Towards resilience against flood risks

Gissing, Keys and Opper discuss potential advances in flood emergency management through an analysis of the key relationships, trends and challenges facing flood emergency management agencies seeking to increase resilience against flood threat in Australia.

ABSTRACT

Increasing the resilience of communities and individuals against natural and other hazards is the primary goal of emergency management. In Australia flooding constitutes a major environmental threat, and the start of the 21st century has seen emergency services developing their flood emergency management capabilities in increasingly challenging and uncertain circumstances. This paper discusses key trends and challenges facing flood emergency management agencies in seeking to increase resilience against the flood threat and proposes some potential advances in flood emergency management. In addition, the paper explores the importance of relationships between emergency management, flood warning and floodplain management agencies in managing future trends and challenges.

Introduction

Flooding remains the most costly natural hazard faced by Australia. Many individuals and communities are vulnerable to floods of various kinds and origins, and the challenge to increase personal and community resilience to the flood hazard is on-going. At present flood emergency management is evolving in an environment consisting of many challenges, some of which are new and are uncertain. They include climate change, inadequate community preparedness for flooding, lack of flood experience at the level of agencies and in the community generally, demographic change and the growing realisation of the importance of the provision of community information and warnings.

Flood emergency, flood warning and floodplain management agencies need to consider these trends and challenges and consider opportunities to advance key management objectives. The goal should be the better management of floods in terms of reducing their undesirable impacts on communities: this is how community resilience is built. This paper outlines the key trends and challenges facing flood emergency management agencies and identifies areas where future advances can be made to enhance flood emergency management.

The issues over coming years

Climate change

Changes in our climate have been observed. The 2007 Intergovernmental Panel on Climate Change (IPCC) report states:

> *"Warming of our climate system is unequivocal, as is now evident from observations of increases in global average air temperatures, widespread melting of snow and ice, and rising global average sea level" (IPCC, 2007,p 2).*

Sea level rise is of particular concern in the context of flooding: the past century has seen sea levels rise at an increasing rate in most parts of the world. Global sea level has risen since 1961 at an average rate of 1.8 mm/yr and since 1993 at 2.1 mm/yr (IPCC, 2007). Over the period 1920 to 2000 the estimated average relative sea level rise around Australia was 1.2mm per year (CSIRO & Australian Government Bureau of Meteorology, 2007).

The Australian Government Department of Climate Change (2009, p1) in a recent update on climate change science stated *"The climate system appears to be changing faster than earlier thought likely"*.

The Victorian Government (2009) in a recent Green Paper on Climate Change concluded that climate change will result in more frequent, more intense weather events (such as storms, strong winds, floods and heatwaves) and a higher risk of fire. This conclusion is supported by recent scientific studies on the affects of climate change in Australia, which have indicated that impacts will likely include increased storm surge heights, more frequent extreme rainfalls and a greater frequency of hailstorm events (Victoria Government, 2008; Australian Government Department of Climate Change, 2009).

Recent research has concluded that with 1 to 2 degrees of warming there would be a doubling in the number of people exposed to the risk of flooding in Australia (CSIRO, 2006).

An assessment of climate change risks to the Australian coast found that up to $63 billion of existing residential buildings are potentially at risk of inundation from a 1.1 metre sea-level rise, with the number of buildings ranging from a lower estimate of 157,000 to an upper estimate of 247,600 (Australian Government Department of Climate Change, 2009).

Climate change will likely have significant effects on human health as outlined by the CSIRO:

> *"Climate change could cause large increases in flooding deaths and injuries depending upon future changes in precipitation extremes". (CSIRO, 2006, p27)*

Almost certainly, climate change impacts will, if not managed appropriately, have an adverse impact on community resilience to the flood hazard. It will also progressively increase the demand on the services of the State and Territory Emergency Services (S/TESs) not only in their roles in responding to flooding, but across other control and support agency functions; and across the full spectrum of prevention, preparedness, response and recovery functions. This increased demand will occur at a time when the S/TESs are already experiencing increased demand for their services. For example, the Victorian State Emergency Service over the last ten years has seen a 199% increase in the number of tasks requiring response. Such increases have been noted in other emergency service agencies.

Enhancing community preparedness for flooding

Holistic community engagement within an emergency management framework is about fostering a partnership with the community in which the community takes responsibility for emergency preparedness under the leadership of emergency and hazard management agencies (including local government). Post-flood research has demonstrated the success of well-prepared communities for flooding, in that they can save up to 80% of potential flood damages (Gissing, 2003: Bureau of Transport Economics, 2002: Wright and Smith, 1999).

Community preparedness for flooding in the main can be considered low in Australia. In a survey of flood preparedness in the Maribyrnong (Victoria) area, 50% of respondents rated their level of preparedness as either nil or poor (VICSES, 2008). Similar results were found in a 2005 survey of flood prone properties in Maitland, NSW, with only 14% of residents having undertaken any measures that might help in the event of a flood emergency (Hunter-Central River Catchment Management Authority, 2005). Recent community surveys in Victoria and NSW (ABS, 2007; VICSES, 2009; GNS, 2007) have found that only 8-20 percent of households have a written and rehearsed emergency plan. A NSW SES survey across four flood prone communities found only 7.9% of households had emergency kits prepared and that only 60% of property owners thought it necessary to be prepared for floods (GNS, 2007).

There is some evidence that the SES FloodSafe program, that attempts to provide locally tailored community education programs about flood risk and preparedness, is proving successful in improving community flood preparedness. An evaluation of a VICSES facilitated program in Benalla (Victoria) showed the following results after the application of the program (Molino Stewart, 2008):

- Residents reporting that they were unprepared for floods decreased from 31% to 2%.
- Residents reporting that they were very well or extremely well prepared for floods increased from 1% to 34%.
- The proportion of residents reporting that they had a home emergency plan increased from 8% to 24%.

A key challenge to enhancing community preparedness for flooding is not only the development of community awareness resources, but ensuring on-going effective community engagement to deliver and reinforce key messages and address community concerns. Effective engagement is labour-intensive and can be seriously challenged by a lack of community interest in flooding issues, especially during times of drought as has been experienced over much of Australia during the last decade. However, we cannot possibly aim to improve flood community preparedness without engaging with our communities. To be successful there is a need to understand community needs and for engagement to be based upon a two-way flow of communication.

Dealing with a lack of flood expertise

Many underlying difficulties in flood emergency management originate from the fact that though floods do occur frequently across Australia, they do not usually occur frequently at the local level. The result is a lack of flood experience both at the community level and in emergency management agencies. In many of Australia's most populated floodplains, drought conditions have resulted in no significant flooding for many years. The result is complacent and unprepared communities and a significant challenge to emergency management agencies in ensuring that flood expertise is maintained at the local level without first-hand experience. Agency members come to suffer from a lack of flood management experience and can come to believe that flood management, if it does not need to be

Aerial shot of flood plains in the Lake Eyre Basin.

implemented for long periods, has become unimportant and unworthy of continuing effort and commitment. This leads to a need for increased education, engagement, guidance, training and exercising of agency members as well as in the wider community.

The occurrence of other significant emergencies (eg. the September 11 terrorist attacks in 2001, the Asian Tsunami in 2004, the Black Saturday Bushfires and H1N1 pandemic threat in 2009 and the long lasting current Australian drought) has seen prominence given to hazards such as bushfires, terrorism, tsunami and pandemics by governments, the media and the community. This has created a number of challenges for flood emergency management agencies in attracting resources for specific flood related projects, but also in developing strategies to benefit from investment in other hazards, by drawing synergies with the management of them in an all hazards framework. It has also seen some resources used to complete flood-related projects being shifted to contribute to projects relating to other hazards.

Understanding the impacts of demographic change on resilience

Demographic change is occurring in Australia, requiring emergency management agencies to adapt their service delivery strategies and methods to ensure community needs are meet. The following key trends related to community vulnerability are being experienced:

- The sea change shift, with more people moving to live in coastal communities, creating an increase in vulnerability to coastal and estuarine flooding. When combined with the potential impacts of coastal flooding under conditions of sea level rise this trend is likely to impose substantial challenges on emergency management agencies placing further emphasis on the need to ensure appropriate floodplain and emergency management principles are applied to land use planning.
- Increasingly culturally diverse communities, creating challenges in engaging and communicating with different culturally and linguistically diverse communities, before, during and after floods.
- The aging of the population, resulting in increased community vulnerability and likely increases in the numbers of people needing help in times of floods and storms especially when evacuation is required. An aging workforce also results in specialist flood management skills shortages and a loss of critical knowledge.

Improving community flood information and warnings

The purpose of community-based flood information and warnings is to provide advice to community members about impending flooding and the necessary response actions, so that they can appropriately prepare and respond to the consequences of flooding before those consequences are apparent. Flood warning is potentially a highly effective and relatively cheap means of ensuring public safety and reducing flood losses, because it allows people adequate time to evacuate and to lift or remove contents (Handmer & Smith, 1995). Many recent studies have suggested that flood warning systems are not performing to their full potential (Gissing, 2002; Pfister, 2002; Anderson-Berry, 2002; Opper et al., 2006; Gissing et al., 2008; Keys and Cawood, 2009). It is a challenge to all emergency managers to ensure that warning systems are effective, and this requires considerable planning and maintenance.

The importance of warnings as a method of protecting life and property was demonstrated on Black Saturday, 2009 and became a key theme of the Victorian Bushfires Royal Commission, with its key conclusion that timely and accurate warnings may save lives (Victorian Bushfires Royal Commission, 2009). The views of the Commission are best summarised below:

> *"The evidence before the commission has demonstrated that the community depends on (and has come to expect) detailed and high quality information prior to, during and after bushfires. In addition, the community is entitled to expect to receive timely and accurate information whenever possible, based on the intelligence available to control agencies."* (Victorian Bushfires Royal Commission, 2009, p 120).

It might be noted here that after many disaster episodes over the past decade or so, great community concern has been expressed about the lack of warning provided or the inadequacy of the warnings that were promulgated. Examples include the tragic Sydney-Hobart Yacht Race in 1998, the Sydney hailstorm in 1999, the North Coast floods in NSW in 2001, the Canberra bushfires in 2003 and the Queensland floods in 2008. Indeed, community concern about warning is a constant theme in the Australian emergency management experience.

Community education is an essential part of any flood warning system as there is a positive linkage between community preparedness and warning systems. Well-prepared communities respond better to emergency warnings and improve the effectiveness of these systems. The Victorian Bushfires Royal Commission's conclusion could equally apply to flood warnings:

> *"The success of specific bushfire warnings partly depends on the standard of the information and education provided to the community prior to its issue." (Victorian Bushfires Royal Commission, 2009, p 120)*

Keys and Cawood (2009) have argued that most weaknesses in Australian flood warning practices are cultural rather than technical, with flood warning products under-used by a combination of poor attention given to flood warning practice and a response-biased (as distinct from preparedness-focused) culture in which proactive flood emergency management is not valued. Flood emergency management agencies should continue to enhance their management capabilities by focusing on the proactive management of potential flood consequences.

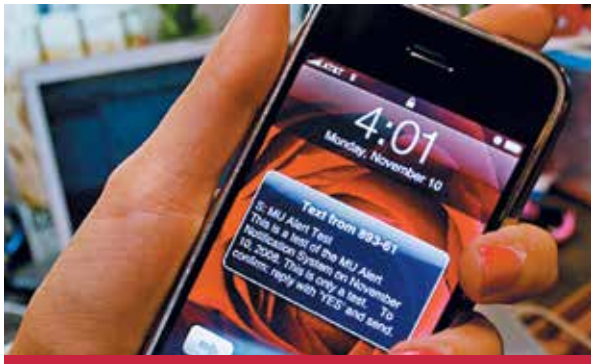
There is a growing demand for web-based emergency information and warnings, since the internet has become an important and widely available source of information before, during and after emergencies. In 2006-07, 64% of Australian households had internet access in their homes (ABS, 2008). A growing proportion of internet availability is through mobile phones. Around 50% of respondents in a recent Victorian flood survey indicated they would search for information about flooding on the internet (Molino, 2009).

Social media websites such as Twitter, Facebook, Youtube and the like are increasingly being identified as means of providing information before, during and after emergencies. These new media provide emergency managers the opportunity to communicate directly with the community and for community members to engage with each other on emergency management matters. Depending upon the specific social media they can be used in direct one-way engagement or in a two-way communication flow.

A national telephone-based warning system (Emergency Alert), capable of alerting communities either by a recorded voice message or text message based upon an intended recipient's billing address, is currently being implemented. As the system only has the realistic capacity of providing alerts with limited information there will be a need for people to seek further information either via the media, though telephone hotlines or the internet, again placing a greater requirement on the websites of emergency services to have adequate capacity; and timely, helpful and accurate information and advice available.

Future directions

Adopting technological advances



National telephone-based warning system – Emergency Alert.

Flood emergency management agencies should continue to investigate and, where current or emerging needs are satisfied, make use of technological advances. Current emerging technologies which flood emergency management agencies are investigating or implementing include:

- Improved computer-based incident management systems to provide operations controllers with improved awareness of flood situations
- Spatially-based flood intelligence systems to help flood managers become aware in advance of likely flood consequences and thus to inform flood emergency planning activities and response operations. At present in Australia, even basic flood intelligence systems (in short, systems which contain information on the likely effects of floods in specified areas under conditions of varying flood severity as measured, for example, by river heights at gauges) are poorly developed in some jurisdictions. There is scope for much improvement both in data (by using information from past floods and from modelling) and display (for example in the utilisation of modern Geographic Information Systems), and for increases in their use in the provision of flood warnings.
- Temporary flood mitigation devices to protect property, critical infrastructure and heritage assets
- Warning technologies to provide additional warning tools including the implementation of the National Emergency Warning System (Emergency Alert). Opportunities also exist to improve the efficiency with which warnings are issued across multiple mediums, through the adoption of technology, which enables emergency managers to disseminate a consistent warning message through multiple mediums through simple software solutions. Mediums include the broadcast media; telephone-based warning systems; social media (Twitter etc.); websites etc.
- Increased use of remote sensing and aerial technologies to collect real-time flood information to improve situational awareness

Improving flood warning systems and community flood preparedness

Much can be done to improve flood warning system performance and community flood preparedness and a high priority should be given to such improvements by emergency and floodplain management agencies. There is considerable evidence of the economic value of flood warning systems and community flood preparedness to support a high priority being given to this area (Molino Stewart, 2009). It is essential that emergency management agencies provide specific resources for education, emergency planning and warning to improve these areas and adopt a proactive flood emergency management culture.

Potential future flood warning advances will depend on the following issues being addressed:

- Recognition of the importance and value of warning systems
- Security and maintenance of existing flood warning infrastructure including stream flow gauges
- Investigation of the need for improved flash flood warning systems and means of developing them
- Ensuring community and media awareness of flood warning products and appropriate means of responding to them
- Continued development of pre-written flood bulletin templates to improve the accuracy, comprehensiveness and timeliness of warning messages
- Improved use of websites and social media to disseminate flood information and warnings
- Improved use of graphics in flood warning products to provide more information and improved community understanding in relation to flood consequences

- Improved capability to provide warnings and information in languages other than English
- Ensuring flood intelligence is available for warning gauges so that likely flood consequences can be identified and communicated to the community
- Improved dissemination of warnings, through community networks, to vulnerable groups who maybe isolated within society
- Linkage of spatial flood intelligence to the National Emergency Warning System (Emergency Alert)
- Cultural change in information units (units established to coordinate public information) to provide a focus on proactively warning the community about flood threats

Key potential future community education issues include:

- Continued research into the effectiveness of different community engagement methods to ensure that the most effective methods are utilised
- Building capability amongst SES volunteers to conduct community education
- Ensuring that community education programs are risk-based, containing locally- based information
- Ensuring community education programs are accessible to the community, including to culturally and linguistically diverse communities and to disability groups
- Development of enhanced strategies, in partnership with road safety organisations and road owners, to reduce the instances of people walking, riding or driving through floodwater
- Partnering with other emergency service and hazard management agencies to provide all hazards community education programs
- Renewed focus on school based community education, particularly around the dangers of floodwaters
- Using websites to deliver self paced business and household planning tools

Flood emergency planning aims to prepare community-based plans of action to guide the preparedness, response and recovery phases of flood emergency management. These plans are a key to ensuring emergency management and community preparedness for floods. More can be found about the importance of flood emergency planning and emergency planning processes in Gissing et al (2007). Key issues in this area include:

- Ensuring adequate community and stakeholder consultation within the emergency planning process
- Ensuring plans are risk-based and are developed using appropriate and easily- understood flood information
- Developing an understanding of communities to ensure plans reflect likely community behaviours during floods
- Building capability on the part of flood emergency planners to understand flood risk information and how to plan for flood emergency management strategies
- Convincing response-orientated emergency managers of the need for emergency planning (and the need to utilise plans when responding to floods)
- Ensuring flood emergency plans are kept alive through exercising and training and that all agencies with responsibilities under the plans maintain operational readiness for flooding
- Greater incorporation of critical infrastructure consequences into flood intelligence and flood emergency plan strategies
- Improved planning for large scale flood rescue operations.

Evacuation modelling developed by the NSW SES (Opper et al, 2009) is available for use to estimate the amount of time required to evacuate communities at risk of flooding. Evacuation modelling is essential in ensuring timely evacuation decisions are made to enable everybody to escape the area of danger in time. Evacuation modelling can also be used to assist floodplain management agencies in assessing whether a development proposal can be safely evacuated given the constraints of the likely warning time and evacuation routes available and without causing significant negative consequences on the evacuation capacity of the pre-existing community.

Promotion of best practice flood emergency management principles

Recently the National Flood Risk Advisory Group, with the assistance of S/TES agencies, completed the review of the Australian Emergency Manual Flood Series originally published in 1999. The series promotes flood emergency management best practice principles in flood emergency management and includes comprehensive manuals on Flood Preparedness, Flood Response, Flood Warning and Emergency Management Planning for Floods Affected by Dams (available from www.ema.gov.au). These manuals should be seen as critical in collecting and promoting industry best practice, but to succeed in actually improving the quality of flood emergency management the manuals must be marketed to emergency and floodplain managers and integrated into training and exercising practices.

It is essential to invest in the knowledge and expertise of emergency managers. Though there are successful initiatives such as the NSW SES's Exercise Nevagazunda, the NSW DECCW/UTS Floodplain Management course and VICSES's Managing Floods Using AIIMS course there exists a need for more formalised training to educate and exercise practitioners in best practice flood emergency management concepts and principles.

Improving relationships between flood emergency, flood warning and floodplan management agencies

Over the last decade, the relationships between floodplain management, flood warning and flood emergency management agencies have grown stronger. The importance of these relationships must be recognised across the contexts of prevention, preparedness, response and recovery. Effective relationships have mutually beneficial outcomes. For those involved in managing floods there is an improved

A key to future directions is maintaining and building the relationships between agencies.

opportunity to gain essential data from flood studies to inform flood intelligence and to use the knowledge of floodplain managers in informing flood response operations and flood warning. For floodplain managers there is an opportunity to gain emergency management and warning input into land use planning and floodplain management initiatives; and to partner in the delivery of community flood awareness programs. It is essential in ensuring effective service delivery that relationships between industry sub-groups continue to grow and strengthen.

Conclusion

Much can be done by emergency, warning and floodplain managers to address the key industry challenges and trends assuming appropriate resources are available. A primary key to future directions is maintaining and building the relationships between flood emergency, flood warning and floodplain management agencies, particularly in sharing the expertise the industry sub-groups can provide.

Cultural change within the emergency management agencies, especially the S/TESs, is critical to ensure that emergency and floodplain managers recognise the importance of warnings, intelligence and emergency planning. Further engagement is required to ensure stronger partnerships are developed between emergency, warning and floodplain management agencies and between agencies and the community. These elements are the keys to building a strong culture of community-based flood resilience in the future. Many of the tools for better flood management are well understood, but a major challenge will be to improve our adoption and utilisation of them in the search for a greater degree of community resilience against the flood hazard. The legacy of the current generation of flood managers will depend on how well we perform this task.

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References

Anderson-Berry, L. (2002). *Flood Loss and the Community. In: Smith, D.I & Handmer, J. (Eds), Residential Flood Insurance The Implications for Floodplain Management Policy. Water Research Foundation of Australia, Canberra.*

Australian Bureau of Statistics (2007) *Household preparedness for emergencies. Available online www.abs.gov.au.*

Australian Bureau of Statistics (2008) *Social Trends 2008. Available online www.abs.gov.au.*

Australian Government Department of Climate Change (2009) *Climate Change 2009 – Faster & More Serious Risks. Australian Government Department of Climate Change. Available online www.climatechange.gov.au*

Australian Government Department of Climate Change (2009) *Climate Change Risks to Australia's Coast. Australian Government Department of Climate Change. Available online www.climatechange.gov.au*

Bureau of Transport Economics (2002) *Costs of Natural Disasters in Australia. Bureau of Transport Economics, Canberra*

CSIRO (2006) *Climate Change Impacts on Australia and the Benefits of Early Action to Reduce Global Greenhouse Gas Emissions. CSIRO*

CSIRO and Australian Government Bureau of Meteorology (2007) *Climate Change in Australia. Available online – www.climatechangeinaustralia.gov.au*

Gissing, A. (2002). *'The business of warning', Risk Frontiers Quarterly. Available online http://www.es.mq.edu.au/nhrc/web/nhq/rfnews1_3/rfnews1_3tables.htm.*

Gissing, A. (2003) *Flood Action Plans –making loss reduction more effective in the commercial sector. The Australian Journal of Emergency Management No 3. pp. 46-54.*

Gissing, A., Morgan, M., and Ronan, C. (2007) *Planning for the inevitable – emergency planning for floods in NSW. Presented at 2007 Floodplain Management Authorities Conference, Gunnedah.*

Gissing, A., Molino, S. and Cameron-Smith, C. (2008) *How do you improve community response to warnings. Presented at 2008 Floodplain Management Authorities Conference, Wollongong.*

GNS (2007) *Flood risk perceptions, education and warning in four communities in New South Wales, Australia – results of a questionnaire survey, 2005. GNS Scientific Report 2007/30.*

Handmer, J. & Smith, D. I. (1995). *Cost-Effectiveness of Flood Warnings, Volume 2, Assessing Flood Warnings. Report prepared for the Bureau of Meteorology. Centre for Resource and Environmental Studies, ANU, Canberra.*

Hunter-Central River Catchment Management Authority (2005) *Flood Education Advisory Committee Survey. Hunter-Central River Catchment Management Authority*

IPCC (2007) *Climate Change 2007. Available online - www.ipcc.ch*

Keys, C. and Cawood, M. (2009) *Identifying and reducing the inadequacies in flood warning processes: an Australian perspective. Journal of Flood Risk Management, Vol 2, Number 3, pp. 190-197.*

Molino, S. (2009) *Unifying Flood Information – The Victorian Flood Web Portal. Presented at 2009 Floodplain Management Authorities Conference, Albury.*

Molino Stewart (2008) *Evaluation of the FloodSmart and StormSmart pilot programs and their transferability to the urban environment. Prepared for the Victorian State Emergency Service.*

Molino Stewart (2009) *Community Education for Floods and Storms Cost Benefit Analysis for VICSES Business Case. Molino Stewart, Parramatta.*

Opper, S., Gissing, A., Molino, S. and Edwards, G. (2006) *To flee or not to flee – an evaluation of warning and evacuation effectiveness. Presented at 2006 Floodplain Management Authorities Conference, Lismore.*

Opper, S., Cinque, P., Davies, B. (2009) *Timeline modelling of flood evacuation operations. Presented at First International Conference on Evacuation Modelling & Management, Netherlands*

Pfister, N. (2002). *'Community response to flood warnings: the case of an evacuation from Grafton'. Australian Journal of Emergency Management, Vol 17, No 2.*

Victoria State Emergency Service (2008) *Maribyrnong flood survey. Unpublished*

Victoria State Emergency Service (2009) *Operational and Communication Effectiveness Survey. Jobshift Pty Ltd, Melbourne*

Victorian Bushfires Royal Commission (2009) *Interim Report. Parliament of Victoria, 2009 Victorian Bushfires Royal Commission*

Victorian Government (2008) *Climate Change Victoria: 2008 Summary. Victorian Government.*

Victorian Government (2009) *Victorian Climate Change Green Paper. Victorian Government.*

Wright, C. & Smith, D (1999) *How to capture the benefits of flood warning. Proceeding Australian Disaster Conference 1999.*

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