DEVELOPING OUR EXPERTISE IN THE MANAGEMENT OF FLOODING: SOME RECENT INITIATIVES

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Of all the natural hazards which Australian communities have to deal with, flooding is in economic terms the most significant. The average annual cost of floods in Australia was estimated in the early 1990s as being nearly $400,000,000, most of it incurred in New South Wales and Queensland (Australian Water Resources Council, 1992). Fortunately, floods are amongst the most manageable of environmental threats: the areas which are liable to flooding are relatively easy to determine and a range of measures is available by which flood prone communities can be protected (Smith and Handmer, 1984; Benning, 1996). As a result it is possible to plan for and develop defences against floods so that their impacts can be mitigated by maximising human safety and minimising property and other losses. In Australia, however, flood management strategies have evolved in a very uneven manner across the states and territories and as a consequence there are substantial differences in the effectiveness of flood mitigation efforts.

Given the severity and manageability of the flood threat, it is perhaps surprising that there is little consistency in or co-ordination of flood management practices in Australia and that few blueprints on flood management practices exist. Floodplain management, which in its emergency-related context is usually taken to involve the implementation of structural (flood-modifying) and non-structural (community-altering) measures to protect populated areas from the effects of floods, varies greatly in sophistication between jurisdictions. Some states have well developed floodplain management policies and funded programs, while others have virtually none of either (Smith, 1995). Accordingly there are wide variations between states in levels of community protection against flooding. These are not simply the result of differences in the severity of the flood threat in different parts of Australia: Queensland and New South Wales, for example, appear to be similarly exposed to the hazard, but New South Wales is widely acknowledged to be much further advanced in terms of the development of floodplain management policy and flood defence measures.

There is equal variability in terms of planning for what must be done during actual flood events. Some jurisdictions have prepared comprehensive plans to guide flood warning and response activities while others still lag well behind. The result is that the responsibilities of different agencies with respect to flood management are not clearly spelled out in all states and territories. Accordingly, real-time flood management is in some areas based more on custom than on formally agreed or legislated agency responsibilities, a situation which discourages effective responses to flooding and retards the development of expertise with respect to flood management. Many parts of the country still have no flood response plans and no written strategies for managing difficult operations such as large-scale evacuations.

There is, of course, no single prescription for flood and floodplain management which could fulfil the needs of all the states and territories of Australia. The various jurisdictions are exposed in differing degrees to the flood threat, and in addition they

have different institutional and legislative arrangements with respect to both water management and emergency management. It is not possible, because of these differences, to devise a single management system which would be equally appropriate in each state and territory. What is possible, however, is the development of a series of blueprints on aspects of flood and floodplain management which can be used to encourage the development of improved management strategies in those jurisdictions which are lagging and to define benchmarks against which current practice can be measured and assessed. This paper reports on progress in the preparation of a series of four best-practice guides in the field.

Guidelines Development

In April 1990, severe flooding occurred simultaneously in the three mainland states of eastern Australia. Gippsland, Victoria, was severely affected, as were large areas of inland Queensland and New South Wales, and thousands of people had to be evacuated from their homes including virtually all the residents of Charleville (Queensland) and Nyngan (New South Wales). In the aftermath of this flooding the Australian Counter Disaster College (now the Australian Institute of Emergency Management) sponsored a national workshop to consider the lessons of the floods and to determine what might be done to ensure those lessons were learned. The workshop, which was attended by about fifty people with responsibilities for flood management (including police and emergency management personnel, hydrologists, meteorologists, council engineers and members of welfare agencies) concluded that although deficiencies in a range of flood management practices had been revealed, flood warning systems needed particular attention - especially in terms of the development of multi-agency commitment and input to the flood warning task. A later workshop specially convened to examine this topic decided that an appropriate way to foster this objective would be the production of a best-practice guide on the flood warning task which could be used to educate the members of the numerous agencies with roles to play in the flood warning process.

The flood warning guide was produced some time later (Emergency Management Australia, 1995). Soon after, EMA decided to sponsor another flood management workshop with the purpose of producing three further best-practice guides - one each on Floodplain Management, Planning for Flood Response and Flood Response Operations. The development of these documents, which are discussed in the following sections of this paper, is now well advanced and their publication is expected during 1997. In a sense they will complete the writing down of current expertise in Australia in the broad flood management field and provide aiming points for flood management practitioners in the various states and territories as they seek to better manage their flood threats.

Flood Warning: an Australian Guide

There have in Australia been many examples of good practice in flood warning, but equally there have been examples when such practice has been absent and in general the potential of warning efforts to minimise damage is not fulfilled. In part, sub-optimality of practice results from a tendency not to define the task **holistically**; that is, to deal with only **parts** of it or to carry out only **some** of the actions which are needed. The guide to warning practice deals with this issue by focussing on a multi-faceted 'total flood warning system' and identifying appropriate strategies for implementing or developing its various parts.

The total flood warning system is defined as including the following elements, each of which can be posed as a question:

- Flood prediction ('How high will the water go, and when will that height be reached?')

- Interpretation of flood predictions ('At the predicted height, where will

the water go and who will be affected?')

- Message construction ('What do those who will be affected need to know and how can we give them an easily understood and persuasive warning?')

- Communication ('How do we get the warning message out to those who need it?')

- Response ('Did the people understand the message and act to reduce the impact of the flood on them?')

- Review ('How do we improve our warning system by checking its performance after an event or upgrading it when there has been no flooding for some time?')

These questions determined the structure of the guide, a chapter being devoted to each element. The first of them is normally the preserve of the Bureau of Meteorology, which produces a statement saying that a flood on River W at location X will reach Y metres at Z time. This statement is usually called a Flood Warning, but in reality it is a flood prediction which forms only **part** of a warning. Value which can be added to such a prediction will greatly augment its usefulness to the community which is being warned.

The first element of added value is in the interpretation of the warning: that is, working out where the water will go at the predicted height and what the consequences will be. In essence, this means defining the horizontal spread of a flood at the forecast height. Vital tools here include records and assessments to indicate what happens at a range of gauge heights in terms of roads being cut, farmlands, houses and business premises being inundated, levees being overtopped or other consequences. Much of the information can be obtained from records of past floods and can be stored on intelligence cards or in Geographic Information System databases.

At their best, such records can provide fairly complete and accurate pictures of the impacts of floods of various levels of severity. These pictures can be used so that people are advised before the arrival of a flood of its likely impact on them: armed with this advice, they will have the opportunity of following appropriate strategies to maintain their own safety and to minimise the property damage they will sustain.

The existence of high-quality flood assessment records allows flood managers to work out in advance what the consequences of a flood of any predicted severity will be. In many flood-liable communities in Australia, however, the necessary data are non-existent or sketchy, and flood managers have only very general notions of what the impact of a coming flood is likely to be. Where this is the case, the potential for the development of high-quality warnings is likely to be severely limited.

A second element of added value relates to the construction and content of warning messages. These should indicate the consequences which have already ensued (for example, the roads which have been closed or the areas which have been inundated) but even more importantly they should describe in simple words what is likely to happen as the flood rises towards the level predicted. This becomes the basis for indicating what people should do to mitigate the probable effects of the flood - whether that means avoiding particular roads on the next journey to work, lifting pumps, stocking up on food, or preparing to evacuate. For different communities, or parts of communities, different messages are likely to be needed in a given flood.

The best warnings are of little use, though, if they are not heard and understood by those who need them - that is, by those who will be affected in one way or another by the rising flood. Frequently, messages are transmitted only via radio stations. Radio transmission is vital and must be used - but there are other relevant dissemination modes including telephones, doorknocks, loud hailers, warden systems or, in some

cases, newspapers. Which modes are used should be a matter of both the flood (its severity and the time which is available before impact) and the nature of the community and the probable effects of the flood upon it. If evacuation is likely to be necessary, optimal warning practice implies that those who might have to move should be advised **personally** if at all possible - preferably by telephone or doorknock - and given information on what to do before they leave and on where they should go to. As a general rule, and especially in severe floods, **several** modes should be used.

The final element of the total flood warning system relates to the need for a review of system performance after an event. Predictive models need to be re-examined, as do intelligence records and message-construction and dissemination procedures. The questions that must be asked are about whether the information provided was accurate and whether everyone who needed it received it in a timely fashion, understood it and acted appropriately. Asking and answering these questions should help build in improvements for the 'next-time' response. System review should also be undertaken as technology and environmental circumstances change.

After publication, the flood warning guide was widely disseminated to those responsible for the design or operation of some part of the warning process. These include professional hydrologists and emergency managers employed by various government agencies, local council personnel (especially those in departments of technical services and engineering), police, and volunteer members of emergency service organisations. Most work at the local level of the flood-prone community. As the guide was distributed, briefings were conducted in several of the states and territories to introduce practitioners to its philosophy and contents and to provide an opportunity for these practitioners to apply its recommendations to local flood circumstances in workshop exercises.

Floodplain Management

Managing the use of floodplains has been necessary in Australia since the early years of European settlement. The history of the development of floodplain management has seen shifts from the mere 'encouragement' of flood-appropriate development, to a focus on engineering works to protect communities from flood waters, to the prescription of development through planning restrictions, and now to a situation in which an integrated, merits-based approach is generally adopted by responsible agencies. The merit approach recognises that flood-liable land is a valuable resource that should not be sterilised by unnecessarily precluding its development. The approach does, however, require that the full economic and environmental costs of proposed floodplain development be properly accounted for.

A national approach to floodplain management has slowly developed. Prior to 1990, national co-operation on matters relating to floodplain management was basically on an ad hoc basis, with meetings of officials to discuss specific issues and occasional papers at hydrology conferences. Each state adopted its own methods, suitable to its policies and legislation. In 1990, the then Australian Water Resources Council established a Floodplain Management Working Group to examine the state of floodplain management on an Australia-wide basis. The resulting report, entitled 'Floodplain Management in Australia' (Australian Water Resources Council, 1992), contained a range of recommendations that included regular contacts to encourage progress in the implementation of sound floodplain management practices. Precisely what this meant was different in the various states and territories, because of the variations in legislation and policy that characterise the federation.

After considering the many complexities involved, the Floodplain Management Working Group decided to develop a document summarising a National

Approach to Floodplain Management, not as a prescriptive statement but rather as a guide to best practice. Not long after, a decision was made to integrate this work with emergency management initiatives relating to the production of best-practice guides in the flood management field. Flood and floodplain management, as a result, are now being considered on a 'comprehensive' basis which should encourage interaction between fields which have tended in the past to operate and develop quite separately.

It has been agreed that a national approach to floodplain management should be centred on the vision that effective management involves a long-term strategic approach to the management of land, water and related vegetation. Based on this, strategic goals for floodplain management are to:

- Reduce the vulnerability of the nation to the dangers and damages that result from floods.
- Preserve and enhance the natural resources and current and future land uses and functions of floodplains.
- Streamline the floodplain management process.
- Capitalise on technology to provide the information required to manage floodplains.

A draft document has been prepared and is currently being reviewed. Its contents are as follows:

- Introduction: the purpose of the document (to facilitate the development of effective and comprehensive floodplain management plans).
- The place of floodplain management: threats to and uses of floodplains; their position in the environment; national potential flood damages.
- The basis for a national approach, including promoting consistency in Total Catchment Management and interstate co-operation and efficiencies in research, development and funding.
- Achieving an integrated approach to floodplain management.
- The principles underlying the national approach, employing the social, economic and environmental issues as well as those related specifically to flooding, and
- The recommended process leading to the adoption of a Floodplain Management Plan (which is based on detailed technical studies and linkages between related flood management fields and which identifies what the technical process can supply to emergency managers and vice versa). The process must ensure that the plan is reviewed periodically for continuing relevance and applicability to the long term use of the floodplain.

The intention is that the document will help those states whose current floodplain management strategies are relatively less well developed to augment their approaches in line with current best practice. To do this the various states will need to develop their own floodplain management manuals to suit their own legislative and institutional arrangements with regard to matters relating to flooding.

Planning for Flood Response

Planning for the moment when floods occur begins with an appreciation of the nature of the flood threat. As noted above, floods are amongst the more manageable of hazard agents. They happen fairly often and in some areas according to a regular seasonal rhythm (which creates familiarity with them and opportunities to gather data on their behaviour), they are predictable as to location (that is, they occur on and adjacent to rivers or other water bodies), there is usually some warning of their occurrence (which facilitates resource allocation and decision-making in the response phase) and it is usually possible to determine who will be affected and what the problems will be as far as

warning, evacuation, rescue and resupply tasks are concerned. In short, much can be known about flooding before it occurs, and there is an opportunity to work out in advance how it can best be managed in the interests of protecting property and maximising human safety.

What needs to be determined early in the planning process is the **coverage** of the flood plan with respect to flood type and severity and area of reference. Ideally, plans should cover all identifiable, credible flood threats both natural and (where applicable) related to the potential failure of dams with known flood-passing or structural deficiencies. They should cover all levels of flood severity, from mere freshes on rivers (requiring no more than the issuing of pump warnings for farmers) to events which could necessitate mass evacuations possibly involving thousands of people. As far as possible, they should relate to whole flood liable communities.

Much of the information on which a flood plan is based is likely to be available from records of past flood consequences which can often be related to particular heights on stream gauges. Some information, however, may need to be specifically generated and may need to come from specialist sources including hydrologists, engineers and others. Examples might include surveys to determine the flood vulnerability of evacuation routes, to identify problems of shrinking islands and to determine potential failure or overtopping heights of levees. Where storage dams must release or spill large quantities of water, or when they have deficiencies which could cause their failure, dam owners need to provide input. This would include the provision of information on the area at threat should failure occur and the amount of time which is likely to be available between the point at which dam failure becomes a real possibility and the time by which an evacuation must be completed. This information should provide a basis for determining what sorts of warning procedures and evacuation arrangements will be necessary.

Clearly, a full understanding of the flood problem is likely to require the tapping of a **variety** of information sources. No single source is likely to provide all the knowledge which is needed, and even those people who have lived with and responded to floods in an area over a long time cannot be assumed to be fully equipped merely by dint of their experience. Indeed, such individuals may be prisoners of that experience, unable to contend effectively with floods outside the range of severities that they have witnessed.

The actual writing of a flood plan should involve the flood liable community and all the agencies with roles to play, but it will normally be co-ordinated by an organisation which is central to the flood management process. Involving several players helps bring a team approach to problem solving and encourages comparisons of strategies for coping with particular issues such as warning or evacuation. Often, for simplicity, a generic model plan will be utilised though care must be taken to ensure that such models are used flexibly and that appropriate variation in content and detail is permitted from plan to plan. One standard format in use in Australia arranges the content as follows:

- Introduction: the purpose and authority of the plan; the area it deals with; the identified roles of the agencies involved; conditions for plan review.

- Preparedness: public education; plan activation; sources of flood intelligence; types of warnings provided and means of disseminating them.

- Response: control arrangements; operations centres; liaison requirements, communications systems used; provision of public information; road control; flood rescue; evacuation management; logistics and resupply.

- Recovery: welfare; registration; issue of 'all clear'; recovery co-

ordination; debriefing arrangements.

- Annexes: the flood threat; areas affected by flooding; gauges monitored; guide to the content of evacuation warnings; dissemination of flood bulletins.

- Maps: areas affected; river and creek systems; communities at risk; flood mitigation systems and operational areas (sectors).

The **actual** writing of a flood plan is inevitably confined to a small number of key actors, but it is important that the plan be known and understood by all who will need to be involved in the management of flooding. This includes the members of organisations with roles to play as well as the wider community. It is a principle of emergency management that communities which understand the hazards they face and know how to prepare for and react to them will have a better chance of mitigating the effects of disaster than those which do not (Emergency Management Australia, 1993).

What this means is that flood-prepared communities must be purposefully created. When awareness is generated, people will more easily be able to respond to warnings with appropriate actions - whether these involve avoiding particular routes on the journey to work, stocking up on food and other essentials or lifting belongings prior to evacuating from their dwellings. Systematic efforts to raise flood awareness in Australia are still very much in the developmental stage, though a growing range of educative strategies is being employed (see Keys, 1995 and Soste and Glass, 1996).

The flood plan itself is perhaps the central document for raising public awareness about the flood threat and creating a community that is prepared for flooding. Plans can be made publically available in council libraries, schools, hospitals and elsewhere, and publicised in local media outlets which can reproduce excerpts from them on particular themes. Commemorations of well-remembered floods can also be used to generate community awareness of the flood hazard: such events, used in conjunction with the plans, can be used to debunk well-known myths such as the notion that very severe floods of the past will never be equalled in scale in the future, and the mistaken belief that mitigation devices such as levees, diversion channels and retention basins will render future floods harmless.

Maintaining the currency of flood plans is also important. This involves not only keeping them under review to incorporate changes in the flood environment or the community, but ensuring also that regular briefings are undertaken of the members of the organisations with roles to play in them. Equally, it means that activities designed to keep the flood problem in the community mind are conducted periodically - and kept varied and fresh so that people do not lose interest in them. The plans must also be exercised and discussion and tabletop exercises must be built in to the review process to ensure that the lessons learned are properly incorporated for future responses.

The chapter headings under which this document is being prepared are:

- Why plan for floods?

- Defining the threat.

- Developing the plan.

- Getting the message across.

- Quality assurance and keeping the plan alive.

- Preparation for recovery.

Flood Response Operations

Flood response operations involve the management of a range of activities during the development, passage and recession of the flood. These activities are aimed at minimising the impact of the flood by reducing the risk of death, injury and the property damage within the community.

Operations will involve some or all of the following matters depending on the scale of the event:

- Receipt of flood prediction

information and its interpretation in terms of community vulnerability. This can only be achieved if the hydrological research has already been done and combined with social and demographic data. This information needs to be developed in the planning stage as it will not be able to be developed in the face of the flood's impact except in floods with very long lead times.

- Issue of timely warnings to the community in a manner designed to achieve appropriate response and maximum community participation. A range of methods of dissemination needs to be incorporated into the warning system to ensure effective targeting, and a system for evaluating the response should be developed.

- Activation of the Emergency/Disaster Operations Centre and the appropriate agencies. Without a functional operations centre the execution of the various phases of the response plan will be severely limited and therefore an understanding of the various systems required in an operations centre is required. Management systems that will be needed include operational planning, logistics, liaison and information management. Planners will be required to address these processes within the functions of their operations centre.

- Operations management including communications and information management. The overall operational management system within which the flood response will be conducted will have a direct bearing on how the operation will be run. Such systems vary between jurisdictions. In some there may be a legislated combat authority to deal with a particular hazard whereas in others there may be an overall management system designed to deal with an operation regardless of the type of hazard impact. The type of state/territory management system which exists will affect the style of command and the control and co-ordination of an operation.

- The communications issue, in a majority of plans in the past, has focussed narrowly on whether there are radio communications between agencies and the operations centre and whether there are sufficient telephone lines in the operations centre. Planners should be encouraged, however, to consider other aspects of communications systems including redundancy and inter-agency compatibility. The means of gathering the information itself, and assimilating it into the reporting system, needs to be considered along with the question of what information is actually needed to conduct the operation successfully.

- Implementation of property protection management including individual and commercial loss reduction initiatives and expedient maintenance or construction of structural mitigation works. Community participation plays an important role in any response to flooding as the people who live and work in the community have the most to lose from not being prepared. By accessing community networks and involving them in the planning, a better response to flooding can be achieved at the grass roots level. If the members of the community are aware of protection and mitigation steps that can be undertaken and are prepared to implement them, the effects of a flood can be greatly limited.

- Evacuation management. The effectiveness of any evacuation plan will depend on the quality of the research undertaken in the planning stages. Before an evacuation plan can be developed, it needs to be known at what stages of a flood's development the various parts of the community and their access and egress routes will be affected. Combining this information with

demographic and social data allows conclusions to be made about the level of transport and other assistance evacuees will require, the locations of assembly points and welfare centres and routes to and from them. This information can be made known in public education programs before flooding occurs.

- Search and rescue. The protocols for determining who will conduct various types and phases of search and rescue operations need to be agreed to by the various response agencies before any flood event. Although police are responsible for search and rescue in all states and territories of Australia the actual agencies which conduct the various aspects of these operations vary. Agreement about which agencies will perform which tasks must be reached.

- Immediate welfare management. Once the evacuees have reached the evacuation point their welfare must be provided for with such items as food, bedding and possibly clothing and personal effects. Special consideration needs to be given to children, people with special needs and the management of pets.

- Transportation management, including the movement of essential supplies and personnel into areas and the evacuation of people from them. Specialist advice from liaison officers from agencies with transport-related responsibilities will be required on matters such as the maintenance of transport routes and the authority to close and open roads, apply restrictions and advise the public. There will also need to be advice on the criteria for making decisions about the utilisation of transport routes and whether these criteria can be relaxed for the purpose of carrying out evacuation operations.

- Acquisition, dispatch, receipt and distribution of essential goods and supplies. Policies for the resupply of isolated communities will need to be developed and agreed by all concerned in the planning process. Points to be considered are what types of supplies will be provided, who will provide them, how they will be transported and distributed and who will pay for which items. Thought should also be given to the practicalities of pre-stocking communities or individual properties prone to isolation in advance of flooding. The resupply of isolated stock will be a matter of priority in rural communities and criteria for this must be preplanned.

- Planners, at all levels, need to be aware of the types of resources which relevant agencies hold, how to access them and who meets the cost of operating and deploying them. They also need to know, if they have exhausted resources in the local area, who has the authority to request resupply from the next higher level in the system and what the agreed procedure is for doing this. A system for the prioritisation of resources must be in place before the operation, not hastily developed as situations arise and resources dwindle. Agreements must be reached between agencies requesting and resupplying resources on how those resources will be tasked and who will have the authority to task them. The concept of pre-positioning of resources will need to be considered particularly in the light of flooding where those resources may be isolated until the end of the operation. Planners will also need an understanding of the protocols for requesting Commonwealth support through Defence Aid to the Civil Community from local defence force commanders.

- Maintenance or establishment of essential services including medical and environmental health support. Consultation with

the medical and public health community should be undertaken in the planning process to ensure that the flood will have minimal impact on the community's health. Points that need to be considered in the medical area include facility and record protection, the transport of patients if facilities need to be evacuated, and the stocking and supply of medication and equipment. Public health areas to be considered include the need to keep water supplies free from sewage contamination and a need to guard against disease and ensure insect control. These matters have to be considered not only in the light of positive action to limit the health problems themselves but also in terms of public education about possible threats to community health.

- Provision of co-ordinated community recovery support in the form of counselling services. The recovery of the community must include the social welfare aspect, not only the reconstruction of buildings and services.

The Flood Response Operations document covers each of these areas in some detail and will provide planners and responders with a reference guide to the steps and processes which should be considered in the development of an effective response capability. Without the active involvement in these processes at the community level, the overall effectiveness of the response plan will be less than optimal.

DISCUSSION AND CONCLUSION

It is one of the characteristics of the management of flooding that it involves many skills and agencies. Scientific, engineering, social scientific, management and planning disciplines must be brought to bear in the identification of problems and the development of solutions, and the members of a wide range of organisations have roles to play - some as paid workers and others as volunteers. One of the traditional problems of flood management has been the difficulty of ensuring that the multiplicy of interests involved is effectively integrated. Often, flood and floodplain management studies have ignored the specialist needs of those with responsibilities for providing warnings or preparing for and managing response operations; equally, emergency managers have not always had or developed skills which an awareness of technical flood studies could have helped provide. These best-practice guidelines spell out the range of interests involved in the various processes of flood management and make clear the need for the effective meshing of them. They also point the way towards the definition of optimal practice and provide aiming points for practitioners.

All this will be for nought, of course, unless the responsibilities for the elements of flood and floodplain management are allocated appropriately within the various jurisdictions. At present the unconscionable situation exists that the management of Australia's major natural hazard is beset by a severe lack of clarity in terms of managerial responsibility. In some states the responsibility for some matters is not allocated at all, in some it is not clear which agency is responsible for flood planning, operations and other tasks, in others the operational management appears to be in the hands of organisations more suited to administrative matters, while in others again there is evidently a fragmentation of operational control. Unless the division of responsibilities is addressed, the progress that is being made to improve flood and floodplain management practices will itself be at risk.

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