DAM FAILURE WARNING AND EVACUATION PLANNING

IN NEW SOUTH WALES: RECENT PROGRESS AND THE FORWARD PROGRAM

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Planning for the kinds of floods which would follow the failure of large water storage dams is relatively new in Australia. In New South Wales it began in the late 1980s following the realisation, based on improved scientific comprehension of severe weather and flood events, that some dams had spillways which were incapable of safely passing very severe floods. For a time progress was slow as far as plan development was concerned but over the past year or two it has picked up significantly. Several plans, under preparation for a considerable length of time, have been completed to final draft stage and a number of new ones have been started. At the same time the 'rules' by which the planning is being done and on which responses to dam-failure would be based have been fine-tuned. Moreover, the shape of the future planning program and associated activities can be seen with increasing clarity.

Until quite recently the State Emergency Service was, like most emergency management organisations in this country, much more oriented towards **responding** to emergencies than in **preparing** to respond to them. Planning, as a consequence, was not given a high priority and there were few trained planners appointed to the organisation and few resources allocated to them. Activities involving planning for floods were in their infancy and planning expertise was lacking. Accordingly, the organisation was not well placed to react quickly when, in the mid-1980s, the PMP/PMF revisions made it clear that several of the state's major water storage dams had inadequate spillway capacities and were in a few cases quite dangerously underdesigned in terms of their security during significant flood events.

Planning activity during the late 1980s, as far as the consideration of dam-failure situations was concerned, tended to be concentrated in the hands of local State Emergency Service volunteers with only very general guidance from the state headquarters of the organisation. Plans were developed for areas downstream of the Chichester and Dungowan dams and planning programs were initiated for areas below other dams - notably Warragamba, Glennies Creek, Burrinjuck, Pindari and Chaffey. But the lack of planning expertise amongst those entrusted

with the task made for many difficulties, not the least of which was the slowness with which the whole process tended to move.

In 1989-90 the State Emergency Service was restructured, an almost totally new headquarters staff was recruited, and a new Act was proclaimed. Part of the restructuring process involved a paradigm shift in which the priority given to planning activities was considerably raised. Existing planning work was put on hold while the new staff of the organisation attempted to define the overall flood planning task and to identify the best means of incorporating dam-failure planning within it. At the same time, though, the political environment was such that it was clear that planning to cater for the extreme flooding that would occur in the event of a failure of the state's largest storage dam - Warragamba Dam near Sydney's western edge - would have to be expedited.

WARRAGAMBA DAM AND THE HAWKESBURY RIVER

Planning for this scenario, as well as for serious 'natural' flooding on the Hawkesbury River downstream of Warragamba Dam, became the priority planning task for the State Emergency Service. By late 1991 a preliminary set of arrangements had been designed in order to create a working basis for handling flood events of all levels, from mere freshes in the river up to and including the catastrophic flooding which would follow dam failure. During 1991 these arrangements were considerably refined and extended to the point that by April 1992 a family of nine plans had been developed to deal with floods on the river downstream of Warragamba Dam. These included a 'state-level' plan, two emergency management zone plans, a State Emergency Service division plan and five plans for local government areas or for parts of them.

Several things have happened since the plans were written. Firstly, the plans themselves have been subjected to a review by two American emergency managers with experience in planning for dam-failure and other severe flood events, and have been judged to be sound in both concept and design. The review was conducted by overseas experts to ensure its independence and because planning experience associated with such large and complex potential flood events as these is currently lacking in Australia.

Secondly, all but one of the plans has been endorsed by the appropriate emergency management committee, whether at local government or emergency management zone level. The exception is the state-level plan which is intended to be submitted to the State Emergency Management Committee for endorsement at its December meeting. Once this plan is endorsed, all nine will have been formally accepted by the emergency management 'communities' in which they are intended to function - which means that all the agencies mentioned in the plans will have accepted the roles identified for them.

Thirdly, almost all of the key actors who would be involved in response activities necessitated by dam-break and other very serious floods have been briefed on the purpose, content and implementation of the plans themselves. These actors include Local and District Emergency Operations Controllers and others with important operational roles once flooding occurs or can be foreseen. Such briefings are obviously vital to the effecting functioning of the plans once their activation becomes necessary.

Despite the progress which has been made on the Hawkesbury-Warragamba planning project over the past year, much still remains to be done before the plans can be said to be able to play their full intended roles on behalf of the communities of the Hawkesbury River valley. In particular the complex question as to how these communities can be effectively educated about the potential flood problems which they may face and about how responses to them will be managed has yet to be addressed. Nevertheless, it is undeniable that the very existence of the plans will make emergency managers better able to handle catastrophic flooding within the valley of the Hawkesbury River than would have been possible had such flooding occurred in 1990 or earlier. Moreover, the plans have become useful as models for dam-failure planning projects in other parts of the state.

FLOOD PLANNING ELSEWHERE IN NEW SOUTH WALES

The State Emergency Service, as the combat agency for flooding in New South Wales, is responsible for flood planning. In 1991 the Service produced the State Flood Plan which, amongst other things, laid out the rules by which flood planning would proceed over the period to late 1993. These rules specified that flood plans would be produced for each of the state's eighteen State Emergency Service Divisions (regions) and for all local government areas with flood problems sufficiently serious to require formal SES responses in the combat agency role. In addition the Plan noted the possibility that 'special' flood plans might be required either because of the extreme nature of particular flood events or because of the potential for dam failures.

Planning has proceeded apace over the past year. Most of the Division plans, and numerous local ones, have been developed in draft form, some have been endorsed by emergency management committees at the appropriate levels, and in a few cases a program of public education about flooding and about the plans themselves has begun.

Dam-failure events have been handled in two ways in these plans. In some cases, individual plans have been written to develop response arrangements tailored specifically to dam-failure floods: this is the method that has been followed for local government areas downstream of the Glennies Creek Dam which is situated

on a tributary of the Hunter River, for areas downstream of the Lyell Dam on the Coxs River, and for the case of the Nepean Dam. Elsewhere, arrangements for dam-break floods have been integrated with arrangements for 'natural' flooding. Thus the plan for the Captains Flat area incorporates a consideration of responses to all levels of flooding from minor events through to a flood brought about by dam failure.

The latter model is now the preferred one and new planning projects are likely to involve the 'integrated' approach rather than creating separate plans for dam-break and other flood events. Thus the flood plan which is presently being prepared by the Oberon unit of the State Emergency Service will reflect arrangements for all levels of flooding within the Shire of Oberon (including flooding consequent upon failure of the Oberon Dam). At the same time the partly-completed Burrinjuck Plan (which was begun some years ago) is being re-cast. Its content is being spread between the Murrumbidgee Division Plan and the various local plans written for the different local government areas along the Murrumbidgee River. Much the same thing is happening with the Pindari Plan, the content of which is being incorporated within the Inverell Flood Plan. Eventually, the plans to take account of the potential failure of the Glennies Creek, Chaffey and Lyell dams are also likely to be 'integrated' with local and division-level flood plans which will then cover all possible levels of flooding within their respective territories.

THE PLANS AND THE PLANNING PROCESS

Considerable experience in flood planning has been accumulated over the past two years in New South Wales, and a number of conclusions can be drawn from the dam-failure planning work that has been carried out to this point. These relate to the content and formatting of plans, the nature of the relationship between the planning agency on the one hand and the Dams Safety Committee and the owners of the dams on the other, and the need to ensure that the appropriate emergency managers are kept fully briefed about the plans and the potential events which they are designed to deal with.

The flood plans which have been prepared to date have been written to a broadly common format which focuses on three primary issues: the responsibilities of those agencies and individuals involved in the events themselves, the warning procedures and the response arrangements which have been developed. Control arrangements are also specified. In some cases of plans involving dam failure, provision has been made for a handover of control from the State Emergency Service as combat agency to the Local and/or District Emergency Operations Controllers. This reflects the need for different management arrangements to be devised for catastrophic flooding (both high-range major 'natural' flooding and the flooding which would follow dam failures) than would apply for lower-order events. Broadly speaking, when it is suspected that a dam may fail, a handover of

control is expected to occur. This point is explicitly written in to each document.

Numerous other agencies besides the Police (from whose ranks the Local and District Emergency Operations Controllers are drawn) and the State Emergency Service will be involved in warning and response activities. The list varies from case to case, but all plans designed to deal with dam-break flooding specify the responsibilities of dam owners, councils and the Disaster Welfare Service amongst many others. Some of these organisations (like the Ambulance Service) would simply be performing their normal disaster-related functions under DISPLAN but others (including the Bush Fire Brigades and the New South Wales Fire Brigades) are being asked in some instances to assist with doorknocking activities and the conduct of evacuation operations.

The Preparedness sections detail procedures for surveillance (both of the dams themselves and of incipient, developing and actual floods) and focus also on procedures for warning the people at risk of flooding should it occur. Where they exist, the automatic alarm systems which are now common in houses within the first several kilometres downstream of a dam are noted in the plans along with procedures for their operation. Other elements of the warning systems and arrangements - including those relating to doorknocking procedures - are also defined.

The Response sections of the plans focus principally on the conduct of evacuation operations. Evacuation routes and destinations are identified and time constraints are defined. Every attempt has been made to ensure that warning time is effectively used, for example, in the calibration of resource needs and to ensure that operations begin early enough to ensure that it is possible to get everybody out of the path of the possible or impending dam-break flood before it arrives and begins to cut the evacuation routes. Where appropriate, Local Government Areas have been divided into sectors and the details of the evacuation arrangements (routes, evacuation centres, control mechanisms, resource requirements and transport control mechanisms) have been specified for each sector within the annexes of the various plans.

As the planning process has proceeded, it has become apparent that closer and more formal links with the Dams Safety Committee and the dam owners are needed. In the early days, some confusion over roles was evident as far as planning tasks was concerned. The Dams Safety Act does not specify that emergency management expertise be incorporated within the Committee, though it does allow for the establishment of sub-committees with particular designated tasks. The State Emergency Service, as the combat agency for flooding within New South Wales and a repository of emergency management expertise, is now to be included on one such sub-committee provisionally entitled the Emergency Management Sub-Committee. This will formalise the link between emergency

managers and dams safety experts and facilitate communication and therefore policy development. The previous arrangement gave the State Emergency Service a flimsy role and less formalised access to the Dams Safety Committee. The change will also provide a stronger legislative base on which the Dams Safety Committee may require dam owners to contribute to the preparedness process as the committee will be able to use the authority inherent in the State Emergency and Rescue Management Act in addition to its own Act.

The need for the formalisation of roles is apparent in other contexts, too. One of the basic tenets of planning is that it works best when steps are taken to ensure that the actors who are involved in plan implementation are genuinely committed to the plan itself. This can be achieved by involving as many of these actors as possible in the planning process. In the case of current planning to cater for dam-failure events, this is being sought in most instances by including on the planning committees the appropriate Emergency Operations Controllers, District Emergency Management Officers (professional emergency planners who are employed as staff officers to the District Emergency Operations Controllers in various locations around the state) and Local Emergency Management Officers (who are council appointees or employees, and in several cases are Council Engineers) as well as SES volunteers. State Emergency Service head office personnel have taken primary responsibility for the actual writing of the plans, but the planning committees serve not only to provide input to plan development but also as vehicles for developing an understanding of the potential event amongst those who would be centrally involved.

One problem here is that high job mobility in the Police Service will mean that special efforts will be required to ensure that the commitment of key players is not lost when people who have been involved in the planning process move on to new employment. The process of plan review and the periodic testing of plans into the future will be vital in this regard. So too will be the emergency management courses periodically conducted for senior police personnel at the Police Academy at Goulburn. These courses are designed to provide training in disaster scenarios which are much more complex than the events for which police personnel have traditionally been trained.

LOOKING FORWARD

None of the plans which have been developed to this point can be regarded as complete or final documents, and there are potential dam-failure events for which planning projects are still in their infancy or have yet to begin. Much work remains to be done, therefore, as far as the planning itself is concerned. But the task is broader than this, too. Increasingly, we will need to be involved in the education of communities downstream of the dams as well as in the education of emergency managers charged with future plan development and plan

implementation. This is shaping to be a critical element of the future planning program.

Public education to prepare communities for dam-failure flooding will not be easy or without cost. Particularly in the case of the Hawkesbury-Warragamba project the task will be larger and will involve more than simply publicising the plans themselves. The public interaction project will need to be designed so as to define the flood threat clearly in the public mind. Just what this threat will be will depend to some extent on the mitigation measures the state government intends to pursue at the dam (spillway enlargement, new mitigation dam or other options). The project will need to focus on a range of issues rather than solely on the plan: to do otherwise will risk the creation of community apathy or, alternatively, the lighting of some sensitive political fuses. Until it is known what is to be done at the dam it will be difficult to define with precision the nature and content of the education program.

Elsewhere, too, there are some difficult management issues involved in the development of public education initiatives. One of the benefits of considering dam-break floods together with other flood events (that is, in the same document) is that it allows the more catastrophic flood scenarios to be treated in a more benign context in the public arena than would be possible if the dam-failure events were to be singled out for special publicity. Partly because of this, the development of a public education program in the Hunter Valley is being delayed until the set of local plans, each of which deals only with the potential Glennies Creek dam-failure event, is re-cast to incorporate 'natural', less calamitous flooding.

In other cases, the public education task is already under way. Below Lyell Dam the potential number of people who could be affected is only a few dozen, and in such a case an appropriate campaign content is not difficult to visualise. There, the program involves presenting each household in the risk area with its own copy of the Plan and discussing with each resident or family what the plan means to them and how they should use it. In essence, this involves a briefing on the warning system (the centrepiece of which is an automatic alarm transmitted by radio to each household in the areas likely to be inundated by a dam-failure flood) and the reaching of agreements on evacuation procedures. These briefings have been conducted as the planning has been going on and as the radio units are installed. This phase of the education process will end with the plan being released at an Information Day gathering late in November of those people who live downstream of the dam. The gathering will allow the residents of the Coxs River valley to meet representatives of the dam owner and the planning group and to seek answers to any concerns they may have. Beyond this, the residents will periodically be reminded (by automatic and voice testing of their radio units) of the flood hazard, the plan and their potential need to evacuate if the dam is under

threat at any time over the next three years while remedial work is being carried out to ensure that the dam is efficiently flood-proofed.

In cases like this one, when the population at risk is very small, the task of public education is relatively simple to design and carry out. For the areas below the Warragamba, Burrinjuck and Glennies Creek dams, where the people who would be affected by dam-break flooding amount to many thousands, this is far from being true. It is safe to say that the program will involve inputs from both dam owners and emergency managers, but much has yet to be done to clarify program content and the methods by which the actual task will be carried forward. Clarifying these issues will be a major focus in 1993.

Beyond the public education role lies another important educative task for emergency managers in New South Wales who have experience in planning for dam-failure flooding. Such planning is evidently further advanced in this state than in other parts of Australia, and accordingly it is likely that expertise has been developed which should be shared with other states. In January 1993 a three-day workshop is to be held at the Australian Counter Disaster College at Mt Macedon, Victoria, on the theme of Dam Break Preparedness. Its aim will be to develop a framework for emergency management specific to dam failure in Australia. Planning for this workshop is well advanced, and the following questions are expected to be examined amongst others:

> Can upgrading a dam be avoided by having an effective warning and evacuation system?
> What products (for example inundation maps and warning-time scenarios) are needed for the development of emergency management plans, and who should produce these products?
> Should dam-failure plans be special plans (focussing, that is, on single events)?
> What should be the legal responsibilities and authorities of the various players?
> What is the community's right to know and when should the people be told?

The workshop will involve about thirty participants from all states and territories. These will be drawn from police and State/Territory Emergency Service personnel as well as from dam owners, water authorities, local government bodies, the Bureau of Meteorology and representatives of various Solicitors Generals' departments. The workshop will exclude discussions of the warning systems and evacuation arrangements which are specific to individual plans, concentrating instead on general emergency management issues as they relate to the management of dam failure problems.

Apart from carrying out tasks relating to public education and the education of other emergency managers, there remains a considerable amount of planning work to be done in New South Wales. To date, plans have been prepared or are in preparation for areas downstream of the Warragamba, Glennies Creek, Burrinjuck, Pindari, Chaffey, Nepean, Captains Flat, Lyell and Oberon dams. Planning is scheduled also for areas below the Burrendong, Chifley, Coeypolly, Redbank, Sooley, Spring Creek and Suma Park dams. Some of this planning could proceed immediately given that the research reports clarifying the nature of the planning problem have already been produced by or on behalf of the dam owners. In other instances the reports have yet to be completed.

Nor is this list of dams a complete or prescriptive one. In the past, some dams have been removed from it as their upgrading works have been completed and others added once it became clear that their flood capacities were deficient. It seems likely that planning projects will soon have to be initiated to take account of the potential danger to areas downstream of the Grahamstown, Winburndale and Company (Grenfell) dams.

Two final points need to be made about future activities. One relates to the hardware installed below some of the dams to provide warnings should there be concerns about dam security. In some instances this hardware has proved unreliable, and efforts need to be made to ensure its efficient operation at all times. Second, some care needs to be taken over the form and content of public announcements about the potential flood security problems of dams. In the past, announcements have been made very soon after the discovery of spillway inadequacy and in a way that is not helpful to the public education process. Dam owners need to understand that premature announcements, particularly if the content of the message turns out on later evidence to be misleading, can cause unnecessary difficulties from an emergency management perspective as far as public interaction is concerned.

CONCLUSION

Three years ago, dam-failure planning in New South Wales was proceeding only slowly. Professional planning expertise was available in only limited quantities, the links between the planners and the dam owners were tenuous and informal and the hazards which the plans were to deal with were not always well defined. By late last year, planning was well advanced for the case of areas below Warragamba Dam but not a great deal of progress had been made elsewhere in the state. In addition, the State Emergency Service had noted the need for closer and more formal contact with the Dams Safety Committee.

It can now be said that rapid progress is being achieved. A mechanism for more formal interaction with the Dams Safety Committee, the dam owners and the

water managers is being devised, and by the end of 1993 most of the areas located below dams with high hazard ratings and severely deficient spillway capacities will have been subjected to plan development to devise appropriate procedures for coping with dam-failure floods. Once the plans have been produced, the task will be one of developing and maintaining an awareness of the problem amongst relevant communities and emergency managers and of keeping the plans relevant and up to date by means of periodic tests and reviews. The shape of the planning task will change and remedial works will continue at the dams themselves, but it will be some time yet before planning for dam-failure scenarios will cease to be a high priority for the State Emergency Service in New South Wales.

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