

FLOOD WARNINGS: RECENT LESSONS LEARNED AND DEVELOPMENTS UNDER WAY

**Neil Pfister, Planning and Research Officer and
Allen Rutledge, Assistant State Planning Coordinator
NSW State Emergency Service**

Introduction

The NSW State Emergency Service (SES) is the legislated combat agency for flooding in New South Wales. It is the SES's job to lead the community's response to the flood threat so as to minimise the risk to life and property.

One of the main means available to assist the community during floods is the provision of information about what will happen as a flood rises and what people should do to manage it in their own interests. The SES, of course, is involved in many other vital activities during floods. These 'acute' activities include assistance with property protection measures (sandbagging and the lifting and relocation of property), the coordination of evacuations, the conduct of resupply operations for isolated communities and the rescue of people who are in danger. These activities, however, generally have a direct effect only on relatively small numbers of people. Conversely, the warnings and advice that the SES provides in its Flood Bulletins, which are broadcast over radio stations, have the potential to directly affect thousands of people by enabling those people to make decisions and take action to protect themselves and their property from floods. The importance of the flood warning task is also apparent when we consider the impact of warnings that are not done well - for example, because insufficient information is provided or because people don't understand the messages that are broadcast. This has happened on occasion in the past and it has been obvious at those times that an ill-informed public is in not in the best position to protect itself. In such cases no action is taken, or too little is done too late and loss and damage that could have otherwise been avoided occurs.

The SES as an organisation is committed to the pursuit of best practice in emergency management. After each significant flood, the SES embarks on a process of critical self-examination and review to ensure that lessons drawn from the event are not lost. This review usually takes the form of operational debriefs. Increasingly, debriefs incorporate feedback sought at public meetings.

Floods on a number of rivers along the NSW North Coast early last year provided the impetus for the SES to engage in the latest round of post-operational reviews. Operational debriefs were conducted at the local, division and State levels of the organisation. Public meetings were also conducted in several towns that were particularly hard-hit by the floods. In addition, the Service decided to conduct a research project in Grafton after the March 2001 Clarence River flood. The survey-based work was undertaken as a means of reviewing the flood warning system, with reference to the actual target audiences of the warnings.

The aim of this paper is to examine some of the recent lessons learnt by the NSW SES in relation to flood warning practice and what it is doing to improve the flood warning services.

The flood warning system

Before considering the lessons learnt from the post-flood review and the work that is being done to address these lessons, it is worthwhile to briefly outline the way in which flood warnings are communicated to the public.

In NSW, flood warning services for streams that are not subject to flash flooding are provided by the Bureau of Meteorology. The Bureau's warnings, which incorporate height-time predictions for key river gauges, are supplemented with other information by the SES Division Headquarters and then issued to media outlets as Flood Bulletins. Local SES units also use the Bureau's warnings, advising directly those who have interests at risk (caravan park managers for example) or responsibilities to manage (councils are a case in point).

These Bulletins include, verbatim, the predictions section of the Bureau's warnings, and they also include the latest river and rainfall gauge readings. These inclusions are the basis of the agreement between the SES and the Bureau on the management of flood warnings which is spelled out in the State Flood Plan.

The SES also incorporates into the Bulletins information about what the predicted flood height means in terms of areas likely to be flooded and the depth and nature of the expected flooding. This part of the Flood Bulletins extrapolates the vertical dimension of the Bureau's predictions out to the horizontal dimension. It translates a numerical gauge height into a range of effects that a community can expect at that gauge height and it establishes the significance of the flood in people's minds. This part of the Flood Bulletin depends vitally on the SES' flood intelligence and consequently, a great deal of time and effort is expended on continually upgrading the flood intelligence system.

The SES Flood Bulletins also include:

- advice on what actions people should take to protect themselves and their property (indicating appropriate time frames for these actions);
- areas of danger to be avoided;
- road conditions (roads that are currently closed, may become closed and/or will not be closed);
- contact details for SES Units in the event of assistance being required; and
- contact details for obtaining road information.

This array of information that the SES aims to include in its Flood Bulletins is consistent with current conceptions of best practice in flood warning (Emergency Management Australia, 1999).

Unfortunately, being aware of the theory of best practice does not guarantee that the Bulletins always conform to best practice. In reality, in the high-stress environment of a flood response operation, the production of good quality Flood Bulletins is not an easy task and can fall short of the ideal.

It is often the case that Flood Bulletins end up being 'media unfriendly'. They can be overly long, and contain lists of information, such as road closures, which are poorly suited to radio broadcasts. This is understandable, given the large volume of information that flood response managers try to get across to the public during floods. The following section indicates what the SES is doing to improve the style and content of its Flood Bulletins.

What can go wrong in the warning process? The results of some post-flood research

The flooding on the north coast of NSW on 10 March 2001 will be used as the background to the discussion of the post-flood research results. At about midday on this day, the Bureau of Meteorology predicted that the Clarence River would rise to 8.1 metres or higher at the Grafton (Prince Street) gauge. The documented crest height of the city's levees was 8.2 metres. This only provided a maximum of 10 centimetres as a margin for error and there was a very real danger that the levees could be overtopped, particularly if rain continued to fall upstream. In a levee-overtopping flood, most of the urban area would be inundated, with only two relatively small areas of high ground in South Grafton remaining above the flood waters. A decision was made to evacuate the 12,000 residents that live in the flood-prone areas of Grafton. The evacuation, however, did not proceed optimally and it was estimated after the operation that fewer than 10% of Grafton's population left the city during the nine hours that the evacuation operation was in effect.

The flood peaked at 7.75 metres, 0.35 metres lower than predicted. This was fortunate, as the level of protection afforded by the levees was lower than expected. As a result of post-flood reviews it was determined that the actual crest height of the levees was no more than about 7.95 metres at the low points. This means that had the predicted height of 8.1 metres been achieved the levee would have been overtopped by 15 centimetres of flood waters.

As the levees were not overtopped, the evacuation turned out to be unnecessary (but not unwarranted, given the uncertainty inherent in flood prediction and the dire consequences of a levee-overtopping flood). Nonetheless, the low-level of community response raised a number of important questions about the effectiveness of the warning process and the evacuation operation:

- Were the warnings heard by the community?
- Were they communicated effectively?
- What were the primary motivations for evacuation?
- Why did so few people leave?

During the research fieldwork, 205 people who were in Grafton during the flood were surveyed over the phone and asked a standard series of questions. A further 12 people participated in more in-depth, face-to-face interviews. The research findings have been detailed elsewhere (Pfister, 2002), but they can be briefly outlined here.

The survey confirmed that few people evacuated from Grafton. Only 13% of the survey respondents who live in flood-prone areas evacuated to a safe area.

Almost a third of the people who stayed at home however, were to some extent prepared to evacuate. These people indicated that they:

- would have gone if they had been advised via doorknocking,
- were waiting for the final order to evacuate,
- had packed and were ready to go,
- were waiting until the last minute, or
- had actually started to evacuate when the evacuation was terminated.

This finding has both positive and negative ramifications. On the one hand, it shows that a large number of people were receptive to the idea of evacuation. They may not have needed much more of a push to get them moving. On the other hand, the fact that they were delaying action until the last possible moment is worrying. A last-minute rush to leave Grafton would be potentially disastrous, especially if (because of flooding to the north of the city) evacuation was only possible via the two-lane bridge across the Clarence River. Furthermore, evacuation is likely to be possible only for a short period after levee overtopping.

The research found that most people had heard the flood warnings and 97% of the people said that they were aware that an evacuation warning had been issued. Over 60% of the people had heard the evacuation warning on the radio and about 30% had heard of it from friends, neighbours or relatives. Approximately one quarter of the respondents were doorknocked and a few heard the evacuation warning broadcast via public address systems from police cars.

It became apparent during the research that most people did not believe that they were really at threat from the flood. Very few people expressed the firm belief that the levee could not be overtopped, but as a community that lives behind a levee, the people of Grafton generally had a low level of awareness of the flood threat. Most people had never experienced any direct effects of flooding, apart from occasional disruptions to travel. They were therefore less ready to act, and in most cases, the people surveyed had never considered the possibility of having to evacuate one day.

In addition, a bafflingly large number of Grafton residents believed that they lived in the higher parts of Grafton. They did not realise that nearly all of the area inside the levee would go under in a big flood.

In any case, many people indicated that they would be willing to 'sit out' a flood in their elevated homes. This is unfortunate, because experience during the 2001 floods (and earlier) has shown that this can be a risky strategy for several reasons. Firstly, the scale of flooding is not always apparent when people make the decision to stay in their homes. What they thought was going to be a minor, 'water in the backyard' type of flood, can progress to be a 'water over the floor' type of flood, or worse. Another reason is that people who are flood-bound in their homes can soon tire of the isolation and start moving around in flood waters placing themselves at further risk. This is especially the case in high velocity flooding or if electricity, telephone, water supply and/or other services fail.

It seems, as well, that 'Murphy's Law' extends to flooded communities. During periods of enforced isolation, injuries and/or routine medical complaints have the potential to quickly escalate to medical emergencies necessitating urgent evacuations under difficult and hazardous conditions, which can put both the patients and rescuers at risk. The fact that the people who are suffering these afflictions are isolated means that the consequences are often more serious than they might have been due to the loss of the normal lifelines and infrastructure.

The main implications of the findings from the research, from the debriefs and from the public meetings are that the warning messages issued by the SES have to be:

- more media friendly,
- readily understood by the public,
- able to convey more valuable information to the public,
- more convincing and compelling, and

- simplified.

Pre-written flood warning messages

To ensure that good quality, communicative and persuasive flood bulletins are produced in a timely manner during flood emergencies, the SES is currently developing a suite of pre-written messages that will form the basis of Flood Bulletins. It is intended that a series of these messages will eventually be prepared for all of the gauges in the State for which Bureau of Meteorology predictions are given. These messages will identify what the effects of flooding will be at a range of gauge heights and what people should do to protect their belongings and their safety.

It is necessary to emphasise that the project to produce pre-written messages is still only in its preliminary stages. Discussions are under way internally, and the messages will be workshopped with State Headquarters and Division personnel before external consultation is conducted.

The best Flood Bulletins are short (one page maximum) and cover a small number of themes. To get the necessary information to the public via the media will mean that the SES will have to release more bulletins more frequently than in the past. Take the Clarence River as an example. There are three warning gauges on the Clarence River; Grafton, Ulmarra and Maclean. Therefore, there may be a requirement to release three bulletins every time the SES receives a Flood Warning from the Bureau of Meteorology when a flood is developing on the Clarence River. Doing it this way will allow the necessary value adding to be done without the one-page limit for individual bulletins being exceeded. It will only be possible to do this if the warnings have been pre-written and if a capacity exists at the SES Division Headquarters to make real-time modifications to the pre-written messages to take account of information which cannot be known during pre-event time.

Other information needs to be released in other bulletins separate from the messages, which are intended to warn of particular river heights being reached. These may involve, for example, what is going on during a flood operation and what human interest or other stories the media might like to follow up on. Likewise, lists of roads that are closed could be covered in separate bulletins (this may perhaps best done by the RTA's Traffic Management Centre or councils rather than the SES Division Headquarters). In other words there could be three different kinds of flood bulletins – warning bulletins, road closure bulletins and news bulletins (media releases).

To meet these objectives could mean that the SES Division headquarters would have to release 20 or more flood bulletins in a day for a number of communities on a river system rather than one or two bulletins for all of them together. This indicates the importance of the Division Headquarters having a trained media officer or a small group of them. The task will not be able to be done by the Division Controller who in any case needs to focus on the overall management of the flood operation rather than on specific functions. There is a growing recognition that the provision of timely and informative flood warnings is critically important. As a consequence, a higher priority is now being given to the recruiting and training of groups of media/warning officers who will focus on this task.

The messages that the SES issues must be aimed at convincing and cajoling people to take action to deal with the consequences of the coming flood. To this end they need to utilise benchmarks to give people context and to strike the appropriately persuasive psychological

notes. This can be achieved by using appropriately colourful and arresting language, winding up the pressure by indicating what a failure to act might mean, and repeating key parts of the overall message in a sequence of bulletins. Where large-scale evacuations are necessary, several different bulletins might be released over, say, an hour, indicating the consequences of staying in a flooded house or being caught on a flooded road. Flood response managers should not fear that they would create 'panic' in disseminating these bulletins; the real challenge is to make sure that people hear and understand the message and are therefore given a chance to do something which is in their own interests.

Many of the changes that are under way are not great revolutions in the theory of best practice, but rather they are key developments in facilitating best practice. They are advances in putting theory into practice.

The need for community flood education

The post-flood review work that the SES has done has emphasised the need for clear, convincing warning messages that are easy to produce during flood-time. It has also reinforced the belief that warnings only work effectively when the community is adequately prepared **before** flooding is predicted and already understands the nature of the flood threat.

One of the keys to people successfully managing their flood response is a readiness on the part of the public to respond to warnings. The post-flood research in Grafton found that the residents there simply were not ready to respond. Community education provides an opportunity to start the work required to successfully manage a flood outside of flood time.

Community education is, however, a difficult challenge. It is especially difficult to mount an arousing and convincing campaign in relation to a rare event such as a levee-overtopping flood that may only have a one percent chance of occurring in any one year. Nevertheless, when (not if) the big flood comes, there is a significant risk for people who are not prepared for a flood and who have not taken heed of warnings issued.

Again, these are not revolutionary thoughts, but it is difficult to put theory into practice. To be successful, an education strategy has to be well thought out and the effort has to be sustained. Working within the constraints of a limited budget, the SES has been building on past experience to mount community education campaigns in conjunction with local government councils and other stakeholder organisations. This year the SES has been involved in flood awareness weeks to capitalise on the first anniversary of last year's floods on the north coast of NSW (Lismore, Kempsey, Bellingen, Grafton, Maclean and the villages and rural areas between them).

The flood awareness week messages went out via newspaper articles and advertisements (usually in the form of special 'flood supplements' in the local press), in pre-recorded radio spots, interviews and talk-back sessions, through public displays and information stands, and through information brochures that the SES call FloodSafe guides. These guides are tailored to small areas. For example, the SES produced six separate brochures (Figure 1) for specific communities in the Macleay valley, seven for communities along the Clarence, three for the Bellinger River valley and five for Lismore.



Figure 1 - Tailored FloodSafe Brochures

The FloodSafe guides give a brief outline of the nature of the flood problem in the area. Including, where appropriate, key gauge heights at which levees are overtopped or evacuation routes are cut. They also give general flood safety advice and any information that is specific to the management of flooding in that area (Figure 2).

What should we do if we have to evacuate?

- Place moveable belongings on tables, beds and benches, with electrical items on top
- Gather up medicines, financial documents and personal items (including mementoes and photo albums) and take them with you
- If possible, check to see if your neighbours need help
- Listen to a local radio station for information
- Take three days' supply of clothes for each person
- Take your pets with you. AgricultureNSW will arrange for their care if necessary
- Turn off the electricity and gas
- Make your way to the evacuation centre: the SES will advise where this is
- Contact the SES on 132 500 if you need transport or other help
- When evacuating, avoid entering flood waters if possible. Driving and walking into floods are major causes of death during times of flooding



Keep this guide handy and refer to it when you hear a flood warning for the Macleay River

Where can I get more information?

The Kempsey Shire Local Flood Plan is available in all council libraries. It describes the arrangements that guide responses to flood emergencies in Kempsey.

The SES and Kempsey Shire Council can provide information on how to protect yourself and your property from floods.

FOR EMERGENCY HELP IN FLOODS AND STORMS, CALL THE SES ON

132 500

Kempsey SES	6562 2228
Kempsey Shire Council (office hours)	6562 6077
Police	000
Ambulance	000

Better FloodSafe than Sorry!

This brochure has been prepared for your protection by the State Emergency Service and Kempsey Shire Council.

FloodSafe in Central and West Kempsey





What is the flood problem here?

- Unfortunately, much of Kempsey is built on a floodplain and severe flooding is possible despite the levees
- A flood of 6.15 metres at the Kempsey Traffic Bridge gauge will cause water to flow over the Eden St levee and cause the CBD to fill rapidly
- Properties south of Eden St are threatened before water flows over the Eden St levee
- The 1949 flood, which reached 7.92 metres at the Traffic Bridge gauge, flooded all of central Kempsey and the much smaller 2001 flood almost did the same thing
- Low-lying parts of West Kempsey begin to be flooded at about 7.0 metres, which is about the peak height reached in March 2001
- More severe floods than the 1949 one are possible

How will we know when a flood is coming?

- Bureau of Meteorology flood warnings will be broadcast over ABC Mid North Coast Radio, 2MC/ROX FM and TANK FM
- Listen to one of these stations for information. It is wise to have a battery powered radio and fresh batteries in case the power fails
- Flood warnings will give actual current heights at various upstream gauges and predicted heights at the Kempsey Traffic Bridge gauge. The SES will indicate the likely consequences at the predicted heights and advise appropriate actions for residents and business people



Map showing the estimated extent of the 1% flood (similar to the 1949 flood)

What can we do to be ready?

- Prepare a family or business flood plan. This plan should indicate which items need to be raised or relocated and what you will need to do if you have to evacuate. The SES can provide information to help you prepare your plan
- Put your plan where you can be sure to find it when a flood is approaching

The key to being ready is recognising the danger and knowing what you can do to manage it.

This includes realising that evacuation may be necessary in the more severe floods.

Figure 2 - Flood safety advice provided in a FloodSafe Brochure

The development of additional flood warning tools

The SES has been using the time outside of flood emergencies to develop other tools that relate to the flood warning task. Members of the planning staff have been making more extensive use of simple time-lining tools. In this way, the SES can model a number of scenarios, especially in relation to evacuation operations, working with different assumptions about rates of rise of flood water, the availability of doorknocking teams, warning times, traffic flow rates and so on. These factors are considered in conjunction with flood intelligence, for example gauge heights at which evacuation routes are cut, to enable a better understanding of the constraints that are likely to be imposed on flood responses during a flood. One frequent result of these time-lining exercises, for example, is the realisation that for an operation to succeed, flood response managers have to make decisions at certain set times. In some situations, these decision points are unrealistic and would force the managers to commence evacuations before they can know with any certainty that an evacuation is necessary. These quantified time-lines have been used in some cases to make an argument for the upgrading and raising of roads to extend the evacuation time available and so push out the point at which a decision to evacuate has to be made. This has been successful in the Richmond and Windsor areas (Hawkesbury-Nepean Flood Advisory Committee, 1997).

In the case of Grafton, time-lining led to the realisation that the SES could never hope to warn all households of the need to evacuate by doorknocking alone. The tried and true method of doorknocking is still considered to be invaluable because of the convincing power of face-to-face communication. However, given the large number of households, the short lead-times, the constrained evacuation routes and the limited number of doorknocking teams that are likely to be available, doorknocking will have to be targeted. If an evacuation becomes necessary, the doorknocking capability can be calculated on the day given the resources available. Teams can be briefed, and areas to doorknock can be targeted using census statistics. In the latest Grafton Local Flood Plan, a map showing numbers of households in census collector districts is included to help the flood response managers plan their doorknocking strategies.

Some people in a community are, of course, more vulnerable than others to the adverse effects of flooding. This is because certain social characteristics may impair a person's ability to protect themselves from, or respond to, critical situations. Elderly people are often frail and unable to respond quickly without assistance. Some of them may also be socially isolated, resulting in them being unaware of evacuation warnings or unable to decide on a course of action. On the other hand, single-parent families are often characterised by low adult-child ratios, which makes evacuation more difficult. Census data have been used to identify areas within Grafton that have a high proportion of residents with these characteristics that translate into vulnerability. Maps of these areas can be used to help target particular areas for doorknocking and for the provision of transport.

Short Messaging Service (SMS)

The SES's SMS system is currently being trialed in Lismore. The mobile phone based SMS is being used to broadcast text messages to targeted, geographically defined groups of mobile phone users who have registered for the free service.

The system has only recently been rolled out, and so far, only test broadcasts have been sent. In the near future however, the system will be used during flood and storm events. For example, as a flood approaches the SES will send text messages to subscribers in the areas

affected. The messages will warn of the impending flood, provide predictions of the flood's likely severity, recommend courses of action and refer the user to sources of further information. If, for example, the flood is predicted to flow over levees, evacuation messages may be issued. The SES SMS can also be used to broadcast warnings about the approach of severe thunderstorms and to disseminate general safety tips. Subscribers to the service will only receive the messages that they register for.

The service is designed to give the SES an additional means of communicating vital information to the public. While the majority of people become aware of flood warnings and current and predicted river heights by listening to the radio and by talking with friends and neighbours, the SMS service provides another string to the bow. With such important information, the SES has to strive for the best coverage possible.

During the launch of the service the SES has been careful to emphasise the privacy of phone users who subscribe to the service will be protected.

After the results of the Lismore pilot project have been evaluated and any enhancements made, the system will be introduced more widely. Two sectors within the Hawkesbury/Nepean valley are scheduled to be the next areas to test the value of the SMS service.

Conclusion

Flood warning is vitally important to ensure the safety of life and property. Accordingly, the SES has continued to work in improving its performance in this area. Post flood review work has reinforced the need for continual improvement and it has pointed the direction in several areas.

The pre-formatting of messages is being pursued to ensure that good quality, communicative, convincing messages can be produced during the high-stress time of flood response operations.

Time-lining is being used to assess the constraints that flood response operations are likely to be confronted with, and census statistics are being employed to facilitate the targeting of doorknocking operations.

The short messaging service provides the SES with an additional means of communicating flood warnings along with Flood Bulletins, doorknocks and telephone calls and others. The key is to get the message out by a variety of channels.

There is a realisation, however, that the best warnings will fall on deaf ears unless the community is aware of the flood threat in the local area and has given some thought to the problem of managing floods. The SES is extensively involved in community education and the production of flood safe guides is happening in conjunction with flood plan reviews. The SES continues to make progress on flood warning services, an extremely important component of flood management activities.

References

Emergency Management Australia (1999) *Flood Warning*, Australian Emergency Manuals Series, Part III – Emergency Management Practice, vol. 3, Guidelines, Guide 5 (2nd ed), Emergency Management Australia, Canberra.

Hawkesbury-Nepean Flood Management Advisory Committee (1997) *Achieving a Hawkesbury-Nepean Foodplain Management Strategy*, Sydney.

Pfister, N. (2002) ‘Community response to flood warnings: the case of an evacuation from Grafton, March 2001’, *The Australian Journal of Emergency Management*, Forthcoming.

Water Studies Pty Ltd (1992) *Grafton Flooding Caused by Levee Overtopping*, Flood Behaviour and Contingency Planning, September 1992, Clarence River County Council, Grafton, NSW.

Presented at the 42nd Annual Conference of the Floodplain Management Authorities of NSW, Kempsey, 2002.