

# Flood action plans— making loss reduction more effective in the commercial sector

*Andrew Gissing* argues that flood action plans can overcome low flood preparedness but research shows they are often poorly developed

*By Andrew Gissing*

Warning systems frequently fail to produce maximum potential benefits. Research results from the Kempsey, 2001 flood suggest businesses responded poorly to warnings because of low flood preparedness. Flood action plans could overcome this problem. If comprehensive flood action plans had been developed before the flooding of Kempsey in 2001, damage could have been reduced by an estimated 80 per cent. However, research into the development of flood action plans in Inverell, Lismore and Adelaide has shown that plans are often poorly developed and that further flood education is needed to improve their development.

## 1. Introduction

Well-prepared persons after receiving sufficient flood warning are able to avoid substantial flood damages. With this principle in mind, global spending upon flood warning systems has grown in an effort to combat increasing global flood losses. However, recent research suggests warning systems frequently fail to deliver maximum potential benefits. An evaluation of warnings delivered to businesses during the Kempsey, NSW, Australia, 2001 flood showed businesses largely responded poorly as a result of low flood preparedness (Gissing, 2002). It was concluded that flood warning performance is dependent not only upon the efficiency and effectiveness of a warning system, but also the preparedness and ability of a community to respond to flood warning. Focus upon improving flood response is important, since effective response may be the only defence against extreme floods. To achieve improved response from better warning systems, enhanced preparedness is required.

Attempts to increase flood preparedness have been focused on the community as a whole, without

distinction between the commercial, residential or industrial sectors. However, Smith (1998) argues that the greatest benefits of loss reduction programs in financial terms exist in the commercial and industrial sectors due to their greater potential losses. The Kempsey 2001 flood caused 2.5 million dollars damage, much of which could have been avoided if businesses had understood flood warnings and implemented effective loss reduction strategies. Wright and Smith (1999) recommended adoption of flood action plans tailored to individual businesses to boost flood preparedness and reduce flood losses. Flood action plans detail actions to be taken in advance and over the duration of a flood. The purpose of planned actions is to reduce direct damage and ensure business continuity by attempting to minimise demands on time, personnel and resources. Flood action plans empower businesses to take some ownership of their flood risk and implement self-protection initiatives.

Little research has been conducted into the development and effectiveness of flood action plans. This paper discusses the development of flood action plans in the commercial sector and evaluates their effectiveness in the Australian cities of Inverell, Lismore and Adelaide (Figure 1). The paper concludes by discussing the potential benefits of flood action plans to Kempsey businesses.

## 2. Development of flood action plans

Numerous stakeholders can be involved in the development of flood action plans including business owners, business managers, customers, suppliers, employees, local government, insurance companies, landlords and emergency services. Each of these persons and organisations has an interest in the continuity of a business. These stakeholders should encourage and be involved in the development of a flood action plan.

The effective development of a flood action plan involves five stages consisting of awareness, flood audit, planning, implementation and review (Figure 2). The process is a continuous cycle involving a feedback process.



Figure 1 – Locations of study areas

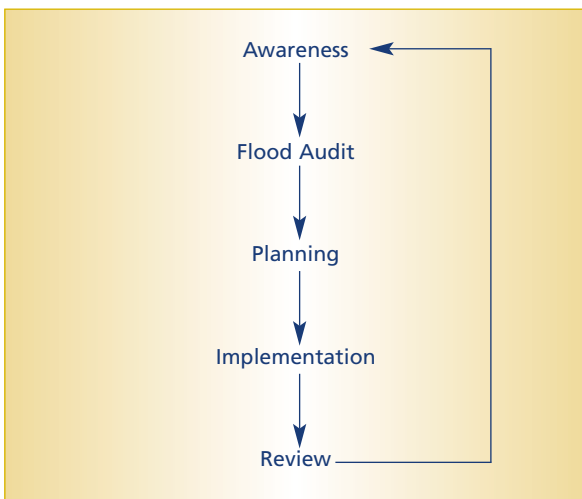


Figure 2 – Stages in Flood Action Plan construction

### Awareness

It is critical that a business is able to identify its flood risk. As an initial step in the development of a flood action plan, businesses must be made aware of their risk and encouraged to take mitigating actions. In communities where floods frequently occur awareness will likely be high and needs only to be reinforced. However, some communities where flooding is less common remain largely unaware of their flood risk; for example, Keswick Creek in Adelaide. These communities require regular awareness programs. Though the construction of awareness programs is beyond the scope of this research it is important that they include:

- Information on how to reduce flood risk, including details on flood proofing and flood action plan development
- Encouragement to create a flood action plan
- Where to receive further information

### Flood audit

A flood audit is an investigation of flood risk faced by a business. A business's flood risk is a combination of the likelihood of flooding and the vulnerability of a business to flooding (Department of the Deputy Prime Minister U.K, 2002). To assess risk the audit process comprises two parts: hazard assessment and vulnerability assessment.

Hazard assessment is an evaluation of flood hazard confronting a business. The assessment aims to deliver accurate flood information about individual businesses. Information about businesses to be determined includes:

- Ground elevation
- Probability of flooding
- Depth of previous or design floods over floor
- Appropriate evacuation routes
- Potential building flood entry points
- Velocity of flood water

This information aims to enable businesses to make informed choices about their flood hazard. The information should enable businesses to relate river heights to their floor level, assess likely flood levels within their buildings, the risk of structural damage to their building and choose the safest evacuation routes.



*Vulnerability assessment evaluates the extent flood hazard may impact upon a business.*

Vulnerability assessment evaluates the extent flood hazard may impact upon a business. This involves assessing the vulnerability of a business to building and contents damage as well as business disruption. The assessment should identify the following:

- Critical products, services, records and operations
- Hazardous materials
- Flood prone contents and structures
- Potential effects of damage on stakeholders
- Likely financial costs
- Resources, personnel and time available to make preparations
- Level of insurance cover

The combination of hazard and vulnerability assessments results in a total risk assessment. The assessment provides managers with knowledge of their business's flood risk. Risks identified must be addressed in the planning stage; hence the audit serves as the main guide in the plan's development.

### **Planning**

Planning involves the development of a pre-defined course of action to reduce flood risk (LeBreton and Henning, 1961). There are five stages in the planning process; risk prioritisation, strategy development, procedure development, testing and consultation and documentation.

Risks identified in the flood audit must be prioritised in accordance with the plan's objectives. Priority should be given to risks that may critically affect the continuity of a business, pose a significant potential tangible or intangible loss or increase a business's vulnerability.

Strategies must be developed to reduce the potential flood risk identified. These may include flood proofing, re-positioning or protection of vulnerable contents and recovery arrangements. Insurance may be used as a means of risk spreading, but is frequently unavailable to flood-prone businesses.

Two forms of flood proofing exist; wet and dry. Wet flood proofing aims to improve the resistance of a building and its contents to flood. This typically involves the use of flood resistant materials and raising electrical wiring. Dry flood proofing aims to prevent water from entering a building. Measures used include permanent or temporary flood barriers to block building openings and the installation of non-return valves to prevent sewage back flow (Department of the Deputy Prime Minister U.K, 2002). Contents can be positioned to reduce vulnerability. This involves either permanently elevating vulnerable contents or removing or lifting contents directly prior to flooding.

Businesses can make arrangements well in advance of a flood to speed recovery and minimize business disruption. This often involves temporarily relocating activities offsite. This may range from switching phone calls to an alternate location to the establishment of satellite facilities or reciprocal aid arrangements with similar businesses elsewhere.

Strategies should be evaluated based on criteria. It is important to balance the level of protection offered, the costs involved and the potential level of damage avoided.

Procedure development involves determining actions to implement risk reduction strategies. Planners at this stage must determine what actions are necessary, who

**Table 1. List of typical flood action plan actions.**

PREPAREDNESS	RESPONSE	RECOVERY
<ul style="list-style-type: none"> <li>• Review insurance</li> <li>• Update plan</li> <li>• Conduct training</li> <li>• Purchase and maintenance of emergency equipment</li> <li>• Maintain employee phone list</li> <li>• Backup computer records</li> <li>• Elevate important documents and store duplicates offsite</li> <li>• Elevate vulnerable contents</li> <li>• Install permanent flood proofing</li> </ul>	<ul style="list-style-type: none"> <li>• Listen to radio</li> <li>• Remove vehicles</li> <li>• Lift or remove contents.</li> <li>• Stay clear of deep fast flowing water.</li> <li>• Re-direct communications</li> <li>• Turnoff utilities</li> <li>• Sandbag or install flood shutters</li> <li>• Seal wall and floor vents</li> <li>• Contact stakeholders</li> <li>• Remove records and cash</li> <li>• Secure building</li> <li>• Evacuate along the predetermined route</li> </ul>	<ul style="list-style-type: none"> <li>• Hose out</li> <li>• Have utilities professionally checked before turning on</li> <li>• Assess damage</li> <li>• Remove damaged contents</li> <li>• Restore business</li> <li>• Advertise re-opening</li> <li>• Restore vital records</li> </ul>

should complete actions, when to complete actions, what resources are needed and, if complex, how to complete actions. Actions should be separated into three phases, preparedness, response and recovery.

The preparedness phase comprises actions to be taken well before a flood, the response phase actions to be taken after the receipt of evidence indicating likely flooding and the recovery phase actions to be taken to re-open a business. Table 1 gives examples of actions comprising these phases of a flood action plan. Actions should be ordered according to the priorities previously established, taking no longer to be completed than the limited time available. Care must be taken to ensure the established procedure is compatible with other emergency plans if any.

Drafting the plan involves the documentation of established procedures and associated details. The three phases of the plan should be listed separately. The plan should also entail additional information including:

- Contact details of emergency services, business owner, manager, staff, suppliers and insurance agent
- List of emergency equipment and location
- List of design and historical flood heights above floor
- Location of where plan is to be kept
- Details of persons in charge of implementing the plan
- Details of who is in charge of performing certain actions
- Criteria to invoke the plan

Testing and consultation enables planners to establish whether plans are realistic. This may involve simulations or group discussions with stakeholders. These exercises provide important feedback to planners about the effectiveness of their plans and how they could be

improved. Improvements should be incorporated and the final plan documented. The document should be simple containing sufficient information for personnel to complete procedures.

### Implementation

Implementation is more than just putting the plan into action: it involves integrating the plan into the organisation (FEMA, 1996). Implementation involves three stages; distribution, training and performance.

Distribution of the plan throughout the organization is essential. The plan must be prominently displayed to ensure all employees have access. It is also important that copies of the plan are kept offsite.

Training ensures that all employees have knowledge and understanding of the plan. Staff should be taught who is responsible for what and how to perform tasks. This may involve group discussions, simulations or quizzes. Training gives employees an appreciation of what a flood situation may be like and prepares them to cope with the stress, uncertainties and demands they may be confronted with (Maslen, 1996). Training should be conducted regularly and new staff trained during their induction. Training will produce important feedback and ensure the plan's effectiveness. Without training, a business, even though it has a flood action plan, is not prepared to manage emergency and recovery procedures (Maslen, 1996).

Performance involves carrying out tasks designated for completion before a flood. The performance of these tasks should be ongoing and only cease periodically for the performance of emergency and recovery procedures.



*Efforts have recently been made to encourage the creation of flood plains in Inverell, Lismore and Adelaide*

### Review

Review involves critically examining all elements of a plan; ensuring the plan functions as intended, remains up to date and incorporates needed improvements. Reviews are critical to maintain performance, ensure lessons are not lost and to account for changes in risk. Reviews should be completed at least yearly and after the following (FEMA, 1996),

- Training drills
- Flood
- Changes in personnel or their responsibilities
- Changes in the layout or design of a building
- Changes in policy or procedure
- Changes in the catchment

Employees should be briefed on changes made and trained accordingly if needed.

### 3. The Flood Action Plan experience

To examine the development and effectiveness of business flood action plans, research was conducted in the Australian cities of Inverell, Lismore and Adelaide. In all three cities efforts have recently been made to encourage the creation of flood action plans.

Inverell, situated upon the Macintyre River, has a population of 10,000 persons (Australian Bureau of Statistics, 1996). The catchment above Inverell is approximately 730 square kilometres in size consisting of steep slopes with quick runoff (Pryor, 1999). Comprising an estimated 250 commercial properties all of which are flood prone, Inverell's business district was last flooded in 1991. Estimated

to have an Average Recurrence Interval of 50 years, floodwaters rose rapidly, giving businesses only several hours to prepare. Damage to businesses was variable totalling an estimated \$15 million (Markar and Joy, 1994). Post-flood, local authorities realised that damage could have been lower if businesses had been more prepared. In response a number of decisions were made including requiring the submission of a flood action plan as a necessary part of development approval on flood-prone land (Pryor, 2002).

Lismore located at the junction of Leycester Creek and Wilson's River, has an urban population of approximately 30,000 (Australian Bureau of Statistics, 1996). The catchment area above Lismore is in excess of 1,400 square kilometres. Approximately 700 commercial and industrial premises are built in flood prone areas, many without raised floor levels. Since 1857 over 130 floods of varying sizes have occurred. The worst of these occurred in 1954 and 1974, the latter being the subject of intense research by Smith et al. (1979). Most recently, flooding was recorded in February 2001. The flood was the 13<sup>th</sup> highest on record, with an Average Recurrence Interval of approximately six years. A survey of 39 businesses by Risk Frontiers revealed that seven had suffered no significant damage whilst some others had estimated their losses in the tens of thousands of dollars (Leigh and Gissing, 2001). Lismore has a substantial floodplain management plan involving the distribution of property specific hazard assessments including floor height and ground height data, contact phone numbers of emergency services and evacuation procedures (Lismore City Council, 2002).

Keswick Creek is a small urban catchment, 32 square kilometres in size, located in the southwest inner suburbs of Adelaide. This urbanised catchment is at risk of flash floods, characterised by rapid stream level rises and short duration inundation. Though no major floods have recently occurred, a 1984 flood study revealed flood risk to approximately 170 commercial properties (WBCM, 1984). Wright (2001) estimated the total flood loss exposure of these businesses for a 100 year Average Recurrence Interval flood at \$100 million. Roughly half of the damages were assessed as being avoidable if flood-proofing measures were introduced and a further 15 per cent if an effective flood warning service was introduced. Little flood awareness exists within the catchment. As part of an Adelaide University research program some businesses have been warned of their risk and encouraged to take mitigating actions. The program has involved door knocking, community meetings and a small number of flood audits.

#### 4. Methodology

Face-to-face interviews with business managers were conducted in each city during July, 2002. Interviews were used to complete a questionnaire about flood preparation. Participants were asked common questions relating to plan development, documentation, procedures, training, review, awareness, costs and benefits.

In total 153 questionnaires were completed, 68 from Inverell, 73 from Lismore and 12 from Keswick Creek. In addition to questionnaires, interviews were conducted with local government officials and emergency managers. These interviews obtained information on the development of flood action plans. To assess the content of plans additional information was also obtained from Inverell Shire Council.

#### 5. Results

Businesses claiming to have developed either a documented or undocumented flood action plan totalled 86 per cent of the total survey sample. Plans were most prevalent in Lismore with 97 per cent of businesses having developed a flood action plan. Businesses were prompted to develop plans by previous flood experience, occupational health and safety regulations, council regulations, encouragement by emergency services and the value of business contents. In Lismore the development of a flood culture as a result of frequent flooding has fostered responsible actions to reduce flood risk. Businesses have accepted that floods are a part of business, with many acknowledging that planning is the key to business survival.

*“Floods are a part of life. We had three floods in one year once.”*

(Lismore shopkeeper)

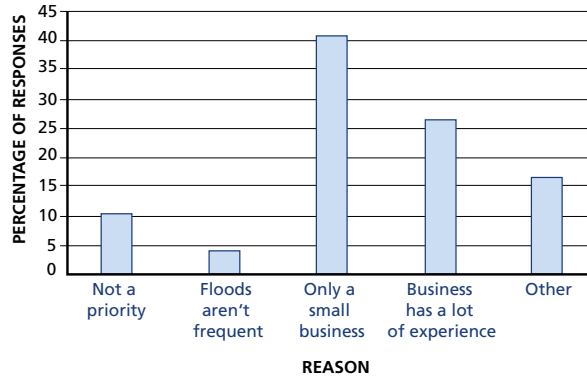


Figure 3 – Reasons for not documenting plans

*“Only those who are not prepared get caught.”*

(Lismore shopkeeper)

*“Wouldn't survive without a plan.”*

(Lismore shopkeeper)

*“You know you live on a floodplain, you do something about it.”*

(Lismore shopkeeper)

Businesses that had not prepared plans did not see flood preparation as a priority, although many acknowledged that if floods were more frequent planning would become important. A small number of businesses viewed flood preparation as pointless, believing that little could be done to prevent flood damage or that floods would no longer occur because of mitigation works. In a few cases businesses did not wish to accept responsibility for flood risk minimisation, believing it to be the responsibility of government.

*“Floods only come twice every century, don't worry about them, just cop them on the chin.”*

(Inverell Shopkeeper)

*“Flood, isn't that what the State Emergency Service is for?”*

(Inverell Shopkeeper)

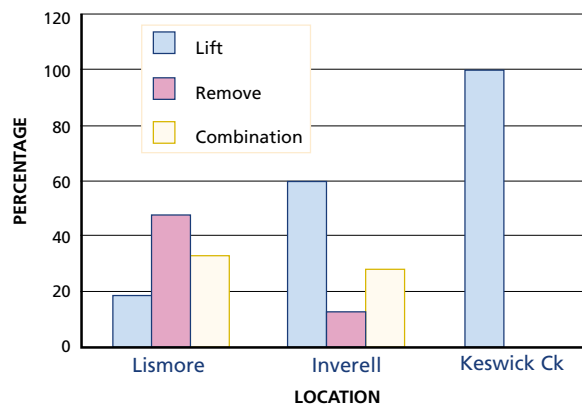


Figure 4 – Proportion of businesses lifting or removing contents

Of those businesses that had developed flood action plans only 25 per cent had documented their plans. Reasons given for failing to document plans are given in Figure 3. Many businesses with few employees believed that documentation was pointless, as only a small number of persons would need to use it; this was particularly clear in owner-operated businesses. Some businesses that had extensive flood experience believed that documentation was unnecessary, as employees had experienced the plan's implementation in previous floods. Many businesses that had documented plans did so to enable the plan's implementation in case management was unavailable during a flood. This points towards the potential failure of undocumented plans if persons with knowledge of the plan are unavailable during a flood.

Documented plans were typically kept in the administration office of a business, either on a wall or in a filing cabinet. However, in a few cases where council regulations had required documentation of the plan, it had been lost. Only a small number of businesses mentioned that they stored duplicates offsite. Not all businesses with documented plans allowed free access to the plan by all staff. In Inverell 93 per cent of businesses allowed access by all staff, though only 70 per cent of businesses in Lismore and 60 per cent of businesses in Keswick Creek allowed access by all staff.

The content of plans was primarily focused upon response procedures, largely neglecting preparedness and recovery phases. Response procedures identified by questionnaires included sandbagging, sealing doors, lifting or removal of contents, listening to the radio, installing flood shutters, removal of vehicles, disconnection of utilities and evacuation of employees and customers. The proportion of businesses planning to remove contents rather than lifting them (Figure 4) is dependent upon anticipated flood conditions. In Inverell and Keswick Creek where flood heights are typically shallow, many businesses plan only to lift contents above the expected flood height. However, in Lismore where flood depths can be far greater, many businesses plan to remove contents. In many cases plans involve removing contents to higher floors inside a building. This often requires an agreement between the business manager and the owner of the building's upper floors.

An analysis of 27 documented plans submitted to Inverell Shire Council indicated that 24 of these plans contained response procedures, only 7 contained recovery procedures and no plans listed preparedness procedures. All submitted plans contained contact details of key staff. The detail of these plans varied considerably, most following the structure recommended by Inverell Shire Council. Table 2 indicates the percentage of documented plans submitted to Inverell Shire Council containing the listed content.

**Table 2. Content of plans submitted to Inverell Shire Council.**

CONTENT OF FLOOD ACTION PLANS	YES %
Radio station to listen to	60
Contact phone number of emergency services	20
List of previous flood heights in the building	75
Flood height at which flooding commences in the building	25
Evacuation routes	33
Points of flood entry	27
Criteria to invoke plan	25
List of emergency equipment and location	40

Of the small number of businesses discovered during surveying that incorporated preparedness procedures; few had documented their intended actions. For these businesses preparedness procedures involved annually insuring their business against flood, checking emergency equipment or replenishing sandbags. Lismore businesses were asked if they kept copies of important records; 64 per cent suggested that they did.

Though it is difficult to give an accurate estimate, a greater percentage of businesses incorporated recovery procedures in their plans. Planned actions were fairly basic, consisting of damage assessment, washing out, cleaning up and checking utilities. To encourage the recovery of sales, advertising and post flood sales were often planned. One business on Keswick Creek has a reciprocal arrangement with a competitor to continue supply of their products in event of disaster (Wright, 2002).

A high proportion of businesses with plans prioritise actions. Survey results indicated that 80 per cent of businesses with plans prioritise response actions. But survey results showed that only approximately 30 per cent of businesses assign a length of time to complete actions.

Only 30 per cent of businesses conducted any form of flood training, indicating that new plans may not be well tested. Training was found to be irregular, being conducted during the induction of new employees. However, two large Inverell businesses conducted regular training to rehearse the installation of flood shutters. Only one business claimed to have completed a simulation of the business's plan. Often businesses claimed to only train management staff, ignoring other staff members. Some Lismore business managers suggested training was unnecessary as many of their employees already had substantial flood experience. Large businesses were more likely to undertake training than small businesses.

**Table 3. Advantages and disadvantages of flood action plans.**

ADVANTAGES	DISADVANTAGES
<ul style="list-style-type: none"> <li>• Do not have a threshold level</li> <li>• Inexpensive</li> <li>• Environmentally friendly</li> <li>• Increases flood awareness</li> <li>• Increases preparation efficiency</li> <li>• Flexible</li> <li>• Encourages owners to take responsibility for their flood risk</li> <li>• No landlord-tenant conflict</li> <li>• Can be effectively implemented in new and existing businesses</li> </ul>	<ul style="list-style-type: none"> <li>• Dependent upon receiving warning</li> <li>• Dependent upon flood warning accuracy</li> <li>• Dependent upon resources being available</li> <li>• Only as good as the information behind the plan</li> </ul>

Approximately 60 per cent of businesses claimed to have updated their plans since their development. Some businesses claimed that their plan was updated yearly, whilst others updated their plan irregularly, prompted by a flood or changes in personnel or floodplain characteristics.

Plans were relatively inexpensive to develop and document. Prices for professionally developed plans range from \$600 to \$800 (Jones, 2002). Businesses that developed their own plan, spent between a couple hours to a week on its development. Some businesses sought advice from government, emergency services, employees and neighbours whilst developing their plan.

It is difficult to quantify the monetary benefit of developing a flood action plan. All ten Lismore businesses that were asked if their flood action plan enabled preparations to be made faster responded in the affirmative. Businesses gave estimates of time saved, ranging from one hour to six hours.

Flood action plans were identified in both new and existing developments. Flood action plans in many existing buildings were the only practical option available to reduce flood risk. Flood action plans,

unlike structural flood proofing measures, do not require the approval of the landowner, therefore making them attractive to leaseholders.

It is clear that individual property hazard assessments distributed by Lismore City Council have increased the level of flood awareness within the business community, in comparison to Inverell where no such information is distributed. Survey results showed that 90 per cent of businesses are aware of the gauge height at which their business initially floods. This compares to only 25 per cent of Inverell businesses.

The heavy reliance of flood action plans on timely and accurate flood warnings was identified as their greatest shortcoming. Flood warnings are the information source that managers typically use to decide to invoke their flood action plan. Without receiving warning, businesses at best will be able to prepare for flood to a limited extent. Currently a flood warning service is not available to effectively warn all businesses on the Keswick Creek floodplain.

**Potential benefits for Kempsey**

Only 54 per cent of businesses had developed flood action plans prior to the Kempsey 2001 flood. Of these businesses none had documented their plan. As a result businesses largely were inadequately prepared to deal with a flood.

Damage surveys conducted after the flood identified that damage to stock and equipment comprised 80 per cent of contents damage indicating that planning could have effectively reduced flood losses. The unrealised benefits of well-developed flood action plans during the 2001 flood were calculated by estimating the ratio of movable contents and structure to total damage. The approximate ratio was equal to 0.8 indicating that effective flood action plans may have reduced direct damage by a further 80 per cent. This would reduce the estimated actual to potential ratio for the Kempsey 2001 flood to



*Only 54 per cent of businesses had developed flood action plans prior to the Kempsey 2001 flood*



10 per cent, close to the ratio calculated for the Lismore 2001 flood of 6 per cent. Further reductions would have been possible if businesses had introduced wet and dry flood proofing measures.

## 6. Conclusion

Flood action plans clearly have the potential to improve response to flood warnings and hence decrease damages suffered as a consequence of flooding. Planning for flood has advantages over other approaches as well as some disadvantages, as outlined in Table 3.

In reality, survey results indicate that initiatives to introduce plans such as business flood audits have increased the flood awareness of businesses and enhanced their knowledge of appropriate actions. Disappointingly, plans in Lismore, Inverell and Adelaide have been poorly developed and implemented. However, substantial damage reductions during the Lismore 2001 flood may suggest otherwise. It is suspected, though, that these reductions are primarily the result of Lismore's substantial flood experience and that such savings would not be possible without plans in less experienced communities such as Inverell and Adelaide. The small percentage of businesses in these locations conducting training suggests that businesses may be poorly prepared to activate their plans.

The poor development and implementation of flood action plans indicates that they should not be used as a means to achieve development consent, as argued by Keys and Opper (2001). Instead, plans should be used as a method for individual businesses to reduce flood risk and enhance business continuity. To this end, the creation of such plans should be encouraged by local governments and emergency services.

Education on how to develop and maintain flood action plans is currently lacking in Australian communities. The ideas presented in this research may be further developed and communicated to businesses to help planners develop more effective methods of flood loss-reduction. This is likely to be a role for the State Emergency Service.

## Acknowledgments

Professor Russell Blong, Director of Risk Frontiers provided guidance with this paper. Christopher Wright, Manager of the SA Bureau of Meteorology Flood Warning Centre, Chas Keys, Deputy Director General of the NSW State Emergency Service, Libby Cumming and David Pryor of Inverell Shire Council and David Ingle Smith provided valuable insights into flood action plans. The project was funded by the Macquarie University postgraduate research fund.

## References

- Australian Bureau of Statistics., 1996, *Census of Population and Housing*. Australian Bureau of Statistics, Canberra.
- Department of the Deputy Prime Minister United Kingdom., 2002, *Preparing for floods*. Department of the Deputy Prime Minister United Kingdom, [www.safety.odpm.gov.uk/bregs/floods]
- Federal Emergency Management Agency (FEMA)., 1996, *Emergency Management Guide For Business & Industry*. Federal Emergency Management Agency, Washington D. C.
- Gissing, A., 2002, The Business of Warning. *Risk Frontiers Newsletter*, vol. 1, no. 3, pp. 1–4.
- Jones, D., 2002, *Personal communication*. David C. Jones (Consulting Engineers) Pty Ltd., Inverell.
- Keys, C. and Opper S., 2001, The consent authority and the combat agency: a perspective on the interaction between councils and the State Emergency Service in floodplain management matters. In: *Proceedings of the NSW Floodplain Management Authorities 40th Annual Conference*, Wentworth.
- Leigh, R. and Gissing, A., 2001, The February 2001 Lismore Flood. *Natural Hazards Quarterly*, vol. 7, no 1, pp. 1–2.
- Le Breton, P. and Henning, D., 1961, *Planning Theory*. Prentice-Hall, Inc., Englewood Cliffs, New Jersey.
- Lismore City Council., 2002, *Lismore Floodplain Management Plan (Draft)*. Lismore City Council, Lismore.
- Marker, M. S., and Joy C. S., 1994, The Cost of February 1991 Flood Damage in Inverell. In: *Proceedings of the NSW Floodplain Management Authorities 34th Annual Conference*, Inverell.
- Maslen, C., 1996, Testing the plan is more important than the plan itself. *Information Management & Computer Security*, vol. 4, no. 3, pp. 26–29.
- Pryor, D., 1999, Inverell's Floods – A Range of Problems a Range of Responses. In: *Proceedings of the NSW Floodplain Management Authorities 39th Annual Conference*, Tamworth.
- Pryor, D., 2002, *Personal communication*. Inverell Shire Council, Inverell.
- Smith, D. I., 1998, *Water in Australia, Resources and Management*. Oxford University Press Melbourne.
- Smith, D. I., Den Exter, P., Dowling, M. A., Jelliffe, P. A., Munro, R. G. and Martin, W. C., 1979, *Flood damage in the Richmond Valley New South Wales: An assessment of tangible and intangible damages*. Centre for Resource and Environmental Studies, Australian National University, Canberra.
- WBCM., 1984, *South Eastern Suburbs of Adelaide: Stormwater Drainage Study*. WBCM Adelaide, South Australia.
- Wright, C. J., 2001, *Flash Flooding in an Urban Environment, Causes effects, potential damages and possible remedies, with particular reference to Keswick Creek in the inner suburbs of Adelaide*. Master of Engineering Thesis, Department of Civil and Environmental Engineering, University of Adelaide, Adelaide.
- Wright, C. J., 2002, *Personal communication*. Commonwealth Bureau of Meteorology, Adelaide.
- Wright, C. J. and Smith, D. I., 1999, How to capture the benefits of a flood warning? In: *Proceedings of the Australian Disaster Conference 1999*, pp. 299–304.

### Author

Andrew Gissing, formerly of Risk Frontiers is a Planning and Research Officer with the New South Wales State Emergency Service. Email Andrew.Gissing@ses.nsw.gov.au