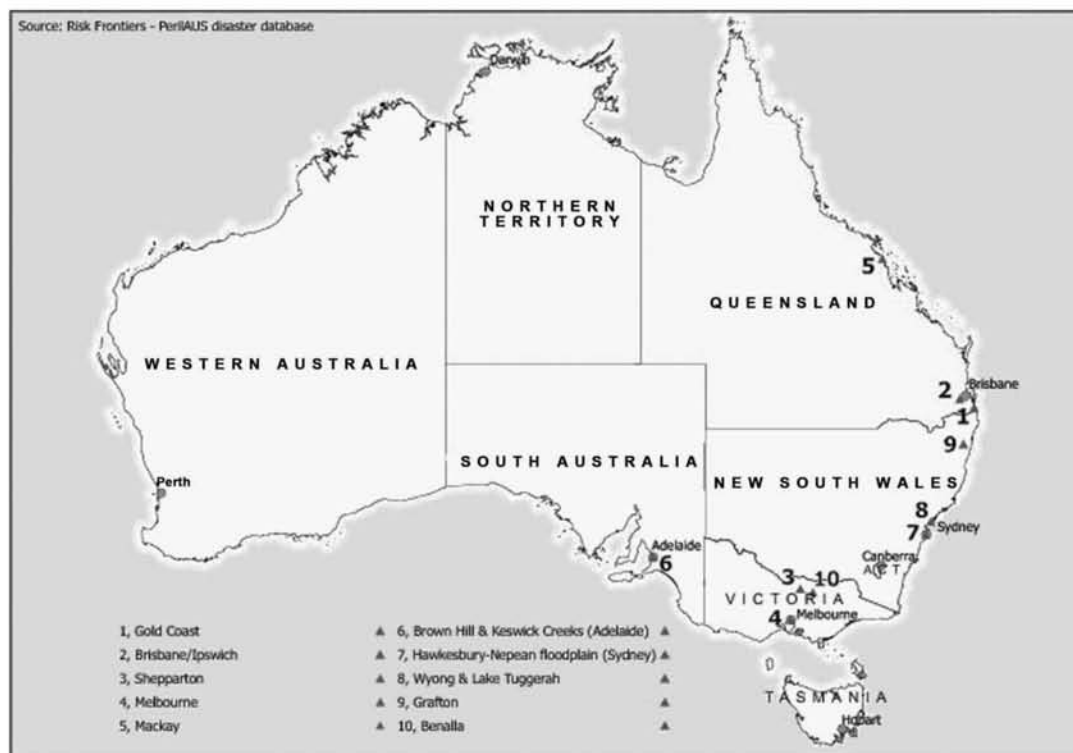


Figure 2. Ten highest-risk areas as identified by Leigh (2006).

Queensland, and Tasmania have high levels of information availability in flood-prone councils. In both the Northern Territory and Tasmania, the total number of councils with flood-prone areas is quite low, while the three most populous states, which are also home to the majority of the nation's flood risk, have a high number and proportion of councils with flood-prone areas. The number of councils with very good websites is also notably higher in those states.

The 10 highest-risk areas in Australia

Leigh (2006) also identified the 10 areas with the highest population at risk to over-ground flooding with an ARI of 100 years. Of the 10 areas identified, three each are located in New South Wales, Queensland, and Victoria, and one in South Australia (Figure 2). Four are located in capital cities, two are urban areas near capital cities, three are regional centres, and one is a medium-sized town with a population of just under 10,000. These 10 areas are home to almost half of all identified addresses prone to over ground flooding in Australia, with the Gold Coast and Brisbane/Ipswich areas of south eastern Queensland combined having more than half of these. All 10 areas are located in eastern or southern Australia, and all but two are located on or close to the coast.

These 10 locations fall within 27 Local Government Areas, 20 of which, or just under 75%, had flood risk information available online. Thirteen councils, or just less than 50%, had flood maps online. Both these results are significantly higher than the overall national results, and slightly higher than the results for councils with flood-prone areas.

Two councils in particular had high-quality maps, with Shepparton in Victoria marking properties liable to over-floor flooding for an ARI 100 flood, and Brisbane having detailed maps for the entire city, searchable by suburb. The seven councils with no information are all located in major cities – one each in Sydney and Adelaide, and five in Melbourne. While the City of Adelaide did not have information on its website, it is involved in a joint flood plan with the other councils in the Brown Hill-Keswick Creek flood plain. The Hawkesbury-Nepean floodplain in Sydney also has completed joint flood studies undertaken by all councils.

Population size

Councils were divided into six categories based on population size, from those with populations of less than 1000 to those with over 100,000, using data from the Australian Bureau of Statistics (ABS, 2010;

Table 4. Number and percentage of councils with flood risk information by population category.

	No. councils	With information	Percentage
A B1000	57	13	22.8%
B 1000 4999	129	32	24.8
C 5000 19,999	151	62	41.1%
D 20,000 49,999	96	48	50.0%
E 50,000 100,000	56	35	62.5%
F 100,000	71	43	60.6%

www.abs.gov.au). Population data were not available for a small number of indigenous councils and unincorporated areas. Table 4 shows that of the six population categories, four of them – those with populations of 5000 residents or more – equal or exceed the national average proportion of councils with information. In contrast, barely 20% of the councils with populations of less than 1000 have flood information available online. Only one council with a population of less than 1000, Dowerin, Western Australia, had a specific flood page. Overall, flood information availability in low population areas was poor.

In comparison, almost two thirds of councils with populations of over 50,000 residents had information available for residents. Fifty-nine percent of Australia's councils have less than 20,000 residents, and these three categories all had lower levels of information availability. It is likely to be more difficult for smaller councils to afford flood studies or to provide detailed information online. Despite this, a number of councils in these categories have highly detailed and user-friendly flood risk information online. It is therefore possible for those smaller councils to prioritise flood risk information, and it is also possible for them to do this collaboratively with surrounding councils, a means adopted by a number of councils, particularly in urban areas.

The ranking of the states looks rather different when analysed by the total number of people living in LGAs with flood risk information on their website. The results are shown in Table 5. The majority of Queenslanders live in LGAs with at least some flood information available on their website, while in both New South Wales and South Australia over 70% of residents live in councils whose websites have some usable flood information. Whereas Table 2 lists only three states having the percentage of councils with flood risk information online greater than 50%, when analysed by total population, in five states more than 50% of residents live in LGAs with at least some flood information available online.

Table 5. Total population in each state and territory in LGAs with flood risk information online.

State/Territory	Total population	With information	Percentage
ACT	352, 189	352, 189	100%
QLD	4, 425, 103	4, 171, 030	94.26%
SA	1, 623, 590	1, 165, 750	71.80%
NSW	7, 134, 421	5, 066, 590	71.02%
TAS	503, 292	265, 061	52.67%
VIC	5, 443, 228	2, 378, 203	43.69%
WA	2, 245, 057	245, 950	10.96%
NT	225, 938	17, 295	7.65%
Australia	21, 952, 818	13, 662, 068	62.23%

It should be noted, however, that the available information does not necessarily cover the entire council area.

The majority of the population lives in the capital cities. One hundred twenty-two councils, or just over 20% of all councils, make up the capital cities. Brisbane, with its high flood risk, has flood information available from all four councils that make up the greater Brisbane area, as do most surrounding urbanised areas of south-east Queensland. By contrast, there was poor availability in Melbourne, with few councils making local flood information available on their websites. It should be noted that flood information in Victoria is often available from Catchment Management Authorities or, for the metropolitan area, Melbourne Water. These were not included in the scope of this paper, as this paper examines information available from local councils only. Sydney is varied, but the majority of councils in the Hawkesbury/Nepean and Georges River floodplains areas of major flood risk have some information available.

Almost all of Adelaide's councils had flood risk information available online, and joint flood studies were being undertaken for each of the two major floodplains making up the city. The information was concentrated on a few websites, but almost all had some flood information, plus links through other councils for further information. Two of three councils in Hobart had flood information available online, but this was not the case for Perth or Darwin. While Perth has a relatively low flood risk, Darwin does experience cyclones and flooding. Darwin did have some general cyclone information, but no mention of the risk of flooding.

Availability of flood risk information in councils affected by the 2010 2011 floods

During severe natural disasters, affected areas can qualify for federal assistance. The criteria for a

federal natural disaster declaration are covered in Natural Disaster Relief and Recovery Arrangements Determination 2011 (Attorney General's Department, 2011). In September 2010, in the course of this study, extensive flooding occurred across inland Victoria, providing an opportunity to examine how well councils provided information in times of flood. Thirty-four of the Victoria's 78 councils were declared natural disaster zones due to flood. Of those, 21 (61.8%) had flood information available online, including updates about the flood situation. Ten had information specifically about the September floods. Four larger regional centres Ballarat, Bendigo, Wodonga, and Swan Hill did not have any flood information available.

During the period 30 November 2010 to 28 February 2011, 267 councils were declared natural disaster zones because of flood by the Federal government, qualifying affected residents and businesses for federal financial assistance. The extent of those disaster declarations can be seen in Figure 3. The results were compared to the list of disaster declarations to see how many of the disaster declared councils had flood risk information available during the survey period. The results for most states were similar to the general state results.

In Western Australia, where 21 councils were declared natural disaster zones due to flood and cyclones, 6 had flood information available. This makes the percentage of disaster declared councils with some flood information 28.6%, roughly twice the state average of 16.3%. Statistics given above exclude some councils that had basic cyclone information but no flood risk information. In South Australia, where four councils were declared natural disaster zones, 50% of those had flood information online. In Tasmania, where 11 of 29 councils were declared natural disaster zones, the percentage with flood risk information available was almost the same as the state average: 4 councils or 36%. In the Northern Territory, 9 of 18 councils were disaster

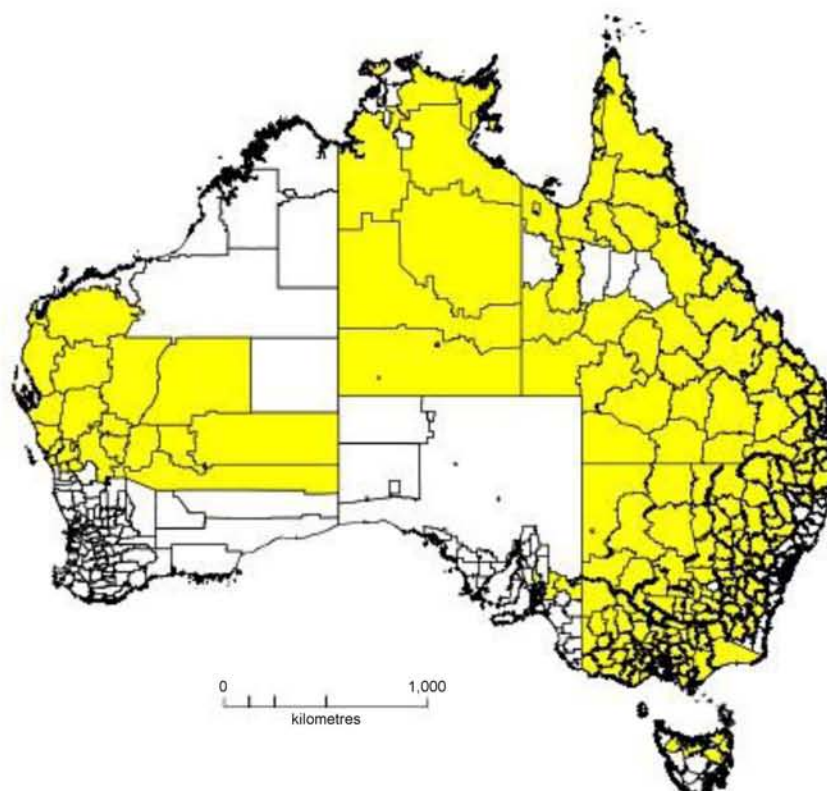


Figure 3. Areas declared natural disaster zones, November 2010 – February 2011. It should be noted that the areas highlighted were not all under water but identify LGAs within which significant flooding and damage occurred.

declared for monsoonal flooding and cyclone damage. Only one had flood information, and another had cyclone information.

The majority of the 2010–2011 flooding occurred in the eastern states of Queensland, New South Wales, and Victoria. In Victoria, all councils except for Port Phillip and Melbourne City were declared natural disaster zones between November 2010 and February 2011 due to flood and storm damage. As the flooding was so widespread, there is no difference in the percentage of councils with flood information between those that experienced flood damage and the state average. Sixty-eight of Queensland's 74 councils, or 91.2%, were declared natural disaster zones between November 2010 and February 2011, of which 39 or 57.4% had flood risk information available online. The proportion of those councils with flood risk information online is almost the same as for the whole state of Queensland. It should be noted that some councils placed additional information online during the flood event, including Cairns, Rockhampton, and Cassowary Coast, which all provided flood maps for the predicted flood heights.

In New South Wales 82 of 155 councils or 53% were declared natural disaster zones between

November 2010 and February 2011. Of those, 48 or 58.5% had flood information online, a figure little different from the state average. In some states only a few councils were declared natural disaster zones, while in others almost all councils were disaster declared. Comparing whether those flood-affected areas were more or less likely to have flood risk information available in these states thus has limitations. It is clear, however, that there are many regions prone to flooding that do not make flood information as available as they could have.

The availability of flood mapping

The Natural Disaster Insurance Review (www.ndir.gov.au) highlights flood mapping as one of the most important types of flood risk information, and as an area where there is currently much inconsistency in quality and availability (NDIR, 2011). Its recommendations include greater flood mapping, which should be nationally coordinated and available. The Government has indicated its acceptance of the NDIR recommendations (McClelland and Shorten, 2011). 132 councils were found to have some form of flood map available online, or slightly over half of

those 233 councils with flood information, and 23% of all councils. The maps varied in detail, ranging from very basic council-wide maps with little more than suburbs and major roads marked, to the individual property search tool of Pittwater Council, New South Wales (www.pittwater.nsw.gov.au), which allows residents to find whether their property is within the 1 in 100 and PMF flood zone, as well as the flood planning level for their property.

Some maps were located within flood studies, emergency plans, or similar reports, and while available are not as easily accessible. Residents are unlikely to search a 200-page technical flood study for a flood map, and the level of detail may be difficult to understand. It should of course be acknowledged that most maps are design floods, not actual floods, and actual floods may differ to those predicted. Whether or not residents understand this is an important question, although one that is beyond the scope of this study.

Not all maps indicate what ARI is being used. In the absence of information to the contrary, it was assumed that these maps were for the 1-in-100 flood, but without confirmation it is not possible to say with any certainty. It should also be noted that without an explanation of what is the ARI, what the terminology means, and its implications, it is of little use to residents. Importantly, many maps also do not provide information on the predicted depth of water.

The maps of greatest use to residents are those that not only mark flood zones and property boundaries, but also highlight properties where the flood level is predicted to cause over-floor flooding. Five councils Yarriambiack, Strathbogie, Northern Grampians, Greater Shepparton in Victoria and Carrathool in NSW had flood maps that included this level of detail. All five are located in regional areas and three of the five Carrathool, Strathbogie, and Yarriambiack have populations of less than 10,000. This shows that a council's size need not be a barrier to providing detailed information.

Many regional councils did not have maps covering their entire council area, but only the major town(s) and immediate surrounds. One exception is Bellingen, on the mid-north coast of New South Wales (www.bellingen.nsw.gov.au), which has highly detailed maps of the whole shire, including flood lines, depths, and topographical lines. Again, this is a small regional council, and shows what councils can achieve if they deem it a priority.

Conclusion

Access to information is one of the most fundamental needs for residents to be able to know their flood risk

and plan their response. At the time of this review, less than half of Australia's local councils provided information about their flood risk on their websites. Even in areas of identified flood risk, only two thirds of councils had flood information online. Of those that do have information online, the quality is variable. Better flood knowledge is beneficial for the resident, the council, state and federal governments, planners, emergency management, insurance companies, and the wider community as it allows all stakeholders to plan for floods. It is encouraging that some councils made further information available during the recent floods, but priority should be given to making that information available before floods occur, so residents can make informed and responsible choices.

The inquiries into the floods in Victoria and Queensland have both highlighted the importance of information and clear knowledge in their interim reports. The final reports from both enquiries are not available at the time of writing. Flood information needs to be available, accessible, understandable, and relevant to the location and will vary for different stakeholders. As shown in this study, Australia's level of accessible flood information could be improved. With widespread flooding having occurred recently, the areas where good flood information needs to be made available are easily identified.

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Chapter 4. Flood Risk in Australia: Whose Responsibility is it, Anyway?

Chapter 3 looked at the state of flood information availability in Australia, and established that information is of variable quality and quantity. But information is only one element of flood risk management, and council provision of information is only the responsibility of one stakeholder – councils. This chapter widens the scope to incorporate three other key players in flood risk management: the State Emergency Service (SES), who are involved in not only flood response, but education campaigns and assistance in preparing flood plans and other household adaptation strategies; the insurance industry, as flood insurance has in recent years become more widely available and was also a source of considerable controversy following the 2010-2011 floods; and residents themselves. This paper responds specifically to research question 1a, “How do key stakeholders perceive responsibility is shared for flood risk management in Australia?” This chapter addresses this question through interviews with four key stakeholders. With the interviews conducted in 2011 and 2012, it also addresses question 1b, with participants’ responses informed by the 2010-2011 floods and often referring to events and discussions arising from those floods.

As noted in Chapter 2’s review of Australia’s flood risk management history and responses to hazard events, poor coordination, a lack of understanding of each stakeholder’s role, and failure on the part of stakeholders to undertake their responsibilities has been a recurring theme in Australia’s response to flood. In this paper, each of the four stakeholders were asked to describe their own roles and responsibilities and the roles and responsibilities of others to identify where there were misconceptions.

This paper looks at the interactions between all four stakeholders; the outside boxes in Figure 2 in Chapter 1. Local councils, the SES, and the insurance industry all have direct interactions with residents as noted in Figure 2. The National Strategy for Disaster Resilience also discusses the need for all involved stakeholders to understand their own and each others’ roles as part of the shared responsibility of hazard management (Council of Australian Governments, 2011). This paper is also specifically about shared responsibility, and the responses and discussions contained within reflect Figure 1 in Chapter 1’s overview of the key responsibilities of each stakeholder in sharing responsibility for flood. At the same time, while the responses given do generally identify the same responsibilities highlighted in

Figure 1, the responses of residents indicated they are less aware of and engaged in their own responsibility for flood preparedness.



'FloodSmart' sign in Benalla, a joint SES and council flood mitigation and education campaign. This is one of a number of signs in the town providing information about flood in Benalla. 4 May 2012. P. Box.

Three of the stakeholders in this paper are 'official' in that they have specific roles around flood – councils have legal responsibility for planning, the SES is the legislated body for emergency response, and insurers, while they don't have a legal obligation to provide flood insurance (although compulsory flood insurance was discussed following the 2010-2011 floods) provide financial support and a cost indicator of risk. Residents respond to flood and rely on these other three stakeholders to protect them from flood, help them respond to flood, and help them recover from flood. Successful flood risk management requires each of these stakeholders to understand and undertake their responsibilities in flood risk management. Chapters 5 and 6 will then focus on the perceptions and preparedness of residents, comparing their responses with those given by the three official stakeholders focused on in this chapter.

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Article

Flood Risk in Australia: Whose Responsibility Is It, Anyway?

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Abstract: This paper presents research into four key stakeholders in flood risk management in Australia: local councils, the insurance industry, the State Emergency Service (SES), and local residents; examining the perception of their own roles and responsibilities, and those of the other stakeholders. Key informant interviews were conducted in four locations—Brisbane and Emerald, in Queensland, Dora Creek, in New South Wales, and Benalla, in Victoria. We find that understanding of the roles and responsibilities of each stakeholder varied considerably between research participants. Insurance representatives felt their concerns about increasing flood risk costs were unheeded until the 2010–2011 floods made them the “canary in the coal mine”. Councils felt they had limited options for reducing flood risk. SES representatives felt they were too relied upon for event response, with requests for assistance outstripping their capacity to assist, and many residents were uncertain how to prepare for flood, relying on emergency agencies and the local council to protect them. Key lessons for flood risk management in Australia are (a) an urgent need for all stakeholders to better understand each others’ roles and responsibilities; and (b) residents must take greater responsibility for their own personal protection. Only then can the vision of shared responsibility presented by the 2009 National Strategy for Disaster Resilience be achieved.

Keywords: flood risk management; responsibility; stakeholders; perception; 2010–2011 floods; Australia

1. Introduction

The 2010–2011 Summer saw significant flooding across Australia, exacerbated by a strong La Nina event, similar to previous widespread flood events in 1974 and the mid-1950s [1]. Australia has recently seen a high number of flood events in a short period of time, at a time when concerns about the future impact of climate change and increased population growth and damage costs in coastal and other flood risk zones have raised questions about how to best address these growing vulnerabilities and costs [2]. Flood risk management in Australia involves multiple stakeholders, including all three levels of government, the State Emergency Service (hereafter SES) and other emergency response agencies, the insurance industry, catchment management authorities, and local communities. To best manage risk, all these stakeholders need to have a clear understanding of their own, as well as each others' roles and responsibilities. This paper is an exploratory analysis focusing on four stakeholders, local councils, the level of government most closely involved with flood impacts, the SES, the insurance industry, and local residents. Councils and the SES make local flood preparation and response decisions, and insurance is a source of financing for personal recovery, *i.e.*, a personal mitigation tool, and local residents can make their own personal plans and preparations. Other stakeholders are involved in flood and water management, including state and federal governments and catchment management authorities. This preliminary study has focused on the stakeholders with the most immediate involvement in flood planning decisions, but the roles of these other stakeholders should be addressed in future research. State governments provide the legislative framework for flood risk management, and federal government is involved in funding flood mitigation and providing disaster relief. Environmental and planning issues are not part of the federal government's mandate [3]. While they provide the national policy framework for flood risk management, they are not directly involved in local flood risk and have therefore been excluded from this study.

The current arrangement is framed by how powers are divided between the three levels of government, starting from the tasks required and moving out to who completes those tasks, and this shifts the approach from stakeholder-focused to task-focused. An early 1980s review of disaster response in Australia found a focus on crisis-response over pre-event planning and mitigation [4]. Beginning instead with the jobs to be done, and assessing how each stakeholder can be involved in completing those tasks, would aim to address some of the current shortcomings.

This paper aims to answer five questions: (1) What importance does each stakeholder group place on flood risk management? (2) What are the views of each stakeholder group on their own and each others' roles and responsibilities with regard to flood risk management? (3) How do the views of key stakeholder groups align or differ? (4) What views does each stakeholder group have about the need for a national standard for flood risk information and management? (5) What lessons can be learned from the recent floods experienced in Australia?

2. Flood Risk Management in Australia

The floods of the 2010–2011 Summer highlighted the extent of the flood hazard across Australia [1], and raised the questions of how to better address flood risk. The inquiry following the Black Saturday fires in Victoria in 2009 raised the idea of “shared responsibility” for fire management; that preparation for, and response to, fires is not the domain of one stakeholder alone, but involves various

levels of government, emergency services, and local communities [5]. The National Strategy for Disaster Resilience (NSDR) applies the same idea to all natural hazards [6]. These documents provide a framework for who needs to be involved and makes general comment about how and why different stakeholders need to be involved [6]. This paper seeks to examine how well four of those stakeholders—Local council, SES, the insurance industry, and local residents—Reflect the aims of the NSDR.

In Australia, land use and hazards planning is the domain of state and territory governments, enacted at local government level. The Australian Capital Territory differs from the other states and territories in that it does not have local councils, only the territory government. The federal government does not make planning laws. In New South Wales, 1977 saw the introduction of policy which allowed for the removal of subsidies to developments built in areas that have at least a 1 in 100 chance of being flooded each year, as well as requirements for mapping of those areas. Public concerns over the impact on housing prices of publically available flood risk information eventually led to a change to a more flexible approach in the mid-1980s, removing the requirement to use the 100 years flood planning level, but also leading to less publically-available flood risk information [7]. A study by the Insurance Council of Australia in the late 1990s found that, although many councils had information about their flood risk, close to half had not included that information in their planning schemes [8].

Flood risk management in Australia has evolved over time, often influenced by flood and hazard events [9]. Table 1 presents a brief overview of key flood hazard events and the changes in planning and response they precipitated. The earliest example of official discussion of living with floods following European settlement was a flood in Windsor, west of Sydney, after which the then-Governor of New South Wales, Lachlan Macquarie, criticised settlers for living in known flood areas and advised them to move to within surveyed townships [10]. At least two towns have been completely relocated due to floods—Gundagai, New South Wales, and Clermont, Queensland, with other towns partially relocated. In the case of Gundagai, floods in the 1840s led to residents requesting the relocation of the town, which was rejected by the New South Wales Governor [11]. That town was moved following an 1852 flood which killed 89 people, the largest number of casualties caused by a flood in Australia [12]. In Clermont, buildings that were not destroyed by the 1916 flood were physically moved to their new location [13].

Discussions about flood insurance have followed a number of flood events. Establishing a scheme paid for by both the general public and those in flood-prone areas was suggested following flooding in Maitland, north west of Sydney, in 1875 [14], and discussed at a federal level in the 1950s [15]. Neither of these suggestions went further, but a national disaster insurance scheme was investigated in the mid-1970s following the flooding of Brisbane in January 1974 and Cyclone Tracy's impact on Darwin on Christmas Day of the same year. After investigation the federal government rejected the proposal based on concerns about the cost, and that a public scheme did not align with the philosophy of the conservative Coalition government of the time, who preferred minimal government intervention in business and private issues [16]. Following storms in Wollongong in 1998, residents used media campaigns to pressure insurers into offering payouts, and the federal Labor opposition issued a media release calling for a federal inquiry into flood insurance [17]. Even as recently as 2008, the involvement of the private sector through the insurance industry in flood management and response

was limited, with government and individuals the predominant actors [18]. Given how recent that was, it is unsurprising that confusion about flood insurance was so common during the 2010–2011 floods.

Following the 2010–2011 floods and confusion over what coverage was included in different insurance policies, the federal government established the National Disaster Insurance Review to investigate issues around the availability and affordability of insurance for natural disasters such as flood [19]. The federal government, in early 2013, rejected the suggestion of the National Disaster Insurance Review to either make flood insurance compulsory or subsidise premiums in the highest risk areas [20]. Most recently, the insurer Suncorp stopped offering cover in the towns of Emerald and Roma, in Queensland, following significant losses in both towns in three consecutive years [21], but have recently resumed offering policies in Emerald after the state government announced funding for mitigation [22]. Globally, with earthquakes in Christchurch, New Zealand in September, 2010, and February, 2011, the earthquake and tsunami in Japan in March, 2011, and floods along the Mississippi in the USA in April and May, 2011, amongst other disasters in addition to Australia's floods, 2011 was the most costly year on record for natural disasters [23]. As a result, the premiums of many insurance companies have increased to more accurately reflect the true cost of providing insurance in high-risk locations.

Table 1. Selected natural hazard events and resultant changes in disaster management in Australia.

Year	Event	Legislation/reports/response
1817	Windsor flood	Edict criticising residents living in known flood areas
1852	Gundagai flood	Relocation of town
1875	Maitland floods	Discussion of flood insurance
1916	Clermont flood	Relocation of town
1955	Maitland floods	Establishment of NSW State Emergency Service
1967	Hobart fires	Establishment of Tasmanian SES
1974	Brisbane flood; Cyclone Tracy	Federal investigation of disaster insurance; building codes for wind resilience; establishment of Qld SES
1983	Ash Wednesday fires	Inquiries, Victorian Emergency Management Act
1998	Wollongong storm	Federal flood insurance discussions
2009	Black Saturday fires	Inquiry; “shared responsibility”; National Strategy for Disaster Resilience (adopted 2011)
2010–2011	Widespread floods	Victorian and Queensland flood commissions; National Disaster Insurance Review
2013		Rejection of compulsory flood insurance

The State/Territory Emergency Service is the key agency for disaster preparedness and response. Preceding the SES were civil defence organisations, established during the Great Depression of the 1930s and World War 2, and concerned with responding to potential attacks on Australia. The New South Wales (NSW) SES was the first agency dedicated to responding to emergencies and natural hazards, and was formed after the floods of 1955 [24]. It was followed by other states, such as in Tasmania after the 1967 Hobart fires [25] and in the Queensland after the 1974 Brisbane flood [26]. Other major events, such as the Ash Wednesday fires in Victoria, led to the drafting of that state's Emergency Management Act [27].

Issues around roles and responsibility have been raised in inquiries into a number of recent events. The National Strategy for Disaster Resilience (NSDR) was originally drafted in 2009 and adopted in

February 2011 [28], following the 2010–2011 floods. The Strategy builds on the 2008 National Disaster Resilience Framework [29], which began articulating the concept of “shared responsibility”, combining shared understanding of risk and a holistic and national approach to all disasters. The commission into the Black Saturday bushfires in Victoria states that communities, individuals, and all levels of government need to “accept increased responsibility” for fire safety and preparedness [5] by developing local fire response plans and shelters, and by improving education and communication. It also noted confusion between agencies about responsibilities and roles during the fires [30]. Although this was again a reaction to a major event, the Black Saturday Commission provided some specific suggestions of how councils and the community—both individuals and as a whole—could address fire risk. The inquiry into the Victorian floods found confusion over roles around both flood warnings and infrastructure, and that communities felt excluded from flood planning and response processes [31]. Similarly, the Queensland Flood Commission of Inquiry (QFCI), whose terms of reference covered the roles and actions of all governments, emergency services, the insurance industry, and a small subsection on the community, amongst other foci, found in its interim report that councils had inconsistent levels of flood knowledge and preparation, that information and warnings were not always shared effectively, and that emergency services were not sufficiently resourced to respond to the scale of flooding [32]. The final report discussed the need for consistent and up to date planning arrangements that take into account flood risk [33].

3. Methodology

Three of the stakeholder groups selected for this study are institutional stakeholders, in that they have official functions: council, SES, and the insurance industry, while the fourth is the local community. As they are responsible for local planning decisions and implementation, local councils were one of the stakeholder groups selected for this paper. State and Territory Emergency Services’ roles have some variation across Australia, but all are involved in natural hazard planning and response. Following media coverage of the 2010–2011 floods, the insurance industry was criticised for non-payment of claims and confusion over policy wording [34]. Flood insurance has only become widely available in Australia in recent years, and so the role of insurance in flood risk management is still being clarified. This study is limited in scale, and it should be noted that interviewees’ responses do not necessarily reflect the wider views of the stakeholder groups.

Semi-structured interviews were conducted with representatives of these three stakeholder groups, with these interviews being digitally recorded. A total of thirteen interviews were conducted, seven with council mayors and environmental or sustainability officers, three with representatives from the insurance industry (one from an insurance company, one from the Insurance Council of Australia, and one from a reinsurer), and three with representatives from the local units of the State Emergency Service. Interviewees were asked:

- how important flood awareness and planning was for their organisation/area;
- how they viewed the other stakeholders’ roles in regards to flood;
- what responsibility they felt residents had in preparing for floods;
- their thoughts on having national standards or guidelines around planning, information, and response.

Council, SES, and insurance participants were contacted by phone or email to introduce the research and arrange an interview. Council and SES participants were identified from their local council and SES websites. Interviews were conducted with council and SES representatives at the same time as fieldwork with local residents. Interviews lasted between 25 min and 1 hour.

A questionnaire was distributed to residents in the four case study locations, asking them about their awareness of flood risk, insurance status, and thoughts on flood risk reduction and the role of council, SES, and themselves in reducing flood risk. Council flood maps were used to identify those streets with the highest flood risk or, in the case of Brisbane and Emerald, those streets worst affected by their recent flood. All homes in identified streets were doorknocked, and 300 questionnaires distributed. Both Brisbane and Emerald surveys were also available online, with the Emerald survey promoted on local radio and available from the council website, so some participants will have completed the survey without direct contact with the researchers. As such, participants were self-selecting and their responses may not represent all views of each community. A total of 247 surveys were completed by residents across the four case study locations. The Queensland fieldwork was conducted in August and September 2011, approximately 7 months after their respective floods. The Dora Creek fieldwork was conducted in April 2012, and the Benalla fieldwork in May 2012. In all four locations the data collection took about one week. Insurance industry interviews were conducted in October and November 2012.

Four case study areas were selected to conduct interviews with local councils and residents in flood risk zones: Benalla in Victoria, Dora Creek in New South Wales, and Emerald and Brisbane in Queensland. The four locations were selected because of their high flood risk, their variation in size and their location in different states. New South Wales, Queensland, and Victoria together are home to more than 90% of Australia's at-risk properties [35]. The four locations selected have all experienced multiple floods in their history. Emerald has had two record floods recently, in 2008 and 2010 [36]. As well as the January 2011 flood, Brisbane has experienced numerous floods, the largest three in the nineteenth century, in 1841, 1844, and 1893 [36]. However, even the most recent previous major flood, in January 1974, is beyond living memory for much of the population. Benalla was only slightly affected by the Victorian floods in 2010 and 2012, and last experienced severe flooding in 1993. Dora Creek was last flooded on the June long weekend in 2007, and has a flood history dating back to the 1920s [37]. The communities are of different sizes: Dora Creek is a small peri-urban community between the cities of Sydney and Newcastle, Benalla and Emerald are large rural centres, and Brisbane is a major state capital. Two locations, Brisbane and Benalla, are among the ten communities with the most properties at risk in the country [35]. Interviews in Brisbane and Emerald also discussed the experience of the recent floods, and those in Benalla and Dora Creek were asked if there had been any changes in attitudes following the 2010–2011 floods.

4. Results

The following results are presented thematically, comparing the responses of the different stakeholder groups across key issues identified. Tables 2 and 3 provide the key points raised by each stakeholder group in response to each theme or question. While the answers provided by individual research participants within each stakeholder group were not always consistent, there was generally agreement on the broader issues. Answers are briefly expanded upon following the tables, and then

analysed in the discussion. Table 2 presents responses about their own and each others' roles, while Table 3 addresses some of the concepts discussed during interviews. Following the tables are some paragraphs and quotes expanding on the key points. Both masculine and feminine pronouns are used to accompany quotes to protect the anonymity of interviewees.

Representatives of council, SES, and the insurance industry held similar views about the importance of flood risk management as a concept, the importance of each stakeholder, and the need for residents to be aware of their flood risk. All three groups were concerned about complacency amongst residents, which they attributed to a lack of memory of previous floods, flood events being smaller than expected floods, and lack of knowledge about their risk. The insurance representatives focused primarily on the cost of premiums as an indicator of risk, and a blunt impetus for change. SES representatives' responses reflected a focus on the practicalities of flood events and the importance of having awareness of risk and applying it. Residents' responses often reflected both a passivity and an uncertainty about flood risk, and expectation that government and emergency agencies would take responsibility for flood prevention and response. Residents were not asked directly about either cooperation between stakeholders or national approaches/guidelines to flood, but a handful of respondents remarked on the need for various government levels and emergency services to work together more effectively.

When asked about the importance their council places on flood planning, council representatives in all locations recognised the high risk of their location. One council representative in Lake Macquarie stated that "realistically it's one of those examples you look back on and think that in hindsight you'd never have allowed development here". The need to adapt to flood risk was well acknowledged, with Emerald, Brisbane, and Benalla councillors emphasising new developments away from flood risk zones and the raising of properties in flood risk areas. Dora Creek is considerably more constrained by its topography, and so the local council and SES focused more on the need for evacuation plans. Climate change was not explicitly covered in this research, but both Benalla and Lake Macquarie councils stated they were incorporating climate change predictions into their planning decisions. On the other hand, one insurance representative felt that, while climate change is an important issue, the more immediate need is to address those areas currently at risk of flood.

The cost of flood risk was raised by respondents. The role of insurance is of course central to cost discussions, and insurance representatives felt that, while premiums have risen, they still do not accurately reflect the cost of living in high-risk locations. At the same time, they were mindful that residents would simply drop insurance if they felt premiums were too high. The greater spending on disaster relief compared to risk reduction was criticised, particularly the contrast between funding for disaster recovery in 2011 and risk reduction funding in 2012. One insurance representative stated that "last year they [the federal government] handed out \$800 million in grants, recovery grants to the local communities across Australia. So contrast \$800 million to \$20 million [for risk reduction], \$800 million in post-event recovery to \$20 million in pre-event mitigation, and we've got it completely wrong as a community". Councils felt that they needed more financial support from state and federal governments to afford to mitigate their flood risk. All stakeholders felt flood risk needed to be included in planning decisions, and worried that other interests—particularly financial interests in development—led to flood risk being downplayed.

Table 2. Perceptions of roles and responsibilities.

Stakeholder	Own role in flood planning	Views of role of insurance	Views of the role of SES	Residents' responsibilities	Views of role of council
Council	<ul style="list-style-type: none"> One of the most important planning issues Desire increased mitigation funding Were aware their locations were at high risk of flood Need for communication about risk Risk cannot be removed 	<ul style="list-style-type: none"> Feel residents should have flood cover Feel insurers only care about profit Aware premium increases are due to new cover Want insurers to do more education Dissatisfaction over insurance in Brisbane 	<ul style="list-style-type: none"> Community engagement and awareness Work with SES on education campaigns Event response Critique in Brisbane for not being visible enough 	<ul style="list-style-type: none"> Must take personal responsibility, not just rely on council Need to know their risk Cannot expect floods to be “prevented” But residents can’t be made accountable Increased interest from residents 	<ul style="list-style-type: none"> Flood planning an important job Use planning laws to reduce flood risk Need to balance with other interests Need good information on their risk
	<ul style="list-style-type: none"> Flood management and response “core businesses” Focus on response and evacuation Different locations have different flood types/issues Education and awareness programs 	<ul style="list-style-type: none"> See it as important personal mitigation Did not have detailed knowledge on insurance issues Have not had enquiries from residents 	<ul style="list-style-type: none"> Provide education and information Event response—Evacuation, sandbagging, etc. Discuss with council at regional level Joint programs with council 	<ul style="list-style-type: none"> Must take personal responsibility Need to know how they’d be affected in a flood Should have plans/ preparations ready to go Can’t expect SES to always be there 	<ul style="list-style-type: none"> Important collaborators on awareness/education Discussions at regional rather than local level Use planning laws to reduce flood risk
	<ul style="list-style-type: none"> Signalling risk/influencing decisions through price signal Want insurance and hazard costs considered in planning decisions Feel councils don’t always take risk into account 	<ul style="list-style-type: none"> The “canary in the coal mine” on flood risk and cost Is an indicator of risk, not transfer of risk Should influence decision-making and planning Attend community meetings on request 	<ul style="list-style-type: none"> Educate community about risk Flood event response Don’t want SES’ role to be “overextended” Role as “flood experts”; general advice, but not specific planning 	<ul style="list-style-type: none"> Must take personal responsibility Insurance as a way to take personal responsibility Concerned about complacency around floods Need to have knowledge, but won’t be “technical experts” 	<ul style="list-style-type: none"> Need to consider flood in planning decisions Feel some councils downplay their risk Should implement stricter building requirements
	<ul style="list-style-type: none"> Expectation that officials will “take care” of the risk More concerned with local issues 	<ul style="list-style-type: none"> Distrust of insurers Misunderstanding of insurance cover Find it too expensive 	<ul style="list-style-type: none"> Response and evacuation assistance Education about flood risk Assistance in flood planning Seen as response agency, rather than preparedness 	<ul style="list-style-type: none"> Confusion over how to prepare for floods Expectation of “official” assistance High awareness of risk in all locations except Emerald 	<ul style="list-style-type: none"> Highly variable; significant levels of dissatisfaction Should use planning laws to keep people out of flood zones
	<ul style="list-style-type: none"> Residents 				

Table 3. Concepts and themes of responsibility from interviews.

Stakeholder	Flood history and memory	Cooperation and coordination	View of role of government	National approaches/standards
Council	<ul style="list-style-type: none"> Need to remind people of the risk Felt long-term residents were better informed than new residents Concerned about complacency following long dry periods or smaller than expected floods 	<ul style="list-style-type: none"> Joint awareness/education campaigns with SES Limited interaction with insurers Need for “strategic” decision makers to communicate with “on the ground” groups 	<ul style="list-style-type: none"> Mitigation and disaster relief funding from all government levels Want increased funding for mitigation and studies Extra assistance for small/poor councils Roles in planning, education, and awareness Facilitate communities helping themselves 	<ul style="list-style-type: none"> Supportive of information standards Concern standards would be too low Want incentives for going above requirements Uniform terminology so it is understandable across the country
	<ul style="list-style-type: none"> Need to remind people of the risk Information/awareness campaigns Benalla’s success with do not drive through floodwater’s campaign Feel long-term residents are aware, new residents are not 	<ul style="list-style-type: none"> Joint awareness/education campaigns with council Minimal interaction with insurers 	<ul style="list-style-type: none"> Funding for education/awareness programs Discussions at state level, no local involvement 	<ul style="list-style-type: none"> Need to take into account local variations/differences Preparations are different for flash flood to slow river floods Similar/same terminology should be used in awareness campaigns
Insurance industry	<ul style="list-style-type: none"> Council should do more flood education Make use of floods to fund mitigation while memory is fresh Flood information on rates notices Flood needs to be “in the conversation at the dinner table at least once a year” 	<ul style="list-style-type: none"> Attend community information meetings when invited Limited interaction with councils Minimal interaction with SES 	<ul style="list-style-type: none"> Disagreement over government involvement in insurance Some support for assisting current residents, but not future Some feeling that market forces should decide Building standards should include structural resilience 	<ul style="list-style-type: none"> Interest in centralised flood information portal Disagreement over government involvement in insurance
	<ul style="list-style-type: none"> Some want reminders, some do not Assumptions about safety: dams would “prevent” floods Misunderstanding of floods frequency and Average Recurrence Interval 	<ul style="list-style-type: none"> A handful of comments on the need for various stakeholders—state and local government, SES, insurers—to work together 	<ul style="list-style-type: none"> Desire for dams, levees, <i>etc.</i>, to prevent floods Expectations that officials would “take care” of floods 	<ul style="list-style-type: none"> No relevant comments

The desire for land use plans that minimise the exposure of the community to floods was common to all four groups. While council representatives discussed the difficulty of balancing development and population growth pressures and limitations of local topography, some other respondents were more blunt. One insurance representative singled out what he/she saw as poor development decisions in Emerald, saying “you can at least take into account what would be worst and what would be best in developments for that area”. At the same time, councils felt they were often unable to meet expectations, particularly the Queensland locations, who were implementing the recommendations of the interim Queensland Flood Commission of Inquiry interim report [32]. As one council representative in Emerald described it, “they want all this done by next week or something. It’s impossible”. SES representatives saw their role as both assisting during flood events and facilitating community preparedness, with one SES representative in Cooranbong (Dora Creek) stating “it (flood preparedness) is our responsibility, but it doesn’t negate what the resident’s responsibilities are too”. Residents had less to say on the role of the SES, with many seeing them as solely a response agency, and a similar view came from the insurance representatives.

5. Discussion

5.1. Cooperation and Shared Responsibility

Both councils and the SES are stakeholders with a clear public interest function and purpose. While flood insurance is available to the public, it is a business with private and financial interests. As such, the three stakeholders are answerable to different groups: councils and the SES to the public, and insurers to policy holders, reinsurers and shareholders. While representatives of all other stakeholder groups interviewed viewed insurers as ethically questionable and concerned only with profit, those views were based on expectations that saw insurers more as charities than businesses. Similarly, while the representatives of insurers felt that their role did not include involvement in local flood mitigation and planning discussions, representatives from both council and SES felt that insurers should do more to educate individuals and communities about their local risk—an expectation for insurers to operate with a greater public interest focus.

Good cooperation between stakeholders is necessary to effectively manage flood risk [38,39]. The findings of this research indicate that the level of interaction between the stakeholders varied, but in these four case studies it was strongest between councils and the SES. While there were examples of cooperation between council and the SES such as the Floodsmart program in Benalla [40], the interaction of councils with insurers was more limited, with some attendance at community meetings and information events, but only at the request of local communities rather than as a formalised process. Even where terms such as resilience and cooperation are used, there is often little in the way of practical application given. Resilience is the ability of an individual, community, or organisation, to cope with and recover from disruption without losing their normal functioning [41]. The National Strategy for Disaster Resilience (NSDR), adopted by the Council of Australian Governments (COAG) in 2011, discusses the need for “shared responsibility” in addressing risks [6]. It defines a resilient community as one that “works together to understand and manage the risks that it confronts”, and recognises that addressing hazards requires the involvement of governments, emergency services, local communities, and insurers, describing it as “the collective responsibility of all sectors of society,

including all levels of government, business, the non-government sector and individuals” [6] but gives little guidance on how this is achieved or looks in reality. Emergency Management Australia’s guidelines have also discussed the need for prepared communities and active citizens [42]. A review by Richards [43] of the 2010–2011 floods observed an improvement in collaboration and coordination between various stakeholders, but noted the need for further improvement. For local and national resilience to floods and other hazards to improve, clear steps for how to work together as stakeholders are needed.

5.2. Residents’ Roles and Expectations

While representatives of councils and the SES stressed that flood risk can never be removed completely and that floods need to be prepared for, residents’ responses indicated they favoured structural flood prevention options. The expectation of residents that preparing for flood was the responsibility of officials is common in regards to natural hazards [35,44,45]. In their analysis of media coverage of the 2011 Brisbane flood, Bohensky and Leitch [46] found that the community had placed expectations for preparedness and even prevention of floods on government. Drabek [47] noted that people will minimise the risk in their minds if disaster information is not specific enough, an observation well demonstrated by the comment of one Brisbane resident who stated that, despite living on the river, because his/her suburb was not specifically mentioned as one that would flood that “I assumed I was fine”. Just as residents in the four case study locations had high expectations of official assistance during flood events, research following the Black Saturday bushfires in Victoria in 2009 found that up to a quarter of residents expected emergency services to personally notify them of the need to evacuate before they would leave their homes [48]. Residents were also more concerned with what councils and the SES could do for them, rather than being proactive with their own preparations [27]. The need for all residents to be proactive in their own flood preparation, emphasised by all three institutional stakeholders, needs to be made clearer to residents.

Research into the 2000 floods in the United Kingdom found that residents there also attributed responsibility for the causes and solutions to official agencies [49]. Lave and Lave [50] found that residents in three Pennsylvanian communities both saw flood management as a government responsibility and lacked adequate knowledge to take flood protective actions themselves, while a Dutch study found the majority of residents see the government as having some or all responsibility for preparing for and preventing flood damage [51]. Despite these expectations, some residents in all four case study locations expressed a desire for better education and information about flood risk. These people recognised the importance of personal preparedness but were uncertain of what they could do to be better prepared. Many of those who expressed an interest in personally taking responsibility for planning for floods wanted information and resources so they could make use of it in future flood events. Comments made by these respondents included “I would follow recommendations”, “I would educate my children”, or saying information would be useful in preparedness simply “cause it would”. While there was a strong expectation of official help during a flood, the desire of some residents for better flood information shows there is ground on which to encourage residents to be more aware of their own flood risk and know what they can do themselves in the event of a flood.

5.3. Role of Emergency Services

While the SES originally emerged as an agency responsible for disaster response and recovery, its role has evolved over time and now also includes the provision of education to the public, the creation of flood plans, starting with the New South Wales State Emergency Service Act 1989, and participation in floodplain management committees [39]. Today, the SES is involved in emergency response, education and awareness, in all states and territories; contributes to development planning discussions in all states except Queensland and the Australian Capital Territory; and is responsible for evacuation in all states except Tasmania [52]. Representatives of the insurance industry saw the role of the SES as predominantly in post-disaster recovery, with one arguing that having too much involvement in other activities, particularly around land use and planning decisions, would “run the risk of diluting the mandate” the SES was designed for. Similarly, many residents largely viewed the SES as a response agency, rather than one involved in disaster preparedness. SES representatives, on the other hand, referred to public education programs, often conducted jointly with local councils, as part of their contribution to flood risk management. Residents voiced a desire for greater assistance from the SES during a flood event. A recent study by Gissing *et al.* [38] showed an increase of almost 200% in the number of requests for assistance in the space of one decade in the state of Victoria. Any attempt to increase the involvement of the SES in flood risk management will need to address the limited resources and personnel of the organisation, an issue noted in the interim report into the Queensland floods [32]. Gissing *et al.* [38] go on to stress the need for community engagement and preparedness, to encourage personal preparation rather than reliance on SES assistance during an event.

5.4. Insurance Discussions

The 2010–2011 floods were followed by confusion and criticism in the media over insurance coverage and definitions [53]. As a result some residents were uncertain of the role of insurance in addressing flood risk and their own flood cover. Until recently, flood insurance has not been widely available on residential policies in Australia [19]. This was at least in part due to a lack of detailed flood risk information, particularly maps indicating the potential extent and depth of extreme events. However, flood insurance has become increasingly available since 2008 because insurance companies now have the information to price individual household risk more accurately [54]. Views of the role and trustworthiness of insurance diverged between the stakeholders. For example, one insurance representative described his/her industry’s role as “the canary in the coal mine”, referring to the high level and cost of flood risk in Australia. On the other hand, one council representative described insurers as “pricks”, and felt they were more concerned with profits than the wellbeing of policy holders. All three insurance representatives suggested that residential dwellings should be constructed in a way that is able to withstand flood impacts, so they can be repaired at a lower cost rather than knocked down and rebuilt [55]. This would also reduce not only the cost of reconstruction but also insurance premiums.

5.5. Remembering, Forgetting, and Knowing Risk

The importance of flood history and memory of these events was frequently mentioned in responses from all stakeholder groups. As one insurance representative put it, “We’ve written poems, songs, and movies about our risk, but we forget when we’re in drought. We need to learn the lessons of the past.

We should use the dry periods as a time to put in mitigation”. The lengths of time since the last flood occurred varied in each of the four case study locations. Emerald has had two very large floods in quick succession (2008 and 2010), and as a result, many residents took further precautions in 2010 [56]. Brisbane’s most recent flood event prior to January 2011 was almost 40 years ago (1974) and, hence, beyond many people’s lifetimes, their memory, or the length of time they have been living in that location. In Benalla, the last significant flood occurred in 1993, still within much of the community’s living memory, but this event was followed by a number of smaller-than-expected floods, which led to residents expressing distrust in the information provided by the council and the SES. While most of the participants interviewed in the four stakeholder groups were in favour of actions that served as reminders of past events, such as memorials, flood height markers, signs, *etc.*, some residents just wanted to “forget”, as one Brisbane resident put it. Even by the first anniversary of the 2011 Brisbane flood, learning about the flood was largely limited to reflections on “community spirit”, as opposed to long-term adaptation [46]. Not only do residents sometimes desire to ignore past events, official responses do not always demonstrate that the lessons from past events have been learnt. For example, the vulnerability of New Orleans to Hurricane Katrina was exacerbated because lessons from Hurricane Betsy in 1965 had not been fully implemented: population growth continued to occur in the areas of the city most at risk, memories of the flood were lost due to population change, and a false sense of safety emerged as a result of the construction of flood protection levees [57].

In Australia, the Commission into the Black Saturday bushfires made similar observations about community memory and changes in population and land use since the severe fires of 1983 and 1939, noting that while previous fires had been severe, they had not been experienced by many of those currently living in the affected areas [58]. Similarly in Brisbane, many of the residents participating in this study commented that they thought the flood risk had been “taken care of” following the 1974 flood with the construction of Wivenhoe Dam. A representative of Brisbane council felt that poor management of the Wivenhoe Dam, upstream from the city and designed for both water storage and flood mitigation, had contributed to the flooding in their ward. Both he/she and several local residents stated that the dam had been described as being “built to stop future floods (so that) Brisbane wouldn’t flood again”, and this reliance on protection contributed to the dissatisfaction with officials over the Brisbane flood.

An interest in standardised information and planning requirements, language, and a single body for all information about flood risk was observed in the three institutional stakeholder groups. However, the need to balance the prescriptive elements of any standards while allowing flexibility to be responsive to local issues was highlighted as a potential challenge to any national approach. Insurance representatives referred to the United States’ National Flood Information Program (NFIP)’s centralised information agency and location as a model Australia could use. Suggestions for government involvement in subsidising insurance was frequently discussed but not supported by all respondents. The concerns expressed by some stakeholders regarding government subsidies were that they might provide an incentive for people to live in the highest-risk areas—this phenomenon has been observed as a result of the United States’ NFIP [59]. Despite those concerns, there is an acknowledged need to address the risk of those residents currently living in high-risk locations and those who were not aware of the risk when they moved into that property. One of the insurance representatives described this as finding a way to “grandfather in the grandfathers”, and made a suggestion he/she described as “lifetime squatter rights”, where the insurance premiums of current residents in such areas would be

subsidised, but those of future residents would not be. This would set a clearly defined time limit to the extent of government intervention. Recently-announced changes to the NFIP will see increases in insurance premiums for properties subjected to repetitive losses due to flooding [60].

This study is small in size, and while the research participants in the four locations showed interest in their flood risk, this cannot be taken as indicative of all councils across Australia. These councils saw flood as a high priority, but those locations that are less concerned may not take action if it is not required, *i.e.*, if any system is purely voluntary [61]. Related to this are Green's [62] warnings against flood risk management assumptions: that approaches and techniques that worked in one place will work in others; that getting stakeholders together will automatically result in cooperation; or, alternately, that the market will solve everything. One difficulty to be addressed is how to have structured, but responsive, approaches to flood events. Any process needs to be both meticulous and spontaneous, having both clear planning beforehand and flexibility to adapt [63]. The comments of residents in Benalla, that they wanted detailed plans from council and yet were critical of "cry wolf" warnings of events that were not serious, demonstrate the challenges of providing flood risk information that is credible and appropriate in a given situation.

6. Conclusions

Responsibility for flood risk management in Australia does not fall to any one stakeholder alone, but needs to be properly understood as the responsibility of multiple government and private sector actors—including the communities at risk. As the government's vision through the NSDR is to share responsibility between these stakeholder groups and calls for a stronger culture of shared responsibility in the face of rising losses due to floods and other natural hazards, future flood risk management arrangements need to focus on better defining and understanding the roles and responsibilities of each stakeholder group and improving communication and cooperation between organisations. While this study is only exploratory, the responses suggest there are differences in the understanding of different stakeholder groups of the roles and responsibilities of their own and those of other stakeholders involved in flood risk management. Differences in expectation are most notable with respect to the role of the resident: while representatives of local councils, the SES, and insurers expect residents to take more responsibility to protect themselves and their properties, the expectation of residents is that flood risk management is "someone else's job". The consequences of this situation are twofold: (1) poor communication, coordination, and cooperation between public and private organisations and residents; and (2) unrealistic expectations of the public of the skills, capacities and services that can be provided by public and private organisations to householders in order to reduce the risk of flooding at the property level. Further investigation into these differences in expectations, as well as the roles and responsibilities of other stakeholders, such as catchment management authorities and state and federal governments, are needed to better be able to address flood risk.

The various inquiries and reports following the 2010–2011 floods largely failed to include the potential roles and responsibilities of residents to be more aware of and better prepared for flood events, instead restricting their comments on residents to recommendations that flood risk information and warnings be more understandable and easily accessible [31,32]. In our opinion, this is an important oversight in the current debate over shared responsibility advocated by the NSDR. The question of whether residents should take more responsibility to prepare themselves for floods and to act in ways

that will minimise their vulnerability and potential impacts must be openly discussed. A debate that focuses only on the roles of governments, emergency services, and insurers and neglects the role of individuals is flawed and misses the boat.

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Conflicts of Interest

The authors declare no conflict of interest.

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Chapter 5. Shared Responsibility and Social Vulnerability in the 2011 Brisbane Flood

Where chapter 3 provided the context of what information is available for residents to inform them about their flood risk and options for risk reduction, and chapter 4 discussed the roles and responsibilities of all four stakeholders, the following two chapters focus on the results of the questionnaires distributed to residents. They both focus on the second research question: “What impact do socioeconomic and perception factors have on individual’s understanding of flood risk and their likelihood to be involved in their own flood preparedness?” While this thesis examines four stakeholders, the focus is on the resident as the key stakeholder in flood risk management as the person who experiences the most direct impacts of flood. Figure 1 lists awareness and preparedness as two key elements of individual residents’ shared responsibility in flood risk management. These two chapters also examine the central section of Figure 2, looking at residents’ vulnerability and use of two elements of personal preparation: flood information and flood insurance.

This chapter presents a case study of a single location: Brisbane. Having been the most visible flood of the 2010-2011 summer, and the first time a capital city had experienced severe flooding in a generation, Brisbane was an ideal case study. Brisbane also has the second-highest number of properties at risk from flood in Australia, with some 10% of Australia’s flood prone properties located in the Brisbane River floodplain (Leigh, 2005). This paper looks at the attitudes and vulnerabilities of residents and the impact of the recent flood on them. Their responses also cover some of their attitudes to the other three stakeholders. The fieldwork was carried out in August and September 2011, 8 months after the flood, and found that, while the wider city had returned to normal, those who had been inundated were still dealing with the flood’s direct impacts. The research for this paper was also conducted as part of a study into the 2010-2011 floods conducted with support from the National Climate Change Adaptation Research Facility (NCCARF) in collaboration with researchers from Risk Frontiers at Macquarie University and the Centre for Disaster Studies at James Cook University. An earlier version of the Brisbane results can be found in the report *Impact of the 2010/11 floods and the factors that inhibit and enable household adaptation strategies* (Bird et al., 2013).

This paper demonstrates that, while strategies such as the NSDR talk of the need for residents to be involved in their own preparedness, many individuals have little idea on what actions they can take and instead rely on protection from government and emergency services. Many respondents expressed anger at how the flood had been handled and the flood itself, feeling it should not have happened and that the responses from council, SES, and state and federal government had been inadequate. Assumptions about what would happen during a flood were found incorrect and inadequate. Even with a direct experience of flood, residents saw flood mitigation as the responsibility of others. Despite the availability of clear and detailed flood information from Brisbane City Council, many residents – both in this study and in Brisbane at large – had an inadequate knowledge of their flood risk.



Flood damage, Tennyson, Brisbane. Photo taken 30 August 2011. P. Box.

This paper found that, while almost three quarters of respondents were aware their location was vulnerable to flood, many had assumed that the Wivenhoe Dam would protect them. Respondents' answers about the handling of Wivenhoe Dam and their erroneous assumption that the dam had 'flood proofed' Brisbane echo the city's response to the 1974 flood, where some residents expressed shock at the flood, having believed the Somerset Dam, constructed in the 1940s, had 'flood proofed' the city (Grigg, 1977). Similar assumptions were made about insurance, with many respondents incorrectly assuming they were covered for flood. Moves by the insurance industry to use a standard and inclusive definition of flood for insurance will be beneficial in removing some of the confusion over insurance policies

and cover, but this paper also highlights the need to better educate individuals in areas at risk of flood of the need to have flood insurance.

This paper was written with Deanne Bird, Katharine Haynes, and David King, and has been submitted to *Natural Hazards* and is currently under review. Candidate's contribution to the following paper: research – 75%; analysis – 75%; writing – 75%; overall – 75%

Shared Responsibility and Social Vulnerability in the 2011 Brisbane Flood

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Abstract

In January 2011 Brisbane, Australia, experienced its first significant flooding in almost four decades. This paper presents the results of a questionnaire conducted in four affected inner western suburbs seven months after the flood. These locations were specifically chosen as the residents within these communities come from a range of demographic, social and economic backgrounds. The research utilised a mixed methods approach involving a quantitative questionnaire and qualitative interviews. This paper examines residents' experience of the flood, their thoughts on risk reduction and insurance, what factors helped or hindered response and adaptation to flood risk, and how to articulate shared responsibility for reducing flood risk. Assessing gender, age, income, and previous flood experience, it finds that those with previous flood experience were more likely to have flood insurance but less likely to have taken precautions to prepare for the flood.

While almost three quarters of respondents said they were aware of the flood risk when they moved to the area they were nonetheless surprised by and largely unprepared for the 2011 flood. The implications of these findings for future flood risk reduction are discussed.

Key words: Adaptation, risk reduction, flood hazard, disaster

1 Introduction

Extreme weather is one of the defining images of Australia. The Australian floods of 2010-2011 affected every state and territory, and were covered by the world media. After a decade-long drought, they refocused attention on the other end of the weather spectrum. In the six months from November 2010 to April 2011, over 90% of Queensland was disaster declared due to flood (QRA 2011). The flooding of Brisbane in January 2011 was the most significant during this period, with an estimated 18,000 properties in Brisbane and surrounds experiencing some level of inundation (van den Honert and McAneney 2011).

Brisbane is situated on a floodplain, and numerous floods have been recorded since the establishment of a settlement in 1824. The Australian Bureau of Meteorology has a comprehensive list of those floods (Bureau of Meteorology, 2013). The most significant flood in recent history had been that of 1974, when the Brisbane River reached a peak of 5.45 metres at the city gauge. The January 2011 flood was the first major flood since 1974, but the city had previously experienced many minor and moderate floods, and three major floods in the 19th Century. Those floods, in 1841, 1844, and 1893, were considerably higher than the 2011 flood, with all three reaching heights above 7 metres (Brisbane City Council, 1999, pg 5), whereas the 2011 flood only reached 4.46 metres at the city gate. Brisbane has a high flood risk with an estimated 18,000 properties within the '1 in 100' flood zone (Leigh, 2006), making flood awareness and understanding among the community vital.

Wivenhoe Dam was built to regulate flood flows and provide water for the city of Brisbane. The dam, proposed in 1971 and then built for water storage and flood mitigation in the aftermath of the 1974 flood (Grigg 1977), does not 'flood proof' the city, although many residents assumed that it would prevent floods. Given Brisbane's history and location, it will continue to experience significant rainfall and flood events into the future. Moreover, the costs of natural disasters is likely to continue increasing with population growth in at-risk areas (Crompton and McAneney 2008), including south east Queensland.

In terms of management of hazard events, the Australian National Strategy for Disaster Resilience describes hazards as a *shared responsibility*, stating that:

A disaster resilient community is one that works together to understand and manage the risks that it confronts. Disaster resilience is the collective responsibility of all sectors of society, including all levels of government, business, the non-government sector and individuals. If all these sectors work together with a united focus and a shared sense of responsibility to improve disaster resilience, they will be far more effective than the individual efforts of any one sector." (NSDR 2009, pg iv).

However, do communities share the responsibility in reducing flood risk? If not, how can we better articulate the responsibilities of each stakeholder – including individual residents? To address these questions, this paper uses Brisbane's flood experience as a case study to examine whether or not residents perceive and have taken a share of the role in this responsibility. To achieve this, the paper examines residents': awareness of flood risk; response to the 2011 event; insurance coverage for flood; information needs; and, opinions of potential strategies that might enable households and stakeholders to reduce future vulnerability.

In Australia, insurance has not typically included riverine flood in standard cover (ASIC 2000). Standard policies have covered storm and flash flooding, but there was variation in claims outcomes between insurance policies (Carter 2012). Confusion over definitions of flood and sources of inundation have been debated. At the time of the research, there was ongoing discussion of insurance issues both nationally and for individual respondents, including respondents awaiting the outcome of claims or disputing insurance companies' decisions. The Australian Securities and Investments Commission reported following multiple floods throughout the 1990s, recommending better information and education from insurers about what is and is not included in a customer's policy (ASIC 2000).

2 Flood experience and social vulnerability

Factors of vulnerability and past experience can affect residents' preparedness and responses to hazard events. Those groups who are generally more vulnerable are the elderly and very young, those with lower incomes, and women (Cutter 2010). Adger (2006) describes vulnerability to natural disasters as being based not only on exposure to a particular hazard, but also on the availability of coping resources. Following Hurricane Katrina, for example, while the impact of the storm was relatively uniform across demographics, those with lower incomes were less likely to have evacuated or had flood insurance (Masozera et al 2007). In the United Kingdom, the

most disadvantaged 20% of the population are significantly over-represented in areas at risk of flooding, with women and the elderly suffering greater adverse impacts (Walker and Burningham 2011).

Risk perception is complex, and often perceived risk and actual risk do not necessarily align. Perceptions are influenced not only by facts, but by experience, media coverage, and personal judgement of one's capabilities (Slovic 1987, Slovic 1999). Responsibility for preparedness for and response to natural hazards is often seen as the job of 'someone else', i.e. the local council, the State Emergency Service, the federal government (McPherson and Saarinen, 1977). This expectation that risks will be reduced by another person or group can lead to inertia on the part of individuals – waiting to be evacuated, waiting to be doorknocked, etc. There is also a desire and even expectation for risks to be contained and controlled. As described by Burton, et al (1968) there is an expectation that authorities have “a social responsibility to cushion all members of society against unexpected events” (pg 4).

The impact of various socioeconomic and cognitive factors on flood preparedness is not clear cut. A post-flood survey in south east Queensland found no correlation between either perception of risk or income and flood insurance (Lo 2013). However, this study was region-wide, rather than specific to those affected by the floods and therefore the impact of flood experience could not be identified. Thieken et al (2006), studying some recently flooded locations in Germany, found higher rates of insurance cover, mitigation, and information acquisition in households with previous flood experience, and Grothmann and Reusswig (2006) found correlation between age, income, and previous flood exposure, and seeking flood information and personal protective actions. A Swiss study found those with flood experience were both more likely to have taken preparedness measures and less likely to think they were prepared for flood (Siegrist and Gutscher, 2008). By contrast, research following a 1997 flood in Manitoba, Canada, found that previous flood experience can be beneficial in preparedness, but is largely useful when that previous experience was recent (Burn 1999), while a study in New Zealand found no link between experience and preparedness (Gregory et al 1997). Research in Cairns, Queensland, also found no links between socioeconomic indicators and flood awareness and preparedness (King 2001), and a Texan study found that, while older residents were more likely to have been flooded, they reported lower levels of stress (Tobin and Ollenburger 1992).

3 Methodology

Data collection involved both a questionnaire and semi-structured interviews with residents of the inner western Brisbane suburbs of Chelmer, Graceville, Tennyson and Rocklea (see Figure 1), along the southern shore of the Brisbane River. These suburbs were selected to represent varied demographics, with Rocklea being a younger and less affluent area, Tennyson and Chelmer older and more affluent, and Graceville in between (ABS 2013).

Using maps of the January 2011 flood, affected streets were identified and doorknocked. Purposive sampling was chosen as the central criteria for participation in this study was direct experience of the 2011 flood. Residents who had moved to the area following the flood were excluded from the study. Doorknocking was chosen in order to provide residents with an opportunity to discuss their experience in more detail while allowing researchers to observe damage first-hand. In general, the questionnaire covered how the flood impacted residents and what factors helped or hindered response and adaptation to flood risk, and what they think about flood risk. Specific questions focused on demographics, the impact of the flood on their property, awareness of flood risk, the state of their insurance coverage at the time of the flood, what information residents desired to have about flood risk, and their thoughts on how to reduce the risk. Most questions were closed, asking residents to select the option that best reflected their opinion or experience. However, options of “other, please specify” and “please comment” were included to avoid limiting responses. Open questions on opinions of how various stakeholders could reduce flood risk were also included.

Between 29 August and 3 September, 2011, 430 residences were doorknocked. If home, residents were given a hardcopy of the questionnaire for collection the following day or at an alternate time as specified by the resident. Alternatively, residents were given the option to complete the questionnaire online. During the doorknocking process, many residents took the opportunity to discuss their flood experience. Where permitted, an audio device was used to record these discussions. These interviews provide valuable qualitative data in the form of quotes, some of which are used throughout this paper.



Figure 1: Location of questionnaire area, Brisbane city is to the north east of the map

Occupants were home at 110 or 26% of the residences. Of those, 72 agreed to participate, a provisional participation rate of 66%. Thirty-four people took a hardcopy of the questionnaire, while 38 gave their email address and were later sent a link to the website SurveyMonkey, where they could complete the questionnaire up until the end of September 2011. Sixty-two completed questionnaires were received, giving a completion rate of 86% from those distributed. As not all respondents listed their suburb concrete completion rates cannot be given, other than for Tennyson, where 100% of distributed questionnaires were returned completed.

The 320 residences where nobody answered were divided into three categories: absent, empty, and abandoned. 'Absent' was used for addresses that appeared to be occupied, 'empty' was for addresses where it appeared nobody was currently living but the property was in some stage of repair or up for sale or rent, and 'abandoned' was reserved for houses that clearly had not been returned to – locked gates, mud-caked walls, overgrown gardens, etc. Two hundred and thirty-five residences or 73%, were categorised as 'absent', 69 residences or 22% were categorised as 'empty' and 14 residences or 4% were categorised as 'abandoned', making just over one quarter of properties unoccupied. The percentage of absent residents was close to uniform across the four suburbs, but variation existed in the other categories. Twenty-two percent of residences were 'empty' in Graceville, the highest rate. The highest rate of abandoned residences was 8% in Tennyson, with no abandoned homes in Chelmer.

4 Results

4.1 Questionnaire findings

In the following sections, results are analysed by gender, income, age group, and previous flood experience. These categories were chosen as previous studies have suggested they can influence residents' awareness and flood actions (see Weinstein, 1989, Kellens et al, 2012, Hansson et al, 1982, Burningham et al, 2008). As this study uses only self-reported data, the potential for some responses to be inaccurate – either accidentally or deliberately – is acknowledged.

4.2 Demographics

The largest proportion of respondents were from Chelmer (28%), 21% were from both Rocklea and Tennyson, 16% were from Graceville, and 13% gave no response. Table 1 shows the demographic spread across the questionnaire area. Percentages are given for all categories, and raw numbers are also given for the number of respondents from each suburb. When the questionnaire data is compared to 2011 census statistics (ABS 2013), the two suburbs with the lowest median age also have the highest proportion aged under 45, and Rocklea, with the lowest median weekly income, has a notably smaller percentage of respondents with household incomes above \$100,000. Seventy-four percent of residents had no previous flood experience, 26% said they had experienced flood previously. Of those with previous flood experience, 38% listed the 1974 Brisbane flood as their previous experience. Statistically significant correlations were found between income and experience ($p < 0.02$), and age and experience ($p < 0.01$), with those residents who had experienced flood prior to January 2011 more likely to be over 65 and have incomes below \$50,000.

	Chelmer	Rocklea	Tennyson	Graceville	Not listed	Total
Respondents	28% (17)	21% (13)	21% (13)	16% (10)	13% (8)	100% (61)
Female	47%	69%	54%	40%	75%	56%
Male	53%	31%	46%	60%	25%	44%
No flood experience	76%	69%	69%	70%	87%	74%
Flood experience	24%	31%	31%	30%	13%	26%
Age: under 45	29%	46%	38%	50%	50%	41%
Age: 45-64	41%	31%	46%	30%	37%	34%
Age: 65 and over	29%	23%	23%	20%	-	21%
Income: under \$50,000	18%	31%	31%	30%	13%	25%
\$50-100,000	24%	46%	-	20%	62%	30%
Over \$100,000	35%	8%	38%	30%	13%	26%
Don't want to say	24%	15%	31%	20%	13%	20%

Table 1: Demographics by suburb

4.3 Awareness and preparation

The questionnaire first sought to discover residents' awareness of flood risk. Residents were asked: *When you purchased/started living in your home were you aware it was vulnerable to flood?* The majority of those questioned (73%) said they were aware of the flood risk when they moved to their current address (Figure 2). Income and gender had no impact on resident's awareness of flood risk, but those with previous flood experience (56%) and aged 65 and over (54%) were less likely to have been aware of the risk when they moved to their current address.

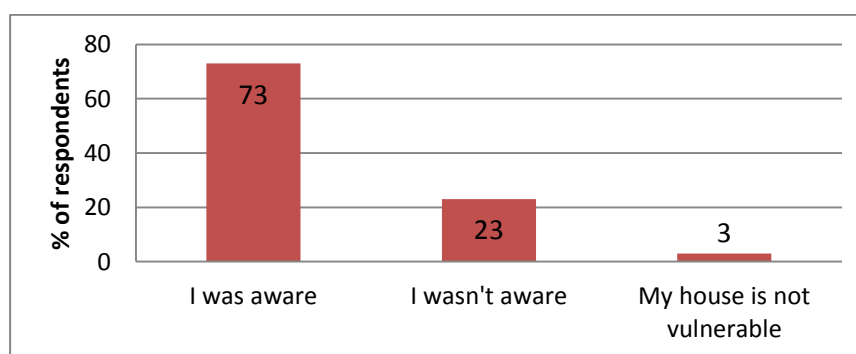


Figure 2: Awareness of risk when moved to current address

While the majority said they were aware their location was vulnerable to flood, many had assumed the Wivenhoe Dam would protect them from flood. One resident remarked “*we bought this house with the understanding that Wivenhoe would protect it, protect here*”. One respondent wrote they were “*foolishly convinced it would not reach previous levels as dam would be used to manage flooding*”, another wrote that they “*knew it flooded back in 1974 and were under the impression that it would not happen again as they had built Wivenhoe Dam as flood mitigation*”. Others misunderstood the ‘1 in 100’ flood terminology – thinking this meant another flood was not ‘due’ to happen for more than 50 years, given the last major flood was less than 40 years earlier.

Respondents were then asked: *What was the most valuable source of information about flood risk?* To which seven options were provided: local government; emergency services; friends/family/neighbours; community groups; media; personal experience; and other (see Table 2 – please note, no respondents selected emergency services or community groups, so those categories have been omitted). For ‘other’, two respondents mentioned awareness of the 1974 flood, five listed doing their own private research, and one was informed of their flood risk by their solicitor. Those with previous flood experience equally cited local government, friends/family/neighbours, and personal experience (i.e. 27% each category), while those without previous flood experience most valued information about flood risk from friends/family/neighbours. The sample size was too small to be statistically significant, but personal experience was more valued by respondents aged 65+ years, and information from friends and family was more valued by women, younger people, and those on middle incomes.

Information sources	Local government	Friends/family /neighbours	Media	Personal experience	Other
Female	29%	48%	5%	10%	10%
Male	16%	26%	5%	21%	32%
No flood experience	20%	43%	9%	9%	20%
Flood experience	27%	27%	0%	27%	18%
Age: under 45	22%	50%	0%	5%	22%
Age: 45-64	24%	29%	18%	6%	24%
Age: 65 and over	20%	40%	0%	40%	0%
Income: under \$50,000	25%	30%	0%	25%	17%
\$50,000-100,000	15%	54%	15%	8%	8%
Over \$100,000	20%	40%	10%	0%	30%
Average	22%	39%	7%	13%	20%

Table 2. Most valuable sources of flood information

Residents were asked what actions they took to protect their family and/or home prior to the 2011 flood (Table 3). Those with no previous flood experience took more actions, an average of 3.18 per respondent, than those with previous flood experience, who took an average of 2 actions each. That those with no flood experience appear to be less prepared is somewhat surprising. However, those with previous experience were also predominantly older residents, whose previous experience was the 1974 Brisbane flood. Both age and income can act as limiters to preparedness, and explain some of the lower preparedness of residents with flood experience. Some residents with experience also stated that their previous experience had led them to feel that some actions, such as sandbagging, would have no impact on protecting their homes and were therefore useless. Minimal variation is seen when the results are analysed by income, except for the middle income group being less likely to have followed warning advice. The younger age group were most likely to have evacuated and followed warning advice, with the oldest age group undertaking the fewest preparations. While men were more likely to have an evacuation plan, there was no difference in evacuation rates between genders. Again, statistical tests were carried out but the sample sizes were too small to be significant.

Action taken	Evacuated	Flood resilient building	Evacuation plan	Evacuation kit	Followed warning advice	Sandbag home	Cleared drains	Raised items
Female	62%	6%	12%	12%	41%	12%	9%	62%
Male	59%	7%	37%	15%	44%	15%	7%	59%
No flood experience	60%	9%	29%	16%	44%	18%	11%	64%
Flood experience	63%	0%	6%	6%	38%	0%	0%	50%
Age: under 45	72%	8%	24%	16%	56%	16%	12%	68%
Age: 45-64	48%	10%	33%	14%	27%	19%	5%	52%
Age: 65 and over	62%	0%	8%	0%	38%	0%	8%	62%
Income: under \$50,000	67%	13%	20%	22%	47%	7%	7%	60%
\$50,000-100,000	61%	6%	17%	22%	11%	17%	11%	67%
Over \$100,000	69%	6%	25%	13%	44%	25%	6%	56%
Average	60%	7%	23%	13%	42%	13%	8%	65%

Table 3. Actions taken by residents before/during flood

4.4 Flood insurance knowledge and cover

Respondents were asked about their insurance cover at the time of the flood, as well as whether or not they had since changed it, or planned to change it. The first question aimed to gauge the level of flood insurance penetration into the study area: *Please indicate which of the following most accurately describes your knowledge of your insurance cover prior to the 2011 flood.* Respondents selected from four responses:

I knew my insurance covered me for all types of flood

I thought my insurance covered me for all types of flood

I knew my insurance covered me for storm flood only

I knew I did not have any insurance cover at the time of the flood

25% of those with flood experience and 33% of those with no flood experience had thought their insurance covered them for all types of floods (Table 4). The results were too small to be statistically significant, but show a slight tendency for those with previous flood experience to be more aware of what their insurance covered. When assessed by age, those over 65 were most likely to have full cover and least likely to have no insurance, while the youngest age group was most likely to have thought their insurance covered them for all types of flood. Those with higher incomes were both most likely to have full flood cover and most likely to have thought they had full cover. Insurance cover was also assessed by home ownership status, comparing renters to those who owned or had a mortgage on their property. The majority of renters had no insurance (71%) and no renter had full flood insurance. It should be noted, however, that only 7 respondents were renting, so no conclusion can be drawn from these percentages.

	All flood	Storm only	No insurance	Thought I was covered
Female	22%	16%	28%	34%
Male	27%	23%	19%	31%
No flood experience	20%	18%	20%	33%
Flood experience	31%	19%	25%	25%
Age: under 45	20%	20%	24%	36%
Age: 45-64	24%	14%	24%	24%
Age: 65 and over	31%	23%	15%	31%
Income: under \$50,000	13%	27%	33%	27%
\$50-100,000	17%	22%	28%	22%
Over \$100,000	25%	13%	-	50%
Average	23%	18%	21%	33%

Table 4: Respondent's insurance status at the time of the flood

A second question was asked to those without full flood cover: *If you did not have insurance prior to the 2011 flood, why?* Respondents selected answers from: didn't think I needed it; too expensive; I thought it wasn't available; it wasn't available; I thought I was covered; or other, where they could then give further detail. Cost was regularly singled out as the biggest reason for not having insurance (Table 5). One resident said he had been quoted \$6,000 a year for cover, which he judged beyond his ability to pay. Cost was particularly prohibitive for women, those with flood experience, and the younger and middle aged groups. Those with high incomes were most likely to have thought their insurance covered them for all types of flood. In giving their reasons for not taking out cover, some residents indicated they did not trust insurance companies, describing them variously as "bastards", "morally corrupt", and "thieving mongrel lousy guys". One respondent commented he felt insurers wrote policies in unclear language so they could "wangle their way out".

	Didn't think I needed it	It wasn't available	Too expensive	Thought it wasn't available	Thought I had insurance	Other
Female	15%	8%	54%	8%	15%	-
Male	8%	17%	17%	8%	17%	33%
No flood experience	16%	11%	32%	5%	16%	21%
Flood experience	-	17%	50%	17%	17%	-
Age: under 45	15%	-	46%	-	31%	8%
45-64	11%	11%	33%	11%	-	33%
65 and over	-	50%	-	25%	25%	-
Income: under \$50,000	13%	25%	38%	13%	-	13%
\$50,000-100,000	22%	11%	33%	11%	11%	11%
Over \$100,000	-	-	-	-	67%	33%
Average	12%	12%	36%	8%	16%	16%

Table 5: Reasons why residents did not have flood insurance

A third insurance question asked: *Since the 2011 flood, have you updated or purchased an insurance policy for all types of flood?* Some residents commented they were waiting for insurance decisions to be finalised, or were investigating upgrading their cover, one writing "will be purchasing tomorrow – full flood cover". No demographical difference was observed between any of the categories.

4.5 Residents' thoughts on risk reduction

Residents were asked what they thought could be done by the council, and SES, as well as what they felt were the best options overall to reduce flood risk. While residents were able to give up to three responses, some gave one, two, or no suggestions. As these questions were open-ended, a wide array of responses was received. This section will discuss some of the common issues raised.

Residents were first asked: *What are the three main things you think can be done from a council perspective to help reduce your risk from future flood?* There were four main suggestions for council: Wivenhoe Dam (32% of responses), flood information and mapping (17%), improving stormwater drainage (15%), and regulations such as land use planning (8%). Others made suggestions about Oxley Creek, which empties into the Brisbane River facing upstream (see Figure 1), causing backup flooding into suburbs such as Rocklea. Some residents suggested widening the Creek mouth, "so that the River doesn't think that Oxley Creek is the river to flow straight into", while another suggested "build a groyne to stop Bris River flowing straight up the Creek." Other responses concerned sandbagging, building levees, and clearing the Brisbane River of debris.

The second question concerned the response of emergency services: *What are the three main things you think can be done from an emergency service (e.g. SES) perspective to help reduce your risk from future flood?* Fewer responses were given for this question. While 25% of responses wanted better early warning, many residents made suggestions that not emergency services' responsibilities, with 13% suggestions concerned the running of Wivenhoe Dam or land use planning. A few residents expressed satisfaction with the SES, saying they were "good", "did all they could", and even "they were brilliant!" 9% suggested more volunteers and resources as one way the SES could improve for the future, and 7% called for general information and education. The responses

asking for more information and warnings suggest that residents wanted to do more themselves but felt they did not have adequate knowledge to do so.

The final of the three questions was: *What do you think are the three best measures or strategies to help reduce your risk from future flood?* This question allowed residents to state which issues they felt were most important, and also gave them the opportunity to suggest any steps they could take themselves to reduce their risk. Management of Wivenhoe Dam (27%) and early warnings (14%) were the most commonly raised issues, making up almost half of all responses. One resident wrote “*Have the brains to realise Wivenhoe needed controlled releases well before Jan 11. Do you need to be a hydrologist to work this out?*” Other suggestions included raising homes, moving, or using flood resilient building materials, and only 4% of responses mentioned having “*appropriate insurance*”, but most respondents did not suggest actions they could personally take.

4.6 Information desired

Residents were asked: *What information would you like to be available on flood risk in your area?* Residents could select as many options as they wanted from the list of: flood maps; flood studies; brochures; media campaigns; flood/disaster page on council website; and council newsletter (Figure 3). It should be noted that Brisbane City Council already had flood maps and studies available on their flooding web page, along with further tips on flood risk and preparation. While some residents indicated they were aware of this information’s availability, the broader responses suggest information is being underutilised. Those in the youngest age group were most interested in both maps and a web page (75% and 62% respectively), with the oldest age group least interested in those information types, at 46% and 23%, respectively. In comparison, respondents 65 years and over were most interested (46%) in information being available via media campaigns. There were few differences in responses from men and women, except for a higher interest in brochures and newsletters from women compared to men (32% each for women, 19% and 7% respectively for men).

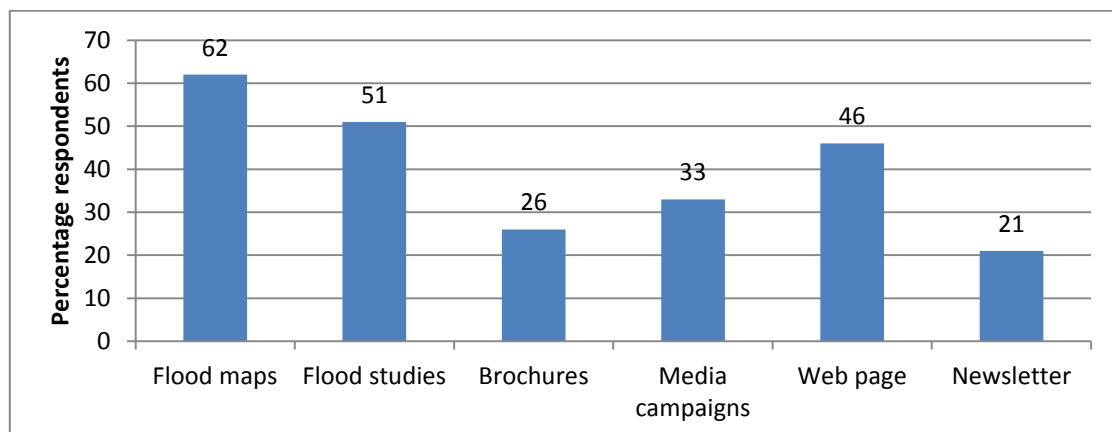


Figure 3. Information types desired by residents

5 Discussion

The sample size for this study was small, but did find some variations in responses based on gender, age, income, and experience. Women, those on lower incomes, and the young, were less likely to have insurance, and more likely to find it too expensive. Women also found personal and ‘official’ sources of information most valuable, while the young valued personal sources most. Some residents made assumptions of their safety, with expectations that council, SES, or some other official agency would prevent any potential flood. The desire for information – both generally and specific warnings from the SES – suggest that residents may be uncertain how to respond, and this limits their actions.

Previous experience did not have the effect of improving residents’ preparation for the January 2011 flood. The only positive correlation with previous flood experience was for insurance knowledge and cover. The sample size of this study limits what conclusions can be drawn, but the categories that showed higher vulnerabilities – the youngest and oldest, women, and those on lower incomes – are the same categories identified by Cutter (2010). Walker and Burningham (2011) found similar results in the United Kingdom, and also found gaps

between official recovery actions and the needs and desires of residents, something some Brisbane residents also alluded to, particularly regarding how council and SES could reduce future risk.

The findings from Brisbane are similar to those found in other post-disaster research, such as that conducted following a 1998 storm event in Townsville, Australia (King 2000). King's argument that 'people who experienced severe loss of property, experienced that loss precisely because they never expected it' (pg 226) is supported by the comments of Brisbane residents. Assumptions about changes in flood mitigation, misunderstanding of flood terminology, and low risk perceptions all affect how people 'apply' their flood risk awareness. That their area is a flood plain may not prompt people to take precautionary action if they believe that is the responsibility of others (Paton, 2003), and Brisbane residents' comments about the management of Wivenhoe Dam and decisions of the council reflect a belief that preventing the flood was the job of 'someone else'.

Simply knowing that an area has flooded in the past does not lead to understanding that it could flood again. In their paper, Burton, et al (1968, pg 18) identified four common responses to uncertainty about hazards: deny the hazard's existence, dismiss the hazard's recurrence, make it determinate (i.e. floods happen every X years), and transfer responsibility to another power (e.g. the government or God). All these attitudes were encountered in Brisbane, particularly with reference to the role of Wivenhoe and the responsibilities of council, state government, and dam management. One recent paper (Burningham et al, 2008) listed two further components to flood risk awareness beyond just knowing the risk: awareness of flood warning systems and methods; and awareness of what actions to take in a flood. These further criteria expand awareness from simply being a piece of knowledge to something that is applied.

In Brisbane, not only had it been close to four decades since the last significant flood, there had been the construction of the Wivenhoe Dam and adoption of stricter building controls in the interim. These had contributed to complacency about risk. Even an evaluation report on the Wivenhoe Dam recognised the potential of such 'forgetting', referencing the earlier-constructed Somerset Dam, built during the 1940s, as being seen by residents as having 'flood proofed' Brisbane (Grigg 1977, pg 80). Just as the 1974 flood reminded residents that Somerset Dam could not prevent flooding entirely, January 2011 showed that neither could Wivenhoe. Linked to this is poor understanding of the '1 in100' flood terminology. That a flood was less than 40 years after a prior flood was pointed to by some residents as a reason why the flood wasn't meant to happen. Not only is this a misunderstanding of flood terminology, it does not reflect the magnitude of the 1974 flood, which was estimated not to be a '1 in 100' flood, but to have a recurrence interval closer to 40 years (Brisbane Council, 1999). The Queensland Floods Royal Commission (QFCI) highlighted this lack of understanding in its discussion of the Q100 design flood height previously used in Brisbane (QFCI 2012, pg 39). Therefore, even for those who were aware of the risk, their perception of that risk was lower than that quantified by the experts.

Flood insurance received significant media coverage during and after the flood. It included anger at rejected payouts (for example, Priest et al 2011; Johnston 2011; Gillard, 2011), as well as calls for companies to be 'compassionate' and provide ex-gratia payments (Bligh 2011). Negative attitudes to insurance were evident in the questionnaire responses and interviews, and anti-insurance banners were observed hanging from multiple houses. Following the floods, consumer advocacy group Choice awarded the insurance industry their 'shonky' award, given out each year to businesses or industries seen as not acting in the interests of consumers (Choice, 2011). Similar sentiments were expressed in the Consumer Federation of America's 2012 report on the American insurance industry described the "illegitimate shift [of] costs and risks to taxpayers and consumers" (CFA 2012). With one third of respondents being mistaken about their insurance cover, such attitudes are unsurprising.

One outcome of the 2010-2011 floods has been the adoption of a new single definition of flood for insurance purposes. This move was supported and proposed by the Insurance Council of Australia (ICA 2011). The new regulation, made in June 2012, defines flood as:

"the covering of normally dry land by water that has escaped or been released from the normal confines of:

- *any lake, or any river, creek or other natural watercourse, whether or not altered or modified;*
or
- *any reservoir, canal, or dam."*

(SLI 2012 No. 116) A number of residents expressed confusion about what sort of water damage was covered by their insurance, so clarity and uniformity in terminology should address that particular concern. At least one academic paper published following the flood has agreed with public and media suggestions that insurers have done an inadequate job in outlining what is and is not covered by different policies (Tarr 2011). Some residents who had no insurance had made that decision based on their mistrust of insurance companies, but had nonetheless prepared for the flood. Those residents generally had more positive stories about their experiences,

and had been more proactive in the lead-up to the flood, in contrast with those who thought their insurance covered them for flood. Flood insurance needs to play an increased role in risk reduction, with high premiums in the highest risk areas encouraging people away from those locations. To aid the transition for those already in high risk locations, government subsidies should be offered to current residents.

In discussing risk reduction options, some residents recognised their role in flood preparation and response. This was seen in the comments for more information and more warnings, suggesting residents rely on council and emergency services for preparedness and response information. But the value of flood information and warnings is in how residents use that information. All sources of information listed in the ‘information desired’ question were already available from Brisbane Council, but many residents were unfamiliar with them. Hurst (2011) reported on public criticism in relation to information availability, with Brisbane Council’s website crashing in the days before the flood due to the volume of traffic attempting to access flood maps. Another theme was discussion around restrictions and controls on building in flood prone areas. One related restriction, not raised in any questionnaires or interviews, but touched on in media coverage, was council buybacks of severely affected homes. Brisbane Council had a buyback scheme in the years before the 2011 flood, but the strict qualification criteria, requiring there to be “no other viable infrastructure solution” (BCC 2011, pg 1), worked against it. Only 55 of 525 eligible houses were purchased in the buyback scheme. The Queensland Flood Commission (QFCI) recommended buy-back schemes be implemented and funded by the National Disaster Resilience Program (QFCI 2012, pg 275). In the two years following the 2011 flood, Brisbane Council has purchased 38 properties (Brisbane Council 2013). When residents expect governments and public agencies to protect them from flood they are less likely to take personal precautions (Grothmann and Reusswig 2006). A Netherlands study asked residents to rate responsibility for disaster preparedness and preventing damage to personal possessions on a scale from completely the individual’s responsibility to completely the government’s responsibility; most people thought they and government were equally responsible for disaster preparedness, but felt government was more responsible for preventing damage to possessions (Terpstra and Gutterling 2008). Following the Black Saturday fires in Victoria in 2009, almost three quarters of people had expected official warnings to be given to them directly, and almost two thirds did not receive them (Whittaker et al 2013). In Brisbane, one Chelmer resident specifically stated she had thought she was not at risk because her suburb was not mentioned, while other residents noted a lack of SES warnings and presence. Beatson and McLennan (2010) felt the Black Saturday fires exposed a lack of effective education before and understanding of warnings during the fires, as well as lack of planning by householders.

Dissatisfaction with the response of Brisbane council, the managers of Wivenhoe Dam, and the SES was very high. Many residents described feeling ‘ignored’, describing a lack of presence of SES and council during and in the immediate aftermath of the flood. However as the SES is a largely voluntary organisation, they are limited in what they can do in a flood of the scale of Brisbane. Any push for shared responsibility needs to include an understanding in the public of the abilities and limitations of emergency services in disaster situations, including limited manpower. More volunteers were suggested by two respondents, and the same recommendation was made by the interim QFCI report (QFCI 2011, pg 16). Concern about lack of or inadequate warnings from emergency services have been raised after previous disasters in Australia (Gissing et al 2010). The one exception to the dissatisfaction with council was opinions about the local councillor for the survey area, who was viewed positively by all respondents who mentioned her.

Residents’ experiences were not entirely negative. There was a lot of positivity about the community response, and stories of neighbours assisting each other in both evacuation and clean up, one resident saying the floods “*gave permission to help each other*”, while others described an increased sense of community (Bird et al 2012). The help of local community and other volunteers was also highly valued. The ‘Mud Army’, the 20,000+ volunteers who helped in the clean-up on the first weekend after the flood (Moore, 2011), many travelling in from outside Brisbane, were also well-regarded, despite a few concerns about them not being entirely prepared.

The Natural Disaster Insurance Review ‘Consumer Perspective’ paper recommended information be available not only on public websites such as local councils, but also be listed on yearly rates notices, provided on insurance policies and renewal letters, and provided when a property is leased or purchased (Connolly, 2011). This would put flood information in front of residents on a regular basis. It also favoured automatic inclusion of flood cover with no ‘opt-out’, i.e. no possibility to have insurance that did not include flood cover, but also asks for government and industry to ‘improve the affordability’ of insurance (Connolly, 2011). This returns to questions of how different responsibilities are distributed amongst the various stakeholders, and where the financial responsibility for residing in flood-prone areas lies. While this is beyond the scope of this particular paper, it is an area in need of further research.

Flood planning decisions in Australia are made at a local government level. As such there is a wide range of policies, as well as varying levels of information availability (Box et al 2012). The Queensland Flood Commission noted both this variation and lack of a single location for flood studies and maps, and recommended

the creation of one repository for such studies (QFCI 2012, pg 58). The variability of flood information across the country is now being addressed by the National Flood Risk Information Project (NFRIP), hosted by Geoscience Australia. Brisbane Council already had a high level of detailed flood risk information available, although they have come in for criticism – including by some of the participants of this questionnaire – for allowing development in known flood risk areas.

The 2010-2011 floods prompted a number of reviews and inquiries, with state flood reviews in both Queensland (QFCI 2012) and Victoria (Comrie 2011), the federal Natural Disaster Insurance Review (NDR 2011), and a review by the Brisbane Council of their flood response (Joint Flood Taskforce 2011), amongst others. All these reviews examined the role and response of governmental, emergency service, and insurance stakeholders, but largely bypass discussion on the responsibility of residents, barring some comments about ensuring information is accessible to the local community. This view of the public as simply recipients of information has been critiqued in the context of both the 2010-2011 floods and the Black Saturday bushfires (Nicholls 2012). The one exception is the National Strategy for Disaster Resilience (NSDR, drafted 2009) and adopted by the Council of Australian Governments in late 2011, which calls for shared responsibility for all stakeholders, including the local community. It provides general principles and aims, but there is a need for research and consultation among all stakeholders to better define how this works in practice.

6 Conclusion

Many residents appeared unsure of what to do in a flood, and were unaware of what responsibilities are held by the various stakeholders, let alone themselves. While the sample size was small, there is a clear feeling amongst residents, which was reflected in the media, that the Brisbane flood was handled poorly. The Queensland flood inquiry did make criticisms of the Wivenhoe Dam management and of council, and of their management decisions before and during the flood. But there was less certainty on what actions residents could take to ensure the risks from future floods are reduced. There is a need for greater communication and support to ensure residents can better understand and fulfil their responsibility to reduce risks. However, the limitations that underlying social vulnerabilities such as age and low income can present to flood preparedness must mediate the level of responsibility residents can assume for their flood risk.

Local and interpersonal linkages are important in a flood event, something reflected in the stories recounted by residents. Other stakeholders, such as SES, council, and insurance need to be brought into the same discussion as that being held by residents, rather than keeping the structural stakeholders separate from the local community. If the aims of the National Strategy for Disaster Resilience for shared responsibility are to be met, then residents need to be seen as more than end users, both by themselves and by other stakeholders. In Brisbane, some residents responded with uncertainty partly because they did not properly appreciate their risk, but also because they either didn't know what to do themselves, or expected another group, such as the government, should or had 'taken care' of it, and that they were protected by Wivenhoe Dam.

This paper found that previous flood experience had no impact on residents' preparedness for flood. Age and income had variable impacts on residents' responses. There is a need for an expanded awareness of flood, beyond simply knowing an area is flood-prone, to knowing what will happen in a flood and what an individual can do for themselves. This also includes better understanding or clearer usage of terminology about the size and frequency of floods to address misperceptions about the '1 in 100' flood. Finally, it is important that the contributions residents can make to their own preparation – such as having flood insurance, using flood resilient building materials, and having an evacuation plan – are better promoted so that when a flood inevitably occurs, risks are reduced.

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Chapter 6. Residents' attitudes to flood hazards in three Australian communities: The role of socio-economic factors and risk perception in household preparedness

The following is the final of the four research papers, and follows on directly from chapter 5. It again focuses on research question 2, "What impact do socioeconomic and perception factors have on individual's understanding of flood risk and their likelihood to be involved in their own flood preparedness?" This paper examines individual's responses based on the two categories of vulnerability factors shown in Figure 2; risk perception and socioeconomic factors. The interactions with the other three stakeholders, depicted in the same figure, are examined through questions on what can be done by council and emergency services to reduce the risk of flood, and questions about insurance cover.

Three case study locations are covered: Emerald in Queensland, Benalla in Victoria, and Dora Creek in New South Wales. This paper looks at two categories of factors: socioeconomic factors, and perception factors. These two categories look at things that can limit residents' capacity to prepare for flood, or their knowledge of the need to prepare for flood. As such, it follows on from chapter 4 by presenting what residents themselves think, and whether or not their thoughts and preparedness align with what the other stakeholders expect of them. This paper brings together the issues of information, perception of hazard, and the preparedness and responsibilities of different stakeholders. As the NSDR notes, cooperation and understanding between stakeholders is necessary for effective hazard management (Council of Australian Governments, 2011), and the questions regarding insurance and the roles of council and the SES identify residents' perspectives on that cooperation.

The previous chapter examined differences within a flooded location, while this chapter examines differences between locations each with a significant flood risk but a different flood history. The purpose of this was to see how those differences influence respondents' answers and attitudes. As already noted in chapter 2, flood experience can contribute to greater awareness of and preparedness for flood, but the effects of experience on individual's actions diminishes over time. While Emerald had experienced its worst flood on record a matter of months before fieldwork was conducted, Dora Creek was last flooded in

2007, and Benalla 1993 – almost 20 years previous. Based on research around experience and preparedness, it would be expected that Benalla residents would be least concerned about their flood risk. While the factors examined here – gender, income, age, previous experience, and awareness of risk – do affect individual's preparedness, their effects are not straightforward.



Visible flood line, Emerald. Photo taken 23 August 2011. D. Bird

As with chapter 5, this chapter discusses respondents' ideas about risk reduction. This links back to the discussions in chapters 3 and 4, about the importance of flood information and the roles of the three institutional stakeholders. Where the website survey in chapter 3 showed great variation in the amount of information available to inform residents about their flood risk, the three institutional stakeholders examined in chapter 4 felt strongly that individuals need to be proactive in their own flood preparedness, through flood insurance, household flood plans, and good knowledge of their risk. This final chapter shows that residents are often less clear about how they can prepare for flood, and make erroneous assumptions that they will be protected by the institutional stakeholders.

This paper has been submitted to *Disasters* and is currently under review. Candidate's contribution to the following paper: research – 80%; analysis – 100%; writing 80%; overall – 90%

Residents' attitudes to flood hazards in three Australian communities: The role of socio-economic factors and risk perception in household preparedness

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Abstract

Many communities across Australia are vulnerable to flooding, but hazard awareness, risk perception, and preparedness vary considerably. Individual's ability and willingness to prepare for flood can be affected by socioeconomic factors, like income, age, and gender, and by perception factors, like hazard awareness, and previous flood experience. This paper presents results of questionnaires used in three Australian towns – Emerald, Benalla, and Dora Creek – to determine residents' knowledge of flood in their community, their flood insurance status, and their ideas on how to reduce flood risk.

This paper finds that socioeconomic and perception factors do not explain all variation within or between locations. While it is important to consider socioeconomic vulnerability and perception factors in addressing individual's flood preparedness, local differences, such as Emerald's transient population and Benalla's relatively mild recent experiences, equally need to be considered in encouraging residents' involvement in their own flood risk management.

Introduction

Local residents are a key player in flood preparedness, and need to be informed and prepared for flood events (CSIRO, 2000). Individual's perceptions of flood risk and their preparedness for flood are informed by a complex set of factors, including their socioeconomic status, their experiences, and their assumptions about local flood risk and protection (Burningham et al., 2008, Green et al., 1991, Handmer, 2003). Flooding is the second-deadliest hazard behind heatwaves (Coates, 1999, FitzGerald et al., 2010), and the average annual cost of flood impacts – covering physical damage, injury and loss of life, and business disruption of almost \$400 million a year between 1967 and 2005 (BITRE, 2008). The need for communities and

individuals to be involved in flood preparedness was formally recognised in the National Strategy for Disaster Resilience (NSDR), signed by federal, state, and territory governments in 2011 following the extensive flooding of the 2010-2011 summer. The Strategy calls for a 'whole-of-nation' effort, involving communities, individuals, governments, and the private sector in preparing for natural hazards (Council of Australian Governments, 2011). Individuals and communities are key players in implementing such policies, and the NSDR sees the role of individuals as actively seeking information about risk and knowing what to do during a hazard event, as well as being financially prepared through insurance.

Yet individual's understanding of flood risk and cause is often different from officials: they are more likely to both over- and underestimate the risk of flood, and often see flood as caused or prevented by human actions (Siegrist and Gutscher, 2006, Green et al., 1991). So what factors may affect individual's risk preparedness and attitude towards risk reduction?

This paper presents the results of research conducted in three Australian communities to investigate residents' flood awareness, insurance cover, and thoughts on how to reduce the risk of flood. The three case studies have different sizes, flood histories, and social compositions. A questionnaire was developed to ask residents what information sources are most useful, what information residents want available, whether they have flood insurance, and what options they see for flood risk reduction. Clear information is necessary not just to inform about risk, but to encourage preparedness, resilience, and communication (Nicholls, 2012).

One potential option for personal flood preparedness is through insurance, which aims to redistribute the costs of flood events by putting the economic impact more directly on those affected (Britton, 1989). Insurance for flood has only recently become widely available in Australia (Mason, 2011), and the role of flood insurance has received considerable attention since the 2010-2011 floods, as some residents discovered their policy did not cover them for

flood (Tarr, 2011, Commonwealth of Australia, 2011). Affordability of insurance was one of the key issues prompting the Natural Disaster Insurance Review (Commonwealth of Australia, 2011). With this context, insurance cover was one component of the research in this paper. This paper examines whether residents' understanding and preparedness vary based on three socioeconomic factors: gender, age, and income; and two perception factors: flood awareness, and previous flood experience. Do these factors have similar influences on individuals in all three communities, or do the different histories and characteristics of each community play a larger part in people's attitudes to flood?

Adger (2006), describes vulnerability to natural hazards as encompassing location, use of natural resources, and the coping resources available to a person or group. This paper focuses on the third element, coping resources. Cutter (1996) sees vulnerability as a social phenomenon, describing it as "the susceptibility of social groups or society at large to potential losses (structural and non-structural) from hazard events and disasters"(pg 530) . Socioeconomic indicators are frequently used to assess vulnerability, with women, children, the poor, and the elderly frequently identified as the most vulnerable groups (Fielding and Burningham, 2005, Walker and Burningham, 2011, Weichselgartner, 2001, Cannon, 2008). Those social groups are more likely to feel they lack the resources to prepare for and respond to hazard events (Gregory et al., 1997), and often see themselves as worse-affected than the wider community (Khunwishit and McEntire, 2012). Other studies however, including research conducted in Australia, suggest that socioeconomic measures do not give a complete evaluation of vulnerability, but need to be complemented by assessment of community characteristics (King, 2001, Kuhlicke et al., 2011).

A second set of factors contributing to people's vulnerability to flood hazards relate to the perception of risk. Knowledge and experience have been identified as key influences on an individual's risk perception (Ludy and Kondolf, 2012, Blanchard-Boehm et al., 2001, Montz and Tobin, 2011). These risk perception elements have been conceptualised in a number of

ways. Kates (1962) discussed what he called the 'prison of experience'; that personal experience and understanding of risk inform how an individual evaluates flood risk. Paton (2003) proposes a social-cognitive model, arguing that individuals need to perceive the risk as real and themselves as capable before they take precautionary action, while Grothmann and Reusswig (2006) use a socio-psychological approach to describe elements of awareness, experience, and coping capacity as distinct from socioeconomic factors.

Recent experience is a strong influence on people's concern about flood (Kates, 1971, Burn, 1999). Personal and 'vicarious' flood experience, through direct communication with neighbours, friends, and family can increase individual's awareness of risk (Siegrist and Gutscher, 2006), and is more effective than general education programs in increasing knowledge of local flood risk (Terpstra et al., 2009). On the other hand, experience can also negate concern about a hazard if the experience was only mild (Weinstein, 1989, Kasperson et al., 1988). Residents' preparation for flood and response to flood information is informed by their existing knowledge (Burningham et al., 2008). Being aware of the risk before moving to a location suggests the risk is well publicised and the individual is interested in the characteristics of their location.

The role of and interaction between these factors is important in determining how to improve flood risk management approaches, and to encourage individuals to take more responsibility for their own flood preparedness. For example, Slovic (1999) finds lower concern about risk in men, particularly those with higher incomes. Drabek (1999) observed that women and younger people were more likely to listen to and act on warnings, while men and older people placed greater trust in their own ability to cope with a potential threat. Grothmann and Reusswig (2006) found those factors related to risk perception more influential than socioeconomic factors, as those related to perception can encourage individuals to prioritise actions to reduce their risk over and above the potential limitations of socioeconomics.

Methodology

Three Australian communities were selected as case studies to examine the influence of these various factors on individual's attitudes to and preparedness for flood. Case studies with different demographic characteristics and flood histories were chosen in order to determine whether these socioeconomic and perception factors influence individual's preparedness, or whether differences in history and community characteristics were more important. The towns selected are: Emerald, Queensland; Benalla, Victoria; and Dora Creek, New South Wales (Figure 1). These locations were chosen because the eastern states of Queensland, New South Wales, and Victoria contain over 90% of the properties in Australia at risk from a 1 in 100 ARI (average recurrence interval) flood (Leigh, 2005).

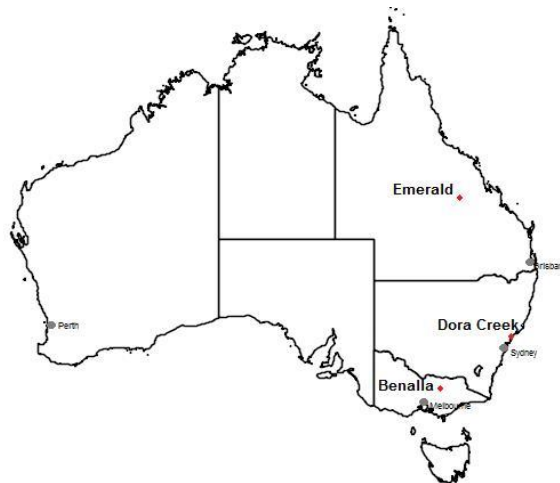


Figure 1: Case study locations

The three towns have similarities and differences: all have a high flood risk and none are protected by levees, but their flood histories and the nature of flood events experienced are different. The towns also have different socioeconomic characteristics. Table 1 uses data from the 2011 census to show the differences in income, home ownership, and housing costs in the three locations (Australian Bureau of Statistics, 2013c, Australian Bureau of Statistics, 2013a, Australian Bureau of Statistics, 2013b).

	Emerald	Benalla	Dora Creek	Australia
Weekly household income	\$2,294	\$770	\$919	\$1,234
Weekly rental payment	\$304	\$175	\$270	\$285
Monthly mortgage payment	\$2,167	\$1,192	\$1,733	\$1,800
Home ownership	15%	38%	45%	32%

Table 1. Key housing statistics and costs in the case study locations and nationally

Emerald is an agricultural and mining centre on the Nogoa River in central Queensland, with a population of almost 13,000 at the 2011 census (Australian Bureau of Statistics, 2013c). Emerald has a high rate of population turnover, with 15% of the population having moved to the town in the year before the 2011 census (Regional Australia Institute, 2013). It experiences riverine flooding, with 5 severe floods occurring since 1918 (C&R Consulting, 2011). Emerald has had two recent floods, January 2008 (Pace, 2008), with its largest flood on record occurring in December 2010 (Agius, 2010), and is the most recently flooded of the three locations. The 2010 flood inundated 1,000 properties above floor level (Bird et al., 2013).

Benalla is an agricultural town in central Victoria, situated on the Broken River. At the 2011 census, it had a population of just over 9,000 (Australian Bureau of Statistics, 2013a). The town's worst flood on record, with an Average Recurrence Interval (ARI) of 100 years, occurred in 1993 (Benalla Rural City, 2004). During the 20th century, Benalla experienced 15 notable floods, and almost 900 properties would likely experience over-floor flooding during a 1 in 100 flood (Delatite Shire Council, 2002). While surrounding rural areas were affected by floods in September 2010, January 2011, and March 2012, they did not cause flooding in Benalla itself (Benalla Council personal comm. 2012).

The third case study, Dora Creek, is located on the Central Coast of New South Wales, between the cities of Sydney and Newcastle. It was last flooded in June 2007, during a storm that caused widespread damage across the region (Jones, 2013). Dora Creek is the smallest of the three communities, with a population of just over 1,600 (Australian Bureau of

Statistics, 2013b). It is located on low-lying ground beside the Creek, and is susceptible to fast-onset flash floods, with 10 such floods occurring during the 20th century (Lake Macquarie Council, 1998). Approximately 180 properties would experience over-floor flooding during a 1 in 100 year flood (Lake Macquarie Council, 1998).

A questionnaire was used to assess residents' flood risk awareness, preparedness and response in the three case study locations. Questionnaires were distributed in Emerald in September 2011. The Emerald case study also formed part of a National Climate Change Adaptation Research Facility (NCCARF) funded project into the 2010-2011 floods (Bird et al., 2013). Using a map of the 2010 flood extent provided by council, the worst-affected streets were identified. All houses in identified streets were doorknocked, and residents asked if they would like to complete the questionnaire. Fieldwork was conducted in Dora Creek in April 2012, with council-provided maps used to identify properties at risk from a 1 in 100 flood. Benalla fieldwork was conducted in May 2012, using maps of properties at risk in a 1 in 100 flood provided by the State Emergency Service. The same doorknocking process was used in Benalla and Dora Creek. A total of 185 questionnaires were completed across the three locations: 50 in Benalla, 40 in Dora Creek, and 95 in Emerald. The completed surveys represent 10% of households flooded in Emerald, 5% of those at risk in Benalla, and 22% of those at risk in Dora Creek.

The questionnaires all covered the same issues but the Emerald questionnaire was worded to specifically examine respondents' flood risk awareness and insurance cover at the time of the 2010 flood. Socioeconomic questions included respondents' gender, age, and household income. Data on tenure was not collected. Income responses were divided into three categories: low income (under \$50,000/annum), middle income (\$50,000-100,000/annum), and high income (over \$100,000/annum). Age was divided into those under 45, the middle-aged group (45-64), and retirement age (65 and over). Compared to the broader community profiles from the 2011 census, the samples in this study had a

similar income structure, but the samples in Benalla and Dora Creek had a higher proportion of respondents aged over 65 than the overall population (Australian Bureau of Statistics, 2013c, Australian Bureau of Statistics, 2013a, Australian Bureau of Statistics, 2013b). Risk perception questions asked whether respondents had previously experienced flood in any place they had lived, and whether they were aware of the risk of flooding when they moved to their current residence. These questions were chosen to determine whether having certain knowledge makes respondents more likely to be concerned about and better prepared for flood.

Respondents were also asked about flood information, their insurance status, and their views on how to reduce flood risk. Residents were asked about the most valuable source of information, rather than the first source of information, as the quality and availability of information varies greatly (Box et al., 2012). Of the three locations addressed here, only Dora Creek had detailed flood information available online from their local council.

Respondents were also asked what sort of information on flood they would like to have available, to see if any particular types of information could be better utilised or targeted. Respondents were asked what insurance cover they had: full (including flood cover), none, storm only (no flood insurance), or unsure. Given recent discussions about the roles of different stakeholders in hazard management and discussions of shared responsibility (Council of Australian Governments, 2011, Box et al., 2013), respondents were asked to suggest what could be done to reduce the risk of flooding by three stakeholders: local councils, responsible for local planning and infrastructure decisions; the State Emergency Service (SES); and themselves. These questions aim to see what influence respondents' expectations of government and emergency services have on their personal preparedness decisions. In particular, they aim to see if high expectations of government protection result in low levels of personal preparedness (Soane et al., 2010).

Results

The results are presented in three sections. The first addresses what influence the socioeconomic and perception factors have on respondents' flood preparedness. The second section examines whether residents in Benalla and Dora Creek, which were not directly affected by the 2010-2011 floods, have become more concerned about their flood risk since those events occurred through the 'vicarious' experience of risk through friends and family or the media, as described by Paton (2003) and Slovic (1987). The third section presents a discussion of risk reduction, and the views of residents on the roles and responsibilities of three stakeholders in reducing flood risk.

The overall results are presented in Table 2. While the age and income distributions of the three case studies varied, there were more female respondents than male in all cases. Notable differences were around the perception factors of flood experience and awareness. Although Emerald had experienced a flood only two years earlier, Emerald had the smallest percentage of respondents with previous flood experience, and less than 20% of Emerald respondents were aware of the risk when they moved to their current location. Emerald is notable for the high levels of population turnover due to growth in the local mining industry which results in a continuing inflow of new residents unfamiliar to the area and potentially unaware and unprepared for flood.

In all three case studies, some respondents did not consider themselves vulnerable to flood. Yet when a larger flood occurs, those who see themselves as not vulnerable are likely to find at least their grounds flooded. In Dora Creek, in particular, the floods previously experienced have had ARI of about 1 in 25 years (SES Cooranbong, pers. comm.). In Emerald, 56% of those who answered they were not vulnerable to flood reported water in their yard, with one respondent reporting over 1 foot of water (Bird et al., 2013). In Benalla, a number of residents dismissed the council as 'crying wolf' about flood risk, as projected possible floods in September 2010 and January 2011 did not eventuate, leading them to feel that the council

exaggerated the flood risk. These results confirm the findings of Kaspersen et al. (1988) that mild personal experiences can reinforce an individual's perception that they are safe.

	Emerald	Benalla	Dora Creek
What is your gender?			
Male	36%	36%	42%
Female	64%	64%	58%
What is your age?			
Under 45	62%	14%	25%
45-64	31%	32%	25%
65+	7%	54%	50%
What is your annual household income?			
<\$50,000	26%	62%	61%
\$50-100,000	24%	39%	21%
>\$100,000	50%	8%	18%
Have you ever experienced flooding anywhere you have lived?			
No experience	48%	38%	26%
Experience	52%	62%	74%
When you purchased/started living in your home were you aware it was vulnerable to flood?			
Aware	18%	64%	67%
Unaware	72%	28%	28%
Not vulnerable	10%	8%	5%
Which of the following provided the most valuable information about the risk of flood?			
Friends/family	36%	25%	39%
Experience	27%	19%	18%
Local council	0%	28%	24%
Media	9%	3%	3%
Community groups	23%	0%	3%
SES	0%	16%	6%
Other	5%	9%	6%
What insurance cover do you have?			
Full insurance	42%	22%	30%
No insurance	16%	10%	22%
Storm only	9%	51%	24%
Unsure	34%	16%	22%
What information on flood risk would you like (tick all that apply)			
Flood maps	68%	70%	50%
Flood studies	56%	44%	48%
Brochures	34%	30%	25%
Media campaigns	27%	48%	18%
Webpage	58%	40%	30%
Newsletter	32%	38%	30%

Table 2. Summary of questionnaire results by location

Emerald had both the highest proportion of high income earners and the highest rate of households with flood insurance. Benalla, with the fewest high income earners, had the lowest rate of full insurance. A number of Benalla respondents commented that their insurance premiums had risen to provide flood cover,

and had not renewed their policies due to cost. The majority of residents in each location had inadequate or no insurance, and in Emerald, one third of respondents had discovered that their insurance did not cover them for flood. The varied wording of insurance policies as to whether and what type of flood damage is covered was noted by Tarr (2011) as contributing to underinsurance, while flood insurance has only recently become widely available in Australia.

Personal experience and friends/family were seen as valuable sources of information by respondents in all three locations. In Benalla, local council was the most favoured source of information, a result likely linked to the 'FloodSmart' program the council and SES began in 2006 to increase local flood awareness (Dufty, 2008). A proactive public education campaign can provide residents with some knowledge of their local risks. When asked what information sources they wanted, Dora Creek respondents showed consistently lower interest in almost all forms of information, with some stating that the area's flash flood risk made flood information useless, as once a flood was coming it would be too late to prepare.

The influence of socioeconomic and perception factors on flood preparedness

Income

Income can affect an individual's preparedness for flood as it can limit accessibility to different resources for preparing for and responding to flood. In particular, low incomes are linked to lower likelihood of having insurance cover (Tooth and Barker, 2007, Gregory et al., 1997), or not perceiving insurance as a necessity (Sheehan and Renouf, 2006). In Emerald lower rates of insurance cover in the low income households were recorded compared to high income households (22% versus 48%), there was no difference in Benalla (26% and 29%), while in Dora Creek 38% of low income residents had flood insurance, a level slightly higher than the high income group (36%). As such, low income does not appear to have been a limiting factor in either Benalla or Dora Creek.

Summarising research on poverty and hazards, Fothergill and Peek (2004) found that low income groups are less likely to hear or respond to warning messages. While no respondents in Emerald selected local council as the most valuable source of information, council was selected as the most valuable source of information by 33% of low income earners in Dora Creek and 20% in Benalla, where a further 20% of respondents selected the SES as the most valuable information source. In both cases, this suggests that local council and SES education programs have been effective in informing residents of their flood risk. Friends/family and personal experience were seen as the most valuable information source across locations and income groups. In Emerald, 100% of middle income respondents listed personal experience as the best source of flood risk knowledge, compared to only 33% of low income earners and 14% of high income earners. This high rate of selecting experience as the most valuable source of information is likely another reflection of the high population turnover in Emerald.

In all three locations, a smaller percentage of those in the lowest income group were aware of their flood risk than the highest income group: 16% aware versus 24% aware in Emerald, 57% compared to 75% in Benalla, and 56% compared to 80% in Dora Creek. As noted above, low income individuals are less likely to hear flood warnings. This lack of awareness can contribute to a lack of preparedness for low income individuals.

Gender

Research has linked women to greater vulnerability to hazards as they are likely to have fewer resources (Enarson et al., 2007, Fordham, 1998), have less control over finances (Blaikie et al., 1994), and perceive risks as more serious than men (Flynn et al., 1994). In both Benalla and Dora Creek, more female respondents were in the youngest age group: 19% of women compared to 6% of men in Benalla, and 35% compared to 12% in Dora Creek. Women were also more likely to be in lower income households: 33% of female respondents in Emerald had a household income below \$50,000 per annum compared to

13% of male respondents; in Benalla the numbers were 67% for female respondents and 6% for male, and in Dora Creek the numbers were 67% and 55% respectively.

Looking at preparedness-related issues, however, shows different results. In all three locations, more female respondents than male had full flood cover: 46% compared to 35% in Emerald, 29% compared to 11% in Benalla, and 36% compared to 25% in Dora Creek.

Female respondents' lower incomes did not translate into a lack of insurance cover. Male respondents in Emerald and Benalla were more likely to be aware of the flood risk when they moved to their current location (27% compared to 16% and 79% compared to 67% respectively), but there was no difference in awareness levels between genders in Dora Creek. Looking at the most useful sources of information, more female respondents selected local council: 29% compared to 19% of male respondents in Dora Creek, 45% of female respondents in Benalla, and no male respondents in Benalla – and none at all in Emerald – selected council. There was no link between gender and valued information sources, with female respondents in Emerald valuing friends/family as a source (40% compared to 33% of male respondents) and male respondents in Benalla valuing friends/family most (33% compared to 20%). Experience was almost equally valued by both genders in Emerald (25% male, 30% female), but was more valued by male respondents in Benalla (25% compared to 15%) and Dora Creek (38% compared to 0%). Community groups were only selected by women – 10% of Emerald respondents and 6% of Dora Creek respondents.

Enarson et al. (2007) suggest women often make greater use, both before and after hazard events, of grassroots and community groups and connections, and when all such information sources are combined women in Emerald and Benalla did favour those sources more than men (50% compared to 33% in Emerald, 59% compared to 33% in Dora Creek), in Benalla 55% of men favoured grassroots are community connections as sources, compared to 35% of women.

Age

More than half of the oldest group respondents were in the lowest income group: 50% in Emerald, 80% in Benalla, and 82% in Dora Creek. In Emerald, none of the oldest group had been aware of the flood risk when they moved to their current location, all age groups were equally aware of the flood risk in Dora Creek, and in Benalla awareness decreased with age: 86% of those under 45 knew of the risk when they moved to their current address, compared to 73% in the middle aged group and 63% in the oldest group. In Benalla, 57% of those in the youngest group had flood experience compared to 70% in the oldest group, and in Dora Creek 89% of the oldest group had flood experience compared to 50% of the youngest group. The difference was smaller in Emerald, where 47% of the youngest group and 57% of the oldest group had previous experience.

In both Benalla and Dora Creek, the oldest age group had the highest rate of flood insurance, with 31% of older Benalla residents and 47% of older Dora Creek residents covered for all types of flood. By contrast, in Emerald, 43% of older residents had storm cover only. Age did not have any impact on what source of information respondents considered most valuable. Age was the only variable that had an impact on what information respondents desired, with the oldest group in all three locations showing consistently lower interest in all forms of information. This suggests that to reach older groups, traditional education campaigns and sources may not be enough. Older residents are often more likely to be physically impacted by flood, but also report higher ability to cope (Tobin and Ollenburger, 1992, Walker and Burningham, 2011), and the results in these three case studies confirm this finding – despite lower incomes, less interest in flood information, many older respondents still had flood insurance to financially prepare for flood.

Previous experience

This section discusses factors relating to risk perception. While socioeconomic factors discuss an individual's *capacity* to respond to risks, perception variables examine their

knowledge of risk. Addressing risk perception is important to engage residents as active participants rather than passive recipients in flood risk management (Green et al., 1991). The two factors examined in this study are previous flood experience and awareness of flood risk when they moved to their current location.

Research has shown that experience can lead to greater concern about flood (Siegrist and Gutscher, 2008) and encourage self-protection (Grothmann and Reusswig, 2006, Mileti, 1999). However, these connections are often dependent on the experience being recent (Burn, 1999, Siegrist and Gutscher, 2006). In all three locations respondents with no previous experience were more likely to have been aware of the risk when they moved to their current location: 26% compared to 14% in Emerald, 76% compared to 66% in Benalla, and 80% compared to 67% in Dora Creek. Emerald's recent floods influenced the responses given for most valuable source of information, with 33% of those who had no experience before the 2010 flood citing that flood as the most valuable information about their flood risk.

Previous flood experience did not necessarily lead to better knowledge of their insurance cover. For example, in Emerald, more than 30% of those with previous flood experience did not know what their insurance cover included at the time of the 2010 flood. In Emerald and Dora Creek a higher percentage (49% and 41%) of those with previous flood experience had full cover than those without previous experience (34% and 0%). The reverse is true for Benalla (16% and 33%) which may be explained by a lessening influence of previous experience over time (Burn, 1999) and the small magnitude of events in the ensuing years (Weinstein, 1989). The results in these three case studies support the argument Siegrist and Gutscher (2006) make, that personal experience can both increase and decrease concern about flood, depending on the frequency and magnitude of the events experienced .

Awareness

The second perception factor is whether respondents were aware of the flood risk when they moved to their current location. Being aware of a location's flood risk is one requirement for flood preparedness (Burningham et al., 2008), although it is not sufficient. Despite some variation in insurance responses, including a higher rate of coverage amongst those who had not been aware of the risk when they moved in – 44% compared to 37% in Emerald, 29% compared to 23% in Benalla, and 50% compared to 26% in Dora Creek – awareness made little impact on insurance cover, except in Dora Creek.

While Dunbar (2007) highlights the benefits of information and risk knowledge, general awareness that a risk exists does not immediately translate into interest in enhanced preparedness (Burningham et al., 2008). Nicholls (2012) noted that what is needed is not single-direction information, but bi-directional communication with communities engaged in a process of increasing their knowledge of risk and response. While 64% of Benalla respondents and 75% of Dora Creek respondents were aware of the flood risk when they moved to their current location, only a quarter of those in each town had full insurance. Even though Benalla council and SES had undertaken extensive flood education (Vic SES, 2008), the respondents to this survey had not taken precautionary measures. Knowledge of the risk of flood does not necessarily result in personal preparation in individuals.

Those respondents who were unaware of their flood risk were asked if they would still have moved to their current location if they had known the risk at the time. In both Benalla and Dora Creek, more than 50% said they would still move knowing the risk, while in Emerald only 30% gave the same response, their recent experience making them less likely to want to continue living with that risk.

Increased concern about flood risk after the 2010-2011 floods?

Further questions on risk perception were asked in Benalla and Dora Creek to investigate the influence of the 2010-2011 floods on other communities at risk. Did the 'vicarious' experience (Paton, 2003) influence attitudes to flood risk, and did media coverage result in more concern about the risk (Slovic, 1999)? Respondents were asked to describe the level of their concern about flooding in their area (Figure 2). In Benalla, the youngest age group was most concerned about flood, and in Dora Creek, women, those with lower household incomes, and those who were not aware of the risk when they moved in were more likely to answer that they were 'very' or 'somewhat' concerned.

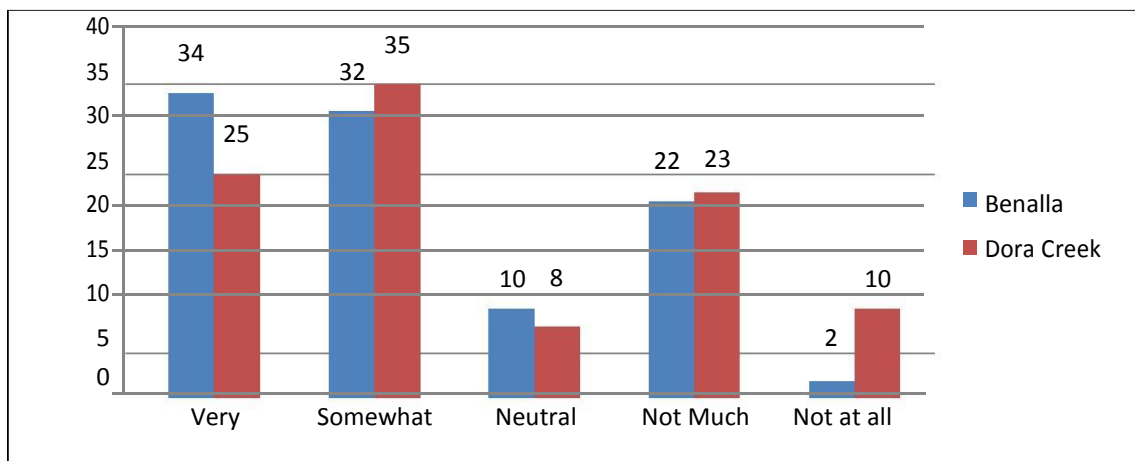


Figure 2. Level of concern of respondents about flood risk in Benalla and Dora Creek

Respondents were then asked to describe whether their level of concern had changed since the 2010-2011 floods, by choosing one of the following options: more concerned, less concerned, or about the same. In Benalla and Dora Creek 58% and 70% of respondents respectively reported that their level of concern was unchanged. While 32% of respondents in Benalla and 27% in Dora Creek described themselves as 'more concerned', the fact that the majority of respondents stated their level of concern was unchanged indicates that flood occurrences elsewhere did not serve as a motivator for the residents to enhance their own flood preparedness. For these two questions Benalla residents showed a slightly higher

overall level of concern about flood risk, but this has not translated into taking precautionary measures such as flood insurance.

Residents' views of responsibilities of different actors in flood risk management

Recent years have seen increasing discussion of the need to clarify the roles and responsibilities of different stakeholders in flood management (Box et al., 2013, Council of Australian Governments, 2011). Three open-ended questions on flood risk management were included to encourage respondents to think about what could be done and by whom to reduce flood risk. The responses given in these three questions were analysed by both socioeconomic and perception factors, but there were no correlations between those factors and the responses given. The responses are presented by location only.

The first question asked: *What are the three main things you think can be done by the council to reduce the risk of flood in your area?* Respondents' answers were collated, refined, and put into five categories (Figure 3). Hard/structural flood risk management options include physical interventions such as dams and levees to control and constrict flood waters; soft/planning options refer to education campaigns, building controls, and keeping drainage clear; during event solutions include early warnings and emergency assistance; nothing/unsure was selected by respondents who specifically stated they did not know what could be done or thought nothing could be done; and other included suggestions that did not fit in any category, such as cooperation with state government or catchment management authorities. The use of structural barriers to 'prevent' flood has a long history (Burton and Kates, 1963, McPherson and Saarinen, 1977, Takao et al., 2004). In the three locations examined in this study, both Benalla and Dora Creek respondents wanted diversion channels to take water around their towns, while in Emerald respondents wanted the Fairbairn Dam, located upstream from the town, to be raised to hold more water.

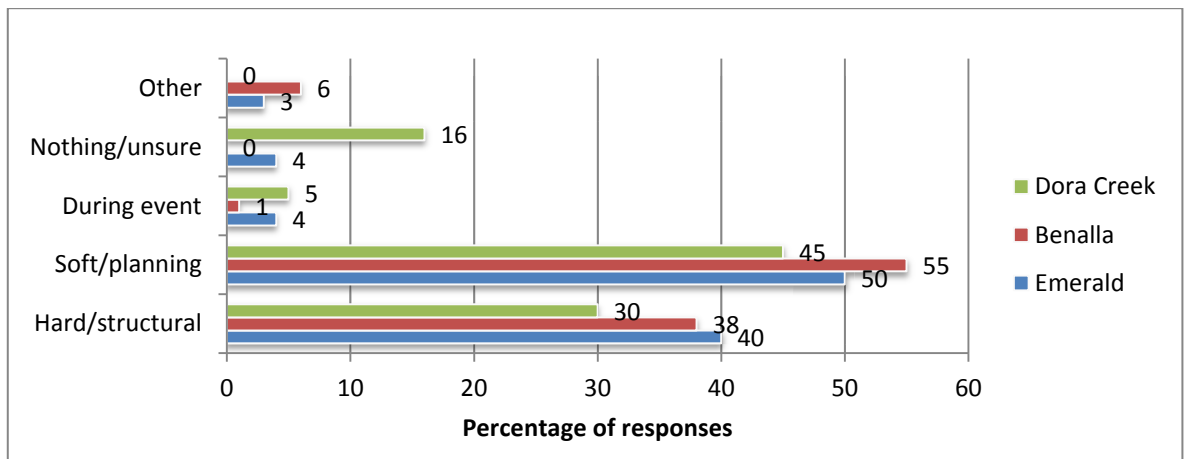


Figure 3. Actions suggested by residents to be done by local council to reduce flood risk

The second question asked: *What three main things do you think can be done by the State Emergency Services (SES) to reduce the risk of flood in your area?* (Figure 4). The SES is the agency responsible for emergency response in Australia. Its role has since expanded to include education, preparedness, and some planning activities, but it is still largely identified with its role in responding to storm and flood events (ACSES, 2012). Responses were divided into four categories: pre-event planning, encompassing all education and other activities undertaken when no flood is occurring; during event responses, covering all actions once a flood is coming, including sandbagging, warnings, and evacuation; council responsibilities, where respondents had made suggestions that were the responsibility of council, rather than of the SES; and praise. Praise covers answers such as “they were great”, “they do all they can”, and similar responses. In all three locations, at least 40% of responses concerned during event actions such as evacuation and early warnings, with less than one third of responses concerning flood planning.

Some respondents held a narrow view of the SES’ role, with one Dora Creek resident stating “emergency services only operate after a flood has occurred”. The focus on actions during a flood suggests that a lack of awareness of the full role of the SES is common. In order for residents to be more prepared for flood, the information and assistance of the SES

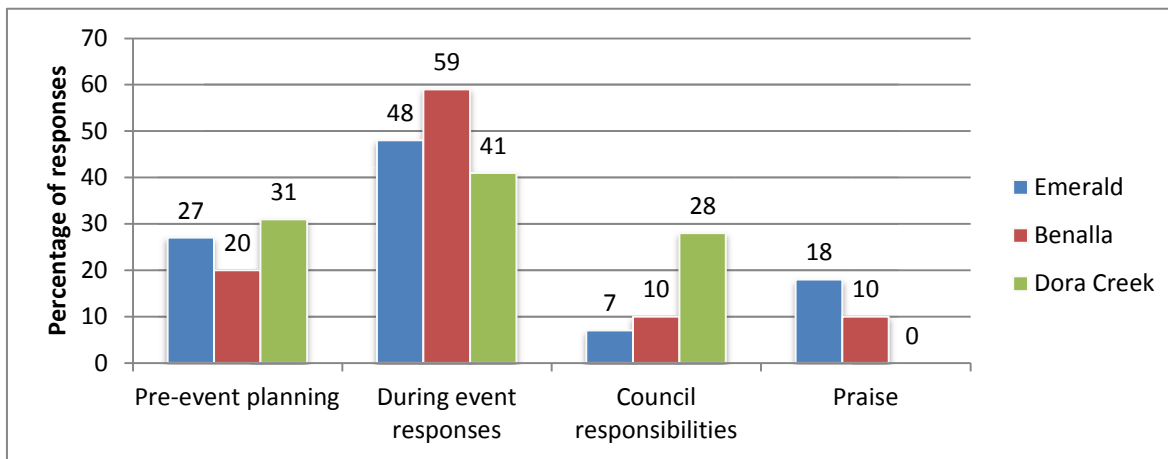


Figure 4. Actions suggested by residents to be done by the SES to reduce flood risk

is crucial so they do not rely on them during an event. These assumptions about emergency preparedness and response appear to be ingrained, with similar attitudes found about Civil Defence, the precursor to the SES, following the 1974 flooding of Brisbane (Macey, 1978), and in more recent research in New Zealand (Gregory et al., 1997). Again, a lack of awareness about the assistance the SES can provide in education and planning before a flood leads to residents not taking full advantage of available resources, and puts further pressure on all emergency services during flood events.

The third question was worded differently in Emerald than in Benalla and Dora Creek. The Emerald questionnaire asked: *Overall, what do you think are the three best measures or strategies to help reduce your risk to future flood?* For Benalla and Dora Creek, this question was amended to: *What are the three main things you think you can do to reduce the risk of flood in your area?* to clarify the desire for responses to be about respondents' personal actions (Figure 5). Responses were divided into four categories: council responsibilities, where once again respondents had made suggestions that were the responsibility of the council; pre-event actions covers preparations residents can make in and around their home before a flood occurs, such as flood insurance, evacuation plans, and property modifications ('flood proofing'); during-event actions such as evacuation and raising/moving items to higher ground; and information and communication about flood.

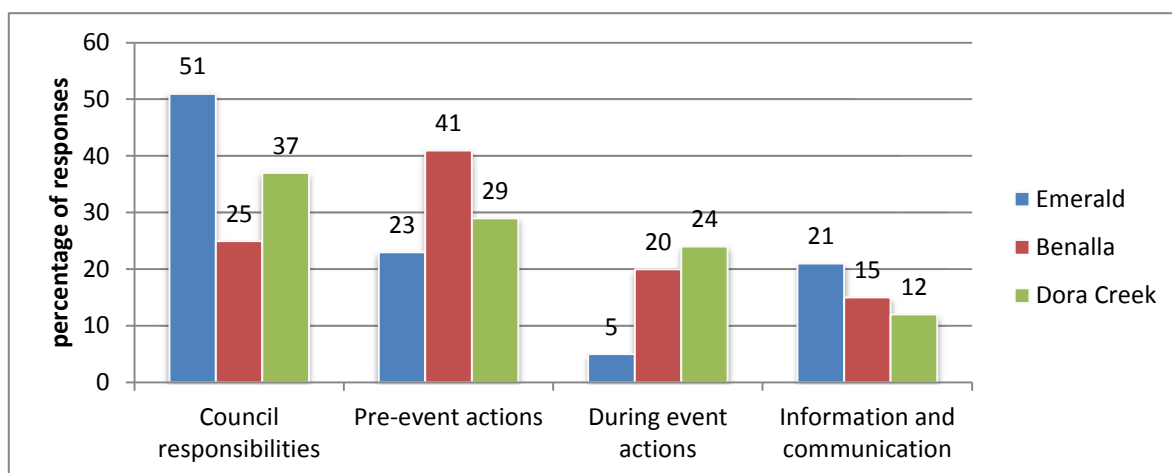


Figure 5. Actions suggested to be done by themselves to reduce flood risk

Of the three open-ended questions, this one had the greatest variation between the locations. The focus on council responsibilities in Emerald respondents' answers reflects the different wording of the question, but also suggests Emerald residents see flood risk management as the responsibility of officials. In both Benalla and Dora Creek, approximately 20% of responses were for keeping drains and gutters clear, while approximately 10% of respondents suggested raising items during floods. 14% of Emerald respondents, 12% of Dora Creek respondents, and 3% of Benalla respondents suggested raising/flood proofing their home or moving to a flood-free area, although the proportion of overall responses was small. 59% of respondents in Benalla and 55% in Dora Creek made suggestions of actions they could personally take before or during a flood to protect themselves, although approximately 10% of responses in both locations were general 'be prepared' comments. Less than 5% of respondents in each location mentioned flood plans or flood insurance. This

compares to research following a severe storm in Wollongong, New South Wales, in 1998, where 40% of respondents had made changes around their homes in the two years following the storm (Fletcher, 2002). These findings suggest there is interest in personal involvement in flood preparation, but this is limited by lack of knowledge of what they can do. The transience of Emerald's population is reflected in their unfamiliarity with actions to take during flood events, and their greater expectations for the council to lead flood preparedness.

Discussion

Research on vulnerability indicates that women are generally more vulnerable than men (Walker and Burningham, 2011), and this may be reflected in women's lower levels of risk awareness in all three locations. Yet, female respondents in this study were also more likely to be financially prepared through having insurance. The link between age and vulnerability is similarly complex, with those in the oldest age group in all three locations less likely to have been aware of their risk when they moved to the area, but, in both Benalla and Dora Creek, more likely to have full flood insurance. With income, those in the lowest income group were most likely to have been unaware of their risk, but more than a quarter of such respondents in Benalla and Dora Creek had full flood insurance. With all three socioeconomic indicators, membership of the more vulnerable group did not necessarily prevent residents taking financial precautions. Socioeconomic factors can limit capacity, but are not the only influence on individual's decisions.

Recent flood experience increases the likelihood of preparing for floods (Burn, 1999). But expectations and actions often result in preparing for a repeat experience (Weinstein, 1989, Green et al., 1991). Many residents in Emerald based their level of response on the height of the 2008 flood, despite the fact that the 2010 flood was predicted to be and was larger. While experience can have an effect on preparedness, it does not necessarily lead to taking out flood insurance or looking for flood information: these are more likely to be prompted by fear of flood (Takao et al., 2004). As such, it is not the knowledge or experience of flood, but the concern about its impacts that influence people's decisions. With Benalla respondents showing little concern about flood, it is unsurprising their results showed less flood preparedness.

Individuals commonly perceive their risk as lower than it is (Terpstra et al., 2009, Van Arsdol et al., 1964). Disbelief in possibility of disaster often leads to lack of precaution (Burton and Kates, 1963), and a lack of belief in the potential seriousness of flood can lead to inaction

until floodwaters are visible (Skertchly and Skertchly, 2000). The combination of the long time since their previous flood and the smaller-than-expected events in 2010 and 2011, contributed to the lower results in Benalla. The dismissal of the seriousness of the flood threat, and the lack of concern as the town avoided predicted flooding, meant residents in Benalla showed less interest in preparing for flood and may lead to being less prepared when the next flood occurs. That a number of Emerald respondents who had water on their property in the 2010 flood considered themselves 'not vulnerable' demonstrates that individual ideas of what is flood vulnerability differ greatly.

The majority of residents expressed interest in at least one form of flood information, most commonly flood maps. Despite a lower amount of available information from their local council, Benalla respondents were most likely to choose local council as the best source of information about flood risk. Given the other responses in Benalla, information does not necessarily translate into preparedness, nor trust in official agencies for flood preparation. While individuals voice an interest in having flood risk information, they do not necessarily make use of it. When flood maps in Adelaide were advertised, they were viewed fewer than 300 times in the first three months, while in Brisbane following the 1974 flood almost 6000 maps were sold in the first month (McKay and Finlayson, 1982). In the days leading up to the Brisbane flood of 2011, the city council's website crashed due to the number of people searching for flood maps (Bird et al., 2013), suggesting the desire to find flood information is sparked by flood events, not by general interest in flood risk.

Respondents in all three locations saw many responsibilities for council in flood preparedness. In contrast, research in Charleville, Queensland, found residents ranked individuals as having greater responsibility than all three levels of government (Keogh et al., 2011). One recent survey found almost half of surveyed Australians believe the government

should do more to protect communities from and prepare for natural disasters (MWH, 2011). Yet the same report found little willingness to pay higher costs to undertake such works. Structural or technical solutions to flood risk are often desired (McPherson and Saarinen, 1977, Takao et al., 2004), and yet again this study found many respondents were reliant on council actions to prevent flood. Just as Lave and Lave (1991) found in their examination of three Pennsylvanian communities, there were those who saw flood not as simply a natural occurrence, but the result of officials' decisions. Respondents would point to specific decisions they felt – rightly or wrongly – contributed to their risk of flood, rather than seeing preparedness as something they could participate in. While respondents did have a high expectation of government protection (Soane et al., 2010), there was also a desire to be more involved in their own flood planning, but this is hindered by a lack of knowledge of what to do.

The different community characteristics and flood histories of the three locations are reflected in their results. Emerald's high population turnover is evident in the lower level of risk awareness and fewer suggestions for how individuals could be involved in their own preparedness. Benalla's long period since its last severe flood, combined with low incomes, has led to a lower interest in personal preparedness. Finally Dora Creek sits in between, with higher levels of flood cover than Benalla but cynicism about the ability to prepare for floods due to the rapid nature of the flash flood threat. These characteristics combine with the socioeconomic and perception factors in determining individual's decisions about flood preparedness.

Conclusion

This paper has compared towns with different socioeconomic characteristics, different flood knowledge, and different flood histories. The town with the lowest levels of interest in flood and the highest levels of criticism was the town where it had been the longest since a severe flood, suggesting people had become complacent in the intervening years. This

complacency will contribute to a lack of preparedness, and, combined with unrealistic expectations of government and emergency services, will lead to blame-shifting, rather than mitigation, preparedness, and resilience. Also important is educating individuals on what options are available to prepare for flood, whether through insurance, the use of flood-proof building materials, or having an evacuation plan. Better knowledge of the options available can increase individual's capacity and reduce the damaging effects of flood.

While socioeconomic and perception factors can impact individual's preparedness for flood, the results of this paper show that there is more complexity than these factors determining individual's vulnerability. The differences seen between the three locations in this study show local factors have a large impact on each community. While there are identifiable general trends across particular socioeconomic groups in all three locations, there are also differences, showing that the broader social group of a community is equally significant in determining individual preparedness. To address flood risk, equal attention needs to be paid to local community attitudes and situations as to vulnerability factors. To focus on one and neglect the other will leave communities underprepared. This is particularly important when looking at individual responsibility, as expectations of government protection may be shown to be unrealistic in the event of a flood. The NSDR vision of individual's role in hazard preparedness is crucial, but it is moving from aims to reality that is key.

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Chapter 7. Conclusion

7.1. Where we started

Flooding is one of the most common natural hazards experienced in Australia, with much of the country liable to flooding (Middelmann, 2007). This is influenced by historic settlement patterns that have seen towns and cities established on waterways prone to flood (Bureau of Transport and Regional Economics, 2002). Floods are the most costly natural hazard in Australia (BITRE, 2008), and the most deadly (Coates, 1999, FitzGerald et al., 2010). Flood and other hazard events have often been followed by academic and government studies. In the last 40 years, studies have been conducted following the 1974 Brisbane flood (Macey, 1978, Murison and Woolard, 1974), Cyclone Tracy (Walters, 1978), the Ash Wednesday bushfires (Britton, 1986a, Clayer et al., 1985), the 1986 Sydney flood (Handmer, 1988), the 1990 Nyngan flood (Wills, 1996), the 1997 Cloncurry flood (King and Goudie, 1997), the 1998 Wollongong storm (Fletcher, 2002), and the 2007 Newcastle and Central Coast storm (Gibbins et al., 2008, Jones, 2013). Research on residents' preparedness for and response to floods has frequently shown many people to be inadequately prepared, and has criticised poor communication and coordination on the part of governments and emergency services.

The floods of recent years in Australia, particularly the 2010-2011 summer, have brought flood back into the public discourse. It also prompted state inquiries in Queensland (Queensland Floods Commission of Inquiry, 2012) and Victoria (Comrie, 2011), as well as federal investigations into insurance (Commonwealth of Australia, 2011, Standing Committee on Social Policy and Legal Affairs, 2012). Interest in hazard preparedness is often one of the main reactions following a disaster, but memory of events fades. The 2010-2011 floods should provide an opportunity to look at how Australia plans for flood and note the weaknesses highlighted. The decision to adopt a standard definition of flood for insurance purposes (Australian Government, 2012), after previous moves had failed (Commission, 2008), is an important step to remove confusion about insurance cover.

The National Strategy for Disaster Resilience, drafted in the aftermath of the 2009 Black Saturday bushfires, was adopted following the 2010-2011 floods (Council of Australian Governments, 2011). It builds on the Black Saturday Commission's discussions of shared responsibility in the context of bushfire planning and response (Teague et al., 2009) to

emphasise that hazard management is the responsibility of multiple stakeholders. Shared responsibility requires the identification and addressing of gaps in the expectations of different stakeholders. It also requires identifying what can affect individual's ability and interest in their own flood preparedness. This thesis used this idea as the basis for an exploration of the roles of four key stakeholders in flood risk management in Australia.

7.2. Key findings from each chapter

The preceding chapters established key issues in flood risk management generally and in Australia in particular, such as discussions about the role of insurance and the idea of shared responsibility in hazard preparedness and response. Chapter 3 to 6 have addressed what information is available, and how flood risk is perceived by residents in four communities. They have discussed various factors that influence individual's preparedness, and looked at the attitudes and roles of three other key stakeholders.

This thesis began with an examination of flood risk information availability from Australia's local councils in chapter 3. It used this as a base from which to ask the question of how easily residents are empowered to participate in their own flood preparedness, through being aware of any risks their location may have. It found that information was not always available in councils with identified flood prone areas, and the quality and useability of the information available varied widely. With the concept of shared responsibility including individuals being active participants in knowing and preparing for their own risk, there is a clear need for such information to be made readily available. Shared responsibility requires more than just listing which stakeholders need to be involved, it requires taking explicit steps to enable that involvement.

Chapter 4 moved on to look at the thoughts about flood of four stakeholders: councils, the State Emergency Service, the insurance industry, and residents. It reported the results of interviews with the three institutional stakeholders, and the questionnaires as well as some comments from residents. The three institutional stakeholders included in this study had broad agreement on flood risk management, but different understandings of each others' role. In particular, the role of insurers in encouraging preparedness was seen differently by different respondents. This chapter highlighted also that insurers feel their input is not listened to, and that the price of premiums are a reflection of the real risk associated with living in a location, and should not be used to demonise insurers but instead should encourage changes in how flood prone land is used. The SES found themselves

overstretched during flood events, and suggested that residents need to take charge of their own preparation, making use of the resources of the SES to plan what to do before a flood occurs, rather than relying on SES assistance once a flood hits. All three institutional stakeholders were concerned that residents were not engaged in their own flood preparedness, but saw it as the job of the institutional stakeholders. The focus of the Queensland and Victorian inquiries on what institutional stakeholders need to do, rather than discussions of how residents should take part in their own preparedness, was a missed opportunity to encourage greater responsibility of residents in areas prone to flood.

Chapter 5 took a detailed look at four of the worst affected suburbs in Brisbane. Presenting four suburbs with different socioeconomic characteristics, it found that preparedness was not necessarily affected by socioeconomic characteristics. The Brisbane study identified that residents with previous flood experience were more likely to be older, from low income households, and were least likely to have flood insurance. Attitudes towards insurance were strongly negative, with confusion over insurance cover. At the time of fieldwork, some participants were still in negotiation with their insurance companies. There were positives found in Brisbane, with residents grateful for the volunteer 'mud army', even if some people's enthusiasm outstripped their ability to help. Community involvement following major events is one option for them to take shared responsibility. In discussing what should be done to reduce their risk, Brisbane respondents unsurprisingly focused many of their comments on the Wivenhoe Dam, with few respondents suggesting modifications to their own properties or taking out flood insurance. This reflects an idea that the flood was due to poor decisions by the government and dam operators, and that, if things were simply 'managed better', individuals would have no need to take precautionary measures. Information and warnings were also raised as ways to reduce risk, but again, most residents appeared to interpret the question not as what actions they could personally take, but what actions would reduce the risk at their location. This difference in interpretation – actions a resident could take to reduce their risk versus actions that could reduce the risk to the resident – likely influenced the high rate of responses focused on actions from other stakeholders.

The comparison between the three case studies in chapter 6 showed that, while identified socioeconomic and perception factors can affect individual's vulnerability and capacity to prepare, they are not definitive. They form the basis on which individuals make decisions, but are complemented by local conditions and community factors. These need to be taken into account in responding to flood risk, as responses may need to be different in different locations. Respondents in each location had specific local concerns that they felt were important. In Dora Creek, some respondents felt the quick onset of any flood meant there was little they could do to prepare. In Emerald, despite higher incomes and a higher

proportion of respondents with flood insurance, respondents had few ideas about what they could do to prepare for flood instead seeing flood preparedness and response as largely the job of council. As noted, Emerald has a high population turnover that would contribute to a lack of awareness. Benalla, the poorest and oldest of the case studies examined, had the lowest rate of flood insurance and the fewest suggestions for actions to reduce the town's flood risk. Benalla's minor floods will have contributed to an attitude of complacency, as residents felt the warnings were exaggerated.

One finding from chapters 5 and 6 was that many residents – particularly in the two flooded locations, Emerald and Brisbane – had believed themselves protected from flood by structural measures. Others desired new structures, such as dams, levees, and drainage channels, to remove the risk of flood. Expectations that structural measures would 'fix' flood risk are still common after decades of academic and governmental discussion and adoption of land use planning. The surprise expressed by many Brisbane residents at being flooded demonstrated the level of trust many people place in dams and levees. The interest expressed in all four locations in structural measures such as dams, levees, and diversion channels show trust in structural measures is widespread. While land use planning and restricting building on land with high flood risk was raised by residents in all four locations, it was not a priority. Councils, SES, and insurance representatives placed greater emphasis on land use planning to reduce flood risk and damage.

7.3. Findings for the research questions

This thesis has examined the concept of shared responsibility and flooding in Australia. The term 'shared responsibility' is used due to its adoption in the National Strategy for Disaster Resilience (Council of Australian Governments, 2011), and is referred to – either through referring to the NSDR or through discussion – by the Queensland and Victorian inquiries and the Natural Disaster Insurance Review (Comrie, 2011, Queensland Floods Commission of Inquiry, 2012, Commonwealth of Australia, 2011). This short-hand term for the need for multiple stakeholders to be involved in flood risk management has entered official-level discussions as well as academic ones (McLennan and Handmer, 2011, Eburn and Dovers, 2012). The term was used in this thesis because of its prominent usage in the NSDR, and also to see how well the concepts are understood and applied by key stakeholders in flood risk management.

Within that broad concept, and using the 2010-2011 floods as context, this thesis has looked at flooding in Australia. Looking at four key stakeholders, it aimed to address two questions:

1. What gaps exist in flood risk management in Australia?
 - a. How do key stakeholders perceive responsibility is shared for flood risk management in Australia?
 - b. What can be learnt from the 2010-2011 floods?
2. What impact do socioeconomic and perception factors have on an individual's understanding of flood risk and their likelihood to be involved in their own flood preparation?

The first question was the focus of chapters 3 and 4, while chapters 5 and 6 focused on the second question. The first question lays the groundwork on which the second question is built, and the second question feeds back into the first through the opportunities available for residents to address their own flood risk.

Question 1, on the gaps in flood risk management in Australia, is the subject of chapter 3. The key gap raised in chapter 3 is that of information. Education and information about flood risks is a prerequisite for individuals and communities to participate in their own flood risk management. Local councils, who were examined for that element of this thesis, have created that gap by not all providing easily accessible and detailed flood information. This has a follow-on effect to the second question, as flood knowledge (or lack thereof) will affect an individual's perception of risk and the decisions that individual makes. The Queensland Flood Commission made specific recommendations that all local councils produce flood studies and maps for their catchments and make easy to understand information about flood risk in their area publicly available (Queensland Floods Commission of Inquiry, 2012). The NSDR emphasises the importance of information being made available to and communicated with all involved stakeholders (Council of Australian Governments, 2011), with governments and emergency services having responsibility for creating and communicating hazard information, and the community having responsibility for hearing the information and responding appropriately.

Chapter 4 focused specifically on question 1a, the perceptions of responsibility of the four stakeholders. It showed that the gaps in flood risk management in Australia are gaps in expectations and assumptions. These gaps exist below a surface of agreement, which is why they come out through poor coordination during major events. This has been highlighted in numerous reports into major disaster events going back to Ash Wednesday. All stakeholders

agreed on the importance of each other in flood risk management, what is necessary is to capitalise on the interest created by the 2010-2011 floods and create clear agreement on roles and responsibilities.

All stakeholders agreed on the importance of risk awareness in preparing for and responding to flood. How this should be done and whose responsibility it is received varying suggestions. While insurers did not see public education as their area, council representatives and residents expressed concern that insurers were not adequately informing the public about their risk and their cover. Yet again, there were comments from stakeholders and in public inquiries about the need to better coordinate and collaborate on hazard management and response (Queensland Floods Commission of Inquiry, 2012, Comrie, 2011). The same comments were made by Britton in his assessment of the 1983 Ash Wednesday fires in Victoria and South Australia: the expectations the public had in council and emergency services was not fulfilled (Britton, 1986a). Britton also notes change only happens after major events. The floods of the 2010-2011 summer have resulted in the adoption of the National Strategy for Disaster Resilience (Council of Australian Governments, 2011) to set out the roles of government, private, and community stakeholders in better planning for and responding to hazard events, and a standard definition of flood for insurance purposes (Australian Government, 2012) to reduce confusion over cover. Previously, Cyclone Tracy led to the adoption of stricter building standards in cyclone prone regions (Mason and Haynes, 2010), and the 1955 Hunter Valley floods led to the establishment of the first State Emergency Service (Keys, 2006). While these examples of changes in policy and practice are encouraging, individual's lack of preparedness and problems with communication and coordination between different stakeholders are recurrent themes in most hazard events.

Research question 2 was the focus of chapters 5 and 6. The results across the four case study locations were variable. In Brisbane, older residents and those with low incomes were less prepared and less likely to have flood insurance. But in the other three case studies, the situation was more nuanced. Socioeconomic and perception factors do have some influence, particularly on an individual's capacity and their knowledge, both of which can promote their involvement in their own flood preparedness, but they are not sufficient explanations. In Benalla, with lower average incomes, there was a lower rate of insurance cover, but individual's incomes did not influence their likelihood of having flood insurance. In Emerald, low risk perception resulted in a lack of ideas of how individuals could be involved in their own flood preparedness, while in Dora Creek residents had a good awareness of their flood risk but were cynical about their ability to prepare for floods.

Local community differences have at least as much of an impact on individual's decisions as their socioeconomic capacity, and awareness of risk, while important, are not sufficient to promote action. Both of these have some impact, but are not a complete answer and do not have an effect on all respondents. The second question of this thesis requires better engagement with local communities to understand their thoughts on their risk and any barriers that exist. It is here that centralised and standardised information would be helpful, as it would better enable people like those unfamiliar with the risk in Emerald due to the high population turnover to learn about and have a basic understanding of their risk. The adoption of a standard definition for flood for insurance also aids by addressing the confusion that resulted following the 2010-2011 floods.

7.4. Limitations of the study

This thesis presented four case studies, but it should not be taken as an exhaustive representation of attitudes to flood in Australia. Including four case studies allowed comparisons to be made and variations to be identified, but there are likely other issues that affect other flood-prone locations that were not raised in the four case studies covered here. It also does not involve all the stakeholders in flood risk management – while federal and state government roles are referred to; they are not discussed in detail. Because those two levels of government were not participants, this thesis did not include detailed discussion of flood policy variations across Australia, nor did it go into detail about how the three levels of government interact on flood and hazard issues.

The role of the wider community, the Bureau of Meteorology, and catchment management authorities were also excluded, although they do play a role in making decisions around flood policy and water use. Businesses, community groups, and non-government organisations are also listed in the National Strategy for Disaster Resilience as participants in the shared responsibility for hazards and response (Council of Australian Governments, 2011), and their roles would need to be articulated in developing specific policies. But the role and input of those groups is likely to be more specific to each area, so they do not suit a broad-scale study. They would need to be consulted and included when any particular community makes plans for dealing with their local flood risk. Again, this limits the results of this study to only discussing the specific locations and stakeholders involved, rather than an entire assessment of flood risk management in Australia.

The actions people take during a flood are not necessarily the actions they thought they would take. It is not possible for people to predict exactly what they will do, alternatively, they may give the response they think is the 'correct' response, rather than their personal answer, or they may interpret the question differently to its intent. This has been seen in previous studies, such as that by Siegrist and Gutscher (2008), who received very different responses about what individuals thought a flood would be like from those who had previous experience compared to those with no flood experience. The disconnection between the number of people in Brisbane who were 'aware' of the flood risk and the number who were prepared when the flood occurred clearly demonstrate the difficulty of this issue.

The sorts of responses individuals give will be affected by their experiences, so the answers received in Brisbane 8 months after the flood would be different to those received before the flood, two years after the flood, and even one month after the flood. This was acknowledged in the design of this study by choosing both case studies with very recent flooding and with a longer period since their last flood, but it also highlights the fact that the impact of broader circumstances on individual's responses can make wider application difficult.

The number of interviewees from each of the three institutional stakeholder groups was small, and their answers cannot be taken as definitive of their entire group. As qualitative data they identify a series of important issues and concerns about flood risk management in Australia and how well each stakeholder understand the roles of the others. Some further participants were contacted but declined involvement.

Only one source of flood information was assessed, and councils were not directly contacted to ask about their information. It was also a snapshot in time, and the amount of information available now – three years after the web survey was undertaken – is likely to have changed on a number of websites. It was also, as noted in chapter 3, only my judgement of what constitutes accessible and useable information, and each individual will have a different personal framework through which they interpret information. How each person accesses, judges, and responds to information is different, and two people may come to different conclusions from the same piece of information. While it is beyond the scope of this thesis to discuss how different individuals interpret the same information, identifying the variability in quality and availability of flood information is necessary to encourage better and more widely available flood information.

This thesis also did not look in detail at the information provided by State Emergency Services, although information and education are key elements of their role. The ACSES Performance Indicators 2012 (ACSES, 2012) lists the different education and awareness

campaigns run by the SES in the different states and territories. An assessment of the quality and range of information provided by the SES across the country would also be a valuable addition to discussions of flood risk management in Australia.

The occurrence of so many significant floods across Australia a year into my PhD acted as both a help and a limitation. It gave me numerous options for case studies, and allowed me to compare the thoughts of residents in both areas with very recent flood experience and those without. Rather than a hypothetical discussion of the preparedness of residents for flood, I was able to talk to people directly about their experiences. The context of the national discussions and various inquiries held following the floods has also made this an extremely topical discussion. At the same time, the debates and shifts in policy and proposals made it difficult to have a clearly planned approach for my overall project as I needed to be ready to change should any more events occur, or should any major policy decisions be made. At times, this made my research feel like it could be redundant by the time I completed it. The original proposal for this thesis was much more heavily focused on the role of the insurance industry, but the occurrence of actual flood events necessitated a shift in focus on to the individual, with the insurance industry, councils, and the SES as complementing and assisting stakeholders, enabling individuals to share the responsibility for their own flood risk management. This shift can be noted in the four research chapters, with chapter 3's research and analysis undertaken prior to the 2010-2011 floods its focus is noticeably different to although not inconsistent with the three following chapters. The ideas behind shared responsibility were part of the research throughout, but the concept solidified as a focus part way through my research, so again, chapters 3 and 4 are less explicit in their links to this concept than chapters 5 and 6.

7.5. Where to now?

A central element of getting residents involved in that 'shared responsibility' is for them to be informed and educated to make their own decisions. Currently, the availability and quality of flood risk information, which individuals can use to educate themselves, is varied. While information is not sufficient to motivate individuals to take responsibility for their own preparedness, and individuals will react differently to the same information (Emergency Management Australia, 2009), it is necessary in order for individuals to know about their risk. As was shown in chapter 3, while some local councils have excellent information available, others are severely lacking. The ease with which the information can be understood also varies, as do some of the standards used. This can make understanding the information

presented more difficult. As suggested in chapter 4, uniform information and planning standards and terminology would aid in removing some confusion around flood.

This thesis has discussed shared responsibility, but has particularly focused on getting residents involved, and on what barriers prevent residents being involved in their own preparedness. The concept of shared responsibility has been raised and promoted through a number of disaster inquiries as well as the National Strategy for Disaster Resilience, but what is needed is for there to be a clear understanding of what this means for each stakeholder. The contradiction between having policies like the NSDR stating that residents need to be responsible for their part in preparedness, and then politicians and the media heavily criticising insurers for not paying out those who did not have flood cover, or failing to have the discussion about the role individuals play in their own risky situation, makes concepts like shared responsibility meaningless.

Individual's understanding of and preparedness for flood risk is affected by socioeconomic and perception factors, but also by the community they reside in. In chapter 5's discussion of Brisbane, respondents' stated awareness of the risk of flood did not translate into being prepared for a flood for a significant number of respondents. The existence of Wivenhoe Dam gave them a false sense of security: while their location is historically a flood plain, the actions of the state government in building the dam meant they believed were now protected from any flood. Another assumption was that their location should be safe because the local council would not allow development in areas prone to flood. Criticism of zoning land for development was also made by the institutional stakeholders, particularly the insurance industry.

The recent inquiries into floods and related issues have contained little in the way of comments on how to involve residents in flood risk management. While the NSDR uses the term 'shared responsibility', and while other reports acknowledge residents as a stakeholder, they do not elucidate on what their role should be. Shared responsibility is clearly seen as an important idea, but the implications of that idea and how it is to be applied is unclear. The Emergency Management Australia manual, *Managing the Floodplain* (Emergency Management Australia, 1999b), has a detailed discussion of coordination between governments and agencies with official responsibilities, but its only comments on residents are on the need for awareness. Future inquiries and manuals need to better articulate the responsibilities of residents.

Structural measures do have benefits – indeed, the moves towards a levee in Emerald is specifically going to bring insurance premiums down, and options to stop backflow from

Oxley Creek in Brisbane would reduce the flood risk in the suburbs of Rocklea and Tennyson. But neither measure will remove the flood risk from the location, and nor are such measures possible in all locations. Dora Creek, for example, does not have the option to build levees or stop the flow of water. As such, the approach in each location will be different and will depend on the flood type, the topography, the current land use, and the cost of changes.

7.6. Future work

Looking at more case studies and in more states would be beneficial and provide a more rigorous assessment of residents' preparedness for flood. Expanding to look in detail at other stakeholders – especially state and federal governments – would allow for an analysis of the framework within which flood risk management occurs. As local councils operate under state laws, looking at the state level would particularly give insight into why there are differences between states. While the federal government's official involvement in flood-related issues is limited to funding of disaster relief and mitigation, they are still important to the discussion, because it is in their financial interest for the more on-the-ground stakeholders to do all they can to minimise risk and damage so the financial involvement of the federal government is minimised.

A detailed discussion of how the National Strategy for Disaster Resilience can be implemented is needed. The Strategy has good general detail and sets out which groups need to be involved, but how can it be turned from a policy document into practical decisions? And can it be used to design specific targets and expectations for different stakeholders to meet? As the Strategy is still a relatively new document, it is to be hoped that such assessments of the Strategy's implementation will be carried out.

Follow-up research in the same locations would be beneficial, to see how the attitudes and concerns of the community change over time. These would be particularly useful in Brisbane and Emerald, with their recent experience. The nature of the PhD timeline makes a longitudinal study impractical at best, but hazard research would benefit from such studies. Of course, any follow-up study would not necessarily result in asking the same people, as people move and may not be at home when visited. Nevertheless, a follow-up study could examine the broad community attitudes to see how they have changed. Knowing how and why attitudes might change would help in working out how to better educate and engage residents in their own flood preparedness.

One-off studies of the effectiveness of particular programs have value, such as the Benalla FloodSmart program (Victoria State Emergency Service, 2008), but studies and assessments need to be bigger and longer and wider. The anecdotal evidence given by SES in Benalla, that education campaigns about not driving through floodwaters in Benalla region resulted in a reduction of car rescues to zero in that region during their most recent floods shows consistent programs can change behaviour, but it is only a local anecdote. Larger studies would be beneficial.

7.7. Recommendations

It is the responsibility of all stakeholders to work together for effective flood risk management. It is key for there to be clear understanding of the roles and responsibilities of each stakeholder. The 2010-2011 floods exposed holes in the understanding of the stakeholders, and although they agreed in broad terms, further discussion with each stakeholder showed their ideas were not so similar. This section provides some recommendations for how to encourage proper shared responsibility for flood risk management in Australia. The recommendations are then summarised in Table 1, which lists both the action or policy suggested and the theory or other examples to support the suggestion.

As noted in chapter 3 and reflected in the responses of participants in chapters 4-6, the availability of flood information in Australia is highly variable. To ensure individuals have the best opportunity to be involved in their own flood preparedness, national standards for flood risk information should be implemented. Those regions that wish to provide more information should be encouraged to do so, with councils such as Pittwater and Bellingen serving as examples of best practice. At minimum, clear maps of the 1 in 100 flood extent should be developed and made publicly available from all councils. A centralised location would also be beneficial, particularly for population change and ease at learning about an area they are unfamiliar with. The National Flood Risk Information Portal has the potential to fulfil this role (Australian Emergency Management Institute, 2012). The findings in Emerald of low awareness of the risk result from a lack of available information, but also the high proportion of residents who move to the region for work and are unfamiliar with its hazards. To be able to look at one central location and find maps and other information in clear language and with standard measures and terminology would be an aid for individuals who wish to know more about their location.

Currently there are standard flood classifications used to determine whether a flood is minor, moderate, or major based on its impacts on a community (Emergency Management Australia, 2009), but the meaning of these terms may not be well understood by the public. Better education on what those terms mean would be beneficial. Emergency Management Australia's flood manuals list a number of approaches to educate the community, including school education kits, flood commemorations, and doorknocking (Emergency Management Australia, 1999a). As noted in chapter 6, Benalla's SES campaign reminding people not to drive through floodwater has proven incredibly successful. This is only one campaign in one region, but it shows education and information can have a positive effect. More funding and resources would allow such campaigns to be expanded and, hopefully, have similar success.

Flood insurance needs to be better utilised in flood risk management. The cost of insurance can be a limitation for some residents, but as the results in chapters 5 and 6 show, low income did not necessarily stop individuals from having insurance. More important is residents knowing it is available and knowing they need it, and not assuming it is included without checking. Better education about what policies include is necessary. The adoption of a standard definition of flood for insurance purposes will remove the confusion over the source of water, which was particularly controversial in Brisbane. However, cost will still be potentially prohibitive in some areas, and for some people who were unaware of the flood risk when they moved in. A government insurance scheme is unlikely to be able to adequately price risk in a way to discourage settlement in dangerous areas without negative political outcomes, and it is not an approach supported politically. However, there could be value in a limited role for the federal government for a short period of time. This could be done by providing limited subsidies of flood insurance to residents already living in highly flood prone areas who have been in their current location for a decade. This would restrict those eligible to residents who can justifiably claim to have not been aware of the risk. Given that insurance has been found to encourage people into high risk areas as they expect to get full compensation in the event of a flood (Shaw and Britain, 2005), any use of insurance to better manage flood risk must address this issue.

The value of flood insurance needs to be greatly promoted. During and after the 2010-2011 floods, much of the public discussion of flood was negative, portraying insurers as greedy, 'unAustralian', and uninterested in supporting flood victims (Johnston et al., 2011, Local Government Association of Queensland, 2011, ABC News, 2011c). Confusion over insurance definitions contributed to this, and the adoption of a uniform definition of flood for insurance purchases will have the effect of removing that particular difficulty. However, this is not sufficient. There is a need for a better understanding of what the role of the insurance

industry is and is not. Insurance needs to be a tool to inform the public about whether a location is viable, and it may result in some areas being unaffordable or some residents needing to leave. This will not be popular, but, in areas with extreme flood risk, it may be necessary.

The use of the same terminology and risk ratings across the country and across stakeholders should be a priority. The use of the 1 in 100 flood as a planning standard should form one element of this, but it alone will not adequately convey flood risk and how it can vary between locations. The difference in potential flood heights was discussed in the introduction, as were the different flood typologies for the four case areas. While a uniform base planning standard should be a foundation, it should be complemented by a simple to read colour-coded rating of the flood hazard in different areas such as the one used in the map of Benalla in chapter 1 (Figure 7). This should incorporate data on flood speed and topography, and should, where necessary, include locations outside the 1 in 100 flood boundary. One example would be the Hawkesbury-Nepean region in north-western Sydney, where a larger than 1 in 100 flood would significantly increase the number of properties likely to be inundated. The poor understanding of what '1 in 100' means, and erroneous assumptions about land beyond those bounds being 'flood free' (as noted in some Brisbane responses), demonstrates the need to better educate about the potential for rarer events. These areas should be identified on maps as having a low, but still very real, potential for flood.

Using the EU Directive as a guide, flood information should be centralised, standardised, clarified, and made publicly available (European Commission, 2007). The directive's requirement for regular updating of maps is also worth pursuing, although the cost of such a program would be prohibitive for some councils under current funding arrangements. While the federal government does not have formal responsibilities regarding flood, they have historically been involved through funding of mitigation and disaster relief. Providing a regular funding body for flood studies and mapping for public use would result in a more orderly and formalised process than currently exists, and would allow standardisation and centralisation of information. If exercised well, it should result in better individual and community preparedness, which will also reduce the financial impact on the federal government through disaster relief payments following flood events.

Recommendation/policy change	Supporting theory	Other examples
National standards for flood information; better information availability	(Kasperson et al., 1988) (Gissing et al., 2008) (CSIRO, 2000)	EU Directive 2007/60/EC National Flood Information Portal
Clarification of the roles and responsibilities of all stakeholders	(McLennan and Handmer, 2011) (Eburn and Dovers, 2012) (Dynes, 1994)	Emergency Management Australia manuals; expanded detail on each stakeholder
Better use of flood insurance - Standard definition of flood - Limited government involvement	Howard Kunreuther Erwann Michel-Kerjan (Smith and Handmer, 2002)	National Flood Insurance Program

Table 1. Key recommendations and supporting theories

Major hazard events can lead to changes in approach. The adoption of wind resistance standards for building construction following Cyclone Tracy is a clear example of using a hazard event to promote resilience (Mason and Haynes, 2010). The adoption of a standard definition of flood for insurance purposes following the 2010-2011 floods and the Natural Disaster Insurance Review (NDIR) is one beneficial development to have resulted from these most recent floods (Australian Government, 2012). It is to be hoped that discussions of how to improve flood risk management in Australia do not fade as more time passes since the 2010-2011 floods, but that the importance of proactive planning is recognised, and improved strategies for responding to flood risk are developed and implemented.

7.8. What does ‘shared responsibility’ mean for flood risk management in Australia?

The Victorian Bushfire Commission described shared responsibility as

“increased responsibility for all. It recommends that state agencies and municipal councils adopt increased or improved protective, emergency management and advisory roles. In turn, communities, individuals and households need to take greater responsibility for their own safety and to act on advice and other cues given to them before and on the day of a [hazard event]” (Teague et al., 2009).

The National Strategy for Disaster Resilience builds on this, emphasising the need to build community resilience and avoid an overreliance on governments for protection before and during hazard events. The comments of some residents in Brisbane about waiting for the SES to assist them, or not hearing their suburb mentioned and assuming they'd be fine, or those in Dora Creek wanting help evacuating during a flash flood, show there are many people who do have an expectation of official help above their own preparedness. In all four case study locations, many respondents seemed uncertain about their options for their own flood preparedness. This automatically puts extra pressure on the institutional stakeholders to protect and assist in times of flood, which in turn limits learning opportunities.

In 1817, Governor Macquarie admonished residents for living at Windsor in locations known to flood, and warned official assistance would not be forthcoming after future events (Macquarie, 1817). Such an approach would not receive political support now, but Macquarie's recognition that individuals need to take responsibility for their decisions is one that can and should be used. The recent floods should be remembered and used to spur better flood management. Rather than allowing concerns about the price impact of flood to stop public information as happened in New South Wales in the 1980s (Handmer, 1985), the value of information in making better decisions needs to be emphasised.

There are gaps in assumptions of what will happen and who will provide assistance and how during a flood. These assumptions are the biggest barrier to better flood risk management. In this context, shared responsibility means a clear articulation and understanding of those roles and responsibilities. Shared responsibility requires proactive engagement with flood risk by all involved stakeholders. It entails collaboration and understanding of each others' role, and standardised expectations and approaches in order to best simplify the process for individuals and the community. But simplification cannot mean lack of adaptation for individual circumstances.

The flooding rains of Dorothea Mackellar's *My Country* will always be a feature of Australia. As such, they need to be planned for. As the National Strategy for Disaster Resilience notes, responsibility for preparing for hazard events is shared between all elements of society. A disaster resilient society requires all stakeholders to be participants in flood risk management, and for residents in particular to be prepared for flood.

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Appendices

There are four sections to this appendix.

Section A contains copies of the questionnaires used in the four case study locations. The first questionnaire was used in Benalla and Dora Creek, the second in Brisbane and Emerald.

Section B contains copies of the interview questions for the council, emergency services, and insurance representatives.

Section C is a copy of the information and consent form signed by interview participants.

Section D is a copy of the ethics approval email for this project.

Appendix A



Resident flood survey

You are invited to participate in a survey on flood awareness and flood insurance in Australia. This study is investigating attitudes of residents, council, SES, and the insurance industry to flood risk.

The survey will take approximately 10 minutes. Participation is voluntary and all information or personal details gathered in the course of the study are confidential. No individual will be identified in any publication of the results.

Thank you for agreeing to participate. If you have any questions, please contact

pamela.box@mq.edu.au

If you have any complaints or reservations about any ethical aspect of your participation in this research, you may contact the Director, Research Ethics (tel. (02) 9850 7854; email ethics@mq.edu.au). Any complaints will be treated in confidence and investigated, and you will be informed of the outcome.

1. Please indicate your gender

- ☐ Male
- ☐ Female

2. Please indicate which age group you belong to

- ☐ 18 – 24
- ☐ 25 – 34
- ☐ 35 – 44
- ☐ 45 – 54
- ☐ 55 – 59
- ☐ 60 – 64
- ☐ 65 – 74
- ☐ 75+

3. What is your annual household income?

- ☐ Under \$25,000
- ☐ \$25,000 - \$50,000
- ☐ \$50,000 - \$75,000
- ☐ \$75,000 - \$100,000
- ☐ \$100,000 - \$150,000
- ☐ \$150,000 - \$200,000
- ☐ More than \$200,000
- ☐ Don't know
- ☐ Don't want to say

4. What is your postcode?

5. Have you ever experienced flooding anywhere you have lived?

☐ Yes

☐ No

If yes, please give detail:

6. How concerned are you about flooding in your area?

☐ Very

☐ Somewhat

☐ Neutral

☐ Not much

☐ Not at all

7. Are you more concerned about flood since the widespread flooding of the last two summers?

☐ More concerned

☐ Less concerned

☐ About the same

8. When you purchased/started living in your home were you aware it was vulnerable to flood?

☐ Yes

☐ No

☐ My house is not vulnerable to flood

9. If you answered 'yes' to the previous question, which ONE of the following, if any, provided the most valuable source of information about the risk of flood around your home?

- ☐ Local council
- ☐ SES
- ☐ Friends/family/neighbours
- ☐ Community groups
- ☐ Media
- ☐ Personal experience
- ☐ Other (please provide details)

10. If you answered 'no', would you still have moved there if you knew?

- ☐ Yes
- ☐ No

11. Please indicate which of the following most accurately describes your insurance cover

- ☐ I know my insurance covers me for all types of flood
- ☐ I think my insurance covers me for all types of flood
- ☐ I know my insurance covers me for storm damage only
- ☐ I do not have insurance

12. If you do not have flood insurance, why?

- ☐ Too expensive
- ☐ Don't think I need it
- ☐ Don't think it's available
- ☐ It is not available

13. Have you checked/changed your insurance cover since the widespread flooding of the last two summers?

- ☐ Yes
- ☐ No

14. What are the three main things you think can be done from a council perspective to reduce the risk of flood in your area?

15. What three main things do you think can be done from an emergency services perspective to reduce the risk of flood in your area?

16. What are the three main things you think you can do to reduce the flood risk in your area?

Demographic questions

1. Please indicate your gender

- ☐ Male
- ☐ Female

2. Please indicate which age group you belong to

- ☐ 18-24
- ☐ 25-34
- ☐ 35-44
- ☐ 45-54
- ☐ 55-64
- ☐ 65-74
- ☐ 75+

Demographic questions (continued)

3. Please indicate your HIGHEST educational attainment (one only)

- ☐ No formal qualifications
- ☐ Higher School Certificate or interstate equivalent
- ☐ Vocational qualifications e.g. diploma, trade certificate
- ☐ Bachelor degree or equivalent
- ☐ Postgraduate qualification – Masters or PhD
- ☐ None of the above

4. Please indicate your working status:

- ☐ Working - Full time (30+ hrs)
- ☐ Part-time (9-29 hrs)
- ☐ Unemployed
- ☐ Not working - retired
- ☐ Looking after house/children/others
- ☐ Invalid/disabled
- ☐ Student
- ☐ Other

Demographic questions (continued)

5. What is your annual household income?

- ☐ Under \$25,000
- ☐ \$25,000 - \$50,000
- ☐ \$50,000 - \$75,000
- ☐ \$75,000 - \$100,000
- ☐ \$100,000 - \$150,000
- ☐ \$150,000 - \$200,000
- ☐ More than \$200,000
- ☐ Don't know
- ☐ Do not want to answer

6. What is your postcode?

Demographic questions (continued)

7. What is the composition of your household?

- ☐ Couple with children or other dependents
- ☐ One adult with children or other dependents
- ☐ Couple without children or other dependents
- ☐ One person household
- ☐ Shared house with other adults
- ☐ Other (please specify)

8. At the time of the floods, were you or your family working as a paid or volunteer member of any emergency services group, community group, council or local government organisation?

- ☐ Yes, emergency services volunteer
- ☐ Yes, emergency services employee
- ☐ Yes, community group (e.g. Rotary, Lions, CWA, etc)
- ☐ Yes, local council
- ☐ Yes, local government organisation
- ☐ No, none of these
- ☐ Other (please specify)

Questions about previous flood experience

9. Have you previously experienced flooding in any location where you have lived?

- ☐ Yes
- ☐ No

If yes, please give detail:

10. Please indicate which of the following most accurately describes your current situation since the 2010 or 2011 flood:

- ☐ I plan to live where I am for many years
- ☐ I plan to move in the coming years

Questions about your wellbeing

11. How would you describe your relationships with family/friends?

	very bad	bad	neither good or bad	good	very good	N/A
before the flood	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
now	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

12. How would you describe your financial status?

	very bad	bad	neither good or bad	good	very good	N/A
before the flood	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
now	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Questions about your wellbeing (continued)**13. How would you describe your health?**

	very bad	bad	neither good or bad	good	very good	N/A
before the flood	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
now	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

14. How would you describe your general happiness?

	very bad	bad	neither good or bad	good	very good	N/A
before the flood	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
now	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Questions about your wellbeing (continued)**15. Do you think the flood has had an impact on your:**

- ☐ Relationships with family/friends
- ☐ Financial status
- ☐ Health
- ☐ General happiness

Questions about your home at the time of the flood**16. At the time of the flood, how long had you lived at that address?**

- ☐ 0 < 6 months
- ☐ 6 months < 1 yr
- ☐ 1 < 2 yrs
- ☐ 2 < 3 yrs
- ☐ 3 < 5 yrs
- ☐ 5 < 10 yrs
- ☐ 10 < 20 yrs
- ☐ 20+ yrs

17. At the time of the flood, how long had you lived within this region?

- ☐ 0 < 6 months
- ☐ 6 months < 1 yr
- ☐ 1 < 2 yrs
- ☐ 2 < 3 yrs
- ☐ 3 < 5 yrs
- ☐ 5 < 10 yrs
- ☐ 10 < 20 yrs
- ☐ 20+ yrs

Questions about knowledge of insurance

18. Were you aware of your insurance cover prior to the 2010 or 2011 flood events?

- ☐ Yes, I had insurance and knew what type of cover I had
- ☐ No, I had insurance but did not know what type of cover I had
- ☐ Yes, I knew that I did not have any insurance cover

Questions about building insurance

19. At the time of the flood, did you have building insurance?

- ☐ Yes
- ☐ No
- ☐ Not sure

Question about riverine flood building insurance

20. If yes, were you covered for riverine flood?

- ☐ Yes
- ☐ No
- ☐ Not applicable

Question about contents insurance

21. At the time of the flood, did you have contents insurance?

- ☐ Yes
- ☐ No

Question about riverine flood contents insurance

22. If yes, were you covered for riverine flood?

- ☐ Yes
- ☐ No
- ☐ Not applicable

Questions about insurance (continued)

23. If you had insurance, was the cover adequate?

- ☐ Yes, it was adequate
- ☐ No, I was underinsured

Question about why you didn't have insurance

24. If you did not have insurance prior to the 2010/2011 flood events, why?

- ☐ Too expensive
- ☐ I thought I was covered
- ☐ Didn't think I needed it
- ☐ I thought it was not available
- ☐ It was not available
- ☐ Other (please specify)

Question on updating or purchasing insurance

25. Have you since updated or purchased a building or contents insurance policy for riverine flood?

- ☐ Yes
- ☐ No

Please provide details:

Questions about under insurance

26. If underinsured, by approximately how much?

- ☐ 0-25%
- ☐ 25-50%
- ☐ 50-75%
- ☐ 75%+

Questions about your home at the time of the flood

27. At the time of the flood, were you renting or did you own or have a mortgage on your house?

- ☐ Renting
- ☐ Owned
- ☐ Mortgage
- ☐ Living with family/friends
- ☐ Other (please specify)

28. At the time of the flood, were you living in a single story home, multiple story home, unit or duplex?

- ☐ Single story house
☐ Multiple story house
☐ Unit ground floor
☐ Unit first floor or higher
☐ Single story duplex
☐ Multiple story duplex
☐ Other (please specify)

Questions on the impact of the flood

29. To what extent did the flood impact your:

	It was not impacted	0-10 cm	10-20 cm	20-50 cm	50-100 cm	100-200 cm	200+ cm
House	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Property/yard	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

30. To what degree did the flood impact the following of yours?

	not impacted	minor impacts	moderate impacts	major impacts	completely destroyed	N/A
House contents	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
House structure	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Property/yard	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Own business	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Questions on personal preparedness for flood

31. Did you do anything to help protect your family and home from flood prior to the 2010 or 2011 flood events?

Tick all that apply.

- ☐ Chose to live in a house that was out of the flood hazard zone
- ☐ Chose/built/modified a house/property that was more resistant to flood
- ☐ Devised an evacuation plan
- ☐ Prepared an evacuation kit
- ☐ Followed warning advice on radio/television/internet
- ☐ Evacuated to a safe house or centre
- ☐ Sandbagged house
- ☐ Built temporary flood barriers around property
- ☐ Kept drainage clear of debris
- ☐ Raised household items up off floor
- ☐ Moved household items to a safe place

Other (please specify)

32. Did anything prevent you from adopting the above measures?

- ☐ Yes
- ☐ No

If yes, please give detail:

Questions about the impact of the flood on you

33. If you evacuated your home, have you been able to return on a permanent basis?

- ☐ Yes
- ☐ No
- ☐ I did not evacuate

If yes, please indicate how long you were evacuated. If no, please indicate when you expect to return to your home.

34. Did the flood affect your ability to earn an income?

- ☐ Yes
- ☐ No

If yes, why and for how long?

Questions on flood adjustments

35. Have you, or how likely are you, to make the following changes as a result of the 2010 or 2011 flood?

	not at all likely	unlikely	undecided	likely	very likely	already done
Permanently move to a flood safe location	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Raise level of home	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Change exterior and/or interior design e.g. use flood proof materials	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Move electricity outlets/meter box higher	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Anchor water tanks to the ground	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Improve garden drainage	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Build permanent flood barriers around property	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Modify insurance policy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Other (please specify)

Questions on flood adjustments

36. In comparison to other people in your community, do you think you are more or less able to make changes to reduce your risk from flood?

- ☐ significantly more able
- ☐ more able
- ☐ about the same
- ☐ less able
- ☐ significantly less able

37. What do you think are the main factors that prevent you from making changes to reduce the impact of future flood to your home/property?

Questions about flood preparedness/mitigation within council and emergency ...

38. What are the three main things you think can be done from a council perspective to help reduce your risk to future flood?

39. What are the three main things you think can be done from an emergency services (e.g. SES) perspective to help reduce your risk to future flood?

Final question!

40. How likely do you think there will be a damaging flood in your area in the next:

	not at all likely	unlikely	undecided	likely	very likely
10 years	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
25 years	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
50 years	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
100 years	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

41. If you are interested in taking part in an interview or focus group to discuss the issues raised through our questionnaires, please give your email address or contact number.

Appendix B

Questions for council representatives

1. How do you view the flood risk in your LGA? (i.e. how serious is it, how high a priority, how much time/budget/resources go towards flood-related issues)
2. What flood plans and maps do you have? How recent are they?
3. How do you communicate flood risk to residents? How do they respond?
4. What responsibility do you think residents have to know about and plan for their flood risk?
5. Have you noticed a change in residents' attitudes awareness of flood recently/since the widespread flooding of the last two years?
6. What role do you think councils should play in flood planning and awareness? Both planning measures and informing residents?
7. What role do you think state and federal government should play in flood planning and awareness?
8. What role do you think developers should play in planning for flood risk? Do you have any difficulties with developers? Do you work with developers to ensure developments are low flood risk?
9. What is your opinion on flood insurance? (i.e. is it helpful, do you think it is a useful part of the approach to flood risk)
10. Do you think the new standard definition of flood for insurance purposes? Why/Why not?
11. Do you support state or nationwide guidelines for flood information and planning? Why/Why not?
12. Is there anything else you want to say about flood risk in your area or in general?

Questions for State Emergency Services Representatives

1. What do you see as your role in communicating about flood risk to the public?
2. What do you think of flood insurance? (i.e. is it helpful, do you think it is a useful part of the approach to flood risk)
3. What role do you think governments should play in flood planning and awareness?
4. What role – if any - do you think flood insurance could play in improving flood planning and awareness?
5. What responsibility do you think residents have to know about and plan for their flood risk?
6. Have you noticed a change in people's attitudes to flood risk as a result of the widespread flooding of the last two years?
7. Do you support state or nationwide guidelines for flood information and planning?

Questions for insurance representatives

1. How do you view your role in addressing flood risk: is it purely risk quantification, or is it also risk reduction?
2. What responsibilities do you think other stakeholders – i.e. council, SES, residents – have to be aware of and prepare for flood?
3. What central lessons do you think Australia needs to learn about flood risk in the aftermath of the last two years' floods?
4. Are there any lessons you think Australia could learn from the American National Flood Insurance Program in terms of how to (or how not to) better approach flood risk?

Appendix C



Department of Environment and Geography
Faculty of Science
MACQUARIE UNIVERSITY NSW 2109

Phone: (02) 9850 9670

Fax: (02) 9850 6052

Email: frank.thomalla@mq.edu.au

Dr Frank Thomalla

Senior Lecturer, Macquarie University

Information and Consent Form

Changes in flood insurance provision in Australia

You are invited to participate in the study of flood risk and flood insurance in Australia. The purpose of this study is to investigate flood awareness, attitudes to flood insurance, and ideas of who is responsible for flood planning and awareness.

The study is being conducted by Pamela Box, Department of Environment and Geography, (ph: (02) 9850 8410, email pamela.box@mq.edu.au) to meet the requirements of a Doctorate under the supervision of Frank Thomalla (ph: (02) 9850 9670, email frank.thomalla@mq.edu.au) of the Department of Environment and Geography.

If you decide to participate, you will be asked to complete a survey/answer interview questions about flood risk in your area, flood insurance, and the responsibilities of residents, emergency services, and governments in addressing flood risk. The interview/survey is expected to take approximately 30minutes/15 minutes. Audio recordings will be made of interviews.

Any information or personal details gathered in the course of the study are confidential. No individual will be identified in any publication of the results. The data will only be accessed by the researchers. A summary of the results data can be made available to you via email on request.

Participation in this study is voluntary: you are not obliged to participate and if you decide to participate, you are free to withdraw any time without having to give a reason and without consequence.

I, have read and understand the information above and any questions I have asked have been answered to my satisfaction. I agree to participate in this research, knowing I can withdraw from further participation in the research at any time without consequence. I have been given a copy of this form to keep.

Participant's Name: _____
(Block letters)

Participant's Signature: _____ Date: _____

Investigator's Name: _____
(Block letters)

Investigator's Signature: _____ Date: _____

The ethical aspects of this study have been approved by the Macquarie University Human Research Ethics Committee. If you have any complaints or reservations about any ethical aspect of your participation in this research, you may contact the Committee through the Director, Research Ethics (telephone (02) 9850 7854: email ethics@mq.edu.au). Any complaint you make will be treated in confidence and investigated, and you will be informed of the outcome.

Frank Thomalla, Senior Lecturer, Macquarie University
Department of Environment and Geography
frank.thomalla@mq.edu.au
ph: (02) 9850 9670

(Investigator's/participant's copy)

Appendix D



Pamela Box <pamela.box@mq.edu.au>

Fwd: Final Approval- Ethics application reference-5201100474

1 message

PAMELA BOX <pamela.box@students.mq.edu.au>
To: PAMELA BOX <pamela.box@mq.edu.au>

Fri, Mar 9, 2012 at 9:51 AM

----- Forwarded message -----

From: **Ethics Secretariat** <ethics.secretariat@mq.edu.au>

Date: Thu, Jun 16, 2011 at 1:53 PM

Subject: Final Approval- Ethics application reference-5201100474

To: Dr Frank Thomalla <frank.thomalla@mq.edu.au>

Cc: Prof John McAneney <john.mcaneney@mq.edu.au>, Miss Pamela Margaret Box <pamela.box@students.mq.edu.au>

>

Dear Dr Thomalla

Re: "Changes in flood insurance provision in Australia" (Ethics Ref: 5201100474)

Thank you for your recent correspondence. Your response has addressed the issues raised by the Human Research Ethics Committee and you may now commence your research.

The following personnel are authorised to conduct this research:

Dr Frank Thomalla- Chief Investigator/Supervisor
Miss Pamela Margaret Box & Prof John McAneney- Co-Investigators

NB. STUDENTS: IT IS YOUR RESPONSIBILITY TO KEEP A COPY OF THIS APPROVAL EMAIL TO SUBMIT WITH YOUR THESIS.

Please note the following standard requirements of approval:

1. The approval of this project is conditional upon your continuing compliance with the National Statement on Ethical Conduct in Human Research (2007).
2. Approval will be for a period of five (5) years subject to the provision of annual reports. Your first progress report is due on 16 June 2012.

If you complete the work earlier than you had planned you must submit a Final Report as soon as the work is completed. If the project has been discontinued or not commenced for any reason, you are also required to submit a Final Report for the project.

Progress reports and Final Reports are available at the following website:

http://www.research.mq.edu.au/for/researchers/how_to_obtain_ethics_approval/human_research_ethics/forms

3. If the project has run for more than five (5) years you cannot renew approval for the project. You will need to complete and submit a Final Report and submit a new application for the project. (The five year limit on renewal of approvals allows the Committee to fully re-review research in an environment where legislation, guidelines and requirements are continually changing, for example, new child protection and privacy laws).
4. All amendments to the project must be reviewed and approved by the Committee before implementation. Please complete and submit a Request for

Amendment Form available at the following website:

http://www.research.mq.edu.au/for/researchers/how_to_obtain_ethics_approval/human_research_ethics/forms

5. Please notify the Committee immediately in the event of any adverse effects on participants or of any unforeseen events that affect the continued ethical acceptability of the project.

6. At all times you are responsible for the ethical conduct of your research in accordance with the guidelines established by the University. This information is available at the following websites:

<http://www.mq.edu.au/policy/>

http://www.research.mq.edu.au/for/researchers/how_to_obtain_ethics_approval/human_research_ethics/policy

If you will be applying for or have applied for internal or external funding for the above project it is your responsibility to provide the Macquarie University's Research Grants Management Assistant with a copy of this email as soon as possible. Internal and External funding agencies will not be informed that you have final approval for your project and funds will not be released until the Research Grants Management Assistant has received a copy of this email.

If you need to provide a hard copy letter of Final Approval to an external organisation as evidence that you have Final Approval, please do not hesitate to contact the Ethics Secretariat at the address below.

Please retain a copy of this email as this is your official notification of final ethics approval.

Yours sincerely
Dr Karolyn White
Director of Research Ethics
Chair, Human Research Ethics Committee
