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ABSTRACT

Manual 21 Flood Warning (Attorney-General's Department, 2009) stresses that 'reviewing the performance of the total flood warning system (including the responses by agencies and the community) is a vital component of the system'. Furthermore, it states that 'flood warning systems need regular attention to ensure they will function as intended and to continue to improve their performance. System review should occur at different levels and, where possible, performance indicators should be devised so system effectiveness can be assessed objectively'.

Based on Manual 21, learnings from recent reviews of Victorian total flood warning systems and recommendations in the Victorian Emergency Management Reform White Paper (Victorian Government, 2012), this paper offers suggestions to improve the review approach across the state.

The suggested improvements are:

1. Ensuring the regularity of review, both between and after flood events.
2. Using a standard set of performance indicators and evaluation process for all reviews of total flood warning systems across Victoria to enable comparison and continuous improvement.
3. Including an understanding of the flood-affected communities in the analysis of the response component of the total flood warning system.
4. Using best practices in evaluation (e.g. as recommended by the Australasian Evaluation Society) to provide a well-balanced, objective review with relevant judgements.
5. Using new and emerging technologies in pre- and post-flood reviews.

Introduction

Flood warning systems are a critical linkage between emergency agencies and affected communities just prior to and during a flood event. The purpose of a flood warning is to provide advice on impending flooding so people can take action to minimise its negative impacts.

The guiding document for the development, implementation and evaluation of flood warning systems in Australia is Manual 21 Flood Warning (Attorney-General's Department, 2009). According to Manual 21, 'Flood warning systems and services are integral to the achievement of high-quality community flood response. The development of flood warning services requires information, knowledge sharing and effective communication. Well-developed flood warning services that are understood and acted upon by the communities for which they are provided can contribute significantly to saving lives and protecting property. They should be regarded as central to the management of flooding' (p. 3).

Manual 21 (p. 6-7) states that an effective flood warning system can be defined as having six integrated components:

1. Prediction - Detecting changes in the environment that lead to flooding, and predicting river levels during the flood.
2. Interpretation - Identifying in advance the impacts of the predicted flood levels on communities at risk.
3. Message Construction - Devising the content of the message which will warn people of impending flooding.
4. Communication - Disseminating warning information in a timely fashion to people and organisations likely to be affected by the flood.
5. Response - Generating appropriate and timely actions from the threatened community and from the agencies involved.
6. Review - Examining the various aspects of the system with a view to improving its performance.

Other research splits 'prediction' into two parts: data collection; and prediction. In either case, diagrammatic representations tend to show the total flood warning system as a linear process (e.g. Victorian Flood Warning Consultative Committee, 2001), although this has been questioned by some researchers (e.g. Molino, Dufty, Crapper & Karwaj, 2011).

Manual 21 stresses that 'reviewing the performance of the total flood warning system (including the responses by agencies and the community) is a vital component of the system'. Furthermore, it states that 'flood warning systems need regular attention to ensure they will function as intended and to continue to improve their performance. System review should occur at different levels and, where possible, performance indicators should be devised so system effectiveness can be assessed objectively'.

Table 7 of the Manual 21 (p.71) provides a list of performance indicators related to each component of the total flood warning system. Review should occur between flood events (e.g. when a flood study is completed or when technological, environmental or organisational changes occur) and 'as soon as possible' after a flood event.

Total flood warning system reviews in Victoria

There has been significant planning for and scrutiny of Victorian total flood warning systems conducted during the past ten years.

In 2001, the Bureau of Meteorology issued the 'Arrangements for Flood Warning Services in Victoria'. The arrangements are 'principles, responsibilities and cost sharing details for achieving effective development and performance of flood warning services in Victoria. They are to be used for developing, improving and managing services where it can be shown that services are required and can be supported in the short and long term'.

In 2005, the Victorian Flood Warning Consultative Committee released its Flood Warning Service Development Plan report, which focussed on preferred non-structural solutions to flood management and warning throughout the state.

The report found that there are many organisations actively participating in floodplain management and warning including the Bureau of Meteorology, Department of Sustainability and Environment, Catchment Management Authorities (CMAs), Water Supply Authorities, Victorian State Emergency Service (VICSES), Local Councils and others but, with a few exceptions, the roles and responsibilities of each are not well defined and this can result in important tasks not being done well or not done at all.

The report made 22 recommendations as part of the plan for improving Victoria's flood warning service. These were sorted into 10 themes of action by the State Flood Policy Committee.

As the control agency for flood response in Victoria under the *Victorian State Emergency Services Act 2005* and the State Emergency Response Plan, prepared under the *Emergency Management Act 1986*, VICSES sought to explore its role in flood warning systems across the state. Molino Stewart (2007) reviewed Victorian total flood warning systems and helped to clarify the important role of VICSES. It used the 2007 June/July Gippsland floods as a case study in this review to identify issues in total flood warning systems and possible solutions.

The 'Review of the 2010-11 Flood Warnings and Response' (Victorian Government, 2011) has been the most extensive review of the total flood warning system over the past ten years. The Review, conducted by the Victorian Government and led by Neil Comrie, found that 'improvements are required to Victoria's Total Flood Warning System which needs to be better tailored to meet local requirements' (p.4). The Review also found other deficiencies including:

- Lack of clarity over roles and ownership. 'At best, these roles are shared or fragmented which does not provide accountability. This situation includes the Bureau of Meteorology and consequently the level of service it provides to Victorian communities needs revisiting' (p. 4).
- Gaps in the gauging framework.
- Lack of community involvement (including use of local knowledge) in the total flood warning system.

Of the 93 recommendations made by the Review, 30 related to improving flood predictions and modelling (components 1 and 2 in Manual 21) and 12 to improving the timeliness and effectiveness of warnings and public information.

Post-flood reviews were also conducted by the Victorian Government for the March 2012 North-East Floods (Office of the Emergency Services Commissioner, 2012a) and 2012 Gippsland Floods (Office of the Emergency Services Commissioner, 2012b). These reviews found similar weaknesses in total flood warning systems to the Review of the 2010-11 Flood Warnings and Response.

CMAs have conducted several between-event reviews of existing and potential local total flood warning systems, largely dependent on their success in achieving external funding. For example, the Glenelg Hopkins CMA in conjunction with Moyne Shire Council is currently reviewing the potential of establishing a total flood warning system for Port Fairy.

The Victorian White Paper

Recently, the Victorian Government has signalled improvements in components of warning systems across the state, including for flood. The Victorian Emergency Management Reform White Paper (Victorian Government, 2012) is largely a result of the final reports of the 2009 Victorian Bushfires Royal Commission and the Review of the 2010-11 Flood Warnings and Response.

The White Paper particularly concentrates on components 3 and 4 (Message Construction, Communication) of the Manual 21 effective warning system guidelines. It states that ‘the current multi-agency, multi-hazards and multi-channel approach to providing community warnings and information will continue to be improved, in line with Floods Review recommendations and recognising the various ways communities choose to access information. Such a comprehensive approach is also essential to reach particular community sectors – such as youth, the disabled or the elderly – with a preference for specific types of communication’ (p. 8).

According to the White Paper, the Emergency Management Commissioner will ensure appropriate warnings are issued to the public and keeps relevant ministers informed during the course of the emergency.

The White Paper stresses that a ‘strong performance-monitoring and review body is essential for sector accountability. To achieve this, ‘the statutory role of Inspector General for Emergency Management (IGEM) will be established as the assurance authority for Victoria’s emergency management arrangements. The IGEM’s role will build on the refocused and reoriented role of the current Emergency Services Commissioner. The IGEM will report to the Minister for Police and Emergency Management’ (p.27).

Although not explicitly stated in the White Paper, it is apposite that the IGEM monitor and evaluate total flood warning systems across the State.

Suggested improvements

From the above, it appears that the first five of the six Manual 21 warning system components will be markedly improved across Victoria as recommendations from the Review of the 2010-11 Flood Warnings and Response are addressed and the White Paper initiatives are introduced.

However, it is the last component – Review – that may require further recognition and effort than that outlined in these two documents. Although the IGEM would have responsibility for total flood warning system review, it is relatively unclear how this would be conducted.

Issues with the conduct of flood warning system reviews are not confined to Victoria, with those outlined below common throughout Australia and many other countries. The issues (and suggested improvements) are:

1. Regularity of system review. As noted above, Manual 21 suggests that ‘regular’ checking of the total flood warning system occur between flood events and that reviews are conducted as soon as possible after floods. It is important that the Victorian Government decides on who is responsible for total flood warning system review (e.g. the IGEM) and develop a program of regular between-events flood warning system review across the state as part of its ‘program to drive continuous improvement’.

It appears from the White Paper that the IGEM will be responsible for developing and maintaining ‘a framework for reviewing and evaluating system performance in response to non-routine emergencies (i.e. those that do not require an independent or judicial inquiry)’. However, if total flood warning system review is part of this regime, it will have to be decided what level (e.g. major flood) and non-routine circumstances trigger a review.

2. Standard set of performance indicators and evaluation process. Manual 21 provides guidance for the development of performance indicators for each component of the total flood warning system. A standard set of performance indicators and evaluation process should be used for all flood reviews of total flood warning systems across Victoria to enable comparison and continuous improvement.

It should be noted that 'as part of its role to provide assurance on the effectiveness of Victoria's emergency management arrangements, the Office of the Emergency Services Commissioner (OESC) is developing a Performance Monitoring Framework to track the performance of elements of emergency management across all hazards. Once finalised, the Framework will enable the OESC to use a consistent post-incident approach to measure performance to support improvement across the emergency services sector' (Office of the Emergency Services Commissioner, 2012a). It is envisaged that this activity be transferred to the IGEM and include aspects relevant to total flood warning systems.

3. An understanding of the flood-affected communities in the analysis of the response component of the total flood warning system. This can be done through community profiling, social network analysis and forms of post-event social research including community surveys, focus groups and community debrief meetings. This research is critical as even though the upper components of the Manual 21 total flood warning system (i.e. Monitoring and Prediction, Interpretation) may be working well, there may be a poor or little community reaction to warnings due to issues such as individual psychological barriers and lack of community connectedness.

Examples of social research (including community surveys) for post-flood reviews of total flood warning systems were conducted by the OESC (Office of the Emergency Services Commissioner, 2012a; 2012b) and are available from the links in the reference list.

The post-event social research should be conducted as soon as possible after the flood event to avoid people losing memory of key response details.

4. Using best practices in evaluation to provide a well-balanced, objective review with relevant judgements. When conducting a review of components of the total flood warning system - either between floods or immediately after a flood - it is important to use best evaluation practices e.g. as recommended by the Australasian Evaluation Society (AES).

The AES is the primary Australasian professional organisation for people involved in evaluation including evaluation practitioners, managers, teachers and students of evaluation, and other interested individuals. Guidelines for best practice are provided by the AES at <http://www.aes.asn.au/> including the AES Guidelines for the Ethical Conduct of Evaluations.

An example of evaluation best practice is the development of a review (evaluation) plan which outlines at least the review objectives/performance indicators, research questions, methodology, data used and timing. This plan should be negotiated between the client and reviewer prior to the review being conducted. As Owen (2006, p.67) stresses, 'A major milestone that needs to be reached through negotiation is an evaluation plan. While there may be differences in emphasis in the degree of planning, effective use of evaluation findings is heavily dependent, in all arrangements and settings, on the degree to which the evaluator and clients agree on a plan for the evaluation. This is the up-front agreement that determines the directions the evaluation will take'.

All potential data sources should be identified and assessed for use in the review plan. There are a broad range of data sources that could be used to assess components of the total flood warning system including flood hydrologic data, rainfall data, flood warnings issued by the Bureau of Meteorology, flood bulletins issued by VICSES, evacuation warnings issued,

evacuation centre data, media coverage transcripts (e.g. radio announcements of warnings), Emergency Alert data, notes from community meetings, ESTA data (emergency calls to 132 500), agency de-brief notes and community responses to social research (e.g. surveys).

5. Using new and emerging technologies in the review. New and emerging technologies should be monitored and examined for potential use in pre- and post-flood reviews.

For example, the proliferation of live 'crowdsourced' crisis maps generated from SMS and social media platforms is driven by the increasing availability of real-time geo-referenced data and new mapping technologies that are often free, open source and easier to use than earlier, proprietary systems, although 'verifying crowdsourced information is quite a challenge' (Meier, 2011). These maps can be used to help review the responses of flood-impacted community to warning messages.

Conclusions

Emergency management is generally well-evaluated, especially through exercising and drilling. This said, more can be done, particularly in evaluating interactions between emergency management and affected communities, such as community education and warning systems.

The article indicates that there will be marked improvements in the most components of Victorian flood warning systems in the next few years. However, it is unclear if this optimism can be related to the Review component of the total flood warning system across the state, although evaluation initiatives (e.g. Performance Monitoring Framework) commenced by the Office of the Emergency Services Commissioner appear promising.

Hopefully, a future 'culture of evaluation' in Victorian emergency management as indicated by the White Paper will enable the review component of the total flood warning system as outlined in Manual 21 to be regularly, consistently and adequately addressed.

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