

A combat agency and its hazard: a New South Wales State Emergency Service perspective on the management of flooding

The best way to combat floods is to build better practices and agencies argues *Chas Keys*

The New South Wales State Emergency Service was formed, nearly 50 years ago, as a direct result of flooding. The period 1949–55 had seen floods in many parts of the State, some of them catastrophic in their consequences:

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dozens of people had died, massive damage had been wrought on urban and rural assets and community life had been severely and repetitively disrupted across large areas. In response the government of the time decided that an agency was needed to coordinate community reactions to the flood threat and to protect and sustain communities during and

after flood events. For many years the SES's actual role in flood management was only vaguely defined, however, and was interpreted largely to mean the management of floods as they occurred – that is, at the real-time moment of emergency response. In recent times this has seen considerable change: the role has been considerably broadened as well as being more formally defined, and today's SES is involved in a wide spectrum of activities relating to flooding and its management.

Since the passage of the State Emergency Service Act in 1989 the SES has been formally designated as the State's 'combat agency' for flooding. This status, and the criticism levelled at the SES in a government-commissioned 1989 report which led to its restructuring, caused the organisation to rethink its purpose and the ways it carried out its responsibilities. As a result the SES moved to participate in or lead activities beyond those real-time response activities such as warning, rescue, evacuation, resupply, property damage mitigation and the provision of information and advice to communities actually under the threat of flooding. Nowadays, the SES also concerns itself with preventative and preparatory activities including planning for floods, developing improved warning systems and procedures, participating in decision making processes relating to flood mitigation and the use of flood liable land, and fostering the

education of community members about floods and their management. The combat agency's remit these days is treated as being a very broad one requiring the development of wide-ranging expertise.

Developing expertise in flood management

Perhaps the principal responsibility that the conferring of combat agency status implies is that the agency becomes expert in the management of its hazard. Virtually by definition this responsibility requires that a broad view be taken, as is also implied by the 'comprehensive approach' to emergency management that has been accepted Australia-wide for several years (Emergency Management Australia, 1993). In essence, this approach suggests that combat agencies should maintain an interest across all phases of the management of the relevant hazard.

Expertise in emergency management is created and enhanced by many means, including the experience that is gained by managing actual events. But real-time involvement in response activity is not enough by itself, and in New South Wales the personnel of the SES is encouraged to develop their flood management expertise outside actual flood time as well as within it. This they can do by participating in the flood planning process and in training in relevant field skills (for example the operation of flood rescue boats) as well as learning about and applying management principles (through, for example, courses on working in



A selection of documents designed to develop the expertise of SES personnel.

operations centres or workshops on coordinating evacuation operations). Forums for providing information and to promote discussion on aspects of flood management are also organised. Thus trained staff impart information and facilitate the examination of relevant issues in regular regional conferences of SES members and in meetings with small, locally-based planning teams, in post-flood debriefs and in public meetings held to capture lessons and to learn from mistakes. Formal exercises are also devised whereby volunteers and staff members can simulate a coming flood and construct and debate responses in a tabletop environment.

It falls to a combat agency to define and then to follow 'best practice' in the management of its designated threat and to provide resources to encourage the achievement of best practice. Some time ago the New South Wales SES took the lead in developing a set of national guides on various aspects of flood management (*Emergency Management Australia*, 1999a, 1999b, 1999c), and the organisation has sought to ensure that the contents of these guides are promulgated and used. In effect the SES takes the view that as the flood combat agency it must be an effective custodian of the knowledge that applies to the management of the hazard and must ensure that it keeps abreast of and contributes to developing practice in the field. If done poorly, it risks criticism from outside (for example, in adverse findings in coronial inquiries or in public criticisms of its actions during floods).

Ensuring that best practice is genuinely sought extends to carrying out research on particular problems as they arise: a recent example in New South Wales related to the problems of motivating and organising a large-scale evacuation of the levee-protected town of Grafton in March



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2001 when for a time the overtopping of the levees looked likely (Pfister, 2002). Other work of this kind has included assessing the merits of new technologies which may be used to warn of developing floods (Molino et al, 2001), promulgating improved warning procedures (Keys, 1997; Opper and Rutledge, 1999) and defining an appropriate modus operandi for incorporating emergency management considerations into consent authorities' decisions relating to the development of flood liable land (Keys and Opper, 2001).

Combat agency responsibilities, then, should not be confined to the moment of response to a particular event. Rather, they should be discharged with consideration to the whole of the management of the hazard even when other agencies have the lead role for some elements of that management. Accordingly, the SES in New South Wales believes it must be able to advise agencies with responsibilities for mitigation: hence it needs to deal with councils of local government in their consent role as well as with other organisations including the Department of Land and Water Conservation (the State's adviser on floodplain management issues and the coordinator of floodplain management studies at

the local level), planning NSW (the caretaker of land management regulations) and the Land and Environment Court (which in effect settles disagreements on matters relating to the utilisation of land). Likewise the SES must be able to communicate with and advise the Commonwealth Bureau of Meteorology on matters relating to flood prediction and the promulgation of flood forecasts via the warning process, and with dam owners and dam safety authorities (in New South Wales the Dams Safety Committee) on issues relating to potential dam failure and its management as regards prevention, warning and evacuation. In addition, it must be able to deal with the Department of Community Services as the deliverer of welfare services to evacuees and other victims of flooding. With all of these organisations the flood combat agency has a high degree of common cause and shared interest.

Because flood management is the business of many agencies, it is important that there be robust structures for inter-agency communication and consultation. Active networking is vital here, and the combat agency must be involved in relevant forums to learn about the threat and its management, to impart ideas and to



SES Operations Centre staff at work during a flood. Photograph courtesy of the Grafton Daily Examiner.

negotiate responsibilities and tasks. In New South Wales the SES is heavily involved in the deliberations of the Flood Warning Consultative Committee, the Dams Safety Committee, councils of local government and the Floodplain Management Authorities (an organisation which lobbies the state and federal governments on behalf of councils in relation to flood mitigation). In addition the SES interacts closely with relevant consultancy and research organisations, of which there are many, and with other emergency services in the context of regular meetings of emergency management committees at the local, district and state levels.

It follows from what has been said that contacts must be developed across agency boundaries so that learning can be maximised, activities integrated and expertise built. The combat agency for flooding cannot be an island unto itself: to remain apart from other organisations with roles to play in relation to floods would be to invite becoming isolated from its own core business. The combat agency cannot do the whole job of flood and floodplain management, but it does need to be aware of the whole job and to be thoroughly well

networked with those people and agencies whose work relates in some way to flooding. Then the results of the knowledge gained from this networking have to be communicated internally within the combat agency to ensure that expertise is developed at all levels including, most importantly, the local one where an understanding of principles must be grafted on to the comprehension which is gained by managing actual floods in real time and in specific areas. Participation in the preparation of local flood plans also helps local SES volunteers in this regard. In short the combat agency must be encouraged to be a learning organisation and must create an environment in which learning about the management of the threat is consciously fostered.

Some individual functions

What has been said indicates that the New South Wales SES believes that it has a wide range of responsibilities in the flood management field and that these go beyond the management of operational tasks when floods are actually occurring. Space allows a detailed consideration of only four of these functions here – planning

for the occurrence of floods, developing flood warning systems, playing a role in floodplain management processes and ensuring that community members are ready for floods and able to manage them effectively at the level of the individual person.

Planning for floods. The New South Wales SES has been actively and systematically planning for floods in all flood prone areas in the state for only about ten years. In that time the planning effort has become increasingly clearly focussed, the inputs to it better understood and its goals more sharply defined. The state now has a flood plan for almost every council area which can be said to have a significant flood problem beyond those produced solely by minor overland inundation from local heavy storm rains. As far as possible each plan covers all flood threats that could occur in its reference area, including floods from rivers, creeks, lakes and caused or exacerbated by dam failure, as appropriate to the possibilities in the local environment. They also include for coastal areas flooding from the sea in the context of storm surges that may result in erosion of real property as well as inundation.

All possible levels of flooding are considered to the extent that this is possible by virtue of what is known from studies of the flood problem. Thus floods more severe than have been seen in the short period of reliable flood records are anticipated and the levels likely to be reached by the Probable Maximum Flood (PMF) are taken into account where they have been established. This is important given the potential for very heavy loss of life during rare and severe floods in some heavily populated areas, especially along the coast. In the Hawkesbury- Nepean River valley, for example, it is possible that several thousand people could be trapped on islands that could disappear in floods much less severe than the PMF (Hawkesbury-Nepean Flood Management Advisory Committee, 1997). The evacuation routes of the town of Windsor are lost at a flood height of 14 metres (roughly the 20-year flood level) on the local gauge, and the town itself is likely to become unviable well before it is fully submerged at about 21 metres (approximately the 500-year event which is itself about 5 metres below the PMF (Gillespie et al, 2002). The general problem is one that applies in many locations in New South Wales, including a large number of leveed towns whose levees are not designed to keep out floods higher than the predicted 1per cent event. In these cases some very complex evacuation operations must be anticipated and planned for and some difficult decisions made relating to the evacuation of large numbers of people before evacuation routes are closed (and perhaps even before significant flooding has begun in the areas which will need to be evacuated). The alternative – evacuation by air and flood boat after roads have become untrafficable – will in some cases be impossible in the time likely to be available.

The flood plans are written to a standard structure from a generic

model that is an enclosure in the State Flood Plan (NSW State Emergency Service, 2001. The details of the content and structure of these flood plans are spelled out in *Emergency Management Australia*, 1999a, pp.25–28). The planning process starts in each case with an appraisal of the hazard, in which the SES has benefited from the numerous flood and floodplain management studies commissioned over the past two decades by the Department of Land and Water Conservation and its predecessors.

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These studies have collected vast amounts of data on flood history and frequency and have made estimates of the discharges, velocities and flood levels that would apply at various locations on a floodplain for a range of design floods. Recently, the SES has sought to ensure that these studies, along with studies of potential dam failure commissioned under the aegis of the Dams Safety Committee, also gather data of specific relevance to emergency managers. This data is added to material collected by the SES during and after floods on the extent of flooding and its consequences at specified gauge heights. The SES places considerable emphasis on the development of ‘flood intelligence’ and its application to decisions relating to warning, evacuation, property protection, resupply and the provision of information and advice to community members. This intelligence is consciously tied to decision-making processes and written in to the flood plans, making the plans themselves into ‘records of intended proceedings’ that should prompt previously considered actions when floods are rising.

Where necessary, special arrangements necessitated by particularly serious floods are incorporated in near stand-alone annexes dealing, for example, with warning and evacuation arrangements for dam-failure floods, floods likely to overtop urban levees, or floods in individual parts (sectors) of a council area.

With almost all council areas which have flood prone territory now having a flood plan – and this means the vast majority of council



SES flood rescue boat crew assisting with submerged trucks.

areas in the state – the focus of the SESs six full-time professional planners is now one of coordinating reviews which will lead to better plans. The first round of planning produced documents that were not always recognised by volunteer members of the SES as being useful, and as a consequence they were not necessarily used effectively when floods arose. One of the reasons for lack of acceptance may have been that local members were not sufficiently involved in the plan-preparation process. To correct this a conscious effort has been made to ensure that local commitment to and ownership of plans is fostered: this has been sought by enlarging the size of volunteer planning groups, emphasising the notion of problem solving in advance to encourage careful consideration of necessary actions, and identifying special planning projects for individual volunteer local planners to pursue. These have included projects to locate the sites of potential road closure and to devise doorknocking strategies and estimate the numbers of doorknockers needed to cover an area in a specified time frame. In addition volunteers are encouraged to devise or enlarge community networks so that warnings and information can be effectively disseminated, to review flood classification levels against flood intelligence and revise them if necessary, and to develop strategies to ensure that a positive view is taken of the property protection function (including expedient sandbagging, the provision of assistance with furniture raising and the transportation of moveable items to safety, and the relocation of caravans from flood liable areas). Most importantly in the planning meetings, evacuation strategies are given detailed attention, as is the provision of quality warnings that are likely to motivate appropriate property- and life-protecting actions.

The flood plans are becoming more detailed and more agencies,

community organisations and businesses are being listed in them with agreed tasks to perform. The problems of the bulking up of plans are minimised by the creation of near stand-alone annexes, and increased emphasis is being placed on the briefing of participating agencies and other players. There is no doubt, though, that the approach to planning which is being fostered – slow, thorough, comprehensive and genuinely involving of local interests – is onerous, and the volunteer members of local planning groups need significant support. With six professional planners available to the SES this support can now be provided and reviews will be able in future to be undertaken more frequently than was previously possible. These same professional planners will also facilitate the utilisation of census material to fine-tune local responders' understanding of their flood liable communities, and they will be able to lead in the application of Geographic Information System (GIS) tools which will allow better advance appreciations to be achieved of the likely impacts of coming floods.

Development of flood warning systems. Of critical importance to the effective real-time management of flooding is the development of appropriate means of warning people who are in the paths of coming floods. Effective warnings unlock the essential 'manageability' of floods by telling people what to expect, advising them of what they can do to protect belongings and maintain personal safety, and motivating them to pursue certain actions such as raising items above likely flood reach or evacuating to safe locations.

For some 40 years New South Wales has had a high quality flood prediction service operated by the Commonwealth Bureau of Meteorology. This service operates by polling rain and river gauges and applying scientific analysis to

produce forecasts of how high floods on a river will reach at specified locations at nominated future times. Using flood intelligence the SES is increasingly able to add value to this service by estimating where the floodwaters will go at the forecast heights and thereby deriving the likely effects on the community. A knowledge of these effects provides a basis for giving advice to community members about how the impact of a rising flood can be managed in the appropriate time frame. Thus people who live or work on floodplains can be empowered to manage 'their' floods in their own interests.

The knitting together of predictive, interpretative and advice-giving functions is critical to the achievement of what has been called the 'total flood warning system' (Emergency Management Australia, 1999b, pp.5–16). The task has been a difficult one to manage in a response-focussed SES culture which has had to come to grips with the development and use of flood intelligence and the need to communicate clearly with flood prone communities, and much still remains to be achieved before flood warnings are well and convincingly disseminated in ways which routinely motivate appropriate threat-mitigating actions on the part of those needing to be warned. This is at its most important when the warning messages seek to motivate evacuation: here the need to be persuasive is especially critical, particularly if large numbers of people will need to move to safety in a short period of time. The SES seeks actively to improve its performance here by examining its own warning performance during floods (Pfister, 2002) and instituting improvements. Since the North Coast floods of early 2001, the SES has sought to devise draft-warning messages outside of flood time so that they cover the necessary content in appropriate styles and are ready for dissemination with a minimum of real-time modification

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Combating floods the NSW SES way *continued from page 18*

to take account of information that cannot be known before the actual event. It became clear, during those floods, that appropriate warning measures simply could not be created 'from scratch' in a way which would incorporate the necessary information and advice and stimulate a large-scale evacuation.

An important element of the development of flood warning systems is the appraisal and incorporation of appropriate technical systems to alert and warn people. There is an increasing range of methods to be used beyond the traditional door-knocking and broadcast radio means, including various types of siren, automated telephone dialling and other systems. In New South Wales the SES is actively pursuing the assessment of different methods for their suitability in different types of environment: a recent addition to the battery of methods being used to disseminate flood warnings is the Short Messaging Service (SMS) by which people can be warned via the display units on their mobile phones.

What is important here is that appropriate arrays of dissemination techniques are chosen for different environments. Warning is not matters of using individual techniques but of using several that operate in different ways to get the message out. It is also a matter of ensuring that messages which are received are able to motivate the taking of appropriate actions: in the end, effective flood warning systems are those which incorporate techniques which operate well at a psychological level and in doing so stimulate desired behaviours.

The New South Wales SES sets itself the goal of adding value to the flood prediction service provided by the Commonwealth Bureau of Meteorology. In essence this means ensuring that the predictions can be

understood in the community, and that they can be acted upon. There is ample evidence that Bureau predictions by themselves are unlikely to produce such actions from many people, and this indicates the importance of the value that the SES seeks to add. Beyond this role, the SES seeks also to set up 'flood watch' networks which can help to verify the existence and severity of flood conditions and can be used to fine-tune predictions.

Such networks can also provide a capacity to assess the severity of floods approaching communities that are not served by Bureau predictions. Despite the density of the Bureau's network of gauges for which formal height-time forecasts are provided, some rural communities remain without a service. This is especially the case in the inland of the state where there are many intermittent streams which lack gauging but which have large catchments and can produce damaging floods after very heavy rains. Here, farmers and farm managers reporting rain and stream conditions to an SES Local Controller can contribute to the operation of simple warning systems of a kind which used to be common in rural areas (see Keys, 1997, p.14) but which appear to have been run down over a long period of rural depopulation and farm enlargement, leading to a weakening of community communication networks. A severe flood in February 2001 on some tributaries of the Darling River was apparently not known to some of the farmers in its path and damage that might have been avoided was caused as a result. Flood watch networks have a role to play in restoring communication about coming floods and maximising the opportunity for rural people to take action to avoid or minimise damage.

Floodplain management. The core concerns of floodplain management are the utilisation of land that is prone to flooding and the protection of existing development from floods. Decisions on land use are made within a well-established legal and regulatory framework, central to which is the Development Application via which owners of land apply to the consent authority – usually a local government council – to use parcels of land in specified ways and to build on them accordingly. In New South Wales councils have for more than twenty years been guided, in the context of land which could be flooded, by manuals which encapsulate state government policy on the use of such land. These manuals have spelled out the processes by which decisions should be made: they are key to the process whose judicial endpoint, when proposed developments are rejected by the consent authority, is in appeals about decisions on decisions in the Land and Environment Court. The current manual is the Floodplain Management Manual (New South Wales Government, 2001.)

Floodplain management involves decisions about future development, then. A second role is in the identification and implementation of appropriate measures to ensure that the costs and dangers of flooding can be significantly reduced in areas in which development has already occurred. Floodplain Management Committees, set up by councils and supported by consultants' studies of local flood problems, advise on which measures would be appropriate to achieve this objective. In different environments the measures might include levees, bypass channels, voluntary buy-back schemes, or schemes to raise houses. All these are 'devices' which reduce the actual effects of flooding when it occurs.

In New South Wales the evolution of the SES role in floodplain management closely parallels the evolution of the flood-planning role referred to above. Until relatively recently the SES played little part in this field, not concerning itself with councils' responsibilities for planning the use of floodplain land or taking any significant interest in considerations of the range of methods which can be employed to reduce the impact of flooding. The SES was rarely asked about land development, or about the application of devices for reducing flooding.

Things have changed significantly over the past five or six years, however. The SES still has no directly legislated role in land use management and it seeks no such role, but increasingly councils have sought SES input to decisions in relation to the consent role, recognising that the SES can provide advice on the public safety and property protection ramifications of proposed developments. This has had significant implications for the SES, which has been forced not only to react to these demands for input but which has also had to provide appropriate resources to ensure those demands can be met effectively. In addition the SES has had to develop a body of principles or doctrine to guide its input. Along the way the SES has sought to have local volunteer input made available to Floodplain Management Committees and has tried to ensure that public safety and property protection issues are properly dealt with in the provisions of the Floodplain Management Manual. All this has been done 'on the run', with cases building up principles and the principles being tested in the Land and Environment Court via the appeals process.

Some specific matters that have arisen as the SES has become more involved in floodplain management issues should be elaborated upon. One relates to the initial tendency for council officers, needing advice

on particular Development Applications, to seek it from Local Controllers of the SES. Local Controllers are exclusively volunteer emergency managers whose expertise does not necessarily encompass the complex specialist field of floodplain management. The SES, recognising the need to protect its volunteers from the likelihood that their advice would antagonise development interests and/or councils, and the equally important need to ensure that councils receive appropriately expert advice, has sought to discipline the process. As a result Local Controllers are now directed to refer requests for advice relating to developments to the SES's State Headquarters where the necessary expertise exists and can be developed, appropriately distanced from particular cases under examination but in close contact with other relevant government agencies. State Headquarters officers involved in particular cases are, naturally, required to consult the relevant Local Controller and to incorporate him or her in the advising process.

The focus of the SES's participation in the process is the public safety dimension of land use management decisions. A particular issue that has arisen on several occasions relates to the loss of roads during floods. Isolation by itself may seem to create only a small danger, but the problem can escalate quickly if people become ill, or if telephone, power and sewerage services fail, or if inundation subsequently occurs above the floor levels of dwellings. In such cases there will be increased demands for rescue or requirements for evacuation which have obvious public safety ramifications and which will create difficulties for the SES that must resource the necessary operations. The severity of these problems is most clearly apparent in the current explosion in rural residential subdivisions. If left unchallenged, this explosion could see large-scale expansions of populations on floodplains, with

egress routes prone to being cut and with local SES units facing big increases in the demand for rescue services during serious floods (not to mention demands for resupply during routine events). Yet there can be no guarantee that road access conditions will be improved (for example, by raising low points at which closure occurs), or that the SES at the local level will be able to grow to meet the increased level of demand for it to act to save lives and property or to resupply people who have been cut off.

One element of debates about whether or not flood prone land should be made available for residential purposes is the notion that people wanting to live on such land should be allowed to do so provided they have an 'evacuation plan'. The SES has argued against such plans on several grounds: they do not meet the Land and Environment Court's strictures about 'permanent, fail-safe and maintenance-free' threat-minimising measures being applied, and there is no guarantee that such plans will be fit or will be kept fit for their purpose over the sometimes long periods which elapse between floods. Indeed there is every possibility that private evacuation plans will be prepared solely for the cynical purpose of gaining development consent. Because of these failings, the Floodplain Management Manual discourages the use of such plans in the development application process. The SES believes, however, that proper community flood preparedness demands that people living on floodplains should know what steps they need to take to manage the impacts of flooding on them and their property – including understanding that evacuation may be one such step and comprehending how and under what circumstances evacuation should be undertaken. Private flood plans are encouraged, then, but not for the purpose of supporting Development Applications.

SES involvement in floodplain management matters also includes officers participating in discussions, including public meetings, in which councillors of local government agencies are briefed and educated about the principles of floodplain management in the context of their legal responsibilities as decision makers. In these discussions the SES is duty bound to note that it is not a rescue service devised for the purpose of covering up for inappropriate developments and somehow making them sound. A site, which flooding makes dangerous for a particular kind of land use, even only occasionally, is dangerous with or without an SES unit whose presence and actions must not be seen as a palliative for poor decisions. Likewise a privately written, property-specific flood evacuation plan does not alter the facts about a dangerous site.

None of this should be taken to mean, incidentally, that the New South Wales SES is opposed to development on floodplains or that it wishes to sterilise land that could be flooded. What is sought is development which is appropriate in public safety terms and which is permitted only after a process that has consciously considered the risks to that safety. This is surely preferable to allowing floods often well below those of PMF proportions to prove the folly of ill-advised developments – perhaps by killing large numbers of people as has happened on a number of occasions in the State's history. The avoidance of massive property damage is also a factor in the SES's deliberations on floodplain management: it makes little sense to encourage increases in the scale of public and private assets which are exposed to flooding and to virtually guarantee increased financial hardship as a consequence when floods occur.

Paid SES flood planning staff have increasingly been involved in floodplain management matters including those related to consent

decisions. Volunteer SES members have also had an enlarged role, since they are now regularly invited to sit on council-sponsored Floodplain Management Committees. In this context the SES also seeks to steer floodplain management consultancies into providing data which is relevant to flood plans – for example, data on the heights at which evacuation routes are cut by flood waters or houses are inundated beyond their floor levels, and the time frames within which such floods could reach nominated critical heights (for more detail on the kinds of data which can be collected, see *Emergency Management Australia*, 1999a, pp.14–18).

In the same forums the SES raises issues relating to the provision of warning systems and services and to the difficulties posed by the need to mount evacuations when floods occur. A particular case in point relates to the valley of the Hawkesbury-Nepean River where, as indicated above, thousands of people could be trapped and their homes inundated by flood waters after the evacuation routes have been cut – and this in floods with return periods of only a few decades. In this case, a multi-million dollar government program has been established to raise evacuation routes, improve warning processes, facilitate the development of flood plans, improve the level of operational capability of the SES and ensure that community members are aware of the need for periodic large-scale evacuations and ready to take part in them. Other environments with problems similar in nature if not in severity will probably need similar treatment in due course.

Educating community members about flooding. It is probably self-evident that people who understand the environmental threats they face and have considered how they will manage them when they arise will cope better than people who lack such comprehension. It is perhaps

less well appreciated that many people who live and work in flood liable areas have little idea of what flooding could mean to them – especially in the case of large floods of severities well beyond their experience or if a long period has elapsed since flooding last occurred. It falls to the combat agency, with assistance from councils and other agencies, to raise the level of flood consciousness and to ensure that people are made ready for flooding.

In other words, flood-ready communities must be purposefully created. Once created, their flood-readiness must be purposefully maintained and enhanced.

Flood-ready communities are communities whose people will be capable of responding appropriately and in timely fashion to warnings – which in different environments might include stocking up on food and other essentials, raising or transporting commercial stock and household belongings out of harm's way, or evacuating by safe routes. Timeliness of actions must be stressed here. In many situations this means that people need to be carrying out their harm-reducing responses before floods have begun to arrive in their vicinities. For this to be possible, people must be able to have trust in the warning services being provided and in the competence of the SES to lead their responses: here, organisational credibility is a quality which must be built and nurtured. As far as the minds of community members are concerned, the goal is not simply one of raised awareness but rather the achievement of commitment to actions appropriate to the nature and severity of a coming flood.

None of this is easy to achieve, and it has probably not been fully achieved in any flood liable community in Australia. Public education about environmental threats, about how agencies deal with them and about how people should act before, during and after the impact of these threats, is still

not strong in this country – with the possible exception of the bush fire threat. This is but one more legacy of the response bias in traditional Australian emergency management. Equally, little has been done in most jurisdictions to ensure that the community sees agencies as competent in discharging their responsibilities.

Things are changing, however. The New South Wales SES has employed specialists in social marketing to develop and deliver flood education campaigns, and there has been considerable work done to develop appropriate conceptual frameworks (see, for example, Young and O'Neill, 1999). Equally the SES has participated or led in educational activities designed around the commemoration, in 'round-number' anniversary years, of severe floods including those which devastated the communities of the Macleay and Hunter River valleys in 1949 and 1955 respectively and which caused substantial damage in the town of Inverell (on the Macintyre River) in 1991. These commemorative events have featured public meetings to discuss floods, flood plans and flood management strategies, large numbers of radio interviews and newspaper articles on similar themes, the production of flood videos, the displaying of flood photographs and other flood memorabilia, guided tours to inspect and explain local flood mitigation systems, and other initiatives. Street parades featuring flood response agency personnel have been conducted, and school projects have been devised with flood themes. The events have produced lively discussions within communities about the likely effects of similar serious floods were they to occur today.

The floods of February and March 2001 on the north coast and in the north-west of the State were also used to build community understanding of the flood problem and its management, and to

improve the SES's understanding of community needs when floods occur. Soon after the floods, public meetings were held in the affected areas to take feedback, to identify better ways of communicating flood information, to ensure that the SES comprehends the expectations of people in flood liable areas – and to indicate to people what they can do on their own behalf to manage future episodes of flooding. Likewise, on the first anniversary of the March floods on the Clarence, Bellinger and Macleay Rivers the SES involved itself in lengthy talkback sessions on local radio stations to respond to questions and criticisms from members of the public. Further meetings and displays were held, for example to demonstrate to shopkeepers in flood liable areas how to sandbag their premises and to discuss on a one-on-one basis how people should react to flood warning messages forecasting particular flood heights and how they could produce their own family and/or business flood plans.

A central element of these commemorations, and of other flood education work elsewhere in the state, has been the production of large numbers of 'floodsafe' guides that are customised to local contexts. Six have been produced for the communities of the Macleay River valley (Kempsey and nearby areas), seven for the Clarence River valley from Grafton to the coast, five for Lismore to cover particular residential suburbs, the CBD and an industrial area, three for the Bellinger River valley, two for Inverell (one for businesses in the CBD and one for residential properties nearby), two for the Muswellbrook area (one for low-lying parts of the town and one for the nearly rural area) and others for Wollongong (a flash flood environment), Orange, Singleton, Denman, Forbes, Narrabri, Moree and Dora Creek (near Newcastle). The total number of guides produced to date exceeds thirty.

Each deals with the local problem, be it isolation, inundation or community disruption, and provides advice on how the relevant community should deal with it.

The guide for Orange deals specifically with the threat of dam failure, there being two local dams that have been found to be deficient in spillway design and/or structural integrity. This indicates an intention to produce guides which are truly tailored to local circumstances: future guides are expected to be published for aboriginal communities and caravan parks as well as for towns, parts of towns, city suburbs and rural communities.

These documents are a natural outgrowth of the flood planning process that produces much of the content and ensures that the brochures are locally relevant. The guides incorporate information on flood warnings and their meaning locally, describe methods of protecting belongings, identify evacuation routes and centres, provide important phone contact numbers and indicate where people can obtain additional, more detailed information. Within the obvious space limitations, the guides also contain relevant maps and local photos (where possible incorporating local landmarks). The SES sees scores of such guides being produced in the future as flood plan reviews are completed and local flood education campaigns are undertaken. The plans themselves need to be made publicly accessible too, for example by being placed in local libraries and being advertised and excerpted in local newspapers.

It follows from what has been said that the SES believes that educational campaigns need to employ a wide range of devices that can, in a sense, be layered upon each other. Partnerships with local councils, other organisations and sponsors should be developed, flood markers indicating the heights reached by past floods fixed to power poles or created as totem

poles, evacuation route signage utilised and radio and television community service announcements developed. All of these devices have been used in New South Wales. Resources have been limited, however, and the campaigns so far have been conducted on a rather piecemeal basis and without real follow-up.

New South Wales has a commendable tradition of floodplain management initiatives, but programs of community education designed to raise people's readiness for inevitable flooding have not been among the stronger elements of this tradition. After the floods of February-March 2001 along the length of the state's north coast, a consensus developed among local government councils in favour of a much greater emphasis on flood education – which traditionally has been funded very poorly by comparison with education about the much less costly threat of bush fires. There is a clear recognition now that because floods do not occur frequently in particular areas, levels of community readiness fall away to the point that people come to believe the flood problem has been 'solved' or no longer exists. The construction of levees to protect towns actually encourages this perception, even though no levees in the state are built to keep out genuinely severe floods. Overtopping should be regarded as inevitable in the bigger events – as happened at Ulmarra and Kempsey in March 2001 and as almost happened at Grafton at the same time. Action must be taken to counter the complacency that develops when levee protection is created, and the floodsafe guides applicable to leveed communities seek to inculcate an understanding of the limits of this protection.

In essence we must build flood readiness 'synthetically', in leveed communities and elsewhere, because nature does not bring floods often enough to a particular

area to create and sustain such experientially-based readiness by itself. In part, too, this work is needed because successful mitigation programs have tamed the flood threat without coming near to eliminating it.

Future directions

The flood management role of the New South Wales SES is quite different today from what it was only just over a decade ago. Naturally the real-time response activities remain, but the SES now seeks to play a larger part than previously in relation to prevention and preparedness functions. To do this it has become much more engaged with the efforts of other agencies than it used to be and much more concerned with interacting constructively with flood prone communities.

Much progress has been made over the last ten years in flood planning, flood warning and floodplain management endeavours and some gains have also been achieved in the field of flood education. Much more needs to be done, nevertheless. The flood planning process would benefit from further decentralisation to SES volunteers in the actual flood prone areas and this will happen gradually, though some outside professional expertise will still be needed. Another planning-related area which needs further development is that of flood exercises, whereby the combat and support agencies are able to practise their responsibilities in simulated flood scenarios. Some work has been done here, but the task is a large one with so many communities in New South Wales having serious flood problems. Given the lengthy periods that can occur in any river valley without significant flooding, frequent and thorough exercising should be a high priority to maintain agency readiness.

Perhaps the area where progress is most urgently needed is that of

community education about flooding and its management. This field has been poorly resourced, and what has been done has necessarily been done cheaply. With better funding it would be possible to mount regional campaigns using community service announcements on prime-time television. This is crucial to making other initiatives – floodsafe guides and commemorative activities, for example – more effective. Television remains the most powerful medium for getting hazard education messages across and adding value to lower-cost initiatives. Thus far the SES has not had the funds to utilise it, though these funds are being actively sought.

Flooding is the nation's most costly, but at the same time most manageable environmental threat, as the Bureau of Transport Economics (2001) has shown. It is important that we invest heavily in the mitigation of the damage which flooding does, and not only by building structures like levees. We must also build practices that help people to combat the threat and agencies that can plan and exercise effectively to ensure that the costs that floods wreak can be better contained.

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Australian Aid: making a difference in times of disaster

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It also recommended that planning for malaria control in the next season begin immediately.

The group recognised the management of potable water and sanitation were difficult issues and more public health measures were needed to overcome deficiencies. In particular, urgent attention needed to be paid to water quality. A study of bacteria and parasites was needed in flood affected areas.

The existing system to identify disaster victims and the analysis of the cause of sudden and unexpected death appeared deficient. A better system was seen as an important step in primary prevention strategies for public health in disasters, in particular epidemics.

After identifying the above issues and making its recommendations, the team conducted a bilingual training program in disaster management for 30 public health professionals. Presentations were delivered in English supported by slides and notes in Portuguese. Participants identified water and sanitation, together with rural access, as the key recovery issues in an emergency.

The training program ended with the development of outlines for a flood response disaster plan and a public health disaster management plan. The course was well received, as it was the first such training opportunity in disaster management for health.

At the end of the mission, the team delivered a formal briefing to a range of senior Mozambican officials outlining recommendations for the development of a National Disaster Management System and highlighting the importance of work to prevent emergencies the scale of the 2000 floods.

Volcano monitoring in Papua New Guinea

Papua New Guinea has many active volcanoes. Fourteen have erupted over the past 200 years.

In September 1994, Tavurvur and Vulcan volcanoes erupted, inflicting enormous damage on the northeastern part of the Gazelle Peninsula, including Rabaul town. The devastation badly affected the basic socio-economic infrastructure system in Rabaul Township and the surrounding villages and left a damage bill in the order of K280 million.

The eruption exposed weaknesses in the National Volcanological Service and consequently the ability of the PNG Government to provide an effective warning service for the community.

The first weakness was the monitoring equipment used throughout the country by the Rabaul Volcanological Observatory. It had deteriorated because of ageing exaggerated by the tropical environment.

The second was that the Observatory was not able to collect and analyse large amounts of data quickly.

The Australian Government agreed to assist the Government of Papua New Guinea in the form of a \$6.5 million project to upgrade and strengthen the National Volcanological Service to try to reduce the impact of active volcanoes on PNG communities. The project had two phases, starting in 1995 and largely ending by June 2000.

During the first phase, the Australian Geological Survey Organisation procured new monitoring equipment for the